National Irrigation Commission
Ministry of Water and Irrigation
The United Republic of Tanzania

The Project on the Revision of National Irrigation Master Plan in the United Republic of Tanzania

Final Report

Volume-I

Main Report

July 2018

Japan International Cooperation Agency (JICA)

Nippon Koei Co., Ltd.

International Development Center of Japan Inc.

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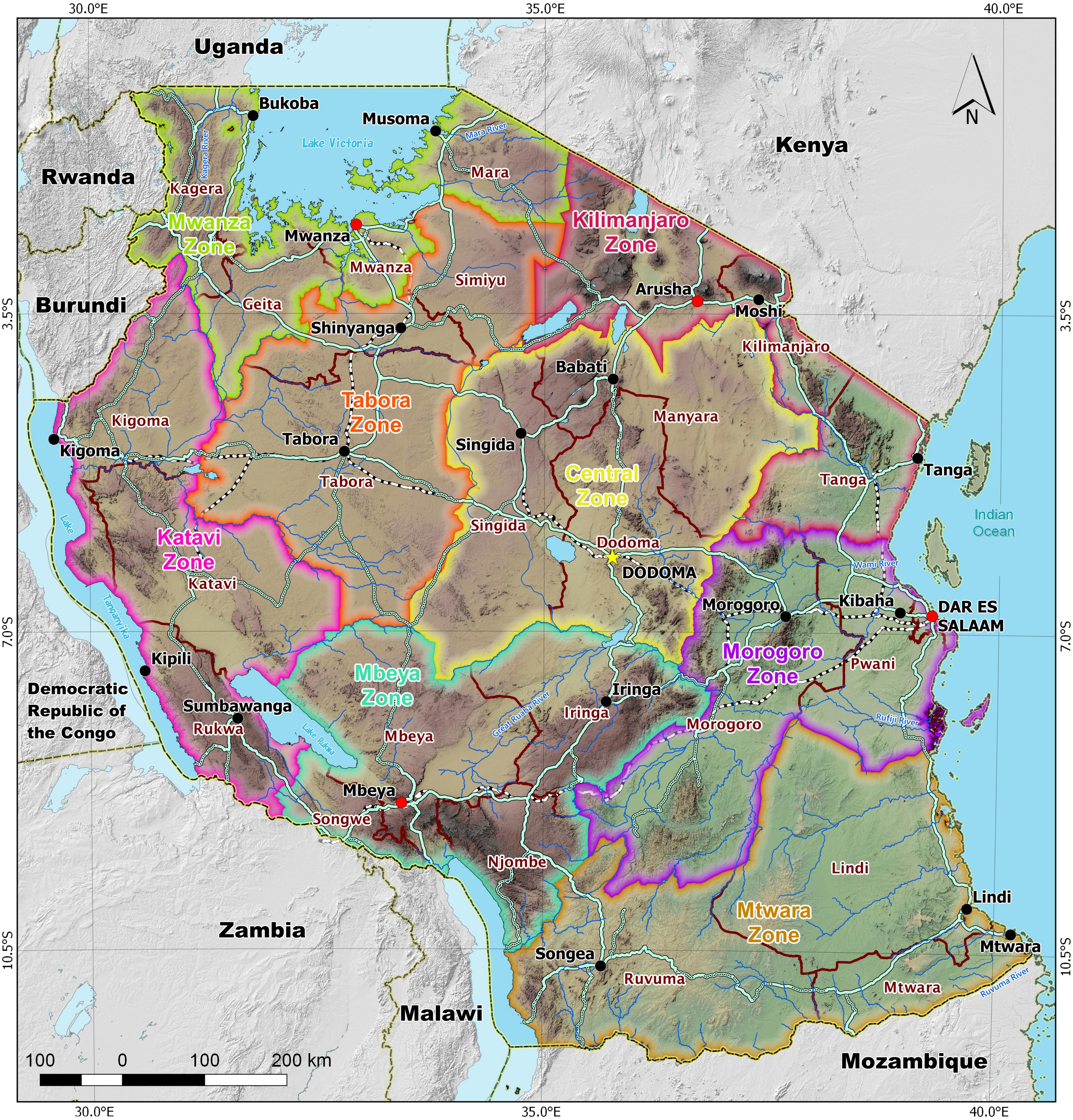
Irrigation Zonal Map in the United Republic of Tanzania



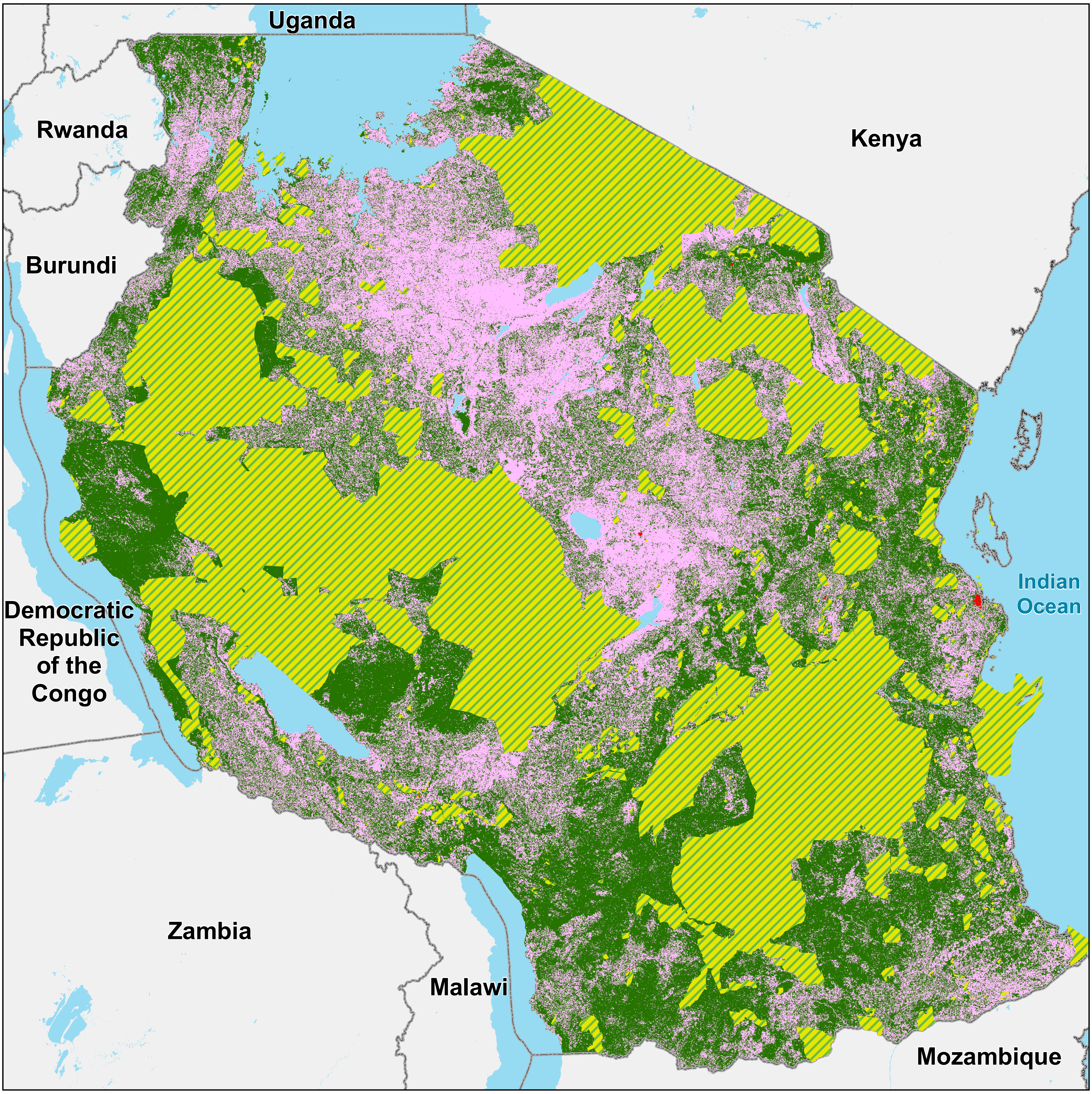
Legend

Urban Center
- City
- Capital
- Town
- Trunk (Paved)
- Trunk (Unpaved)
- Railway
- River
- Water Body
- Region Boundary
- Zonal Boundary
- Political Boundary

Elevation (m)
- 200 >
- 200
- 400
- 600
- 800
- 1000
- 1200
- 1400
- 1600
- 1800
- 2000
- 2200
- 2200 <

Source: Prepared by JICA Project Team based on
Elevation: Shuttle Radar Topography Mission (SRTM) data,
Zonal boundary: NIRC,
Roads: Tanroads
Urban Center: Natural Earth
River: Ministry of Water and Irrigation
Water Body: ESRI
Region Boundary and Political Boundary: GADM

General Land Use Map
in the Republic of Tanzania



Legend

General Land Use

- Forest
- Agriculture Potential Area
- Urban
- Protected Area
- Water Body
- Political Boundary

Class	Area (Km^2)	Area (%)
Forest	302,396	32.3
Agriculture Potential Area	255,637	27.3
Urban	151	0.02
Protected Area	319,093	34.0
Water	60,284	6.4
Total	**937,561**	**100.0**

N

0 100 200 400 km

Source:
Land use: Global Map-Global Land Cover (GLCNMO) Version-2
Protected Area: UNEP-WCMC (Feb/2017), The World Database on Protected Areas (WDPA), Cambridge, UK: UNEP-WCMC.
Available at: www.protectedplanet.net

PHOTO ALBUM (1/6)

01. Buigiri Dam Irrigation Scheme, Chamwino District, Dodoma Zone

02. Ulyanyama Dam Irrigation Scheme, Sikonge District, Tabora Zone

03. Mahiga Dam Irrigation Scheme, Kwimba District, Mwanza Zone

Source: JICA Project Team

PHOTO ALBUM (2/6)

04. Irienyi Dam Irrigation Scheme, Rorya District, Mwanza Zone

05. Lower Moshi Weir Irrigation Scheme, Moshi District, Kilimanjaro Zone

Source: JICA Project Team

PHOTO ALBUM (3/6)

06. Dakawa Pump Irrigation Scheme, Mvomero District, Morogoro Zone

07. Centre Pivot Irrigation Scheme, Kilombero Plantation Ltd (KPL), Kilombero District, Morogoro Zone

08. Serengeti Lake Water Irrigation Scheme, Bunda District, Mwanza Zone

Source: JICA Project Team

PHOTO ALBUM (4/6)

08. Serengeti Lake Water Irrigation Scheme, Bunda District, Mwanza Zone

09. Drip Irrigation Scheme, CHABUMA Cooperative, Chamwino District, Dodoma Zone

10. Kitere Groundwater Irrigation Scheme, Mtwara District, Mtwara Zone

Source: JICA Project Team

PHOTO ALBUM (5/6)

11. Irrigated Paddy, Mombo Irrigation Scheme, Korogwe District, Kilimanjaro Zone

12. Upland Rainfed Paddy Farming, Kyela District, Mbeya

13. Tomato Cultivation with Irrigation in Mkomazi-Mombo, Korogwe District, Kilimanjaro Zone

14. Onion Cultivation with irrigation in Iringa District, Mbeya Zone

15. Workshop on Irrigation Database Updates at Morogoro District, Morogoro Zone (7th to 11th November 2016)

Source: JICA Project Team

PHOTO ALBUM (6/6)






16. Workshop on Irrigation Scheme Mapping with GPS device (February to March 2017)

17. 1st JCC Meeting at Dar es Salaam (6th Dec. 2016)

18. 1st SCM at Dar es Salaam (7th Dec. 2016)

19. 2nd JCC Meeting at Dodoma (21st Sept. 2017)

20. 2nd SCM at Dar es Salaam (27th Sept. 2017)

21. 3rd JCC Meeting at Dodoma (4th April 2018)

22. 3rd SCM at Dar es Salaam (9th April 2018)

Source: JICA Project Team

The Project
on the Revision of National Irrigation Master Plan
in the United Republic of Tanzania

Final Report

Executive Summary

July 2018

1.1 Project Outlines

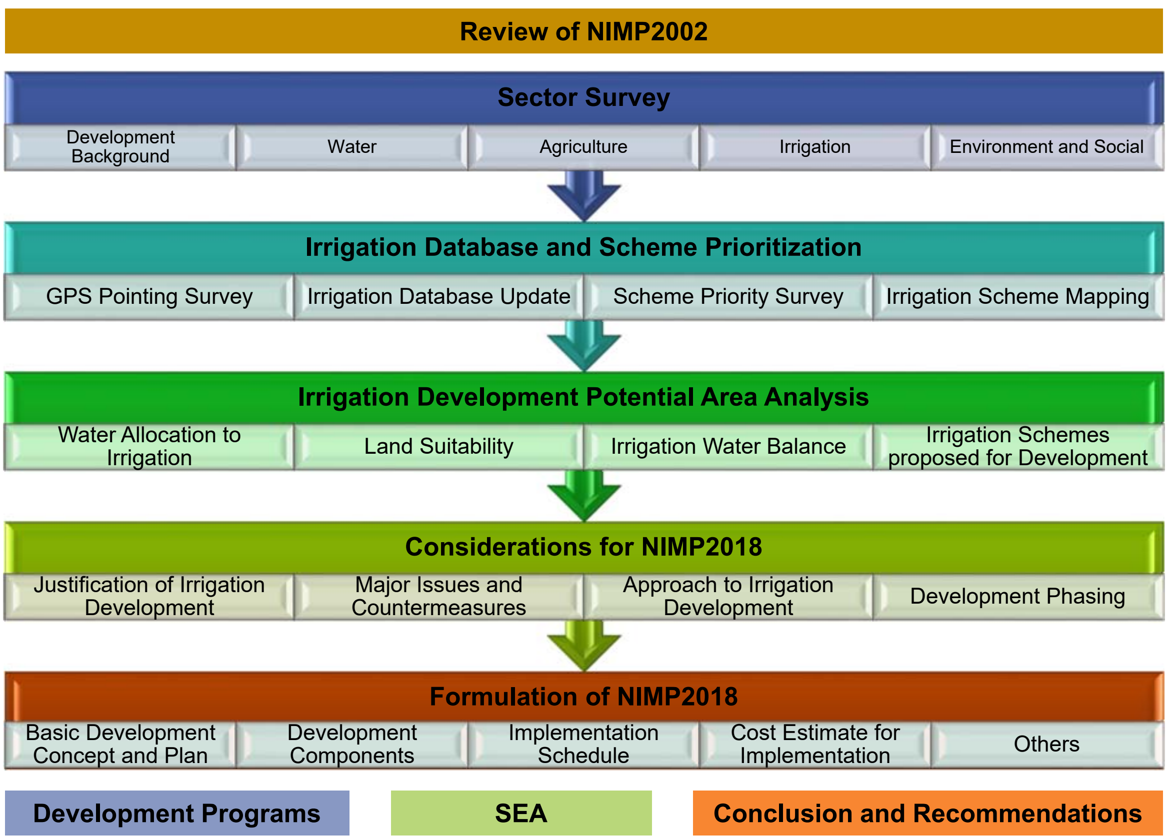
Project Background	◆ More than 15 years have passed since the formulation of the current NIMP2002, and the circumstances around irrigation development have changed, ◆ Need of further efforts for poverty reduction, and ◆ Increasing demands for more sustainable irrigation development.
Project Goal	Irrigation development under National Irrigation Commission (NIRC) is sustainably enhanced.
Project Outputs	Output 1: National Irrigation Master Plan is revised. Output 2: Action Plan is established.
Project Objectives	◆ To revise the NIMP2002 in view of contributing to poverty reduction and addressing the climate change, ◆ To enhance the capacity of NIRC, and hence ◆ To strengthen the sustainable irrigation development of Tanzania.

1.2 Counterpart Agency and Relevant Organisations

Counterpart Agency	National Irrigation Commission (NIRC)
Relevant Government Organisations (Members of JCC)	Ministry of Water and Irrigation (MoWI) Ministry of Agriculture (MoA)*1 Ministry of Finance and Planning (MoFP) Ministry of Energy and Minerals (MEM) Ministry of Natural Resources and Tourism (MNRT) Ministry of Lands, Housing and Human Settlements Development (MLHH) President's Office, Regional Administration and Local Government (PO-RALG), Vice President's Office-Union Affairs and Environment (VPO-DOE), etc.
Stakeholders (Members of SCM)	Development Partners (Donors), Embassies, Private Sector, NGOs, etc..

Note: *1= Ministry of Agriculture, Livestock, and Fisheries (MALF) was split into the Ministry of Agriculture (MoA) and Ministry of Livestock and Fisheries (MoLF) in October 2017.

1.3 General Work Flow



1.4 Achievements of NIMP2002

NIMP2002 was formulated in 2002. With respect to the hardware aspect, NIMP2002 proposed to develop 626 irrigation schemes with total irrigated area of 405,400 ha (counted on accumulation basis), while in terms of software aspect, it proposed 37 reform plans to address various issues.

(1) Accumulated Irrigation Development Area (High, Base, Low Scenarios and Actual)

F.Year	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
High	218	229	239	250	265	276	281	294	312	325	337	352	372	387	405
Base	218	228	236	243	254	264	271	278	290	304	316	325	335	351	362
Low	218	222	234	240	248	261	268	274	287	296	306	321	328	337	350
Actual			264	274	289	311	331	346	355	364	450	461	461	NA	NA

The actual irrigation development area by 2015 was 461,000 ha which is bigger than the area projected in the NIMP2002.

(2) Achievement of Subject-wise Improvement Programs

Category	Action has been taken				No Action
Number of Programs (%)	27 (73%)				10 (27%)
Score Range of Progress	80-100%	50-80%	20-50%	1-20%	
Number of Programs (%)	4 (15%)	14 (52%)	4 (15%)	5 (18%)	

Out of 37 programs, 27 programs are now in progress, especially the CGL* is being disseminated to the large section of stakeholders.

Note: * CGL: Comprehensive Guidelines for Irrigation Scheme Development under District Agricultural Development Plan

2.1 (1) Development Background

(1) Demography of Tanzania

Item	Land Area (thousand km^2)	Population 2002 Census	Population 2012 Census	Population Density (persons/km^2) (2012 Census)	Inter-census Growth Rate (%)	Population 2015*
Tanzania Mainland	945	33,461,849	43,625,354	49	2.7	47,351,275

Note: 2015* is projection

(2) GDP and Its Share by Sector

Economic Activity	2008	2009	2010	2011	2012	2013	2014r	2015p
GDP Per Capita (USD)	584	702	749	785	896	991	1043	964
Agriculture, Forestry and Fishing (%)	26.8	27.2	26.3	25.2	24.8	23.8	23.0	22.0
Industry and Construction (%)	20.2	20.0	20.5	21.3	21.1	21.5	22.2	23.1
Services (%)	47.4	47.0	47.6	47.8	48.8	48.7	48.8	48.8
Balance (%)	5.6	5.8	5.6	5.7	5.3	6.0	6.0	6.1

(3) Poverty Trend of Tanzania

Year	Region	% of Population below Food Poverty line	% of Population below Basic Needs Poverty line	% of Female Headed Households
2007	Dar es Salaam	3.2	14.1	24.4
	Other Urban	8.9	22.7	30.1
	Rural	13.5	39.4	23.0
	Total	11.8	34.4	24.5
2011/12	Dar es Salaam	1.0	4.1	22.5
	Other Urban	8.7	21.7	27.6
	Rural	11.3	33.3	24.3
	Total	9.7	28.2	24.7

2.1 (2) Development Background

(4) Government Development Policy and Plan

Document	Target Period	Characteristics
Five Year Development Plan II (FYDP II) - Nurturing an Industrial Economy	2016/17 – 20/21 (5 years)	· Focus on economic growth · Flagship projects with large investments · Strategic consideration of geographic position (Corridor approach and area focus) · Improving business and investment environment
Agricultural Sector Development Programme 2 (ASDP2)	2016/17 – 25/26 (10 years)	· Focus on commercialization of agriculture · Promotion of value chain and value addition · Prioritized intervention (Commodity and area focus) · Private sector mobilization (Business promotion)
National Irrigation Policy (NIP)	February 2010 – Present	· Formulated to "provide a baseline for a focused development of irrigation sector. · A general guidance for interventions. · Guidance is structured with respect to the types of irrigation scheme (Traditional, improved, smallholders', or commercial, etc.) and key issues in relation to irrigation such as research, appropriate technology, production, capacity, etc. · For each subject, issue, objective, policy statements are given.
National Irrigation Act (NIA)	2013 – Present	· This is a law specifically enacted to facilitate irrigation development of the country. · It has provision of establishing the National Irrigation Commission. · It provides definitions of many terms pertinent to irrigation. · It facilitates improvement of irrigation facility construction and operation by legally demanding particularities of actions to be taken.

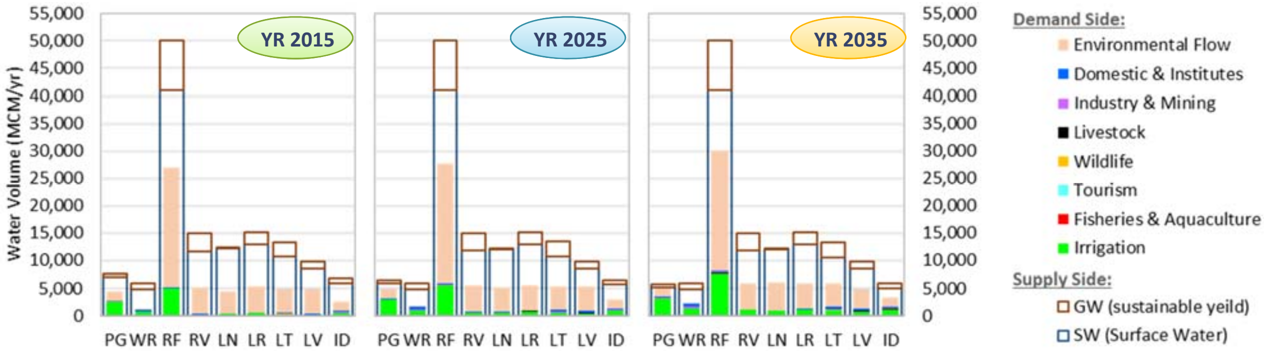
2.2 (1) Water Resources – Approach & IWRMDPs

(a) Basic Approach for Water Resources Study

- Tanzania Mainland is divided into 9 basins and further divided into 71 sub-basins. Water resources assessment is to be done on a monthly and sub-basin basis.
- MoWI has been formulating the IWRMDP* for the respective 9 basins (as of September 2017, assessment completed for 8 basins, planning completed for 6 basins). From the standpoint of harmonization with the relevant plans, due consideration to the IWRMDPs will be required.

(b) Estimation by IWRMDP & LVBC : Water Resources (SW+GW), Water Demands by Sector, EFR

- Irrigation water demand account for more than 80% of total demand (except for EFR).
- Projected irrigation area: 490,000ha in 2015 / 720,000ha in 2025 / 1,050,000ha in 2035
- In NAWAPO (2002), higher priority is given to Basic Human Needs and EFR.

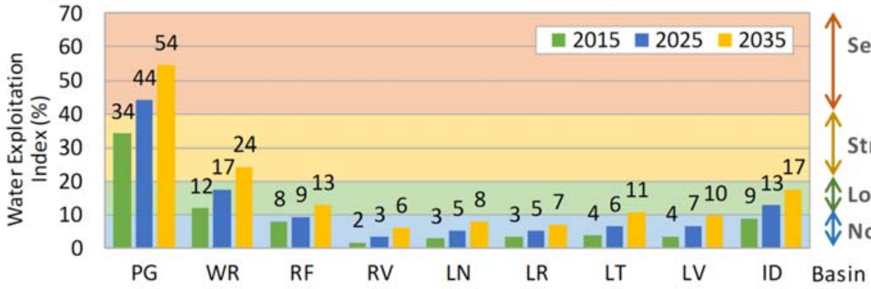


Note: * IWRMDP: Integrated Water Resources Management and Development Plan

2.2 (2) Water Resources – Water Stress & Irrigation Water

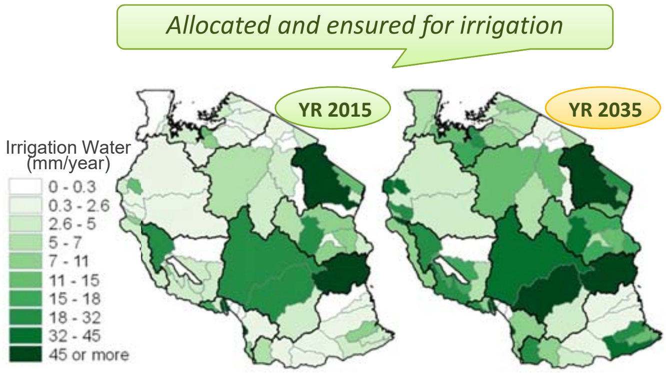
(c) WEI (Water Exploitation Index): Percentage of total consumptive water demands to IRWR*

- Pangani is under stress even in current condition, and Wami/Ruvu will be stressed soon.



(d) Allocated Water for Irrigation

- Basically, allocations of irrigation water have been determined by IWRMDPs.
- Water demands estimated by IWRMDPs were reviewed and adjusted if the demands exceeded available water.
- <u>Finalized amounts of irrigation water (shown in the figures) are used for irrigation areas to be proposed by the NIMP2018.</u>



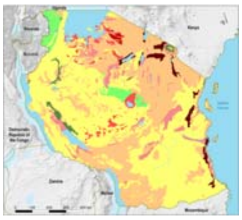
Note: * IRWR: Internal Renewable Water Resources (comprising surface runoff and GW recharge)

2.3 (1) Land Resources – Land Suitability Analysis

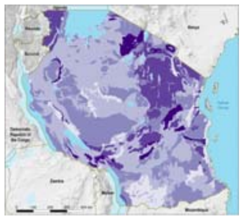
(1) Topographic Wetness Index

(2) Land use

(3) Temperature

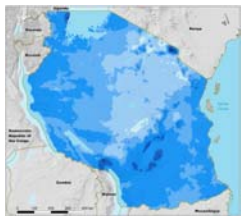


(4) Soil pH



(5) Soil Organic Carbon

Land suitability analysis was conducted using Analytical Hierarchy Process (AHP)*.



(11) Precipitation

(6) Elevation

(7) Soil Type

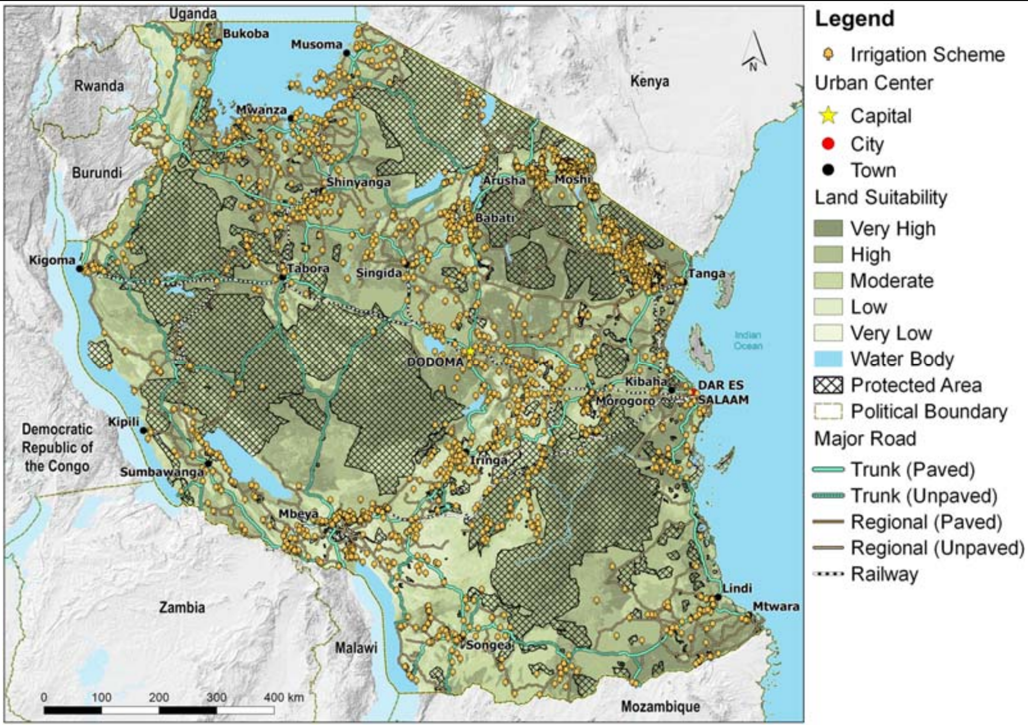
(8) Soil Depth

(9) Slope

(10) Soil Drainage

Note: * AHP: A structured technique for organising and analyzing complex decisions, based on mathematics and psychology

2.3 (2) Land Resources – Land Suitability for Agriculture

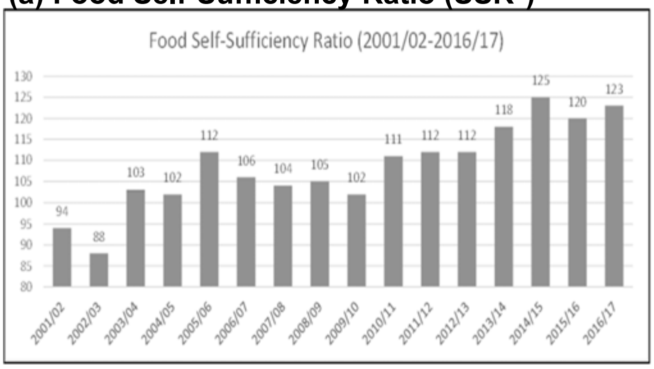


Potential agriculture lands are limited to approximately 25.6 million ha or only 27% of the total land area of Tanzania Mainland. A part of protected area (31.9 million ha or 34% of the total lands) is suitable for agriculture but currently not permitted for the development.

Note: Land use consists of forest (32%), agriculture potential area (27%), protected area (34%), water body (6%) and others (1%).

2.4 Agriculture

(a) Food Self-Sufficiency Ratio (SSR*)



Paradigm Shift for Agriculture In Tanzania

Tanzania has achieved SSR over 110% since 2010/11. Major challenges in agriculture sector are storage, distribution, processing and export. Taking advantage of rich natural resources in the country, Tanzania should become a food basket for East African countries and beyond.

Note: * SSR : Self-Sufficiency Ratio announced by Tanzania Government (Ratio between the total food supply (grain-equivalent conversion of major cereals subtracted by non-food use) and total food demand (650g/person-day x population x 365 days))

(b) Target Crops for Irrigation

Type of Crops for Irrigation Planning	Target Crops	Features
High water demanding crops (60%)	Paddy, Maize, Sugarcane	**(Low Risk, Low Returns)** ● Less production cost ● Less labour intensive ● No large fluctuation in price ● Long storable (except sugarcane) ● Need for extension services, etc.
Low water demanding crops (40%)	Tomatoes, Onions, Oil Crops (Sunflower, Sesame), Beans, Cotton, Grapes, Bananas, Papaya and other crops	**(High Risk, High Returns)** ● Higher production cost ● Labour intensive ● Large fluctuation in price ● Perishable (except oil crops and cotton) ● Need for intensive extension services, etc.

2.5 Irrigation Human Resources

(a) Allocation of Irrigation Engineers and Technicians in NIRC (as of February 2018)

	NIRC-HQ	Dodoma	Kiliman.	Mbeya	Morog.	Mtwara	Mwanza	Tabora	Katavi
Irrigation/ Agricultural Engineer	10	9	6	14	12	8	8	7	1
Irrigation Technician	0	5	5	0	4	1	3	4	0
Others	54	15	20	14	18	4	10	9	4
Total	64	29	31	28	34	13	21	20	5

NIRC/ZIOs need to increase the number of irrigation engineers and technicians to implement NIMP2018.

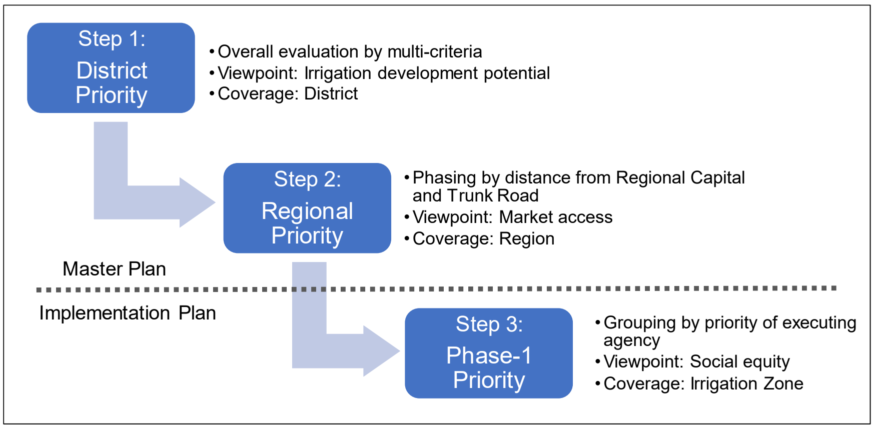
(b) Allocation of Irrigation Engineers and Technicians in LGAs (as of February 2017)

	Dodoma	Kiliman.	Mbeya	Morog.	Mtwara	Mwanza	Tabora	Katavi
Number of LGAs	22	25	22	20	23	31	20	17
Irrigation/ Agricultural/ Civil Engineer	14	13	13	14	10	14	7	8
Irrigation Technician	12	48	35	21	15	22	8	14

LGAs are the main implementers of small-scale irrigation development. Yet they are understaffed with technical officers in the irrigation sector. For instance, 37% of all LGAs (66 out of 180 LGAs) do not have either irrigation/agricultural engineer or irrigation technician. With regard to engineers, 116 out of 180 LGAs (64%) have no irrigation/agriculture engineers.

2.6 (1) Prioritization Process of Irrigation Schemes

(a) Prioritization Process of Irrigation Schemes



Irrigation Development

Existing*1:	461,000 ha
Phase 1:	248,120 ha
Phase 2:	312,110 ha
Sub-total:	1,021,230 ha
Private:	222,000 ha
Total:	1,243,230 ha

Note: *1= 189,828 ha out of 461,000 ha is target for Improvement (no expansion).

(b) Results of Scheme Prioritization by Step 1 and Step 2

Total Number of Schemes identified	Phase 1 (2018-2025)		Phase 2 (2026-2035)	
	Selected Schemes by Step 1	Selected Schemes by Step 2	Selected Schemes by Step 1	Selected Schemes by Step 2
2,947	918	469	1,112	643
	Area Expansion →	248,120 ha	Area Expansion →	312,110 ha

In addition to the above table, large scale commercial irrigation farms are planned for implementation, 54,000 ha by 3 projects in Phase 1 and 168,000 ha by 5 projects in Phase 2.

2.6 (2) Irrigation Scheme Prioritization at District Level

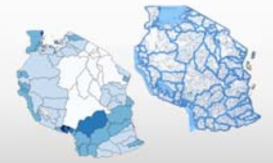
1. National Irrigation Database

2. District Priority

Questionnaire on Priority for Future Irrigation Development for Revision of National Irrigation Master Plan (2025 & 2035)

Other Spatial Analysis with GIS

4. Water Resources Analysis



Calculate the water amount allocated for irrigation in IWRMDPs.

3. Prioritization Analysis

Scheme aspect values × District priority weight vectors

Priority Ranking

Scheme Selection based on the water resource limitation

5. Phasing for Implementation Plan/Master Plan, Program

Calculation of Priority Score

scheme aspects

Scheme	Area			Slope			Distance from markets			Rain			Total	Priority Ranking	Selec-tion
	ha	Class	Value	degree	Class	Value	km	Class	Value	mm	Class	Value	Value		
AAA Scheme	1,200	3	0.6	3	3	0.9	10	3	0.6	600	2	0.2	2.3	1	Yes
BBB Scheme	1,500	3	0.6	1	3	0.9	40	1	0.2	1,000	3	0.3	2	2	Yes
CCC Scheme	250	2	0.4	7	1	0.3	5	3	0.6	800	3	0.3	1.6	3	Yes
DDD Scheme	100	1	0.2	5	2	0.6	20	2	0.4	700	2	0.2	1.4	4	No

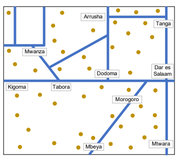
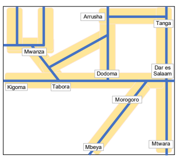
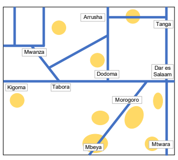
physical values

Classification

Multiply weight

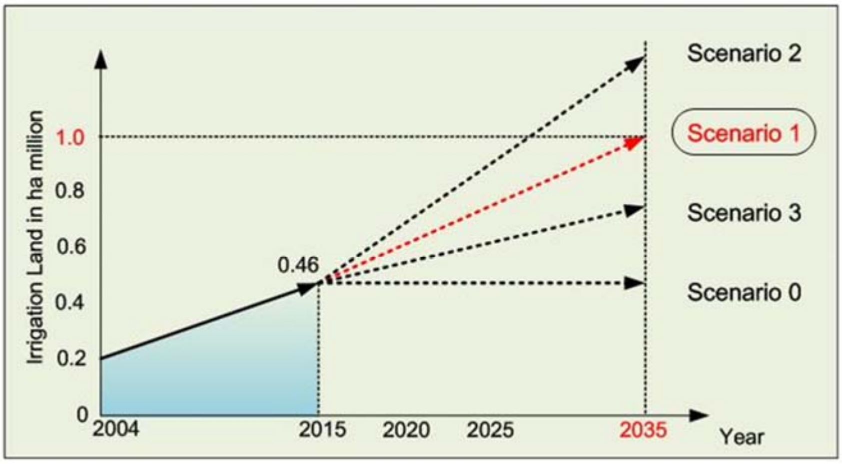
Integrate priority values

2.6 (3) Irrigation Scheme Prioritization at Regional Level

Plan	Phasing Concept	Merit	Demerit
Original 	**Focus on irrigation potential:** Irrigation schemes are classified into Phase 1 and Phase 2 according to the development priority order.	It is most reasonable from the viewpoint of irrigation development potential.	Low cooperation with agricultural development.
Alternative 1 	**Focus on development corridor:** Irrigation schemes along major trunk roads that make up the economic corridor are classified into Phase 1, and others are Phase 2.	High cooperation with the ASDP2, which aims to develop a value chain.	Low priority of the irrigation scheme located at the remote places
Alternative 2 	**Focus on district cluster:** Irrigation scheme is located within the cluster specified in ASDP2 are classified into Phase 1, and others in Phase 2.	High affinity with ASDP2 aiming for cluster agricultural development.	- Regionally concentrated - Imbalance among regions
Alternative 3 	**Focus on major cities and market access:** Irrigation schemes located within specified threshold distance will be conducted in Phase 1 and others in Phase 2.	It will support the value chain suggested in ASDP2 and helps making an economic corridor that serves domestic and international markets	It will reduce the potential of selecting irrigation schemes located in villages and along minor roads.

Note: JICA Project Team proposed Alternative 3 and it was approved by JCC.

2.7 Development Scenarios



Senario 0: NIMP2018 is not implemented.

Scenario 1: New irrigation schemes are developed in addition to improvement and expansion of existing irrigation schemes.

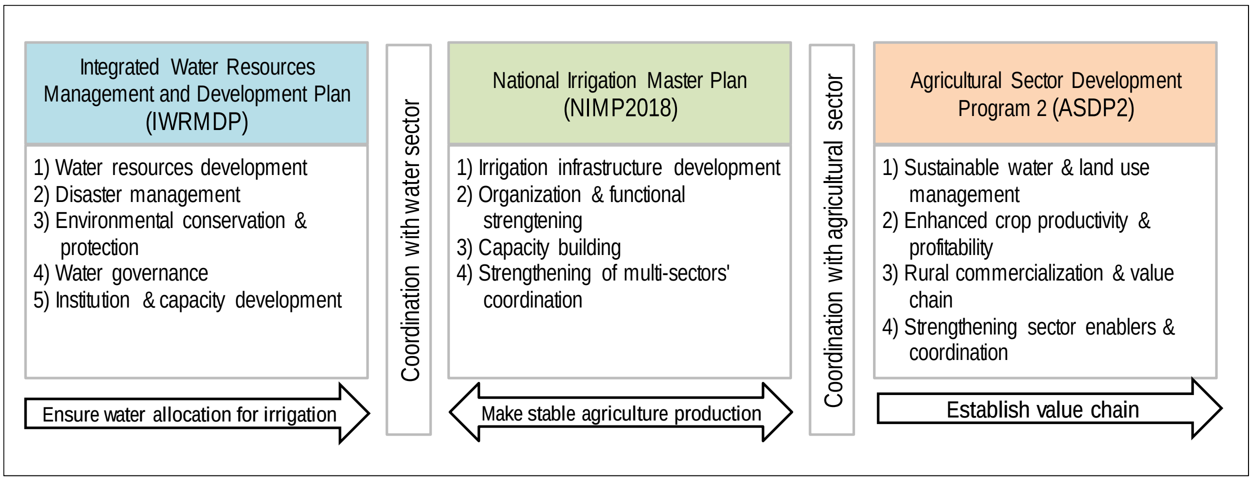
Scenario 2: Large-scale commercial irrigation schemes are developed in addition to Scenario 1.

Scenario 3: Only existing irrigation schemes are improved and expanded.

The government approval and implementation of NIMP2018 as planned are prerequisites for realizing Scenario 1. The following shall be considered in implementing NIMP2018.

1) IWRMDP and ARDP2 are implemented as planned in addition to NIMP2018.
2) Development funds for the item 1 are secured.
3) Organisational set-up for irrigation development and management specified by the National Irrigation Act 2013 is established in addition to increasing the number of irrigation staff.
4) Technical and management capacities of irrigation staff and IOs are strengthened.
5) Coordination among the relevant ministries and agencies is made for cross-cutting issues related to irrigation development.

2.8 Coordination of IWRMDP, NIMP2018 and ASDP2



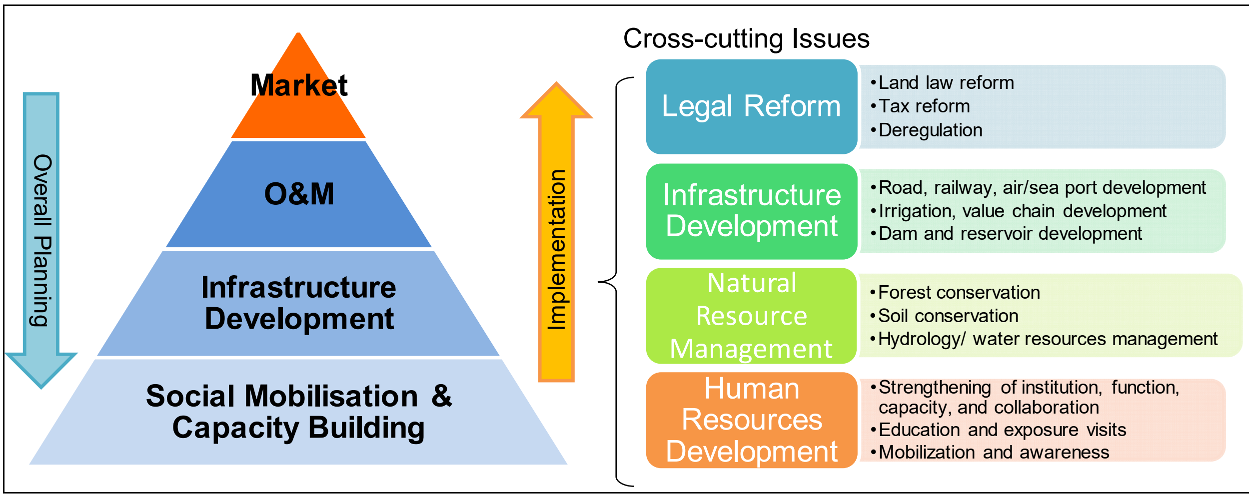
It is important for irrigation sector to make a good coordination especially with water sector (IWRMDP) to secure water allocation for irrigation through river basin management and soil conservation in the upper catchment areas and agriculture sector (ASDP2) to strengthen the agricultural extension services and agricultural value chain enhancing crop productivity and profitability.

2.9 Basic Framework of NIMP2018

		Phase 1 (P1)	Phase 2 (P2)
Overall Goal		Contribution to Agriculture GDP Growth and Rural Poverty Reduction	
Project Purpose		Strengthening of NIRC in a Sustainable Manner	
Development Strategy		• Irrigation Development consistent with National Development Plans • Irrigation Development based on Water Allocation estimated by IWRMDP • Irrigation Development in collaboration with ASDP2	
Hard Component	Development Target	Improvement of Irrigation Efficiency and Expansion of Irrigation Area	
Hard Component	Development Approach	1) On-going projects with priority 2) More matured projects with priority 3) Development priority of executing agencies 4) Formulation of P2 projects	1) Projects formulated in P1 with priority 2) Projects carried over from previous P1 with priority
Hard Component	Major Activities	• Development of small scale irrigation systems (Improvement, Expansion, New Development) • Development of medium to large scale irrigation systems (Improvement, Expansion, New Development) • Promotion of storage-type irrigation development (small dams and ponds) • Promotion of lake water irrigation development • Promotion of water saving irrigation development (Drip, Sprinkler), etc.	
Soft Components	Development Target	Quality Improvement in Irrigation	
Soft Components	Development Approach	1) Institutional and functional strengthening for smooth implementation of projects 2) Capacity building of government staffs for quality irrigation development 3) Capacity building of irrigators' organization for sustainable O&M in participatory manner 4) Strengthening of coordination with relevant ministries and private sector	
Soft Components	Major Activities	• Organization and function: Unified management of irrigation development, etc. • Capacity building: Human resource development for sustainable irrigation development • Coordination: Strengthen efforts towards cross-sectoral issues, and encourage private sector participation	
Scope	NIMP2018	Phase 1 and Phase 2	
Scope	Implementation Plan	Phase 1	To be prepared by NIRC

3.1 Development Concept of NIMP2018

Target irrigation schemes will be selected considering the comparative superiority of market access (domestic distribution and export).



It is not easy for NIRC alone to deal with the cross-cutting issues, coordination and cooperation with other ministries are indispensable.

3.2 Approach to NIMP2018

Approach	Methodology
Irrigation scheme prioritization in a scientific manner	➢ Water allocation to irrigation on a monthly basis in 71 sub-basins ➢ Land resources potential analysis by AHP method ➢ Irrigation development potential area by monthly water balance calculation ➢ Updating irrigation database ➢ GIS spatial analysis ➢ Prioritization of irrigation schemes with priority weight vectors
Consideration of export-oriented agriculture development	➢ Crop selection for irrigation
Phasing development plan enabling a linkage with value chain development by ASDP2	➢ Comparison of an original plan with various alternative plans
Irrigation infrastructure development with locally available water resources (Effective use of water for irrigation)	➢ Completion of uncompleted irrigation systems ➢ Promotion of water harvesting irrigation with pond (small dam) ➢ Promotion of large-scale commercial irrigation farms
Focus on full development of irrigation schemes	➢ Costs for water intake structures, main and secondary canals, O&M roads, drainage canals
Strengthening of supporting system for irrigation infrastructure development	➢ Irrigation organisation and functions ➢ Capacity building of irrigation staff and IOs ➢ Coordination with other sectors

3.3 Development Plan of NIMP2018

Item	Description
1. Overall Goal	➢ To contribute to the achievement of KPIs* for ASDP2 *- Agriculture GDP annual growth rate (6%)* *- Rural poverty rate (24% or below)* *- Food poverty rate (5% or below)*
2. Objective	➢ To contribute to national economy and food security by improving agricultural productivity and profitability through irrigation development, consequently reducing rural poverty and strengthening climate change resilience.
3. Development Target	➢ Irrigation developed area (One million ha), Number of beneficiary farmers (more than 600,000 FHHs), Crop yield (5 ton/ha for paddy, 40 ton/ha for tomatoes and 10 ton/ha for onions), Incremental net farm income (TZS 3 to 4 million/ha/ year on average)
4. Target Year	➢ 2035 - Phase I: 2025 (2018-2025) - Phase II: 2035 (2026-2035) ** The same target year with IWRMDP*

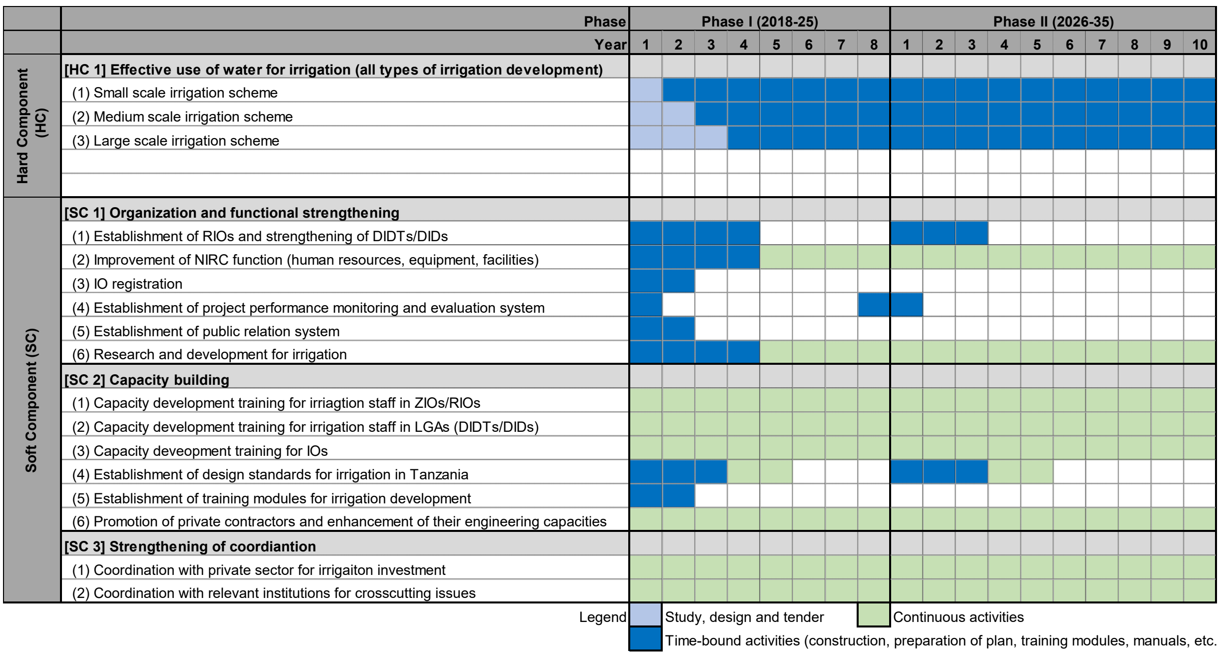
Note: * KPIs= Key Performance Indicators

3.4 Development Components of NIMP2018

	SN	Development Strategy	Development Plan
Hard Component (HC)	HC1	Increase irrigation area through sustainable water use	(1) Dodoma Zonal Irrigation Development Plan (2) Kilimanjaro Zonal Irrigation Development Plan (3) Mbeya Zonal Irrigation Development Plan (4) Morogoro Zonal Irrigation Development Plan (5) Mtwara Zonal Irrigation Development Plan (6) Mwanza Zonal Irrigation Development Plan (7) Tabora Zonal Irrigation Development Plan (8) Katavi Zonal Irrigation Development Plan (9) Large-scale Commercial Irrigation Development Plan
Soft Component (SC)	SC1	Organisation and Functional Strengthening	(1) Establishment of RIOs and strengthening of DIDTs/DIDs (2) Improvement of NIRC function (human resources, equipment, facilities) (3) IO registration (4) Establishment of project performance monitoring and evaluation system (5) Establishment of public relations system (6) Research and development for irrigation
	SC2	Capacity Building	(1) Capacity development training for irrigation staff in ZIOs/RIOs (2) Capacity development training for irrigation staff in LGAs (DIDTs/DIDs) (3) Capacity development training for IOs (4) Establishment of design standards for irrigation in Tanzania (5) Establishment of training modules for irrigation development (6) Promotion of private contractors and enhancement of their engineering capacities
	SC3	Strengthening of Coordination	(1) Coordination with private sector for irrigation investment (2) Coordination with relevant institutions for crosscutting issues (water and land conflict, etc.)

3.5 Implementation Schedule of NIMP2018

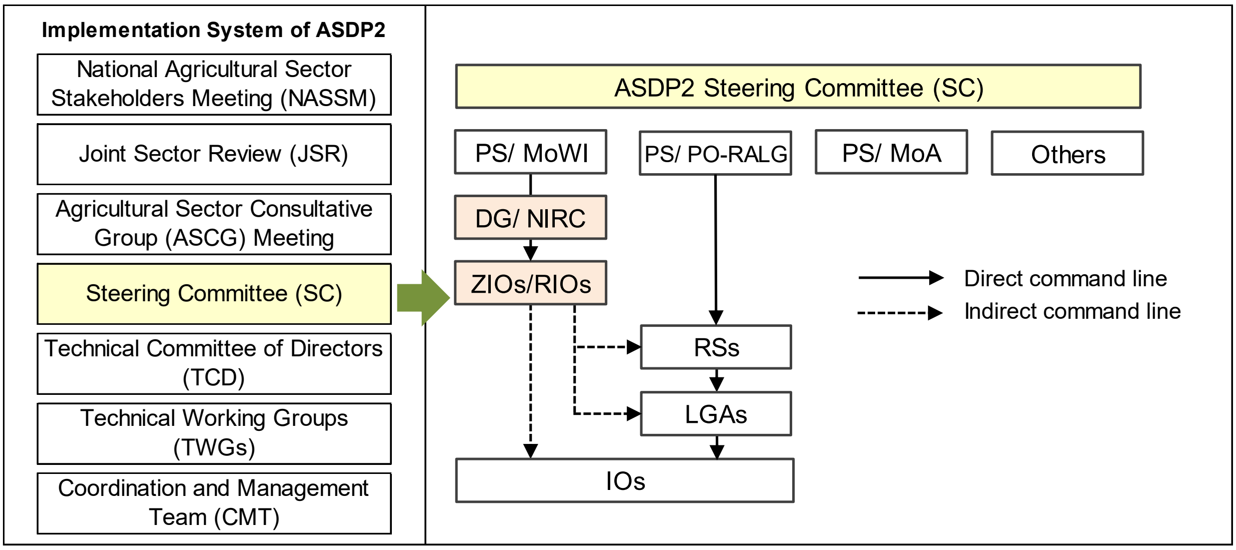
Implementation Schedule of NIMP2018



NIMP2018 will be executed by stage-wise approach so as to make use of experiences in Phase 1 into Phase 2 implementation.

3.6 (1) Organisational Arrangement for Implementation

(1) Alignment with ASDP2 Implementation System



NIRC shall be a member of ASDP2 Steering Committee and seeks to share policies and information by participating in various conferences and committees.

3.6 (2) Organisational Arrangement for Implementation

(2) Responsibility Matrix among Stakeholders by Component

Development Component	NIRC	ZIO	LGA	IO	Consultant	University/ Institute	Contractor	NGO
HC: Irrigation Infrastructure Development								
Irrigation Infrastructure Development (Small Scale)	○	○	●	○	●		●	
Irrigation Infrastructure Development (Medium/Large Scale)	●	●	○	○	●		●	
SC-1: Organisation and Functional Strengthening								
Establishment of RIOs and strengthening of DIDTs/DIDs	●	●	●					
Improvement of NIRC function (HR, equipment, facilities)	●	●						
Registration of IOs	●	○	○	●				
Establishment of project performance monitoring and evaluation system	●	○	●	○				
Establishment of public relations system	●	○						
Research and development for irrigation	●	○				●		
SC-2: Capacity Building								
Capacity development training for irrigation staff (Level 1)	●	●						
Capacity development training for irrigation staff (Level 2)	○	●	●					
Capacity development training for IOs (Level 3)	○	○	●	●		●		○
Establishment of irrigation technical manuals and checklists	●	○			●			
Establishment of training modules for irrigation development	●	○				●		○
Promotion of private contractors/ consultants	●	○			●		●	
SC-3: Strengthening of Coordination								
Coordination with private sector	●	○						
Coordination with relevant institutions	●	○						

Note: ● = Main Player, ○ = Sub Player

3.7 Investment Costs

(1) Investment Costs for NIMP2018 (Phase 1 and Phase 2)

No.	Component	PHASE-1 Cost (USD in Million)	PHASE-2 Cost (USD in Million)	Total Cost (USD in Million)	Total Cost equivalent (TZS in Billion)
1	**Hard Component:** 1. Irrigation Infrastructure Development	2,026	2,423	4,449	9,965
2	**Soft Components:** 1. Organisation & Functional Strengthening 2. Capacity Building 3. Strengthening of Coordination	27	14	41	94
	Total	2,053	2,437	4,490	10,059

Notes: - Exchange rate of USD 1.0 = TZS 2,240 as of July 2017
- All figures in the table include VAT (18%).

(2) Annual Financial Mobilization during NIMP2018 Period (USD in Million)

Financial Demand and Supply (annual amount)		Phase 1: 8 years (2018 – 2025)	Phase 2: 10 years (2026 – 2035)
Financial demand (annual)		217	206
Public	Government	52	41
	DPs	100	85
Private	IO contribution	10	10
	Private Investment	40	40
	Large scale PPP	10	20
	Small scale PPP	5	10

3.8 (1/2) Project Evaluation

(1) Financial Benefits

< Assumption for Farm Budget Analysis >

Crop	Rainfed/ Irrigation	Present (ton/ ha)	Future (without Project) (ton/ ha)	Future (with Project) (ton/ ha)	Crop Intensity
Rice/ Paddy	Rainfed	1.85	1.85	5.00	0.782
	Irrigation	2.50	2.50	5.00	
Tomato	Rainfed	5.00	5.00	40.00	0.065
	Irrigation	20.00	20.00	40.00	
Onion	Rainfed	2.00	2.00	10.00	0.456
	Irrigation	7.00	7.00	10.00	

Note: Total crop intensity is 1.303 with 1.000 in rainy season and 0.303 in dry season.

< Farm Budget Analysis >

Change of Production Mode	Rainfed to Irrigation* (TZS / ha)			Existing Irrigation to Irrigation* (TZS/ farmer)		
	Without	With	Net benefit	Without	With	Net benefit
Present rainfed to irrigation cultivation	▲307,754	3,922,448	4,230,202	805,754	3,922,448	3,116,695
Present irrigation to improved irrigation cultivation	▲492,406	6,257,917	6,768,323	1,289,206	6,257,917	4,986,711

Notes: * Irrigation by NIMP2018
* National average farm land area is 1.6 ha/ farmer (2014/15 Annual Agricultural Sample Survey)

3.8 (2/2) Project Evaluation

(2) Economic Assessment and Sensitivity Analysis

For the assessment of the economic value of the Mater Plan, benefits and costs are adjusted by the following conversion factors.

Conversion factor	Value	Note
Shadow wage	0.65	Applied to unskilled labor such as farm labor, reflecting employment conditions.
Standard conversion factor	0.96	Applied to tradable goods such as machines and fertilizer, reflecting the foreign exchange conditions.

Economic analysis gives following prospect for the Master Plan (2018-2035).

Net Present Value (NPV)	TZS 1,468 Billion
Benefit / Cost Ratio (B/C)	1.40
Economic Internal Rate of Return (EIRR)	16.4%

Benefit	Cost		
	Base	+5%	+10%
Base	16.4%	15.7%	15.1%
-5%	15.7%	15.0%	14.4%
-10%	14.9%	14.3%	13.7%

3.9 Monitoring and Evaluation

Item	Major Indicator	Target		Supporting Units and Divisions of NIRC
		Phase 1	Phase 2	
Impact to National Level	1) Agriculture sector GDP growth rate (Annual %) 2) Reduction in rural poverty (%) 3) Reduction in food poverty (%)	6 ≤ 24 ≤ 5	- - -	Environmental Social Management Unit
Impact to Irrigation Sector (Irrigation Schemes only)	1) Irrigated area accumulated (ha) 2) Number of benefited farm households, accumulated 3) Unit yield (ton/ha) - Paddy - Tomato - Onion 4) Annual incremental net return (TZS/ha) – mixed average	700,000 400,000 5.0 40.0 10.0 3 -4 mil.	1,000,000 600,000 5.0 40.0 10.0 3-4 mil.	Operation and Support Services Division
Output 1 (Hard Component)	1) to 8) Zone Irrigation Development Plans (ha) 9) Private Sector Commercial Irrigation Development Plan	248,120 54,000	312,110 168,000	Planning, Design and Private Sector Coordination Division
Output 2 (Soft Component-1)	1) New establishment of RIO (nos.) 2) Workshop for district implementation system (nos.) 3) Increase in number of irrigation staff (persons) 4) Registered IOs (nos.)	6 3 163 469	12 4 55 643	Information Communication Technology Unit
Output 3 (Soft Component-2)	1) Development of irrigation design manuals (kinds) 2) Development of irrigation checklist (kinds) 3) Development of training modules (kinds) 4) Trainings to ZIOs/RIOs staff (times) 5) Trainings to LGAs staff (times) 6) Trainings to IOs (times)	1 1 1 4 78 78	1 1 1 5 104 104	Research and Technology Promotion Division
Output 4 (Soft Component-3)	1) Investment by private sector (TZS) 2) Cooperation and collaboration for cross-sectoral issues (nos.)	4 4	5 5	Planning, Design and Private Sector Coordination Division

3.10 Risk Assessment and Mitigation Measures

S/N	Risk	Contents	Mitigation Measures
1	Shortage of financial resources for irrigation development	Irrigation development will be delayed due to shortage of financial resources.	NIRC should make every possible effort to secure necessary resources, including defending government budget, expanding DPs contributions, and attracting private sector, etc. Also, it should work hard to find new found sources such as the establishment of the Irrigation Development Fund, new PPP arrangements and enhancement of IOs' access to financial sector.
2	Shortage of human resources for irrigation development	Irrigation development will be delayed due to shortage of manpower and human resources (both in public and private sectors).	NIRC should promote 1) increase of technical staff in the public sector in accordance with NIMP2018 progress, 2) further involvement of local engineering firms and contractors in irrigation projects, 3) practical training (OJT) along the project cycle guided by the CGL.
3	Lower than expected involvement of private sector.	Progress of irrigation development is hampered by limited participation and investment contribution of private sector.	NIRC should widely share information relevant to irrigation. Furthermore, NIRC, without delay, should carry out necessary study on the effective PPP arrangement for irrigation development, and legalize the approach with close consultation with private sector.
4	Capacity development of irrigators' organisations goes so slow that irrigation facilities are left unattended without proper O&M.	Due to lack of proper O&M, many irrigation facilities are left not-functioning. Therefore, irrigation development stagnates.	NIRC should carry out training to and monitoring of irrigators' organisations with close collaboration of LGA's cooperative officers. On the other hand, the zonal irrigation offices should distribute the CGL to all LGAs and irrigators' organisations, and make sure they are referred to in daily operation.
5	Social and environmental conditions surrounding irrigation development deteriorates.	Socio-environmental conditions around irrigation development deteriorate. For example, conflicts surges between livestock keepers and crop farmers, or resistance of neighbouring residents intensifies against irrigation water use.	NIRC should properly conduct the environmental and social assessment study with which stakeholders identify likely problems and agree with possible countermeasures. When any serious issue emerges after operation begins, there should immediately be meetings for discussion and conflict solving among relevant parties.

4.1 (1) Action Plan 1: Hard Components (Phase 1)

(1) New Development of Irrigation Schemes by Zone and Size in Phase 1

Irrigation Zone	Small Scale		Medium Scale		Large Scale		Total	
	No. of Schemes	New Area (ha)	No. of Schemes	New Area (ha)	No. of Schemes	New Area (ha)	No. of Schemes	New Area (ha)
Dodoma	13	2,617	4	2,820	1	500	18	5,937
Kilimanjaro	44	3,491	12	7,001	3	5,650	59	16,142
Mbeya	18	2,111	5	3,610	2	7,660	25	13,381
Morogoro	7	1,281	15	9,493	6	25,600	28	36,374
Mtwara	12	1,297	4	2,793	1	2,710	17	6,800
Mwanza	12	1,755	10	8,412	4	18,500	26	28,667
Tabora	8	1,470	8	4,737	2	4,280	18	10,487
Katavi	9	1,350	5	4,500	3	13,290	17	19,140
Sub-Total	123	15,372	63	43,366	22	78,190	208	136,928
Private Sector	-	-	-	-	3	54,000	3	54,000
Total	123	15,372	63	43,366	25	132,190	211	190,928

(2) Improvement and Expansion of Irrigation Schemes by Zone and Size in Phase 1

Development Phase	Small Scale			Medium Scale			Large Scale			Total		
	No.	Imp. Area	Exp. Area	No.	Imp. Area	Exp. Area	No.	Imp. Area	Exp. Area	No.	Imp Area	Exp. Area
Dodoma	29	5,473	2,177	13	5,045	5,263	3	7,065	6,435	45	17,583	13,875
Kilimanjaro	28	7,557	2,361	4	6,357	1,870	1	3,380	1,900	33	17,294	6,131
Mbeya	37	3,881	4,492	14	5,454	5,198	6	10,155	20,258	57	19,450	29,948
Morogoro	26	2,150	4,009	9	4,453	6,658	2	1,901	6,564	37	8,504	17,231
Mtwara	25	2,546	3,104	7	1,821	4,546	1*	290	-	32	4,567	7,650
Mwanza	15	3,016	1,568	4	1,899	2,954	1	1,040	5,000	20	5,955	9,522
Tabora	12	1,420	2,238	7	2,725	5,146	1	1,850	2,370	20	5,955	9,754
Katavi	7	1,585	1,165	5	2,373	3,125	5	12,883	12,791	17	16,841	17,081
Total	179	27,628	21,114	63	30,127	34,760	19	38,524	55,318	261	96,279	111,192

Notes: "No." means number of schemes, "Imp. Area" means improved area (ha), "Exp. Area" means expansion area (ha).
Scheme number with as asterisk (*) is counted as a new development scheme.

4.1 (2) Action Plan 1: Hard Components (Phase 1)

(2) Action Plan 1: Irrigation Infrastructure Development

No.	Action	Executing Agency	Supporter		2018	2019	2020	2021	2022	2023	2024	2025
				Phase 1								
1	**Small Scale Irrigation Development**											
(1)	Study	LGA	Consultant	Preparation period								
(2)	Design	LGA	Consultant									
(3)	Tender	LGA	-									
(4)	Construction supervision	LGA	Consultant									
2	**Medium Scale Irrigation Development**											
(1)	Study	NIRC/ZIO	Consultant	Preparation period								
(2)	Design	NIRC/ZIO	Consultant									
(3)	Tender	NIRC/ZIO	-									
(4)	Construction supervision	NIRC/ZIO	Consultant									
3	**Large Scale Irrigation Development**											
(1)	Study	NIRC/ZIO	Consultant	Preparation period								
(2)	Design	NIRC/ZIO	Consultant									
(3)	Tender	NIRC/ZIO	-									
(4)	Construction supervision	NIRC/ZIO	Consultant									

(3) Breakdown of Irrigation Schemes in Number by Zone and Size-Group

Irrigation Zone	Small Scale			Medium Scale		Large Scale	Total
	S1	S2	S3	M1	M2	L1	
Dodoma	14	14	14	8	9	4	63
Kilimanjaro	24	24	24	8	8	4	92
Mbeya	18	18	19	9	10	8	82
Morogoro	11	11	11	12	12	8	65
Mtwara	12	12	13	5	6	1	49
Mwanza	9	9	9	7	7	5	46
Tabora	6	7	7	7	8	3	38
Katavi	5	5	6	5	5	8	34
Total	99	100	103	61	65	41	469

Note: Action plan is defined as an implementation plan of each project component within a time frame of NIMP2018.

4.2 Action Plans 2 to 4: Soft Components (Phase 1)

(1) Action Plans 2 to 4: Soft Components

		Activity		2018	2019	2020	2021	2022	2023	2024	2025
HC	AP 1	Small-scale irrigation scheme	Preparation Period		S1		S2		S3		
		Medium-scale irrigation scheme				M1			M2		
		Large-scale irrigation scheme					L1				
SC	AP 2	(1)-1 RIO establishment									
		(1)-2 DID/DIDT strengthening									
		(2) Improvement of NIRC function									
		(3) IO registration									
		(4) M&E system									
		(5) Public relations									
		(6) Research and development									
	AP 3	(1) Capacity development of NIRC *									
		(2) Capacity development of LGA *									
		(3) Capacity development of IO									
		(4) Preparation of technical manuals									
		(5) Preparation of training modules									
		(6) Capacity development of contractors									
	AP 4	(1) Coordination with the private sector									
		(2) Coordination with relevant institutions									

*Note: * Practical / on-the-job training is continuous along project cycle.*

Action Plan 2: Organisational and Functional Strengthening
Action Plan 3: Capacity Building
Action Plan 4: Coordination Activities

4.3 Development Programs (Phase 1)

Development Programs for Phase 1

Development Program	AP1 (HC)	AP2 (SC1)	AP3 (SC2)	AP4 (SC3)	Developed Area *1 (ha)	F. Cost*2 (USD in Million)	EIRR (%)
0. NIRC HQ	●	●	●	●	-	5.5	-
1. Dodoma Zone Irrigation	●	●	●	-	19,812	209.3	16.7
2. Kilimanjaro Zone Irrigation	●	●	●	-	22,274	229.5	15.4
3. Mbeya Zone Irrigation	●	●	●	-	43,329	320.4	16.0
4. Morogoro Zone Irrigation	●	●	●	-	53,605	406.2	18.3
5. Mtwara Zone Irrigation	●	●	●	-	14,450	110.7	18.3
6. Mwanza Zone Irrigation	●	●	●	-	38,189	302.3	18.0
7. Tabora Zone Irrigation	●	●	●	-	20,241	169.0	15.0
8. Katavi Zone Irrigation	●	●	●	-	36,221	300.0	15.2
Sub-Total 1 to 8	-	-	-	-	248,120	2,053	16.4
9. Large Commercial Irrigation	-	-	-	●	54,000	-	-
Total				-	302,120	-	-

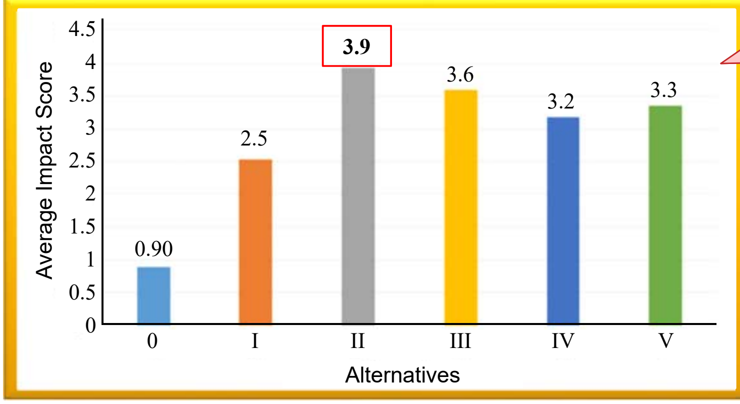
Notes: *1= New development and expansion areas, *2= Financial Cost (VAT inclusive)
Development program is defined as a combination of action plans.

5.1 (1) Strategic Environmental Assessment (SEA)

(1) Alternatives

- Alternative 0: Do not implement the strategic measures and plans in the NIMP 2018
- Alternative I: Promote improvement of traditional irrigation schemes only
- Alternative II: Promote all types of existing irrigation schemes concurrently with new smallholders and commercial irrigation schemes of all scales (i.e. small, medium and large) which are accessible
- Alternative III: Government plays coordination and policy roles and the private sector manages irrigation
- Alternative IV: Promote Public Private Partnership (PPP) in irrigation investment and management
- Alternative V: Promote sharing of O&M such that IOs manage tertiary canals and below while government does the rest.

(2) Scoping Evaluation Result of Each Alternative



Alternative II (3.9) has a largest positive impact among other alternatives.

Note: The higher average impact score means the more positive impact (effect) in each alternative.

5.1 (2) Strategic Environmental Assessment (SEA)

(3) Summary of SEA and Monitoring Plan with High Priority (1/2)

No.	Issues and Concerns	Monitoring Indicators	Monitoring Frequency	Responsible Institution	Time Frame
Regulatory Framework and Institutional Strengthening					
1	Unclear institutional setup and line of command in irrigation services provision	· A well functioning institutional setup established and working	Once	GoT MoWI	2018 to 2025
2	Insufficient human resources at all levels and low capacity in managing irrigation development	· No. of staff recruited and trained · No. of furnished office · No. of vehicles procured · No. of in-service staff trained · No. of retooling, training and outreach activities conducted	Annually	Ministry responsible for irrigation	2019 to 2030
5	Inadequately established Irrigators' Organisations	· No. of registered IOs · Amount of funds set aside for O&M · No. of operating irrigation schemes	Annually	NIRC LGAs	2018 to 2025
6	Inadequate incentives for the private sector to participate in irrigation	· No. of investors in irrigation	Annually	NIRC TIC	2018 to 2025
7	Inefficient marketing systems for agricultural products	· No. of small holder marketing associations established and trained · No. of training conducted	Annually	MoA	2018 to 2025
Financing Mechanism and funding support for Irrigation Development					
8	Inadequate funding and delays in disbursement	· No. of trained accountants · Amount of funds allocated · Development Fund established	Quarterly	LGAs Responsible Ministry	2018 to 2025
Land tenure and ownership rights					
14	Limited understanding of land governing policies, laws and regulations	· No. of training conducted	Annually	LGAs	2018 to 2025

5.1 (3) Strategic Environmental Assessment (SEA)

(3) Summary of SEA and Monitoring Plan with High Priority (2/2)

No.	Issues and concerns	Monitoring indicators	Monitoring Frequency	Responsible Institution	Time Frame
Irrigation Water Resources Development					
15	Inadequacy of reliable and sustainable surface water resources for irrigation	· No. of developed water sources	Annually	ZIU, NIRC	2018 to 2035
17	Reduction in environmental flows and its implications on aquatic and water sensitive biodiversity and wildlife habitats	· % change in the number observed bio-indicators · % change in area of vegetated riparian zones that receive periodic inundation · Quantities of water discharge in the rivers	Seasonal Seasonal Daily	BWOs	2018 to 2035
18	Uncertainty of water supplies due to climate change	· No. of established weather monitoring stations · % of farmers using weather forecast information · % of farmers adopting water saving technologies · % of farmers adopting drought resistant crops	Annually	TMA Ministry responsible for agriculture LGAs	2018 to 2025
Development and Management of Irrigation Schemes					
21	Deficient criteria for establishment of irrigation potential areas in the NIMP	· NIMP2018	Once	NIRC	2018 to 2020
22	Issuance of water use permits which does not conform to available water	· Established quantities of water demand per sector	Annually	Ministry responsible for water research institutions	2018 to 2025
24	Inadequate farm management, operation and maintenance (O&M) skills	· Farm productivity · No. of IOs trained in O&M	Annually	LGAs Responsible Ministry	2018 to 2025
31	Sedimentation from catchment and within irrigation schemes	· Sediment load in canal, rivers and reservoirs · Presence of stable river banks · Intact riparian zones · Incidences of large-scale erosion denuding landscapes · Incidences of excessive fine-scale sediment deposition in river channel	Quarterly	BWO	2018 to 2035
36	Degradation of river catchments and riparian ecosystems including ecologically sensitive areas	· Species composition · No. of rivers with clearly demarcated buffer zones · No. of protected areas	Annually	LGAs Ministry responsible for environment	2018 to 2025

Note: Listed the High Priority only. As a whole, 15 items are categorized as high priority, 18 items as medium and 7 items as low.

6.1 Conclusion

Evaluation Principle	Conclusion
Relevance	(1) Consistency with National Development Goals and Policies (2) Consistency with Development Needs (3) Consistency with Development Partners' Aid Policies
Effectiveness	(1) Enhancement of Crop Productivity with Irrigation (2) Quick Project Effects by Full Development of Irrigation Infrastructure (3) Irrigation Potential Analysis based on Assessment of Water Resources and Land Resources (4) Realistic Irrigation Development Plan by Using a Comprehensive Information System (5) Irrigation Development Plan linking with Agricultural Value Chain
Efficiency	(1) Project Management and Monitoring & Evaluation Systems with a Central Focus on NIRC/ZIOs (2) Smooth Project Operation and Management through Capacity Building of Irrigation Staff in NIRC/ZIOs and LGAs (3) Efficient Project Operation and Management through Strengthening of Coordination with Other Relevant Sectors
Impact	(1) Increases in Agricultural Incomes (2) Becoming Food Basket of East Africa (3) Irrigation Development as Adaptation Measures for Climate Change
Sustainability	(1) Sustainable Irrigation Development through Capacity Building to Irrigation Staff in NIRC/NIOs and LGAs (2) Securing Sustainable Irrigation Schemes through Capacity Building to IOs (3) Motivation to Beneficiary Farmers through Increasing Agricultural Incomes

6.2 Recommendations

Relevant Ministries	Recommendations
MoFP	(a) Securing financial resources for implementation of IWRMDP, NIMP2018 and ASDP2 (b) Full disbursement of approved annual budgets of NIRC
NIRC	(a) Implementation of NIMP2018 (b) Improvement of communication using ICT (c) Development of design standard for irrigation in Tanzania (d) Development of support system for IOs (e) Strengthening of cooperation with relevant government ministries and private sector
MoWI	For Implementation of the NIMP2018 (a) Implementation of IWRMDPs (b) Early Formulation of the remaining IWRMDPs (c) Review of EFR for Rufiji Basin (d) Necessary actions for transboundary water use For Better Water Resources Management (e) Accumulation of hydrological data (f) Consideration of reliability of water utilization (g) Collection of water fee
MoA	(a) Implementation of ASDP2 with firm commitment (b) Facilitating private sector in undertaking development of large-scale irrigation schemes (c) Providing extension services timely to those who have less experience of irrigation farming (d) Developing and promoting water-saving agricultural technologies (e) Promoting value chains with attention to the private sector involvement (f) Promoting export of irrigation products to neighboring countries (g) Promoting farmers' access to financial resources in concert with TADB (Tanzania Agricultural Development Bank)
PO-RALG	(a) Overall coordination between the NIRC and LGAs through RS (b) Promotion of proper staff allocation and organisational arrangement (c) Promotion of sufficient budget allocation (d) Support for irrigation data collection

Note: Please refer to the main report for the recommendations for Environmental and Social Considerations.

The Project on the Revision of National Irrigation Master Plan

in the United Republic of Tanzania

Final Report
Volume-I: Main Report

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Abbreviations

AASS	Annual Agricultural Sample Survey
ACBG	Agricultural Capacity Building Grant
AET	Actual Evapo-Transpiration
AEDG	Agricultural Extension Development Grant
AfDB	African Development Bank
AHP	Analytical Hierarchy Process
ARDS	Agricultural Routine Data System
ASA	Agriculture Seed Agency
ASDP	Agricultural Sector Development Programme
ASDS	Agricultural Sector Development Strategy
ATC	Arusha Technical College
BRN	Big Results Now
BWB	Basin Water Boards
BWO	Basin Water Office
CGIAR	Consultative Group on International Agricultural Research
CGL	Comprehensive Guidelines for Irrigation Scheme Development under District Agricultural Development Plan
CHG	Climate Hazards Group
CHIRPS	Climate Hazards Group InfraRed Precipitation with Station data
CI	Consistency Index
CIF	Cost, Insurance and Freight
CMT	Council Management Team
COWSOs	Coupled Model Intercomparison Project
CR	Consistency Ratio
CRDB	Cooperative and Rural Development Bank
CSA	Climate Smart Agriculture
CSI	Consortium for Spatial Information
D/D	Detailed Design
DADG	District Agricultural Development Grant
DADP	District Agricultural Development Plan
DAEO	District Agriculture Extension Officer
DAICO	District Agricultural, Irrigation and Cooperative Officer
DAO	District Agriculture Officer
DASIP	District Agricultural Sector Investment Project
DC	District Council
DCO	District Cooperative Officer
DCDO	District Community Development Officer
DED	District Executive Director
DEM	Digital Elevation Model
DID	District Irrigation Department
DIDF	District Irrigation Development Fund
DIDT	District Irrigation Development Team
DIE	District Irrigation Engineer
DIT	District Irrigation Technician
DOE	Division of Environment
DP	Development Partner
DPO	District Planning Officer
DSS	Decision Support System
DWT	Dead Weight Tonnes
EA	Environmental Audits
EAC	East African Community
EF	Environmental Flow
EFA	Environmental Flow Assessment
EFR	Environmental Flow Requirement

EIRR	Economic Internal Rate of Return
EIS	Environmental Impact Statement
eGA	e-Government Agency
EIA	Environmental Impact Assessment
EMA	Environmental Management Act
ESMF	Environmental and Social Management Framework
EWR	Environmental Water Requirement
EWURA	Energy and Water Utilities Regulatory Authority
F/S	Feasibility Study
FACF	Food Assistance Counterpart Fund
FAO	Food and Agriculture Organization
FDI	Foreign Direct Investment
FHH	Farm Household
FOB	Free On Board
FSDT	Financial Sector Deepening Trust
FYDP	Five Years Development Plan
GAFSP	The Global Agriculture and Food Security Program
GC	Government Communication
GCM	Global Circulation Model
GDP	Gross Domestic Product
GE	Graduate Engineer
GIS	Geographic Information System
GoT	Government of Tanzania
GPS	Global Positioning System
GRDC	Global Runoff Data Centre
GW	Groundwater
HC	Hard Component
HIV	Human Immunodeficiency Virus
HPP	Hydropower Plant
HQ	Headquarters
HR	Human Resources
ICT	Information Communication Technology
IEE	Initial Environmental Examination
IFAD	International Fund for Agricultural Development
ILFS	Integrated Labour Force Survey
IO	Irrigators' Organisation
IWMI	International Water Management Institute
IWRMDP	Integrated Water Resources Management and Development Plan
JICA	Japan International Cooperation Agency
JCC	Joint Coordination Committee
KPI	Key Performance Indicator
KRC	Korea Rural Community Corporation
LGA	Local Government Authority
LGDG	Local Government Development Grant
LU	Land Use
LS	Land Suitability
LVBC	Lake Victoria Basin Commission
MAFC	Ministry of Agriculture Food Security and Cooperatives
MALF	Ministry of Agriculture, Livestock and Fisheries
MCA	Multi-Criteria-Analysis
MoA	Ministry of Agriculture
MODIS	Moderate Resolution Imaging Spectroradiometer
MoFP	Ministry of Finance and Planning
MoWI	Ministry of Water and Irrigation
NAFCO	National Agriculture and Food Corporation
NAIVS	National Agricultural Input Voucher Scheme

NAP	National Agriculture Policy, 2013
NAWAPO	National Water Policy
NBC	National Bank of Commerce
NBI	Nile Basin Initiative
NBS	National Bureau of Statistics
NEAC	National Environmental Advisory Committee
NELSAP	Nile Equatorial Lakes Subsidiary Action Program
NEMC	National Environment Management Council
NGO	Non-governmental Organisation
NIDF	National Irrigation Development Fund
NIDP	National Irrigation Development Plan
NIDS	National Irrigation Development Strategy
NIMP2002	National Irrigation Master Plan2002
NIMP2018	National Irrigation Master Plan2018
NIP	National Irrigation Policy
NIRC	National Irrigation Commission
NIRTC	National Irrigation Research and Training Centre
NMB	National Microfinance Bank
NRDS	National Rice Development Strategy
NSGRP II	National Strategy for Growth and Reduction of Poverty II
NWSDS	National Water Sector Development Strategy
O&M	Operation and Management
O&OD	Opportunities and Obstacles to Development
PC	Project Committee
PEA	Preliminary Environmental Assessment
PER	Public Expenditure Review
PET	Potential Evapotranspiration
PHRD	Policy and Human Resources Development
PO-RALG	President Office- Regional Administration and Local Government
PPP	Public-Private Partnership
PPRA	Public Procurement Regulatory Authority
PRSP	Poverty Reduction Strategic Paper
PSC	Parliamentary Standing Committee
RAP	Resettlement Action Plan
RAS	Regional Administrative Secretary
RI	Random Index
RIO	Regional Irrigation Office
RPF	Resettlement Policy Framework
RS	Regional Secretariat
RWH	Rainwater Harvesting
SACCOS	Savings and Credit Cooperative Society
SADC	Southern African Development Community
SAGCOT	Southern Agriculture Growth Corridor of Tanzania
SC	Soft Component
SCF	Standard Conversion Factor
SCM	Stakeholder Consulting Meeting
SD	Soil Depth
SDR	Soil Drainage
SEA	Strategic Environmental Assessment
SEAR	Strategic Environmental Assessment Regulation
SEMoP	Strategic Environmental Monitoring Plan
SEMP	Strategic Environmental Management Plan
SESA	Strategic Environmental and Social Assessment
SOC	Soil Organic Carbon
SRESA	Strategic Regional Environmental and Social Assessment
SRI	System of Rice Intensification

SSIDP	Small-Scale Irrigation Development Project
SSR	Self-Sufficiency Ratio
ST	Soil Type
SUA	Sokoine University of Agriculture
SUDECO	Suger Development Corporation
SW	Surface Water
SWOT	Strengths, Weakness, Opportunities and Threats
TAC	Technical Advisory Committee
TaCRI	Tanzania Coffee Research Institute
TADB	Tanzania Agricultural Development Bank
TANCAID	Capacity Development for the Promotion of Irrigation Scheme Development under the District Agricultural Development Plans
TANESCO	Tanzania Electric Supply Company Limited
TANRICE	Technical Cooperation in Supporting Service Delivery Systems of Irrigated Agriculture
TANRICE2	Project for Supporting Rice Industry Development in Tanzania
TARI	Tanzania Agricultural Research Institute
TCDC	Tanzania Cooperative Development Commission
TDV2025	Tanzania Development Vision
TIC	Tanzania Investment Centre
TMA	Tanzania Meteorological Agency
TOR	Terms of Reference
TORITA	Tobacco Research Institute of Tanzania
TPRI	Tropical Pesticides Research Institute
TRC	Technical Review Committee
TRIT	Tea Research Institute of Tanzania
TTCL	Tanzania Telecommunication Company Limited
TWI	Topographic Wetness Index
UDSM	University of Dar es Salaam
UNDP	United Nations Development Programme
USAID	United States Agency for International Development
VAEO	Village Agricultural Extension Officer
VC	Value Chain
VDP	Village Development Plan
VPO-DOE	Vice President Office- Department of Environment
WAEO	Ward Agricultural Extension Officer
WB	World Bank
WEI	Water Exploitation Index
WI	Water Institute
WRMA	Water Resources Management Act
WSDP	Water Sector Development Programme
WSSAs	Water Supply and Sanitation Authorities
WUA	Water Users' Association
ZIE	Zonal Irrigation Engineer
ZIO	Zonal Irrigation Office
ZRC	Zonal Review Committee

Unites

	Area		Volume
cm^2	Square-centimetre(s)	cm^3	Cubic-centimetre(s)
m^2	Square-metre(s)	m^3	Cubic-metre(s)
km^2	Square-kilometre(s) (1,000,000 m^2)	L	Litre(s) (1,000 cm^3)
ha	Hectare(s) (10,000 m^2)	MCM	Million Cubic Metre (s)
acre	Acre(s) (4,046.8 m2 or 0.40468 ha.)		

	Length		Mass
mm	Millimetre(s)	g	Gram(s)
cm	Centimetre(s)	kg	Kilogram(s) (1,000 g)
m	Metre(s)	t, ton	Metric Ton(s) (1,000 kg)
km	Kilometre(s) (1,000 m)		

	Currency		Time
USD	United State Dollars	s, sec	Second(s)
JPY	Japanese Yen	m, min	Minute(s) (60 sec.)
TZS	Tanzanian Shilling	h, hr	Hour(s) (60 min.)
	USD1.0 = JPY 112 = TZS 2,240		
	(as of July 2017)		

Chapter 1 Introduction

1.1 Authority

This final report (the Report) was prepared in accordance with the records of discussion on the Project on the Revision of National Irrigation Master Plan[1] (the Project) agreed upon between the Ministry of Water and Irrigation (MoWI) of the United Republic of Tanzania and the Japan International Cooperation Agency (JICA) on 30th June 2016. The Report presents the National Irrigation Master Plan 2018 (NIMP2018) as outputs of the Project executed by the JICA Project Team.

The Report mainly deals with NIMP2018 and the implementation plans for Phase 1. Chapter 9 has formulated the NIMP2018 based on the data collection and analysis discussed in Chapters 1 to 8. Chapter 11 has summarised the implementation plans for Phase 1. Also, as for environmental and social aspects, it shows a summary of environmental and social considerations in Chapter 10 and strategic environmental assessment in Chapter 12.

1.2 Project on the Revision of National Irrigation Master Plan

1.2.1 Background of the Project

(1) Status of Irrigation Development in Tanzania

The National Agricultural Policy of Tanzania (October 2013) recognizes irrigation development as an effective approach to achieve food security and poverty reduction because it improves productivities of crops and assuring stable expansion of agricultural production. In particular, the policy emphasises its importance in addressing the adverse impact on agricultural production resulting from the variations in precipitation and rainfall patterns due to global climate changes.

(2) Past Trend of Irrigation Development in Tanzania

Tanzania began its irrigation development seriously only since 1994. Until then, irrigation development activities were carried out independently by individual Development Partners (DPs). In 1994, the Government of Tanzania (GoT) formulated the National Irrigation Development Plan (NIDP) to achieve more efficient irrigation development by 2014. After the formulation, however, the NIDP was not implemented as planned. For instance, at the end of the first eight years, the progress of the "institutional reform of the irrigation sector", which is one of the key areas of implementation, was just around 30%. On the other hand, it remained less than 30% in the area of the "development of irrigation facilities". The reasons for the low achievements were the lack of basic information such as hydrological and meteorological data, inadequate institutional setting, constraints in human and financial capacities, and selection of uneconomical schemes. Given these challenges and to streamline the plan with other national policies prepared later, GoT requested JICA to conduct a study to review NIDP and to prepare the National Irrigation Master Plan.

[1] Based on the contract with JICA, the Project was executed in two steps which consisted of Phase 1 (from September 2016 to October 2017) and Phase 2 (from November 2017 to August 2018).

(3) National Irrigation Master Plan 2002 (NIMP2002)

The study on the NIMP2002 started in October 2001 and lasted for 28 months until January 2004. The NIMP2002 prepared an irrigation master plan with a target year of 2017 and an action plan to work on the priority schemes with identified issues. The plan also included investigations on the range of bottlenecks hindering the implementation of the development activities and practical suggestions supported by some remedial measures, which were identified through investigations. The major objective of NIMP2002 was to realize "sustainable irrigation development by effectively mobilizing national resources" which would in turn contributes to the achievement of the goals of the "Agricultural Sector Development Strategy (ASDS)". The NIMP2002 was prepared based on two approaches: scheme-wise development plan (hard aspect) and issue-wise reform plan (soft aspect). With respect to the hard aspect, the plan proposed to develop 626 irrigation schemes with total irrigated area of 405,000 ha (counted on accumulation basis), while in terms of soft aspect, it proposed 37 reform plans to address various issues. With an effort of advancing the irrigation development according to the plan, GoT reported that the irrigated land area grew from 200,000 ha in 2004 to 460,000 ha in 2015, almost achieving the envisaged target.

(4) Background of the New Project

GoT requested JICA to update the NIMP2002 in view of the following developments:

- More than 15 years have passed since the formulation of the current NIMP2002, and the circumstances around irrigation development have changed greatly (greater competition in water use among sectors, urgency of actions to address the climate changes, the establishment of NIRC, necessity for updating data of irrigation schemes, etc.),
- Need of further efforts for poverty reduction, and
- Increasing demands for more sustainable irrigation development.

Having received the request, JICA implemented in December 2015 the "Detailed Planning Survey for Project" on the "Revision of National Irrigation Master Plan".

1.2.2 Expected Goal and Outputs of the Project

The expected goal of the Project is that the "irrigation development under the National Irrigation Commission (NIRC) is sustainably enhanced." The expected outputs are as follows:

Output 1: National Irrigation Master Plan is revised.
Output 2: Action Plan is established.

1.2.3 Target Area

The Project covers the mainland of Tanzania.

1.2.4 Counterpart and Relevant Organisations

Counterpart and relevant organisations of the Project are shown in Table 1.2.1 below.

Table 1.2.1 List of Counterpart and Relevant Organisations

Counterpart Organisation	NIRC
Relevant Ministries and Organisations (JCC Members)	MoWI Ministry of Agriculture*1 (MoA) Ministry of Finance and Planning (MFP) Ministry of Energy and Minerals (MEM) Ministry of Natural Resources and Tourism (MNRT) Ministry of Lands, Housing, and Human Settlements Development (MLHHSD) President's Office, Regional Administration, and Local Government (PO-RALG) Vice President's Office-Union Affairs and Environment (VPO-ENV)
Stakeholders (SCM Members)	Development Partners (DPs) Embassies Private Firms NGO, etc.

*Note: *1= Ministry of Agriculture, Livestock, and Fisheries (MALF) was split into the Ministry of Agriculture (MoA) and Ministry of Livestock and Fisheries (MoLF) in October 2017.*
JCC= Joint Coordination Committee, SCM= Stakeholders Consulting Meeting
Source: JICA Project Team

1.3 Objectives and Scope of the Project

The objectives of the Project are based on the Record of Discussions (R/D) agreed in June 2016 between the MoWI of the GoT and JICA, as follows:

- Revise the NIMP2002 in view of contributing to poverty reduction and addressing climate change,
- Enhance the capacity of NIRC, and
- Strengthen the sustainable irrigation development of Tanzania.

1.4 Major Considerations in Revising the NIMP2002

Prior to the Project, it was recognised that the current NIMP2002 would be updated based on the latest hydrological and meteorological data with particular attention to the following:

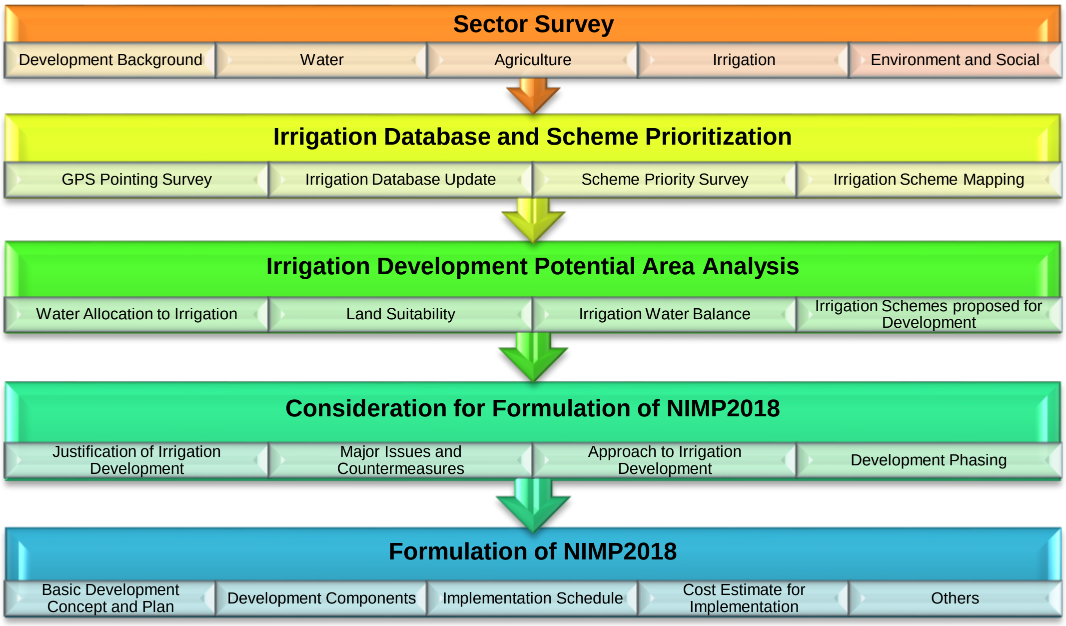
- Envision clearly the end-state of the irrigation development in the last year of the master plan,
- Examine carefully and come up with a scenario with which the end-state will be feasibly attained, and
- Elaborate how the achievement of the plan will contribute to the goals of higher policies and the national economy.

In light of these considerations, the Project will study the present state of the irrigation development and review the achievements and lessons learned. At the same time, it will measure irrigation potential and possible schemes based on the latest data. Then the Project will construct a "framework for NIMP2018" which enables the plan to achieve the development goals by the target year. Subsequently, an action plan will be prepared with clear "composition of development components" which is to be incorporated in the framework.

1.5 Work Plan of the Project

At first, the JICA Project Team reviewed the NIMP2002 to confirm the recent implementation status and also to learn the lessons and recommendations. Taking into account its review results as well as the terms of reference and the contract periods of the Project, the work plan was designed as shown in Figure

1.5.1.



Source: JICA Project Team

Figure 1.5.1 Work Plan of the Project

In addition to the formulation of the NIMP2018, the development programs for priority irrigation schemes to be implemented for the upcoming ten years will be proposed.

1.6 Review of NIMP2002

1.6.1 Proposed Development Plan

To contribute to the productivity and profitability of the agriculture sector, NIMP2002 selected 37 subject-wise improvement programs and 626 irrigation schemes to realize sustainable irrigation development targeting the year of 2017 as shown in Table 1.6.1.

Table 1.6.1 Development Target of NIMP up to 2017

Development Program and Project	No. of Programs and Projects	Accumulated Irrigation Development Area (ha)
(a) Scheme-wise Improvement Programs	37	-
(b) Irrigation Development Projects		
・ Improvement of Traditional Irrigation Schemes	462	274,600
・ Water Harvesting Irrigation Schemes	112	68,200
・ New Irrigation Schemes (smallholders)	42	62,600
Total (b)	626	405,400

Source: National Irrigation Master Plan 2002, JICA, November 2002

In addition, if irrigation development would be carried out under close cooperation with the agricultural sector, it was expected that there would be a high possibility of achieving national rice self-sufficiency in the amount of 1,239,000 ton by 2017.

1.6.2 Achievements of the Proposed Development Plan by 2016

(1) Irrigation-related Expenditure

In the NIMP2002, the government budget for irrigation development is projected for three cases, namely, Base Case, High Case, and Low Case as a result of sensitive analysis, using the past actual expenditures and assuming the increase in gross domestic product (GDP) growth rate. The comparison table between the budget projections and actual expenditure are shown in Table 1.6.2 below.

Table 1.6.2 Comparison between Projected and Actual Expenditures (TZS Billion)

F.Year	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
High	17.8	19.0	20.3	21.7	23.1	24.7	26.4	28.3	30.2	32.3	34.6	37.0	39.6	42.3	45.3
Base	14.8	15.7	16.6	17.6	18.6	19.7	20.9	22.1	23.4	24.8	26.3	27.8	29.5	31.3	33.2
Low	14.7	15.5	16.3	17.1	18.0	18.9	19.9	20.9	22.0	23.1	24.2	25.5	26.8	28.2	29.6
Actual	NA	NA	NA	21.9	34.8	33.6	49.3	21.2	30.3	7.4	22.7	37.4	12.8	10.7	NA

Source: The Study on the National Irrigation Master Plan, Vol. 1 Main Report, November 2002, Nippon Koei (p.7-40) and NIRC for Actual data (2006-2016)

Due to the expenditures from Agricultural Sector Development Program 1 (ASDP1) basket fund between 2006 and 2011, the actual expenditures are higher than those in the projection. However, it tends to be decreasing since 2012 when ASDP1 was closed. The expenditures from 2012 onward are mainly Small-scale Irrigation Development Project (JICA) in 2013 and 2016, Feed the Future (USAID) in 2014.

(2) Accumulated Irrigation Development Area

The possible irrigation development area by 2017 is estimated on a cumulative basis for the three investment cases, taking into consideration the analysis results of inventory survey conducted in the NIMP2002. The comparison table between the projected irrigation development area and actual one is shown in Table 1.6.3 below.

Table 1.6.3 Accumulated Irrigation Areas (Thousand ha)

F.Year	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
High	218	229	239	250	265	276	281	294	312	325	337	352	372	387	405
Base	218	228	236	243	254	264	271	278	290	304	316	325	335	351	362
Low	218	222	234	240	248	261	268	274	287	296	306	321	328	337	350
Actual	NA	NA	264	274	289	311	331	346	355	364	450	461	461	NA	NA

Source: The Study on the National Irrigation Master Plan, Vol. 1 Main Report, November 2002, Nippon Koei (p.7-40) and NIRC for Actual data (2005-2015)

From Table 1.6.3, the actual irrigation development area by 2015 was much bigger than the area projected in the NIMP2002. Compared on the same basis with the NIMP2002, the irrigation development area only for smallholder schemes is 382,000 ha (refer to Table 5.5.5) in actual against 372,000 ha in the High Case by 2015. However, the irrigation development areas are unchanged since 2012. This is due to that ASDP1 was closed in 2012 and the projects implemented under the SSIDP and Feed the Future are improvement of existing irrigation schemes.

(3) National Paddy Production

In the NIMP2002, the possible production of paddy was estimated about 1.17 - 1.24 million tons for 2017. On the other hand, the actual paddy production has been sharply increasing from 2010 onwards as shown in Table 1.6.4. According to MALF[2], there are many reasons that contributed to the increase of paddy production. Among them are: the increase in the area cultivated under paddy, use of fertilizers

[2] Source: Agriculture Overview Report 2005 to 2010, http://www.kilimo.go.tz/index.php/en/resources/category/statistics

under inputs voucher system, enough rainfall distribution as well as increase in the use of irrigation.

Table 1.6.4 National Paddy Production (Thousand ton)

F.Year	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Actual	1,097	1,058	1,168	1,206	1,342	1,421	1,335	2,650	2,248	1,801	2,195	2,621	2,980	2,986	NA

Source: FAOSTAT, Tanzania (30th April 2018)

The national paddy production is estimated at 2.99 million tons in 2016, which is roughly three times that of the production in 2003-2004 or 2.6 times that of the projection by 2016.

(4) Status of Subject-wise Development Programs

In addition to the scheme-wise development program (hard component), the subject-wise improvement program (soft component) was proposed in the NIMP2002 to support the irrigation development in an effective manner, highlighting "Demand driven" and "Consistency in the whole undertakings" as basic principles. The achievement so far is shown in Table 1.6.5.

Table 1.6.5 Achievement of Subject-wise Improvement Program

Category	Action Has Been Taken				No Action
Number of Programs (%)	27 (73%)				10 (27%)
Score Range	80-100%	50-80%	20-50%	1-20%	
Number of Programs (%)	4 (15%)	14 (52%)	4 (15%)	5 (18%)	

Source: JICA Project Team

Out of 37 programs, 27 programs are now in progress, especially the Comprehensive Guidelines for Irrigation Scheme Development under District Agricultural Development Plan (commonly known as the CGL) is being disseminated to the large section of stakeholders. The remaining ten programs have taken no action, which are mostly specified as programs to be implemented in the medium term.

1.6.3 Lessons and Recommendations Abstracted from the ASDP1 Post-Evaluation Report

In Tanzania, the irrigation development was planned and implemented in a participatory manner for the past decade. Table 1.6.6 shows lessons and recommendations abstracted by the JICA Project Team from ASDP1 post-evaluation report.

Table 1.6.6 Lessons and Recommendations Abstracted from the ASDP1 Post-Evaluation Report

Item	Lessons and Recommendations
General aspect	・ Returns from the improvement of existing irrigation schemes were high and those of new schemes were low. It means that, if the decision to invest in irrigation schemes is based only on returns, improvement and rehabilitation of existing schemes should receive high priority. On the contrary, the national level policy of increasing the irrigated area to one million hectares requires investment in new schemes. ・ There is a need to strategize irrigation by reducing the acreage under paddy and replacing it with crops which require less water but this should be accompanied by marketing and post-harvest advisory services to help farmers produce such crops commercially. Additionally, appropriate crops with less water demand are required to address the water shortage reported in many schemes. It is important to expand cultivation area and to improve productivity through trainings on using seeds of good varieties and cultivation techniques such as water saving rice culture, O&M of irrigation system, etc.
Agronomic aspect	・ In most of the evaluated schemes, farmers used improved seeds and practiced good crop husbandry. ・ Salinity is building up in some irrigation schemes such as Mawala, Mbarangwe, Sakalilo, Kinyope, Ochuna, Ruvu, Ruaha Mbuyuni, Ngindo, Bugerega, Mvumi, and Mbeya Mbuyuni. A combination of crop rotation including paddy, drainage and salt flushing, and irrigation management should be employed to address the problem. ・ To ensure the achievement of successful and sustainable result, the available water sources may

Item	Lessons and Recommendations
	need to be integrated with the production of fruit trees and other high value crops with irrigation.
Irrigation infrastructure engineering aspect	・ Future ASDP investment should address the irrigation infrastructure engineering weaknesses and challenges identified in this study. Most importantly, new investment needs to be preceded by thorough feasibility studies to determine the most cost effective irrigation infrastructure, area to be developed for irrigation, and institutional infrastructure for organisation and management of the schemes. Additionally, the feasibility studies are required to give evidence that a given scheme is economically viable with an economic internal rate of return (EIRR) equal to or higher than 12% and ensure proper operation and maintenance (O&M) of irrigation facilities by respective IOs. ・ It is recommended that investment decisions are made after preparing a complete plan and feasibility study commensurate with the CGL for irrigation scheme development. Finally, the designs must be reviewed (for completeness and correctness) and approved by internal and/or external evaluators. ・ Part of the strategy is to design appropriate irrigation infrastructure to increase water use efficiency. This includes appropriate methods of reducing soil erosion and consequent siltation. This is a serious problem in the reservoir based schemes. Catchment area treatment is also required for other schemes to curb the declining irrigation water supply occurring during the dry season. ・ The next phase of ASDP may have to arrange a financial and technical assistance program aiming at enabling each rural household to own one or more sources of irrigation water. The new sources of irrigation water may include, but not limited to, spring, micro dams, subsurface dams, ponds, tanks and shallow wells integrated with groundwater recharge mechanism. ・ Unit cost of investment of new irrigation scheme and rehabilitation in Tanzania is lower than the equivalent cost in sub-Sahara Africa. This is attributed to incompletion of a number of irrigation schemes.
Economic and future development aspect	・ Focus group discussion reveals that such training and extension services were limited to production technologies and advisory services. This suggests the need to have a deliberate effort to enhance farmers marketing knowledge and skills. This should include enhancing farmers' horizontal and vertical linkages. ・ Spill-over effects of irrigation schemes also suggest that they have the potential to attract private businesses and services in their vicinity. Such private businesses can provide processing and other marketing services required to add value to irrigated crops. Investing in development of marketing infrastructure such as roads will further enhance participation of the private sector in the irrigated crop value chain. Such investment will help achieve ASDP objective of involving the private sector in irrigation development.
Institutional aspect	・ Enhancing collective action through building the capacity of irrigators to organise themselves for production, processing, and marketing will also help greatly to ensure sustainability of irrigation schemes. ・ With the increasing number of irrigators, climate change and increasing non-agricultural water uses, the role of the water basin in managing water use is becoming more important. This means the basin authorities need to be more active in coordinating different water users and in managing water use and development.

Source: Assessment of Achievement of the Agriculture Sector Development Program 1 (ASDP1).

1.7 Interview and Discussions with Major Stakeholders

The report has been compiled by the JICA Project Team based on numbers of interviews and consultations with stakeholders. The major meetings for the Project organised by the JICA Project Team are summarised in Table 1.7.1. Moreover, the minutes of Joint Coordination Committees (JCCs) are shown in Attachments-1.7.1, 1.7.2 and 1.7.3, respectively. As a reference, a list of meetings with number of stakeholders is also given in Attachment-1.7.4.

Table 1.7.1 Major Meetings Organised by the JICA Project Team

Major Meeting	Date	No. of Participants	Agenda
1st JCC	6th December 2016	48	Presentation and Discussion on Inception Report
1st SCM	7th December 2016	34	Presentation and Discussion on Inception Report
2nd JCC	21st September 2017	41	Presentation and Discussion on Interim Report

Major Meeting	Date	No. of Participants	Agenda
2nd SCM	27th September 2017	31	Presentation and Discussion on Interim Report
Meeting with Management Officers of MoA	7th March 2018	26	Discussion and Confirmation on Development Scenario of NIMP2018
Meeting with Management Officers in PO-RALG	13th March 2018	10	Discussion and Confirmation on Development Scenario of NIMP2018
Meeting with Management Officers in MoWI	14th March 2018	25	Discussion and Confirmation on Development Scenario of NIMP2018
Technical Transfer Workshop on NIMP2018	27th March 2018	45	Transfer of Technology on GIS and Irrigation Database
3rd JCC	4th April 2018	50	Presentation and Discussion on Draft Final Report
National Seminar on NIMP2018	5th April 2018	81	Presentation and Discussion on Draft Final Report
PSC Meeting	7th April 2018	57	Presentation and Discussion on Draft Final Report
3rd SCM	9th April 2018	32	Presentation and Discussion on Draft Final Report

Notes: JCC= Joint Coordinating Committee, SCM= Stakeholder Consulting Meeting, PSC= Parliamentary Standing Committee of Water and Agriculture Sectors
Source: JICA Project Team

Out of the above meetings, the detailed discussions about the contents on NIMP2018 were made in the meetings organised in March and April 2018. The notable issues and suggestions were made on i) water harvesting irrigation including small dams and ponds, ii) use of lake water (mainly Lake Victoria) for irrigation, iii) use of groundwater for irrigation, iv) land tenure, and v) review of protection areas and environmental flow requirement. These issues and suggestions will be examined from Chapter 8 onwards and be reflected in the development of NIMP2018.

Chapter 2 National Development Background

2.1 General

This chapter describes Tanzania's general conditions (natural, social, and economic) in order to grasp the overall situation in which the National Irrigation Master Plan 2018 (NIMP2018) is to be prepared and implemented. Some of the contents of this chapter are elaborated further in the subsequent chapters.

2.2 Country's Land and Social Situation

2.2.1 Land and Population

Tanzania is located in the eastern central part of African continent facing the Indian Ocean with more than 1,400 km coastline. It is a united republic composed of Tanganyika (Mainland) and Zanzibar. The basic data of the country are shown in Table 2.2.1

Table 2.2.1 Basic Data of Tanzania

Territory	Land Area (thousand km^2)	Population (million)	Density (persons/km^2)
Mainland	883.6	43.625	49
Mainland with water area	*945.0*	-	-
Zanzibar	2.5	1.304	530
Total	886.1	44.929	51

Source: Land area – NBS, 2016, Tanzania in Figures 2015, Population – NBS, Mar. 2013, Population and Housing Census 2012

The country is in the southern hemisphere stretching from latitude 1 degree to 11 degree south. The coastal areas are high in temperature and humid, while inland areas are, due to relatively high elevation, generally of low temperature and dry climate. According to the 2012 Population and Housing Census, the total population of the country as of 2012 is 44.9 million as shown in Table 2.2.2. Tanzanian population growth rate is 2.7% per annum which is higher than the average of African countries (2.55% annually in 2010-15[1]), expected to reach 57.1 million by 2020[2].

Table 2.2.2 Population of Tanzania

Population	2002 Census	2012 Census	Inter-censual Growth Rate	2015*
Tanzania	34,443,603	44,928,923	2.7	48,775,567
Tanzania Mainland	33,461,849	43,625,354	2.7	47,351,275

Note: 2015 is projection*
Source: NBS, 2016, Tanzania in Figures 2015 (Original Source: NBS, March 2013, Population and Housing Census 2012

The breakdown in proportion of the population in terms of sex and residential area is shown in Table 2.2.3.

[1] World Population Prospects: The 2015 Revision, Key Findings and Advance Tables, UN Department Economic and Social Affairs, Population Division

[2] According to the World Population Prospects: The 2015 Revision, Tanzania is considered as one of the nine fastest growing population countries, reaching 299 million by 2100.

Table 2.2.3 Breakdown of Tanzania Population

Population	Total (2012)	Male	Female	Rural	Urban
Tanzania	44,928,923	21,869,990	23,058,933	31,623,919	13,305,004
(%)	100.0	48.7	51.3	70.4	29.6
Tanzania (Mainland)	43,625,354	21,239,313	22,386,041	30,924,116	12,701,238
(%)	100.0	48.7	51.3	70.9	29.1
Zanzibar	1,303,569	630,677	672,892	699,803	603,766
(%)	100.0	48.4	51.6	53.7	46.3

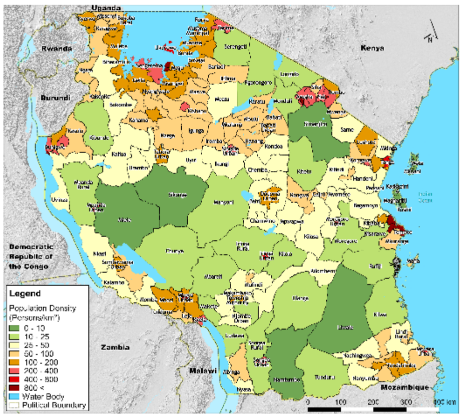
Source: NBS, March 2013, Population and Housing Census 2012)

Tanzania has been tracing the general trend of urbanisation. As shown in Table 2.2.4, as of 2012, approximately one-third of the population resides in urban areas. The pace of urbanisation is declining, but it is still more than 5%.

Table 2.2.4 Past Trend of Urbanisation of Tanzania (Mainland)

Year	Population	Urban Population	Percent Urban	Urban Growth Rate
1967	11,958,654	685,092	5.7	-
1978	17,364,498	2,257,921	13.3	13.3
1988	22,455,207	4,043,684	18.4	6.5
2002	33,461,849	7,554,838	22.6	6.9
2012	43,625,354	12,701,238	29.1	5.8

Source: NBS, 2015, Migration and Urbanisation Report 2015, (2012 Population and Housing Census Volume IV)



Source: NBS, 2013, Population and Housing Census 2012

Figure 2.2.1 Population Density Map

Urban expansion is taking place not only around Dar es Salaam but in those local centres such as Mwanza, Arusha, and Mbeya. As expanding more in the size and economic diversity, these urban areas attract more and more people, especially promising youth from surrounding areas. Given this trend of migration, it is imperative for the government to provide sufficient job opportunities at urban areas while improving efficiency of agricultural production.

Keeping pace with the population increase, the population density is increasing. The population density of the country as a whole is 51/km^2 (Mainland: 49/km^2, Zanzibar: 530/km^2). Regional density distribution is shown in Table 2.2.5. Dar es Salaam is the most populous region (5.2 million) followed by Mwanza and Mbeya (ranked by 2015 population). In general, the surrounding areas of Lake Victoria (Mwanza, Kagera, Mara, Geita, and Shiyanga) are relatively more populous than other parts of the country. On the other hand, Katavi and Lindi are the least populated areas. In terms of growth rate, Rukwa, Katavi, Manyara, and Kagera are the fastest growing (3.2%). Although Dar es Salaam marks the highest growth rate (5.6%), this is primarily due to urbanisation and inflow of population from rural areas.

Table 2.2.5 Regional Population, Density, and Growth Rate

Region	2002 Census	2012 Census	Population Density (2012 Census) (persons/km^2)	Inter-census Growth Rate	2015*
Tanzania	**34,443,603**	**44,928,923**	**51**	**2.7**	**48,775,567**
Tanzania Mainland	**33,461,849**	**43,625,354**	**49**	**2.7**	**47,351,275**
Dar es Salaam	2,487,288	4,364,541	2,644	5.6	5,166,570
Mwanza	2,058,866	2,772,509	240	3.0	3,031,422
Mbeya	2,063,328	2,707,410	45	2.7	2,937,310
Kagera	1,791,451	2,458,023	93	3.2	2,702,715
Tabora	1,710,465	2,291,623	30	2.9	2,501,796
Morogoro	1,753,362	2,218,492	32	2.4	2,380,750
Kigoma	1,674,047	2,127,930	58	2.4	2,286,727
Dodoma	1,692,025	2,083,588	50	2.1	2,217,856
Tanga	1,636,280	2,045,205	73	2.2	2,186,757
Geita	1,337,718	1,739,530	88	2.6	1,882,141
Mara	1,363,397	1,743,830	83	2.5	1,877,451
Arusha	1,288,088	1,694,310	46	2.7	1,839,531
Kilimanjaro	1,376,702	1,640,087	124	1.8	1,728,522
Simiyu	1,317,879	1,584,157	66	1.8	1,674,075
Shinyanga	1,249,226	1,534,808	94	2.1	1,632,593
Manyara	1,037,605	1,425,131	31	3.2	1,567,479
Singida	1,086,748	1,370,637	28	2.3	1,469,469
Ruvuma	1,113,715	1,376,891	22	2.1	1,467,362
Mtwara	1,124,481	1,270,854	71	1.2	1,318,374
Pwani	885,017	1,098,668	34	2.2	1,172,306
Rukwa	729,060	1,004,539	46	3.2	1,105,931
Iringa	840,404	941,238	26	1.1	973,784
Lindi	787,624	864,652	13	0.9	889,197
Njombe	648,464	702,097	33	0.8	719,036
Katavi	408,609	564,604	12	3.2	622,121

Note: 2015 data is projection, Songwe Region is a part of Mbeya Region at this time.*
Source: NBS, 2013, Population and Housing Census 2012

2.2.2 Poverty Status

The poverty status of the country is summarized in Table 2.2.6. Since the early 2000s, Tanzania has placed continuous efforts to eradicate poverty. Because of this, the situation has gradually but steadily been improving. For example, the rural poverty with respect to the Basic Need Poverty has declined from 38.7% in 2000/01 to 33.3% in 2011/12. During the same time, Dar es Salaam has improved from 17.6% to 4.1%, while other urban areas did similarly, from 25.8% to 21.7%. The comparison of the improvements in Dar es Salaam and other areas, it could be said that poverty reduction has still been a phenomenon limited to major urban areas, leaving most of the country untapped. Tanzania’s recent economic expansion has not effectively lifted rural population out of poverty.

Table 2.2.6 Poverty Trend of Tanzania

Year	Region	% of Population Below Food Poverty Line	% of Population Below Basic Needs Poverty Line	% of Female Headed Households
1991/92	Dar es Salaam	13.6	28.1	14.1
	Other Urban	15.0	28.7	23.9
	Rural	23.1	40.8	16.7
	Total	**21.6**	**38.6**	**17.6**

Year	Region	% of Population Below Food Poverty Line	% of Population Below Basic Needs Poverty Line	% of Female Headed Households
2000/01	Dar es Salaam	7.5	17.6	20.9
	Other Urban	13.2	25.8	27.9
	Rural	20.4	38.7	22.1
	Total	**18.7**	**35.7**	**22.9**
2007	Dar es Salaam	3.2	14.1	24.4
	Other Urban	8.9	22.7	30.1
	Rural	13.5	39.4	23.0
	Total	**11.8**	**34.4**	**24.5**
2011/12	Dar es Salaam	1.0	4.1	22.5
	Other Urban	8.7	21.7	27.6
	Rural	11.3	33.3	24.3
	Total	**9.7**	**28.2**	**24.7**

Source: NBS, Tanzania in Figures 2012, 2015 (orig. Household Budget Surveys, 1991/92, 2000/01, 2007 and 2011/12)

2.2.3 Nutrition and Other Welfare Status

Although poverty status of the country is still slow in improvement, other social indicators show general advancement. Table 2.2.7 shows few indicative indexes illustrating the progress of the country's general advancement.

Table 2.2.7 Trend of Child Mortality and Malnutrition

Mortality Indicator (deaths per 1,000)	**1999**	**2004/05**	**2010**	**2015/16**
Infant mortality	99	68	51	43
Child mortality	53	47	32	25
Under-5 mortality	147	112	81	67
Childhood Malnutrition Indicator (%)	**1999 (TDHS)**	**2004/05 (TDHS)**	**2010 (TDHS)**	**2014 (NNS SMART)**
Stunting (%)	48.3	44.4	42.5	34.7
Wasting (%)	5.6	3.5	4.9	3.8
Underweight (%)	25.3	16.7	16.2	13.4

Note: Stunting: Height-for-Age Z-score is less than 2.0, Wasting: Weigh-for-Height Z-score is less than 2.0, Underweight: Weigh-for-Age Z-score is less than 2.0, TDHS: Tanzania Demographic and Health Survey, NNS SMART: National Nutrition Survey, Standardized Monitoring and Assessment of Relief and Transitions
Source (Mortality): Ministry of Health, NBS, Tanzania Demographic and Health Survey and Malaria Indicator Survey 2015-16
(Malnutrition): Tanzania Food and Nutrition Centre, Tanzania National Nutrition Survey 2014, page 74

As seen in Table 2.2.7, all of the children mortality rates have declined by more than half for the last 15 years. Also, there are noticeable improvements in the children nutritional status.

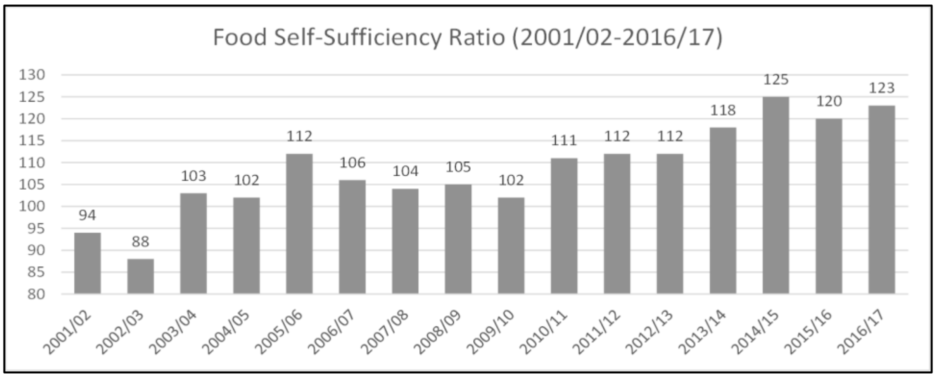
2.2.4 Food Security Situation

The trend of food security situation measured by the Food Self-Sufficiency Ratio (SSR) is shown in Figure 2.2.2 for the last 16 years. As observed in the diagram, the national food situation had improved notably since 2010/11 achieving steadily more than 110% ratio. Therefore, it can be said that the country as a whole has achieved food security with sufficient margin. Although there have been spots of food shortage every year. Note that the SSR is calculated according to the grain conversion of the relevant crop production (tonne)[3].

However, due to continuing dependence on rainfall for food production, there are still areas in the country where food security is threatened by poor harvest. Regional variation of food security situation is shown in

[3] The conversion factors are for example, maize = 1.0, Rice = 0.65, Banana = 0.35, etc. The calculation also considers the subtraction of no-food use of crops.

Table 2.2.8. It should be noted that the data of Table 2.2.8 are from MALF while the Figure 2.2.2 are constructed by assembling data of various national policies.



Source: 1) "MKUKUTA ANNUAL IMPLEMENTATION REPORT 2009/10", Ministry of Finance and Economic Affairs, November 2010
2) "MKUKUTA ANNUAL IMPLEMENTATION REPORT 2013/14", Ministry of Finance and Economic Affairs, November 2014
3) "COMPREHENSIVE REVIEW REPORT FOR TANZANIA FIVE YEAR DEVELOPMENT PLAN 2011/2012-2015/16", Ministry of Finance and Planning, January, 2016
4) http://www.thecitizen.co.tz/News/1840340-3358402-k5r9noz/index.html
5) http://www.kilimo.go.tz/index.php/en/resources/view/hali-ya-chakula-nchini-kuelekea-mwaka-2017

Figure 2.2.2 Trend of Tanzania Food SSR

Table 2.2.8 Regional Variation in Food Security

	Region	2008/09	2009/10*	2010/11	2011/12	2012/13	2013/14*	Average
1	Arusha	92	60	NA	89	91	97	86
2	Dar es Salaam	12	11	NA	5	2	2	6
3	Dodoma	112	78	NA	98	101	100	98
4	Geita	NA	NA	NA	NA	NA	155	
5	Iringa	149	167	NA	130	166	176	158
6	Kagera	125	127	NA	122	147	155	135
7	Katavi	NA	NA	NA	NA	NA	186	
8	Kigoma	118	131	NA	125	138	182	139
9	Kilimanjaro	90	84	NA	116	93	103	97
10	Lindi	121	104	NA	109	104	129	113
11	Manyara	116	85	NA	113	99	98	102
12	Mara	99	92	NA	99	117	118	105
13	Mbeya	131	135	NA	153	152	158	146
14	Morogoro	108	103	NA	116	108	130	113
15	Mtwara	139	126	NA	132	146	139	136
16	Mwanza	95	98	NA	99	101	115	102
17	Njombe	NA	NA	NA	NA	NA	176	
18	Pwani	97	97	NA	101	110	116	104
19	Rukwa	132	167	NA	153	167	186	161
20	Ruvuma	131	136	NA	149	173	197	157
21	Shinyanga	95	95	NA	98	92	98	96
22	Simiyu	NA	NA	NA	NA	NA	98	
23	Singida	99	98	NA	108	118	112	107
24	Songwe	NA	NA	NA	NA	NA		
25	Tabora	99	104	NA	110	94	97	101
26	Tanga	106	100	NA	112	113	111	108
	Tanzania all	**105**	**103**	**111**	**112**	**112**	**118**	**110**
No. of Vulnerable LGAs		21	57		NA	63	61	49

*Note: * indicates data of the "Preliminary Forecast". NA: Data is not available*
Source: Ministry of Agriculture Livestock and Fisheries, AGSTAT reports, 2009, 2010, 2011, 2013

Apart from Dar es Salaam, which is the largest consumption area, regions such as Arusha, Dodoma, Kilimanjaro, and Shinyanga, are relatively prone to food insecurity. Given the nationwide food sufficiency of these years, the challenge is not production but storage and distribution.

2.3 Overview of National Economy

2.3.1 Performance of National Economy

The Tanzania economy as a whole has been growing relatively stable and at a high rate for the last eight years (2008–2015). The real average annual growth rate (at 2007 constant price) was 6.3% as shown in Table 2.3.1.

Table 2.3.1 GDP Annual Growth Rates at 2007 Prices, Tanzania Mainland, 2008 – 2015 (%)

Economic Activity	2008	2009	2010	2011	2012	2013	2014r	2015p	Avg. [8 yrs: 2008-15]
GDP (whole economy) (2007 const. price)	5.6	4.8	6.6	7.6	5.5	6.7	6.9	6.7	6.3
Agriculture, Forestry, and Fishing	7.5	5.1	2.7	3.5	3.2	3.2	3.4	2.3	3.9
Crops	*7.8*	*5.5*	*3.7*	*4.8*	*4.2*	*3.5*	*4.0*	*2.2*	*4.5*
Livestock	*8.1*	*5.3*	*1.4*	*1.6*	*1.8*	*2.0*	*2.2*	*2.4*	*3.1*
Forestry	*3.8*	*5.1*	*3.4*	*3.3*	*3.5*	*4.7*	*5.1*	*2.6*	*3.9*
Fishing	*7.2*	*0.5*	*0.9*	*2.6*	*2.9*	*5.5*	*2.0*	*2.5*	*3.0*
Industry and Construction	6.5	3.3	9.1	12.0	4.0	9.5	10.3	11.3	8.3
Services	4.2	5.8	7.8	8.4	7.2	7.1	7.2	6.9	6.8
GDP at market prices	5.6	5.4	6.4	7.9	5.1	7.3	7.0	7.0	6.5

Note: r: revised, p: provisional
Source: NBS, MoFP, November 2016, National Account of Tanzania Mainland 2007 - 2015,

The values of GDP are shown in Table 2.3.2. As of 2015 (provisional), the Tanzania economy is TZS 44.1 trillion at the current prices.

Table 2.3.2 GDP at 2007 Prices, Tanzania Mainland, 2008 – 2015 (TZS in Million)

Economic Activity	2008	2009	2010	2011	2012	2013	2014r	2015p
GDP (whole economy) (2007 constant price)	24,948,888	27,628,327	29,441,005	31,673,636	33,420,626	35,673,045	38,137,426	40,708,958
Agriculture, Forestry, and Fishing	7,181,357	8,113,750	8,332,436	8,621,829	8,901,917	9,186,731	9,497,468	9,719,965
Crops	*3,603,539*	*4,098,750*	*4,248,443*	*4,454,219*	*4,640,787*	*4,801,783*	*4,993,855*	*5,106,027*
Livestock	*2,513,284*	*2,859,665*	*2,900,642*	*2,948,017*	*3,001,944*	*3,062,481*	*3,129,647*	*3,204,928*
Forestry	*639,762*	*697,692*	*721,555*	*745,684*	*771,590*	*808,231*	*849,445*	*871,448*
Fishing	*424,772*	*457,643*	*461,796*	*473,910*	*487,597*	*514,235*	*524,521*	*537,562*
Industry and Construction	5,406,038	5,949,363	6,489,910	7,271,804	7,566,057	8,287,309	9,144,464	10,174,156
Services	12,692,496	13,989,391	15,076,525	16,341,278	17,520,835	18,767,585	20,119,051	21,511,358
GDP (market prices)	26,770,432	29,781,719	31,675,504	34,179,297	35,936,459	38,546,546	41,231,365	44,100,809

Note: r: revised, p: provisional
Source: NBS and MoFP, November 2016, National Account of Tanzania Mainland 2007 – 2015

Major drivers of this economic growth are not agriculture but industry and construction, and services sectors with eight-year average real growth rates of 8.3% and 6.8%, respectively. Within the industry and construction sector, active subsectors are manufacturing (7.0%) and construction (11.0%), while in the service sector are: information and communication (15.9%), finance and insurance (12.3%) and professional, scientific and technical (11.0%).

In contrast, agricultural, forestry, and fishing sector has attained only 3.9% of average growth rate. Given the average population growth rate being approximately 2.7% (PHC 2012), the net growth of the sector is just over 1.2%. Along with this relatively slow growth, the share of the agricultural sector in the total gross domestic product (GDP) has been declining as shown in Table 2.3.3.

Table 2.3.3 Sector Shares of GDP at 2007 Prices, Tanzania Mainland, 2008 – 2015 (%)

Economic Activity	2008	2009	2010	2011	2012	2013	2014r	2015p
GDP (whole economy) (2007 constant price)	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Agriculture, Forestry, and Fishing	26.8	27.2	26.3	25.2	24.8	23.8	23.0	22.0
Crops	13.5	13.8	13.4	13.0	12.9	12.5	12.1	11.6
Livestock	9.4	9.6	9.2	8.6	8.4	7.9	7.6	7.3
Forestry	2.4	2.3	2.3	2.2	2.1	2.1	2.1	2.0
Fishing	1.6	1.5	1.5	1.4	1.4	1.3	1.3	1.2
Industry and Construction	20.2	20.0	20.5	21.3	21.1	21.5	22.2	23.1
Services	47.4	47.0	47.6	47.8	48.8	48.7	48.8	48.8
Balance	5.6	5.8	5.6	5.7	5.3	6.0	6.0	6.1

Note: r: revised, p: provisional
Source: computed by JICA Team based on NBS and MoFP, November 2016, National Account of Tanzania Mainland 2007 – 2015

The trend of the per capita GDP is shown in Table 2.3.4. While steadily increasing, its overall level is still around USD 1,000 indicating great potential of economic expansion.

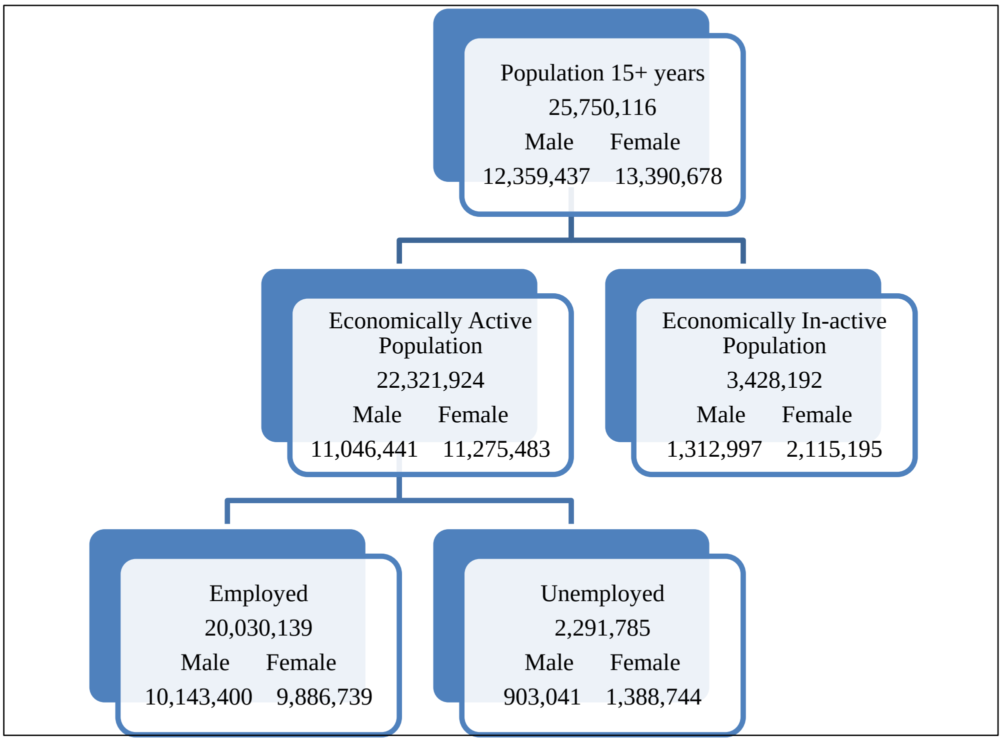
Table 2.3.4 Trend of Per Capita GDP, Tanzania Mainland, 2008 – 2015

Per Capita GDP	2008	2009	2010	2011	2012	2013	2014r	2015p
Per Capita GDP at current market prices (TZS)	699,127	927,330	1,045,848	1,222,224	1,408,223	1,582,797	1,724,416	1,918,928
Exchange rate (TZS/ USD)	1,196	1,320	1,396	1,557	1,572	1,598	1,653	1,991
Per Capita GDP in USD	584	702	749	785	896	991	1043	964

Note: r: revised, p: provisional
Source: computed by the JICA Team based on NBS and MoFP, November 2016, National Account of Tanzania Mainland 2007 – 2015

2.3.2 Labour Market

The employed population of the country is approximately 21 million (Male: 11 million, Female: 10 million) as shown below, which is 82.2% of the population of the concerned age group. In contrast, unemployment population is approximately 1.1 million which is 4.5%. (There is a portion of 13.3% of economically in-active population (like students)).



Source: NBS, November 2015, Integrated Labour Force Survey (LFS), analytical report

Figure 2.3.1 Total Population and Employed/ Unemployed Population

Changes in the unemployment rate are shown in Table 2.3.5, comparing the rates between 2006 and 2014. The table also shows the contrast between urban and rural areas.

Table 2.3.5 Changes in Unemployment Rate and Contrast between Urban and Rural Areas (%)

Category	Dar es Salaam		Other Urban		Total Urban		Rural		Total	
	2006	2014	2006	2014	2006	2014	2006	2014	2006	2014
A: Looking for work (strict international definition)	16.8	10.3	3.6	2.1	8.9	4.6	0.8	0.6	3.0	2.1
B: Available but not looking for work	4.4	9.9	2.9	3.6	3.5	5.5	0.9	1.8	1.7	3.1
A+B: Relaxed international definition	21.2	20.2	6.5	5.7	12.4	10.1	1.7	2.4	4.7	5.2
C: With marginal attachment to employment	10.3	1.3	10.0	4.2	10.2	3.3	5.8	6.1	7.0	5.1
A+B+C: National definition	31.5	21.5	16.5	9.9	22.6	13.4	7.5	8.4	11.7	10.3

Note: International standard definition is the one of A. Tanzania uses different definition with additions of B and C.
Source: NBS、Nov. 2015, Integrated Labour Force Survey (LFS), analytical report

As shown in the table, the unemployment rate has declined from 2006 to 2014. Considering the growth or the total population, it clearly suggests that jobs have been created with a higher rate. The table also shows the seriousness of unemployment in the urban areas. Further characteristics of unemployment are shown in Table 2.3.6.

Table 2.3.6 Unemployment Population by Age Groups, Sex, and Areas

Age/ Sex		Age Group				
		15 - 24	25 - 35	36 - 64	65 +	Total
Dar es Salaam	Male	75,394	37,557	25,004	2,897	140,851
	Female	142,063	162,411	82,501	1,593	388,568
	Total	**217,456**	**199,968**	**107,505**	**4,490**	**529,420**
Other Urban	Male	85,762	44,857	52,351	13,373	196,342
	Female	169,270	117,394	70,055	13,074	369,792
	Total	**255,032**	**162,251**	**122,406**	**26,446**	**566,134**

Age/ Sex		Age Group				
		15 - 24	25 - 35	36 - 64	65 +	Total
Rural	Male	175,453	124,087	223,946	42,361	565,847
	Female	184,483	144,453	249,036	52,412	630,384
	Total	**359,936**	**268,540**	**472,982**	**94,773**	**1,196,231**
Total	Male	336,609	206,501	301,300	58,631	903,041
	Female	495,815	424,258	401,593	67,079	1,388,744
	Total	**832,424**	**630,759**	**702,893**	**125,710**	**2,291,785**

Source: NBS, Nov. 2015, Integrated Labour Force Survey (LFS), analytical report

As general characteristics, it is observable that unemployment is severe in urban areas, young generations, and female population. Given the fact that Tanzania is still moving to more intensive urbanisation, the government needs to work hard to create more jobs in urban areas and to further invigorate economic activities in rural areas.

2.3.3 Export and Import of the Country

Tanzania's overall trade has been expanding rapidly although the yearly rates of expansion vary rather significantly. The average growth rates for the last seven years are 21.4% in export while 20.4% in import. The excess import has been the continuous state of the country's national economy. The excess import together with the balance of the service account (like earnings from tourism) and external support like the official development assistance (ODA) comprises the current account which is being offset by the capital account like private direct investments.

Table 2.3.7 Tanzania Export and Import, 2008 – 2015 (TZS in Billion)

	2008	2009	2010	2011	2012	2013	2014	2015	Avg (7yrs)
Exports (FoB)	3,195	3,672	5,604	7,331	8,653	8,644	11,367	11,586	-
Export Growth Rate (%)	-	*14.9*	*52.6*	*30.8*	*18.0*	*-0.1*	*31.5*	*1.9*	*21.4*
Imports (CIF)	8,839	8,447	11,087	17,217	18,276	18,884	20,977	29,353	-
Import Growth Rate (%)	-	*-4.4*	*31.3*	*55.3*	*6.2*	*3.3*	*11.1*	*39.9*	*20.4*
Balance of Trade	-5,644	-4,775	-5,483	-9,886	-9,623	-10,239	-9,610	-11,586*	

*Note: * This is the value reported in the data source. But correct value is "-17,767".*
Source: NBS, Tanzania in Figures 2012, 2015 (orig. Bank of Tanzania)

Major export commodities are mineral and natural resources such as gold and diamond which have the share of 31.0% on average in the total export value during 2008 through 2015. The similar share of the agricultural commodities is 16.2% for the same period. Major commodities in the agricultural export are coffee (3.1%), tobacco (4.6%), cotton (2.5%), cashew nuts (3.4%), and tea (1.2%). The major commodities and their shares are summarized in Table 2.3.8.

Table 2.3.8 Value and Share of Export Commodities, 2008 – 2015 (TZS in Billion)

Commodity		2008	2009	2010	2011	2012	2013	2014	2015	Avg (8 yrs)
Exports Total (FoB) (TZS billion)		3,195	3,672	5,604	7,331	8,653	8,644	11,367	11,586	
Diamond and Gold	Value	832	1,082	1,351	3,481	3,452	2,832	2,786	2,783	
	Share (%)	26.0	29.5	24.1	47.5	39.9	32.8	24.5	24.0	31.0
Major Agricultural Commodities	Value	605	857	751	1,092	1,167	988	1,843	1,441	
	Share (%)	19.2	23.0	13.4	15.1	13.9	12.1	17.4	15.2	16.2
Coffee	Value	124	150	162	226	293	259	204	310	
	Share (%)	3.9	4.1	2.9	3.1	3.4	3.0	1.8	2.7	3.1

Commodity		2008	2009	2010	2011	2012	2013	2014	2015	Avg (8 yrs)
Cotton	Value	96	147	133	104	165	138	558	80	
	Share (%)	3.0	4.0	2.4	1.4	1.9	1.6	4.9	0.7	2.5
Cashew nuts	Value	82	94	173	190	222	301	648	497	
	Share (%)	2.6	2.6	3.1	2.6	2.6	3.5	5.7	4.3	3.4
Tobacco	Value	210	328	179	438	348	160	319	428	
	Share (%)	6.6	8.9	3.2	6.0	4.0	1.8	2.8	3.7	4.6
Tea	Value	50	88	68	74	87	88	73	91	
	Share (%)	1.6	2.4	1.2	1.0	1.0	1.0	0.6	0.8	1.2

Source: NBS, Tanzania in Figures 2012, 2015 (orig. National Bureau of Statistics)

Although the exports of agricultural commodities are affected by conditions of the international markets, Tanzania's exports are in general expanding while the shares in the total export are in the declining trend.

Among the import, major commodities are oil (Petroleum), machinery, and transport equipment, which jointly amount to almost 50% of the import. The transport equipment is mostly the import of vehicles, passenger cars, or trucks.

Table 2.3.9 Value and Share of Major Import Commodities, 2008 – 2015 (TZS in Billion)

Commodity		2008	2009	2010	2011	2012	2013	2014	2015	Avg (8 yrs)
Food and Beverages	Value	702	724	1,069	1,059	1,749	1,505	1,773	1,498	
	Share (%)	7.3	8.6	8.7	6.1	8.2	7.6	8.5	5.1	7.5
Oil (Petroleum)	Value	2,764	1,850	2,691	4,860	4,571	5,170	5,890	14,627	
	Share (%)	28.9	21.9	21.9	27.9	21.6	26.0	28.1	49.8	28.2
Building and Construction Material	Value	949	805	960	1,325	1,398	1,953	1,942	1,655	
	Share (%)	9.9	9.5	7.8	7.6	6.6	9.8	9.3	5.6	8.3
Machinery	Value	1,107	1,179	1,241	2,068	1,827	1,355	2,164	3,819	
	Share (%)	11.6	14.0	10.1	11.9	8.6	6.8	10.3	13.0	10.8
Transport Equipment	Value	1,127	1,085	1,440	1,795	2,162	2,090	1,933	1,988	
	Share (%)	11.8	12.8	11.7	10.3	10.2	10.5	9.2	6.8	10.4
Others	Value	2,921	2,804	4,753	6,292	8,675	12,645	7,276	5,520	
	Share (%)	30.5	33.2	38.6	36.1	40.9	63.5	34.7	18.8	37.0
Total	Value	9,569	8,447	12,315	17,418	21,201	19,905	20,977	29,352	
	Share (%)	100	100	100	100	100	100	100	100	

Source: NBS, Tanzania in Figures 2012, 2015 (orig. National Bureau of Statistics)

2.3.4 Trend of Agricultural Sector

Agricultural sector is the most important sector in Tanzania's economy due to its dominance in employment (66.0% of Tanzania Mainland Household engages in agriculture[4]), its direct relation to poverty alleviation, and potential for domestic market. Unfortunately, as described in Section 2.3.1, the sector has lagged behind the overall growth of the national economy, despite rapid expansion of few commodities such as oil seeds, horticulture, and dairy products.

First, the proportions of national population engaging in agricultural activities are observed below.

[4] NBS, Population and Household Census 2012, Table 13.1. (Tanzania Mainland Total 66.0%, Rural 85.1%, Urban 14.9%)

Table 2.3.10 Population Engaging in Agricultural Activities

Area/ Sex	Population	Agriculture (Crop) (%)	Livestock Keeping (%)	Fisheries (%)	Other Activities (%)
Tanzania	18,295,288	62.1	2.4	1.0	34.5
Rural	13,288,808	75.7	2.9	1.0	20.4
Urban	5,006,480	26.0	0.9	1.0	72.1
Male	9,407,163	58.0	2.8	1.7	37.5
Female	8,717,862	64.1	1.8	0.3	33.8
Tanzania (Mainland)	17,916,156	62.8	2.4	0.9	33.9

Source: NBS, 2013, Population and Housing Census 2012

As shown in the table, agricultural population (crop, livestock, and fisheries) shares about 65% of the whole working population. Especially in the rural area, the rate goes up to 80%. It is also noted that more female population is engaging in agricultural activities, in particular, in crop production.

Major crops of the sector are maize, sorghum, millet, paddy, wheat, cassava, beans, potato, and banana. Production trend of these crops is shown in Table 2.3.11. Chief staple crops such as maize and rice show steady trend, if gradual, expansion in production.

Table 2.3.11 Production Trend of Major Food Crops, 2005 – 2015 (Thousand Tonnes)

Crop	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Maize	3,131	3,423	3,302	3,555	3,324	4,733	4,341	5,104	5,174	6,734	5,903
Paddy	957	1,148	1,209	1,390	1,460	1,614	1,461	1,170	1,307	1,681	1,937
Wheat	44	110	83	92	94	62	113	109	92	167	72
Millet/ Sorghum	721	942	1,165	1,064	204	1,034	1,119	1,052	1,041	1,246	1,007
Cassava	2,851	2,053	1,733	1,797	1,759	4,548	1,549	1,821	1,943	1,664	1,962
Beans/Legumes	650	1,050	1,156	1,125	1,184	1,254	1,632	1,827	1,641	1,697	1,808
Bananas	2,007	1,169	1,027	982	991	3,156	1,048	842	1,307	1,064	1,195
Sweet Potatoes	1,220	1,704	1,721	1,755	1,667	1,700	1,710	1,418	1,259	1,167	1,090

Source: NBS, Tanzania in Figures 2012, 2015, Statistical Abstract 2011 (June 2012) Table G.2 and G.6 (Original Source: Ministry of Agriculture, Livestock and Fisheries)

Regarding cash crops, those conventional commodities still occupy major position. These commodities are influenced by international market conditions, and in general, Tanzania has not fared well in the past with the market. The Production Trend of Major Cash Crops, 2005 – 2015 is shown in Table 2.3.12.

Table 2.3.12 Production Trend of Major Cash Crops, 2005 – 2015 (Tonnes)

Crop	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Cashew nuts	90,385	88,213	92,573	99,107	74,169	121,070	160,000	160,000	127,947	123,449	197,933
Coffee	34,334	45,534	33,708	58,052	40,000	60,575	56,247	33,219	71,200	47,301	41,674
Cotton	378,000	130,565	199,954	200,662	267,004	163,518	225,938	225,938	357,130	246,767	203,312
Pyrethrum	2,500	2,046	1,000	1,500	3,320	5,000	5,700	5,700	6,100	7,090	6,050
Sisal	27,794	30,847	33,039	33,000	26,363	24,091	33,406	25,690	34,875	37,571	39,204
Sugar	-	-	279,494	276,605	279,850	263,461	260,055	262,880	296,697	294,421	304,007
Tea	30,000	31,348	34,763	34,770	33160	31,646	33,000	32,810	33,700	33,000	35,750
Tobacco	56,500	50,617	50,784	55,356	60,900	130,000	126,624	126,624	86,359	100,000	87,737

Source: NBS, Tanzania in Figures 2012, 2015, Statistical Abstract 2011 (June 2012) Table G.1 (Original Source: Ministry of Agriculture, Livestock and Fisheries)

Apart from these conventional crops, Tanzania has seen rapid expansion in new types of cash crops such as sunflower, groundnuts, and horticultural crops. The first two products are processed to edible oil while the last one is for direct consumption, all of which are response to growing urban consumption with rising income. The details of the expansion of these crops are described in Chapter 4.

On the other hand, livestock products are also expanding. Especially, milk and egg are growing with good pace of expansion. In general, these animal-related commodities are responsive to income increase. It is believed that the production is rising in response to the expansion of middle class in the urban area. Production Trend of Major Livestock Products, 2005 – 2015 is shown in Table 2.3.13

Table 2.3.13 Production Trend of Major Livestock Products, 2005 – 2015

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Milk Production (Thousand ltr)											
Indigenous Cattle	920,000	941,815	945,524	980,000	1,012,436	997,261	1,135,422	1,255,938	1,297,775	1,339,613	1,381,451
Hybrid Cattle	466,400	470,971	475,681	520,000	591,690	652,596	608,800	597,161	623,865	650,570	677,275
Total	1,386,400	1,412,786	1,422,205	1,500,000	1,604,126	1,649,857	1,744,222	1,853,099	1,921,640	1,990,183	2,058,726
Meat Production (Tonnes)											
Beef	204,520	210,370	180,629	218,976	255,178	243,943	262,606	289,835	299,581	309,086	319,112
Goat/ Sheep	78,093	78,579	80,936	81,173	82,884	86,634	103,709	111,106	115,652	120,199	124,745
Pork	27,000	29,925	31,721	33,307	36,000	38,180	43,647	47,246	50,814	74,174	54,360
Chicken	68,896	69,420	77,280	77,250	78,168	80,916	93,534	84,524	87,408	95,292	99,540
Total	378,509	388,294	370,566	410,706	452,230	449,673	503,496	532,711	553,455	598,751	597,757
Egg Production (Number)											
Egg	1,800,000	2,145,000	2,230,900		2,806,350	2,917,875	3,339,566	3,494,584	3,725,200	3,899,569	4,153,800

Source: NBS, Tanzania in Figures 2012, 2015, Statistical Abstract 2011 (June 2012)
(Original Source: Ministry of Agriculture, Livestock and Fisheries)

2.3.5 Tanzania in the East African Regional Economy

Tanzania is the second major country in the East African Community (EAC) which is composed of Burundi, Kenya, Rwanda, Tanzania, Uganda, and South Sudan. The general comparison among the countries is shown in Table 2.3.14.

Table 2.3.14 Comparison of Economic Profile of Tanzania with its Surrounding Countries

No	ITEM	UNIT	Tanzania	Kenya	Uganda	Rwanda	Burundi	S. Sudan
1	Area of the country[1]	km^2	947,300	580,370	241,550	26,340	27,830	643,330
2	Total population[2]	No. (mil.)	53.47	46.05	39.03	11.61	11.18	12.34
3	Population density	No./km^2	56.4	79.3	161.6	440.8	401.7	19.15
4	GDP (current price)[3]	USD (mil.)	47,431	70,529	25,528	8,376	3,007	9,015
5	GDP per capita (current price)[4]	USD	840	1,377	676	697	276	731
6	Export total value (fob) [5]	USD (mil.)	4,924	5,906	2,245	659	111	-
7	Import total value (cif)[5]	USD (mil.)	10,285	16,093	5,780	2,570	755	-
8	Trade (Exp+Imp) (value) proportion to GDP[5]	%	24.1	23.9	24.0	22.2	18.9	-
9	Export with EAC (value)[6]	USD (mil.)	779.4	1,430.8	642.2	352.4	25.5	-
10	Import with EAC (value)[6]	USD (mil.)	709.9	416.9	684.6	465.1	126.1	-

Note: Year of measurement
1. Area of the country: Tanzania (2013), Kenya (2013), Uganda (2013), Rwanda (2013), Burundi (2013), S. Sudan (2013)
2. Total population: Tanzania (2015), Kenya (2015), Uganda (2015), Rwanda (2015), Burundi (2015), S. Sudan (2015)
3. GDP (current price): Tanzania (2016), Kenya (2016), Uganda (2016), Rwanda (2016), Burundi (2016), S. Sudan (2015)
4. GDP per Capita (current price): Tanzania (2015), Kenya (2015), Uganda (2015), Rwanda (2015), Burundi (2015), S. Sudan (2015)
5. Export and Import (value): Tanzania (2015), Kenya (2015), Uganda (2015), Rwanda (2015), Burundi (2015)
6. Intra-EAC Export and Import (value): Tanzania (2014), Kenya (2014), Uganda (2014), Rwanda (2014), Burundi (2014),
Source: Area and Population data: FAO AQUASAT, http://www.fao.org/nr/water/aquastat/data/query/index.html (30/10/2016)
GDP (current price): World Bank, 2016 World Development Indicators http://data.worldbank.org/data-catalog/world-development-indicators
Trade data: WTO Database: http://stat.wto.org/CountryProfile/WSDBCountryPFHome.aspx, South Sudan has not been a member of WTO.
EAC trade data and items: EAC, 2014, Trade Report

In terms of population size, Tanzania is the largest among the six countries, implying good potential for market expansion. However, in the economic size, it is second to Kenya with per capita GDP being only 60% of Kenya. As for trade, Tanzania is again second to Kenya in both overall trade and within EAC trade. However, it seems that Tanzania remains behind Kenya within EAC trade because Kenya's export to the member countries shows dominant size. These data seem to suggest that given the size of population and land area, Tanzania has great potential in developing its economy and contributes to the regional community.

If one expands the comparison to a wider area including other neighbouring countries like D.R. Congo, Zambia, Malawi, and Mozambique, Tanzania's position is similar. It has a large population only after D.R. Congo and third in terms of per capita GDP after Kenya and Zambia. Trade volume (in USD value) is again third after Kenya and Zambia. Overall, Tanzania stands at a leading position among the regional countries with opportunities waiting for further exploitation.

Comparison in agricultural/ irrigation aspects

It is attempted in Table 2.3.15 below (FAO AQUASTAT) to show similar comparison of Tanzania with EAC countries in terms of agriculture and irrigation aspects. Among the basic information, it is observed that due probably to the wider territorial area, both Tanzania and Kenya have less percentage of agricultural and cultivated land than the other three countries. On the other hand, as for water resources, Tanzania is better endowed with available water volume due to rainfall and large territory, giving the highest renewable water per person.

Table 2.3.15 Comparison of Agricultural Profile of Tanzania with Surrounding Countries (FAO AQUASTAT)

No.	ITEM	UNIT	Tanzania	Kenya	Uganda	Rwanda	Burundi	S. Sudan
1	**BASIC INFORMATION**							
1.1	Area of the country[1]	thousand ha	94,730	58,037	24,155	2,634	2,783	64,333
1.2	Agricultural land[1]	thousand ha	39,650	27,630	14,415	1,842	2,033	-
	% against the total area of the country[1]	%	42	48	60	70	73	-
1.3	Cultivated area[1]	thousand ha	15,650	6,330	9,100	1,432	1,550	2,700
	% against the total area of the country[1]	%	17	11	38	54	56	4
1.4	Total population[2]	thousand inhabit	53,470	46,050	39,032	11,610	11,179	12,340
	% of rural population[2]	%	69	74	83	69	88	81
1.5	GDP per capita (current price)[2]	USD	840	1,377	676	697	276	730
	% of Agriculture, value added to GDP[2]	%	31	33	25	33	43	-
2	**WATER RESOURCES**							
2.1	Average precipitation (long term)	mm/yr	1,071	630	1,180	1,212	1,274	900
	in volume (long term)	MCM/yr	1,015,000	365,600	285,000	31,920	35,460	579,900
2.2	Internal renewable water resources (long term)	MCM/yr	84,000	20,700	39,000	9,500	10,060	2,107
2.3	Total renewable water resources (long term)	MCM/yr	96,270	30,700	60,100	13,300	12,536	49,500
	per inhabitant (long term)[3]	M3/yr	1,800	667	1,540	1,146	1,122	4,011
2.4	Total dam capacity[2]	MCM	104,200	24,790	80,082	-	-	-
2.5	Total water withdrawal[4]	MCM	5,184	3,218	637	150	288	658
	% of Agriculture[4]	%	89	59	41	68	77	240
	% of Municipalities (Domestic use)[5]	%	10	37	51	24	17	193
	% of Industry[5]	%	1	4	8	8	6	225
	('% of Irrigation)[4]	%	84	50	-	68	69	-
3	**IRRIGATION AND DRAINAGE**							

No.	ITEM	UNIT	Tanzania	Kenya	Uganda	Rwanda	Burundi	S. Sudan
3.1	Irrigation Potential	ha	2,132,221	353,050	90,000	165,000	215,000	1,500,000
	% against cultivated area[6]	%	13.6	5.6	1.0	11.5	13.9	54.3
3.2	Total area equipped for irrigation[7]	ha	363,514	150,570	11,137	9,625	21,430	38,100
	- Full control irrigation equipped area[8]	ha	245,514	144,100	8,716	4,625	6,960	32,100
	- Equipped lowlands (wet land, flood plains, etc.)[9]	ha	117,000	0	2,412	5,000	14,470	-
	- Spate irrigation[10]	ha	1,000	6,470	-	-	-	6,000
	% against irrigation potential[10]	%	17.0	42.6	12.4	5.8	10.0	2.5
	% against cultivated area[10]	%	2.3	2.4	0.1	0.7	1.6	1.4
3.3	Total harvested area in full control irrigation[11]	ha	332,392	140,200	15,150	4,000	6,960	29,071
	- Rice[11]	ha	71,370	25,000	12,000	2,000	4,210	-
	- Maize[11]	ha	124,000	6,000	400	-	-	-
	- Vegetables[12]	ha	41,721	45,200	300	2,000	800	1,771
	- Sugarcane[12]	ha	13,333	8,000	1,820	-	1,450	1,311
	- Cotton[11]	ha	14,700	6,000	-	-	-	2,591
	- Flower[11]	ha	-	5,000	230	-	-	-
	- Coffee[11]	ha	2,763	20,000	-	-	500	-
	-Tea[11]	ha	2,570	8,000	-	-	-	-
	- Fruits[11]	ha	1,375	17,000	200	-	-	-
3.4	Irrigated cropping intensity for full control area[11]	%	135	103	175	200	156	157

Note: Year of measurement,
1. Tanzania (2013), Kenya (2013), Uganda (2013), Rwanda (2013), Burundi (2013), S. Sudan (2013)
2. Tanzania (2015), Kenya (2015), Uganda (2015), Rwanda (2015), Burundi (2015), S. Sudan (2015)
3. Tanzania (2015), Kenya (2014), Uganda (2014), Rwanda (2004), Burundi (2014), S. Sudan (2014)
4. Tanzania (2002), Kenya (2010), Uganda (2008), Rwanda (2000), Burundi (2000), S. Sudan (2011)
5. Tanzania (2002), Kenya (2010), Uganda (2008), Rwanda (2000), Burundi (2005), S. Sudan (2011)
6. Tanzania (2013), Kenya (2013), Uganda (2013), Rwanda (2013), Burundi (2013), S. Sudan (2011)
7. Tanzania (2013), Kenya (2010), Uganda (2012), Rwanda (2007), Burundi (2000), S. Sudan (2011)
8. Tanzania (2013), Kenya (2010), Uganda (2012), Rwanda (1996), Burundi (2000), S. Sudan (2011)
9. Tanzania (2013), Kenya (2010), Uganda (2012), Rwanda (2000), Burundi (2000), S. Sudan (2011)
10. Tanzania (2013), Kenya (2010), Uganda (2012), Rwanda (2000), Burundi (2000), S. Sudan (2011)
11. Tanzania (2013), Kenya (2012), Uganda (2012), Rwanda (2007), Burundi (2000), S. Sudan (2011)
12. Tanzania (2013), Kenya (2012), Uganda (2012), Rwanda (2007), Burundi (2003), S. Sudan (2011)

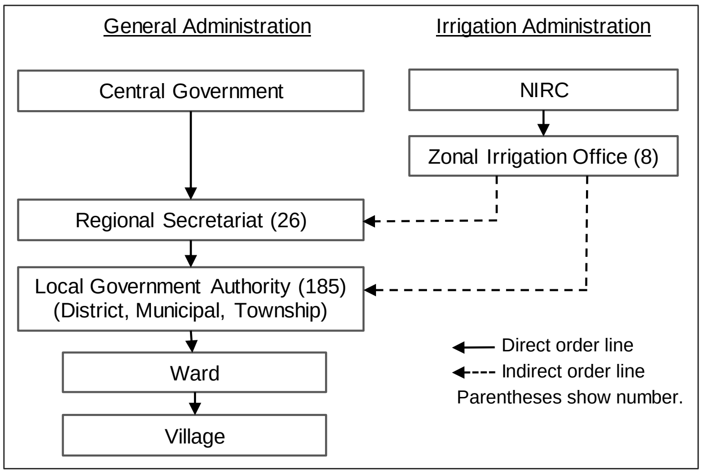
Source: FAO AQUASTAT, http://www.fao.org/nr/water/aquastat/data/query/index.html (30/10/2016)

With regard to irrigation, although Tanzania is relatively advanced in irrigation development, all EAC countries are far below their potential. Only Kenya has so far achieved 42% development against the potentially irrigable land. On the other hand, despite limited irrigation development, probably due to its diverse agro-ecological potential, Tanzania shows the greatest variety of crop production in the irrigated land.

2.4 Government Status

2.4.1 Administrative Structure

Since the end of the last century, the Government of Tanzania (GoT) has been promoting the decentralized structure of the public administration. Following the adoption of the Local Government Reform Programme (LGRP) in 1998, the Local Government Authorities (LGAs) have been tasked to plan, budget, and implement various development activities in order to address challenges at



Source: JICA Project Team

Figure 2.4.1 Administration Structure in Tanzania

the grassroots level. On the other hand, the ministries and agencies at the national level are mandated to provide guidance to LGAs with policies and strategies. There is a Regional Secretariat (RS) which connects guidance of the central ministries to LGAs as a liaison. As shown in Figure 2.4.1, although National-Regional-Local structure is a standard, the irrigation subsector maintains the conventional non-standard line of command. Namely, there is the National Irrigation Commission that directly communicates with the Zonal Irrigation Office which in turn communicates/ instructs/ helps the LGAs.

Although the administrative structure has been arranged according to the vision of decentralization, the financial side has not yet been up to that level, leaving LGAs much dependent on grants provided by the national government.

2.4.2 Public Finance

GoT's overall budget (expenditure) was TZS 14.603 trillion in 2014/15 (provisional) against the total revenue (both national and local) of TZS 10.957 trillion. The difference (TZS 3.646 trillion) was financed by grants and financing (loans). The internal shares of budget components are shown in Table 2.4.1 for 2014/15, the latest financial year where records are available.

Table 2.4.1 Summary of 2014/15 Budget Composition

Budget Components		Amount (TZS in Million)	Share (%)	Remarks
Total Revenue		10,957,765	100.0	
			75.0	Against the expenditure
	Revenue (Central)	10,597,681	96.7	
	Revenue (Local)	360,084	3.3	
Total Expenditure		14,603,714	100.0	
	Recurrent	10,893,486	74.6	
	Development	3,710,228	25.4	
	Development (Local fund)	2,264,506	15.5	
			61.0	Against the development
	Development (Foreign fund)	1,445,722	9.9	
			39.0	Against the development
Grants		1,024,132	7.0	Against the expenditure
Financing (Loans)		2,806,518	19.2	Against the expenditure
	Foreign Financing	2,006,742	71.5	Against total financing
			13.7	Against the expenditure
	Local Financing	799,776	28.5	Against total financing
			5.5	Against the expenditure

Source: Bank of Tanzania, Annual Report 2014/15 (Original source: Ministry of Finance, Bank of Tanzania and National

As can be observed in Table 2.4.1, the total revenue is just 75% of the total expenditure while the remaining amount is fulfilled by grants and loans. As to the proportion of recurrent budget (salaries and duty operation costs of officers) against the total expenditure is 74.6%, with the rest 25.4% going to development projects like construction and studies. The weight of foreign supports in the total budget is observed by the sum of grants and financing (Foreign), which comes to 26.2% of the total expenditure. The details of the past government budget compositions are shown in Table 2.4.3.

On the other hand, the proportion of the government budget (revenue) in the national economy has been changing as shown in Table 2.4.2.

Table 2.4.2 Historical Trend of Government Budget (Revenue) Against GDP (TZS in Billion)

	2007	2008	2009	2010	2011	2012	2013	2014	2015	Avg
GDP at Current Prices	26,770	32,765	37,727	43,836	52,763	61,434	70,953	79,718	90,864	
GDP Growth Rate (%)	-	22.4	15.1	16.2	20.4	16.4	15.5	12.4	14.0	16.5
GoT Revenue*	3,654	4,293	4,645	5,736	7,221	8,443	10,253	10,958	13,907	
Revenue Growth Rate (%)	-	17.5	8.2	23.5	25.9	16.9	21.4	6.9	26.9	18.4
% Revenue against GDP	13.6	13.1	12.3	13.1	13.7	13.7	14.5	13.7	15.3	13.7

*Note: * GoT Revenue is the value of a fiscal year where first half of the year falls into the year of the table.*
Example: the GoT Revenue of 2007 in the table is the revenue of the fiscal year 2007/08.
Source: GDP at Current Price -- National Accounts of Tanzania Mainland 2007 - 2015 (NBS and MoF, Nov. 2016)
GoT Revenue -- Bank of Tanzania Annual Report 2014/15 and 2015/16

The overall trend of the budget is summarized below.

- Government revenue is expanding roughly at the same pace as the economy's expansion.
- On average, the proportion of the revenue to the entire economy is 13.7%, which is lower than the Sub-Saharan Africa median value (17.1%)[5].

Recognizing the possibility of expanding the revenue, the current government is making efforts to increase the tax revenue in which the government can reduce the dependency on external resources for development activities.

[5] Computed by the JICA Project Team based on the IMF Regional Economic Outlook, Sub-Saharan Africa, April 2016

Table 2.4.3 Government Finance (Actual), 2005/06 – 2014/15 (TZS in Millions)

	2005/06	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14p	2014/15p	10 year Average
Total revenue (including LGAs)	***2,124,843.70***	***2,739,022.40***	***3,653,605.20***	***4,293,074.30***	***4,645,213.30***	***5,736,266.10***	***7,221,408.60***	***8,442,611.20***	***10,252,981.00***	***10,957,765.30***	
Total revenue - central government	*2,124,843.70*	*2,739,022.40*	*3,653,605.20*	*4,293,074.30*	*4,645,213.30*	*5,577,986.10*	*7,025,884.10*	*8,221,776.30*	*9,937,753.10*	*10,597,681.00*	
(%) Total revenue - central government	100.0	100.0	100.0	100.0	100.0	97.2	97.3	97.4	96.9	96.7	98.2
LGA Own Sources						*158,280.00*	*195,524.50*	*220,835.00*	*315,227.90*	*360,084.30*	
(%) LGA Own Sources	0.0	0.0	0.0	0.0	0.0	2.8	2.7	2.6	3.1	3.3	1.8
Other [1]					*16,327.00*			*72,300.00*			
(%) Other	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.9	0.0	0.0	0.2
Total Expenditure [2]	***3,873,254.80***	***4,474,680.90***	***5,327,779.30***	***6,734,078.00***	***8,173,749.30***	***9,439,407.20***	***10,764,528.40***	***12,714,236.40***	***14,011,133.00***	***14,603,714.40***	
Recurrent expenditure	*2,661,862.50*	*3,137,469.50*	*3,398,023.90*	*4,681,459.30*	*5,562,443.10*	*6,690,370.00*	*6,989,806.60*	*9,043,323.00*	*10,085,090.80*	*10,893,486.10*	
(%) Recurrent expenditure	**68.7**	**70.12**	**63.78**	**69.52**	**68.05**	**70.88**	**64.93**	**71.13**	**71.98**	**74.59**	**69.4**
Development Expenditure and net lending	*1,211,392.20*	*1,337,211.40*	*1,929,757.40*	*2,052,618.70*	*2,611,306.20*	*2,749,037.20*	*3,774,721.70*	*3,670,913.50*	*3,926,042.20*	*3,710,228.20*	
(%) Development Expenditure and net lending	**31.3**	**29.9**	**36.2**	**30.5**	**31.9**	**29.1**	**35.1**	**28.9**	**28.0**	**25.4**	**30.6**
Local	*296,100.00*	*503,291.20*	*567,421.00*	*906,023.20*	*1,004,530.50*	*984,555.00*	*1,872,311.70*	*2,314,717.90*	*2,121,211.50*	*2,264,506.00*	
(% to Total Exp.) Local	7.6	11.2	10.7	13.5	12.3	10.4	17.4	18.2	15.1	15.5	14.1
(% to Dev Exp.) Local	**24.4**	**37.6**	**29.4**	**44.1**	**38.5**	**35.8**	**49.6**	**63.1**	**54.0**	**61.0**	**46.9**
Foreign	*915,292.20*	*833,920.20*	*1,362,336.30*	*1,146,595.50*	*1,606,775.70*	*1,764,482.20*	*1,902,410.00*	*1,356,195.60*	*1,804,830.70*	*1,445,722.20*	
(% to Total Exp.) Foreign	23.6	18.6	25.6	17.0	19.7	18.7	17.7	10.7	12.9	9.9	16.5
(% to Dev Exp.) Foreign	**75.6**	**62.4**	**70.6**	**55.9**	**61.5**	**64.2**	**50.4**	**36.9**	**46.0**	**39.0**	**53.1**
Overall Balance before Grants	***-1,748,411.00***	***-1,735,658.50***	***-1,699,784.00***	***-2,441,003.70***	***-3,512,209.00***	***-3,703,141.10***	***-3,543,119.70***	***-4,271,625.20***	***-3,758,151.90***	***-3,645,949.00***	
Grants	***1,000,160.20***	***952,225.50***	***1,144,811.60***	***1,166,371.20***	***1,405,287.70***	***1,627,424.70***	***1,855,096.60***	***1,378,718.20***	***1,587,648.60***	***1,024,132.70***	
(% to Total Exp.) Grants	**25.8**	**21.3**	**21.5**	**17.3**	**17.2**	**17.2**	**17.2**	**10.8**	**11.3**	**7.0**	**15.0**
Overall Balance (cheques cleared)	***-924,412.50***	***-955,797.00***	***-902,809.20***	***-1,215,042.20***	***-1,939,623.60***	***-2,393,214.90***	***-2,070,124.10***	***-2,804,319.30***	***-2,497,879.20***	***-2,806,518.20***	
Financing:	***924,412.50***	***955,797.00***	***902,809.20***	***1,215,042.20***	***1,939,623.60***	***2,393,214.90***	***2,070,124.10***	***2,804,319.30***	***2,497,879.20***	***2,806,518.20***	
(% to Total Exp.) Financing	23.9	21.4	16.9	18.0	23.7	25.4	19.2	22.1	17.8	19.2	20.3
Foreign Financing (net)	***561,219.00***	***717,789.30***	***1,250,859.30***	***956,367.40***	***1,379,656.40***	***1,148,884.50***	***1,735,260.40***	***1,734,998.00***	***2,271,136.60***	***2,006,741.80***	
(% to Total Exp.) Foreign Financing (net)	**14.5**	**16.0**	**23.5**	**14.2**	**16.9**	**12.2**	**16.1**	**13.6**	**16.2**	**13.7**	**15.8**
Domestic (net) [4]	***363,193.50***	***238,007.70***	***-351,197.70***	***258,674.80***	***559,967.10***	***1,244,330.40***	***334,863.70***	***1,069,321.30***	***226,742.60***	***799,776.30***	
(% to Total Exp.) Domestic (net)	9.38	5.32	-6.59	3.84	6.85	13.18	3.11	8.41	1.62	5.48	4.5

Notes: 1 EPA refund (2009/10); Radar refund (2012/13)
2 Exclude amortization and expenditure float, includes road fund and retention expenditure
3 Domestic interest payments and amortization include cash and non cash
4 Positive value means financing and a negative value means repayment
p = Provisional

Source: Bank of Tanzania Annual Report 2014/15 (Original source: Ministry of Finance, Bank of Tanzania and National Bureau of Statistics)

2.4.3 Budget and Expenditure of Agricultural Sector

Table 2.4.4 shows the budgets of the agricultural sector-related ministries[6]. Note that these are ministries' total budget including both recurrent and development. Given the mandates of the central ministries, these are mostly recurrent budget. Still it is notable that they are much smaller in comparison with other major sectors such as education or health with their proportions to the total expenditure being approximately 17%[7] and 8%[8], respectively.

Table 2.4.4 Agricultural Sector Ministries' Budget and Total Government Budget (TZS in Billion)

	2009/10	2010/11	2011/12	2012/13	2013/14p	2014/15p	2015/16
Total Expenditure	8,174	9,439	10,765	12,714	14,011	14,604	17,760
Agricultural related ministry budget	386	370	330	331	383	400	401
% of Agriculture Budget	4.7	3.9	3.1	2.6	2.7	2.7	2.3

Note: There are substantial budget allocated to LGAs through DADP and DIDF funds. These are not included here.
Source: GoT Revenue -- Bank of Tanzania Annual Report 2014/15 and 2015/16
Agricultural Sector Ministries Budget: Calculation based on data of Ministry of Finance Budget Book (Data of respective year: 2011/12, 2012/13, 2013/14, 2014/15)

Agricultural sector budgets are also allocated to LGAs. They are primarily under the budget of ASDP funds, namely, funds for DADP. There have been some possibilities that LGA (agriculture) obtains funds from other fund sources such as LGDG[9]. However, that possibility was rather limited until 2015/16 due to the existence of ASDP1. Following Table 2.4.5 summarizes the purposes of DADP funds.

Table 2.4.5 Types of ASDP/DADP Funds at LGA Level

Abbrev.	Full Name	Purpose
DADG	District Agricultural Development Grant	General infrastructure projects. Can be road, irrigation, warehouse, dip tank, etc.
ACBG	Agricultural Capacity Building Grant	LGA's capacity building activities. Can be training, equipment procurement
AEBG	Agricultural Extension Block Grant	Farmer capacity building, extension services. Can be FFS, AI, seeds, farmers' training.
DIDF	District Irrigation Development Fund	Specifically irrigation development, but at the LGA level.

Source: Produced by JICA Project Team

However, as seen in Table 2.4.6, it seems that LGAs were receiving fairly steady funds during the period of ASDP1 (2006/07 – 2012/13) (the Programme was then extended to 2015/16), although the amount may not have been enough if one looks at the per LGA values. On average, an LGA received TZS 214 million by DADG, while TZS 51 million by DIDF. However, the figure of DIDF should be much higher for those LGAs which received the fund because that fund was not for all LGAs. It was provided in response to proposals by LGAs and subject to screening done by NIRC in terms of their viability and profitability.

[6] Here, agricultural sector related ministries are as follows:
1) Ministry of Agriculture, Food Security and Cooperatives,
2) Ministry of Livestock and Fishery Development,
3) Ministry of Water (Irrigation Division) (until 2010/11), and
4) Ministry of Industry and Trade. In addition, since 2014/15, National Irrigation Commission is added.
[7] UNICEF Education budget brief (FY 2011/12–FY 2015/16)
[8] UNICEF Health budget brief (FY 2011/12–FY 2015/16)
[9] LGDG: Local Government Development Grant

Table 2.4.6 DADP Funds Disbursement (TZS in Million)

S/N			1	2	3	4	5	6	7	8	Annual Average	Remark
Year			2006/07	2007/08	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14		
No. of LGA			122	132	132	132		132	132	160		
・ Funds to LGAs	・ ASDP/ DADP Funds	Basic DADG		4,704	4,998			4,998	4,998	0		・
		Top up DADG	8,968	20,414	21,754	33,906		33,568	30,424	0	24,105	Average Annual DADG
		Total DADG/ LGA	74	190	203	257		292	268	0	214	Average Annual DADG/ LGA
		Basic ACBG			7,288			3,493	3,843	5,560		
		Top up ACBG	3,293	15,484	10,697	16,644		0	0	0	9,472	Average Annual CBG
		Total ACBG/ LGA	27	117	136	126		26	29	35	71	Average Annual CBG/ LGA
		AEBG	1,586	9,012	9,401	9,205		0	0	10,907	5,730	Average Annual AEBG
		AEBG/ LGA	13	68	71	70		0	0	68	41	Average Annual AEBG/ LGA
		DIDF	164	7,386	4,635	23,700		11,190	0	0	6,725	Average Annual DIDF
		DIDF/ LGA	1	56	35	180		85	0	0	51	Average Annual DIDF/ LGA
	DASIP Funds	Investment (Top-up)	0	0	0	0		20,324	0	0		
		Capacity (Top-up)	0	0	0	0		2,013	0	0		
・ LGA Fund Total			14,011	57,000	58,771	83,456		64,396	39,266	16,467	47,624	Average Annual DADP Fund
・ LGA Fund Total (w/o DASIP)			14,011	57,000	58,771	83,456		42,059	39,266	16,467	44,433	
・ Average Fund/ LGA			116	434	448	635		490	300	103	361	Average Annual DADP Fund/ LGA
・ Average Fund/ LGA (w/o DASIP)			116	434	448	635		321	300	103		
・ Funds to Region	・ Local							102	102			
	・ Foreign							840	713			
・ All Total			13,847	57,000	58,771	83,456		65,338	40,081	16,467	47,852	Average Annual DADP Fund

Note: Those values shaded grey are total of the category. That is, no classification of Basic and Top-up was available.
Source: MAFC DPP Budget Office. As to the DIDF funds, those 2011/12, 2012/13 and 2013/14 data are given by NIRC.

2.4.4 Budgets for Irrigation Sector

The general trend of the irrigation-related funds since 2006/07 is shown in Table 2.4.7. In irrigation development, there is NIDF for large-scale projects in addition to DIDF, which is for projects at LGA level. Similar to the DADP funds above, DIDF and NIDF surged during the ASDP period, but then decreased as it was closed. The hike in 2014/15 and 2015/16 in DIDF is due to JICA's Small-Scale Irrigation Development Project (SSIDP). On average, government annual resource to irrigation development is TZS 12.8 billion which is approximately USD 8.3 million. Details of NIRC budgets are described in Section 5.5.1.

Table 2.4.7 Irrigation-related Expenditure

S/N	Fiscal Year	NIDF (TZS in Mil.)	DIDF (TZS in Mil.)	Total (NIDF+DIDF, TZS in Mil.)	Incremental Area (ha)	Expenditure/ Incremental Area (TZS in Mil. /ha)	Remark
1	2006/07	5,127	163	5,290	9,557	0.55	ASDP1 Period
2	2007/08	4,044	7,386	11,430	15,300	0.75	
3	2008/09	5,125	4,635	9,760	21,500	0.45	
4	2009/10	5,675	22,198	27,873	20,745	1.34	
5	2010/11	4,111	2,460	6,571	14,200	0.46	
6	2011/12	1,591	11,190	12,781	8,912	1.43	
7	2012/13	7,672	0	7,672	8,912	0.86	
8	2013/14	8,490	0	8,490	86,878	0.10	
9	2014/15	10,659	18,212	28,871	10,934	2.64	
10	2015/16	5,131	14,470	19,601			
11	2016/17	3341	0	2,986			
TOTAL		**60,968**	**80,713**	**141,326**	**196,938**	**---**	
Annual Average		5,542	7,338	12,848	21,882	0.72	
Annual Average (USD in Mil.)		3.60	4.76	8.34	---	466 USD/ha.	

*Note: *1 Exchange rate=TZS. 1,541/USD (2006-2016 average)*
**2 The average of Expenditure/Incremental Area (0.72 USD million) is calculated by TZS 141,326 million/196,938 ha.*
Source: NIRC

In addition to the above NIDF/DIDF funds, there are other funds available for irrigation development. They are so-called "off-budget" funds provided typically by development partners (DPs) stand-alone projects. These funds are often difficult to track the details like annual outflows and appropriation among multiple components of the project. For the concerned period, major source of funds of such nature are shown in Table 2.4.8.

Table 2.4.8 Major Funds for Irrigation Development Other than NIDF/DIDF

S/N	Fund name	Total Budget	Project Period	Budget/ Year
1	Food Assistance Counterpart Fund (FACF)[1]	7,598 (TZS in Mil.)	Irregular	691 (TZS in Mil.)
2	World Bank: Expanding Rice Productivity Project	22.9 (USD in Mil.)	2015 Mar 2020 Apr	4.58 (USD in Mil.)
3	USAID Feed the Future (NAFACA component)	30.0 (USD in Mil.)	2011-2015	6.00 (USD in Mil.)
4	NIRC recorded other sources[2]	29,531 (TZS in Mil.)	Irregular	2,684 (TZS in Mil.)

Note: 1. The total and the average fund of FACF are derived from the data of NIRC of 2006/07 through 2016/17.
2. The total and the average fund of the other sources are derived from the data of NIRC of 2006/07 through 2016/17.
USAID: United States Agency for International Development
Source: NIRC data, World Bank: http://projects.worldbank.org/P144497?lang=en, USAID: Lee Rosne, 2012 May 22, (PPT material), Balancing Quick Wins with Sustainability: Feed the Future's NAFAKA Project in Tanzania

While the level of total expenditure fluctuated depending upon the level of available funds in the Basket Fund, averaged amount of annual fund is USD 8.34 million. On the other hand, there have been a few other non-basket (off-budget) projects. Major examples are USAID Feed the Future Project (NAFAKA component, USD 30 million for five years, i.e. USD 6 million/year), and World Bank Expanding Rice Productivity Project (USD 22.9 million for five years, USD 4.58 million/ year)[10]. Moreover, there was the annual disbursement of DADG fund to all LGAs by the Basket Fund between 2006/07 and 2012/13. DADG was provided primarily for building local infrastructure including irrigation schemes. The annual average was TZS 31,953 million. Because this fund was for any type of local agricultural infrastructure,

[10] These projects covered both physical and institutional components, the former being construction of facilities and latter being training for O&M, production technologies, and organisation management. Because details are not available for expenditure of respective components, the values reported here are simple annual amount derived from total amount divided by the project duration.

it may have not been used for irrigation. Assuming about 10% of the annual total was used for irrigation[11], the available fund is TZS 3,195 million (approx. USD 2.34 million[12]). These expenditures are summarized in Table 2.4.9.

Table 2.4.9 Past Annual Funds Available for Irrigation Development

S/N	Fund Name	Budget/ Year (USD in Mil.)
1	NIDF	3.58
2	DIDF	4.76
3	FACF	0.45
4	WB: Expanding Rice Productivity Project	4.58
5	USAID Feed the Future (NAFACA component)	6.00
6	NIRC recorded other sources[2]	1.74
7	DADG	2.34
	Total	23.45

Note: The conversion of T. Shilling to US dollar was done based on the average exchange rate of the two currencies for the concerned period. The basic yearly exchange rates are obtained from World Bank Development Indicators.
Source: JICA Project Team

There were other project funders such as AFDB, IFAD, BMGF, and EU. However, their targets are often on subjects other than irrigation, like value chain development, extension and research, and promotion of commercial farming, etc. Therefore, their financial contributions are excluded here. In sum, examining the past ten years of irrigation development, average annual public (government and DPs) expenditure is estimated approximately USD 23 million per year.

2.5 Overview of Government Development Policy

2.5.1 National Development Policy

Tanzania's development policies in the last 15 years are all built upon the "Tanzania Development Vision 2025" (Vision 2025) which was proclaimed in 1999 with aspiration that the country would progress from a least developed country to a middle-income country by 2025. The vision was declared despite that it was time of adjustment to excess debts of the country to the international community.

In response to the adjustment process, the development policies of early 2000s were social sector-oriented. Then, gradually, the government veered the policy towards more growth-oriented direction as the country's confidence grows in pace with the country's economic expansion. Major development policies of the last 15 years are summarized in Table 2.5.1 in chronological order.

[11] There was the DADP progress report prepared and submitted by all LGAs quarterly to the central government. Examining the three annual reports, 2008/09, 2009/10 and 2010/11, it was found that the shares of expenditure to irrigation activities in total expenditure were 6.1%, 5.7% and 30.5% respectively. Considering yearly specific conditions such as focus on procurement of vehicles and office equipment in the beginning of ASDP period (2008/09) and government's explicit instruction to LGAs to purchase power tillers (2009/10), and taking relatively safe side, it might be reasonable to assume that 10% of DADG has been diverted to irrigation development.
[12] TZS 1,362.6/ USD which is the average exchange rate 2006-2012 was applied here.

Table 2.5.1 Major Development Policies of Tanzania

Target Period	Name of Policy	Characteristics
2000/01 – 02/03 (3 years)	Poverty Reduction Strategic Paper 1 (PRSP 1)	・ Focus on poverty alleviation. ・ Focus on social sector (education, health, agriculture (research and extension), rural roads, etc.) ・ Macro economy and structural reform
2005/06 – 09/10 (5 years)	Poverty Reduction Strategic Paper 2 (PRSP 2), or National Strategy for Growth and Reduction of Poverty (NSGRP)	・ Cluster approach ・ Cluster I: Economic growth and poverty reduction ・ Cluster II: Quality of life and well-being ・ Cluster III: Governance ・ Equity and broad based development with more focus on economic growth
2010/11 – 14/15 (5 years)	National Strategy for Growth and Reduction of Poverty II (NSGRP II) (or MKUKUTA II)	・ More focus on economic growth ・ Maintaining the cluster approach (with same coverage) ・ More promotion of private sector involvement
2011/12 – 25/26 (15 years)	Long Term Perspective Plan (LTPP)	・ Review of the implementation of Vision 2025 ・ Bases for the three five-year development plans ・ Specific focus on economic growth
2011/12 – 15/16 (5 years)	Five Year Development Plan I (FYDP I) - *Unleashing the Growth Potential*	・ Strong focus on economic growth ・ Intervention priorities rather than sector ones (Flagship projects) ・ Focus on manufacturing sector ・ High promotion of private sector participation
2016/17 – 20/21 (5 years)	Five Year Development Plan II (FYDP II) - *Nurturing an Industrial Economy*	・ Focus on economic growth ・ Flagship projects with large investments ・ Strategic consideration of geographic position (Corridor approach and area focus) ・ Improving business and investment environment

Source: Prepared by JICA Project Team

As summarized above, the country's development orientation has been shifting gradually more towards economic growth while maintaining social sector improvements. However, since the early 2010s, Tanzania has geared clearly to growth drive by introducing the sequential five-year development plans. Now, the country is pressing hard to expand its industrialization by promoting manufacturing, major capital intensive investments, and area specific (corridor) approaches based on the country's locational advantage.

In addition to the general development policies, the government launched in 2013/14 the Big Results Now (BRN) initiative which was an economy-wide but short-duration, very intensive and narrowly focused development program. Identifying six sectors (electricity and gas, transport, agriculture, water, education, and resource mobilization) with highly concentrated sets of interventions, the initiative attempted to accomplish visible changes in a manner of crashing work. Although it did not accomplish the original goals within the planned three years (by 2015/16) due to insufficient resource mobilization, the methodology of intensive engagement and critical monitoring seem to give a fresh impetus to the government operation.

2.5.2 Agricultural Development Policy

Throughout the transition of national development policies, the agricultural sector has always been counted as one of the major sectors for national development. In the poverty reduction policies during the 2000s, which emphasised social aspects in development, the development of agricultural sector was considered critical as it would have a direct impact on poverty reduction as major parts of poverty resided in rural areas. Agriculture was also viewed essential in mitigating both income and food poverty. As the national policy turned more toward growth oriented, the agricultural sector continued to be regarded as important with a few added roles for economic advancement. The new roles are agricultural processing, export promotion of specific commodities, and overall domestic market expansion with an aim of broad-based economic progress.

While the importance of agricultural sector has remained in every national development policy, the aspects to which development interventions are directed have shifted as the national focuses have evolved. During the 2000s, the focuses of development were on conventional areas of productivity, profitability, technical modernisation, etc. As time passes, concepts of marketing, value chain, value addition, private investments, financial supports, and environmental concerns are flowing into the overall framework. Major agricultural development policies, strategies, and programs are listed in Table 2.5.2 with short summary of characteristics.

Table 2.5.2 Agricultural Sector Major Development Policies, Strategies, and Programs

Target Period	Name of Policy	Characteristics
2001 Oct. – (No specific duration)	Agricultural Sector Development Strategy 1 (ASDS1)	・ Response to PRSP 1. ・ Reform in the ministries' interventions to the sector ・ 3 innovative focuses 1) Focus on productivity and profitability with favourable environment for investments 2) Promotion of private/public partnership 3) Introduction of District Agricultural Development Plan (DADP)
2006/07 – 12/13 (7 years)	Agricultural Sector Development Program 1 (ASDP1)	・ Operationalization of ASDS ・ Adoption of the basket fund approach ・ Adoption of DADP (bottom-up approach in planning and implementing development interventions) ・
2013 Oct. – (No specific duration)	National Agriculture Policy	・ Prepared in response to various changes taking place in the surrounding of the sector (Kilimo Kwanza, CAADP, TAFSIP, international trade, etc.) ・ Comprehensive
2015/16 – 24/25 (10 years)	Agricultural Sector Development Strategy 2 (ASDS2)	・ Review of ASDS1, after the completion of ASDP1. ・ 6% growth rate with higher investments ・ Better productivity and commercialization for better income ・ Private sector involvement ・ Improvement in regional trade (EAC, SADC, etc.)
2016/17 – 25/26 (10 years)	Agricultural Sector Development Program 2 (ASDP2)	・ Focus on commercialization of agriculture ・ Promotion of value chain and value addition ・ Prioritized intervention (commodity and area focus) ・ Private sector mobilization (business promotion)

Source: Prepared by the JICA Project Team

The latest relevant policy/ program of the agricultural sector is ASDP2, which is a direct evolution from previous ASDP1. Comparing with the latter, the former is more focused and prioritized in its engagement. It is explicit in target commodities and areas for interventions. Also, ASDP2 gives greater emphasis on value addition and value chain development than any of the previous policies and programs.

2.5.3 Irrigation Development Policy

Parallel to the agricultural development, irrigation development has also been recognized as a crucial component for development. As early as 2002, the government had already prepared the NIMP2002 which became a guiding document for all later irrigation development. On the other hand, it is only recent that the irrigation-specific policies were prepared despite that the importance was repeatedly mentioned in all of the major policy/ program documents.

The irrigation policy was prepared in 2010 followed by other key documents (National Irrigation Act 2013, National Irrigation Development Strategy 2013). Moreover, the National Irrigation Commission was established as a semi-independent organisation under the Ministry of Agriculture Food Security and Cooperatives (MAFC) in 2013. Major policy documents and their characteristics are summarized in Table 2.5.3.

Table 2.5.3 Irrigation Development Policy and Other Documents

Target Period	Name of Policy	Characteristics
February 2010 – Present	National Irrigation Policy	・ Formulated to "provide a baseline for a focused development of irrigation sector". ・ A general guidance for interventions. ・ Guidance is structured with respect to the types of irrigation scheme (traditional, improved, smallholders', or commercial, etc.) and key issues in relation to irrigation such as research, appropriate technology, production, capacity, etc. ・ For each subject, issue, objective, and policy statements are given.
2013 – Present	National Irrigation Act	・ This is a law specifically enacted to facilitate irrigation development of the country. ・ It has provision of establishing the National Irrigation Commission. ・ It provides definitions of many terms pertinent to irrigation. ・ It facilitates improvement of irrigation facility construction and operation by legally demanding particularities of actions to be taken.
November 2013	National Irrigation Development Strategy (Draft)	・ Document is still a draft. ・ Tentatively, it proposes the coverage of 15 years of 2013 through 2028. ・ Although not very specific, it describes how to proceed in major aspects of irrigation development such as: ・ Investment ・ Management ・ Research and technologies ・ Production ・ Training ・ Institution ・ Financial mechanism

Source: Prepared by the JICA Project Team

Recognizing the significance of irrigation development, many policies described specific targets to be achieved in a set year. Following Table 2.5.4 shows the list of such declaration. Unfortunately, however, due to various obstacles such as financial shortage and inadequate manpower, these goals are not yet achieved to date.

Table 2.5.4 List of Irrigation Development Target in the Past

Date of Document	Name of Policy	Target
July 2010	National Strategy for Growth and Reduction of Poverty II (NSGRP II) (or MKUKUTA II)	1,000,000 ha by 2015 [From 370,000 ha (2009)]
June 2011	Five-Year Development Plan I (FYDP I) - *Unleashing the Growth Potential*	1,000,000 ha by 2015/16
2015	CCM Manifesto	1,000,000 ha by 2020
June 2016	Five-Year Development Plan II (FYDP II) - *Nurturing an Industrial Economy*	700,000 ha by 2020 1,000,000 ha by 2025

Source: Prepared by the JICA Project Team

The latest ASDP2 document does not specify target areas of irrigation development.

2.6 Overview of Development Partners Policy and Activities

2.6.1 Development Partners' General Policies in Supporting Tanzania and their Characteristics

Because of its political stability and openness to outside, Tanzania has been favoured by numerous DPs both multilateral organisations like the World Bank (WB) and African Development Bank (AfDB) and bilateral aid agencies like USAID and Irish Aid. In the agricultural sector, major supporters are the following:

- WB
- AfDB
- Food and Agriculture Organization (FAO)
- World Food Program (WFP)
- Bill and Melinda Gates Foundation (BMGF)
- International Fund for Agricultural Development (IFAD)
- USAID
- Japan International Cooperation Agency (JICA)
- Irish Aid

The agencies typically carry out their support, financial or technical, in accordance with their multi-year strategic plans. Perusing the plans, there are some commonalities and general trends in how they engage in the Tanzania agricultural development.

It is the DPs common understanding that despite the fact that the country has enjoyed an impressive growth with more than 6% on average in the last decade or so, such growth has not been translated to enough poverty reduction and economic transformation. Given this observation, many DPs recognize the importance of improving the livelihood of rural population which is mostly smallholder farmers.

At the same time, many DPs align their supports with government key development policies which are TDV 2025 and NSGRP II (and FYDP I) until 2015, and FYDP II since 2016. Following the basic orientation of the recent policies, major DPs are re-focusing to infrastructure sectors such as road and transport, and energy (WB and AFDB), while maintaining the supports to institutional reforms in governance and accountability.

Regarding agricultural sector, attention is increasingly given to commercialization of farming. Often observed expressions are "value chain development", "value addition", and "market access". Paring with these words are "involvement of private sector" and "enhancement of private investments" in agricultural sector. A background or overarching issue of this is the "improvement of business environment". This trend is also a reflection of the general trajectory of the government development policy. Many DPs still maintain the aspects of productivity improvement, but greater elements of commercialization and marketing are being included in DPs aid policies in recent years.

Apart from above trends, there are a few separate lines of focus in DPs. These are concerns about women, youth and children (USAID and Irish Aid), nutrition (USAID, FAO and BMGF), and climate resilience (many DPs). Major points of DPs' aid policies are summarized in Table 2.6.1

Table 2.6.1 Characteristics of DPs' Policies

DP	Policy Doc. Referred	Major Concerns and Goals
WB	Country Assistance Strategy 2012 - 2015	(1) To promote inclusive and sustainable private sector-led growth (2) To build infrastructure and deliver services (3) To strengthen human capital and safety net (4) To improve accountability and governance
AFDB	Country Strategic Paper 2016-2020	(1) Infrastructure development (2) Governance and accountability
IFAD	Country Strategic Opportunities Programme 2016-2021	Strategic Objectives (SO) SO 1: To improve institutional performance SO 2: More inclusive and resilient value chains of priority commodities SO 3: Climate resilient and productivity-increasing technologies SO 4: Land governance enabling more inclusive investments
FAO	Country Programming Framework Jan. 2014 – June 2016	A. Promoting agriculture as a profitable business Outcome A1: Agricultural productivity increases in selected commodities Outcome A2: Smallholders and trader farmers and traders engaged in marketing and commercialization of agricultural produce B. Sustainable management of natural resources Outcome B1: Effective and sustainable natural resources management C. Agricultural development planning and sector investment support Outcome C1: Agricultural statistics Outcome C2: ASDP planning support
USAID	Country Development Cooperative Strategy Oct. 2014 – Oct. 2019	Development Objective (DO) 1: Women and youth empowerment Intermediate Result (IR) 1.1: Gender equality is improved. IR 1.2: Health status is improved. IR 1.3: Lifelong learning skills. DO 2: Inclusive and broad-based economic growth IR 2.1: Binding constraints to private sector investment is decreased. IR 2.2: Agricultural productivity and profitability are increased. IR 2.3: Stewardship of natural resources is improved.
Irish AID	Country Strategic Paper 2011 – 2015	Overall goal: To reduce poverty and vulnerability and to support inclusive growth Specific objectives: 1) To improve livelihood for smallholders and pastoralists 2) To improve food security and nutrition, particularly for women and children 3) To enhance the quality and equity of local health services
Japan/ JICA	Tanzania Country Assistance Policy (September 2017)	Overall Goal: To support the formation and enhancement of a positive feedback loop between inclusive and stable economic growth and poverty reduction along the Tanzania's national strategy which aims at attaining the middle-income status in the world, (1) Formation of sectors driving the economic growth Agriculture: Support to rice production, irrigation development and food value chain within the framework of ASDP II. Industry: Support to business undertaking including the improvement of business environment and KAIZEN under FYDP II. (2) Infrastructure development Transport sector, power and energy sector, and sustainable urban development (3) Governance and public services Local administration management, water, health services, and public financial management
BMGF	"What we do", Strategy overview	Goal: To reduce hunger and poverty for millions of farming families in sub-Saharan Africa and South Asia by increasing agricultural productivity in a sustainable way. Strategy: ・ Listening to farmers and addressing their specific needs ・ Increasing farm productivity (comprehensive approach) ・ Fostering sustainable agricultural practices ・ Achieving greater impact with partners Strategic areas: ・ Research and development ・ Agricultural policies ・ Livestock ・ Market access and market systems ・ Strategic partnerships and advocacy

Source: Prepared by the JICA Project Team

2.6.2 DPs' Major Activities and Financial Engagement in Agricultural Sector

The major activities and financial supports of the major agricultural DPs are summarized in Table 2.6.2

Table 2.6.2 DPs' Major Activities and Financial Supports

DP	No	Title	Period		Budget		Remarks
					Currency	(Mil.)	
AFDB	1	Marketing Infrastructure Value Addition and Rural Finance Support Program (MIVARF)	2012	2016	UA	40.0	Co-finance with IFAD (AFDB portion is UA 40.0 Mil.)
	2	District Agricultural Sector Investment Project (DASIP)	2006	2013	UA	36.0	
	3	ASDP1	2007	2010	UA	40.0	
EU	1	SAGCOT support	2014	2017	EUR	36.5	
GIZ	1	Competitive African Rice Initiative (CARI)	2014	2017	USD	5.6	
IFAD	1	Marketing Infrastructure Value Addition and Rural Finance Support Program (MIVARF)	2012	2018	USD	90.5	Co-finance with AFDB
	2	Rural Micro, Small and Medium Enterprise Support Program (MUVI)	2007	2016	USD	19.5	
	3	ASDP1	2006	2014	USD	93.4	
Irish Aid	1	ASDP1	2007	2012	EUR	24.6	Estimates from Country Strategy Paper
JICA	1	ASDP1	2006	2012	USD	20.0	
	2	Small-scale irrigation development project	2014	2016	USD	34.0	
USAID	1	Feed the Future (Tanzania)	2011	2015	USD	350.0	USD 70 Mil./year
WB	1	ASDP1	2006	2016	USD	90.0	
	2	ASDP1 (Addition (1)) (to Accelerated Food Security)	2009		USD	30.0	
	3	ASDP1 (Addition (2))	2010		USD	35.0	
	4	ASDP1 (Addition (3))	2012		USD	30.0	
	5	Accelerated Food Production	2009	2014	USD	160.0	
	6	Accelerated Food Production (Addition (1))	2012		USD	25.0	
	7	SAGCOT support	2016	2021	USD	70.0	
	8	Expanding Rice Production	2015	2020	USD	22.9	

Source: Prepared by the JICA Project Team

Apart from the activities in Table 2.6.2, there are numerous relatively small projects carried out by different DPs. Many of them are technical cooperation projects conducted by FAO, AGRA, and JICA. Another type of project is location-, crop-, or subject-specific projects such as EU's sugar, or cassava or horticulture project. Another is the support to agricultural finance, which includes Canada's contribution to the Financial Sector Deepening Trust (FSDT), or Netherland and Sweden's support to a matching fund for agricultural entrepreneurship (Tanzania Agribusiness Window)[13].

Overall DPs are supporting the sector along the government development policies, although it is vice-versa as DPs are actively engaging with the government in policy formulation. In terms of funding modality, however, there is a notable shift among DPs from pooled-fund approach to independent stand-alone project approach. Hence, although the government makes it clear that the pooled/ basket fund approach is their preferred modality for ASDP2, it is likely that many DPs support the program through their own individual projects.

[13] Agribusiness Window was first proposed in 2007 at the World Economic Forum (Africa). Then with the supports of Netherland and Sweden, the system began to operate since 2008. The window is one of several matching funds available for those entrepreneur and venture business. Other target areas than agriculture are rural electrification, climate change, and rural finance.

2.7 Private Sector Activities

Tanzania has seen steady and impressive economic growth for the last several years with an average growth rate achieving 6.5%. This growth was spurred by vigorous private sector activities. As shown in Table 2.7.1, they have been taking place mostly in the subsectors of construction, information and communication, financial and insurance, and professional activities. Unfortunately, agricultural sector is not part of this dynamic expansion.

Table 2.7.1 GDP Growth Rate by Subsectors (2008-2015)

Economic Activity	2008	2009	2010	2011	2012	2013	2014r	2015p	Avg. [8 yrs: 2008-15]
GDP at market prices	5.6	5.4	6.4	7.9	5.1	7.3	7.0	7.0	6.5
Agriculture, Forestry and Fishing	7.5	5.1	2.7	3.5	3.2	3.2	3.4	2.3	3.9
・ Crops	7.8	5.5	3.7	4.8	4.2	3.5	4.0	2.2	4.5
・ Livestock	8.1	5.3	1.4	1.6	1.8	2.0	2.2	2.4	3.1
・ Forestry	3.8	5.1	3.4	3.3	3.5	4.7	5.1	2.6	3.9
・ Fishing	7.2	0.5	0.9	2.6	2.9	5.5	2.0	2.5	3.0
Industry and Construction	6.5	3.3	9.1	12.0	4.0	9.5	10.3	11.3	8.3
・ Mining and quarrying	-9.8	18.7	7.3	6.3	6.7	3.9	9.4	9.1	6.5
・ Manufacturing	11.4	4.7	8.9	6.9	4.1	6.5	6.8	6.5	7.0
・ Electricity supply	8.1	4.3	13.4	-4.3	3.3	13.0	9.3	5.8	6.6
・ Water supply; sewerage, waste management	2.3	4.6	2.2	-1.2	2.8	2.7	3.7	0.1	2.2
・ Construction	9.7	-3.8	10.3	22.9	3.2	14.6	14.1	16.8	11.0
Services	4.2	5.8	7.8	8.4	7.2	7.1	7.2	6.9	6.8
・ Wholesale and retail trade; repairs	6.5	2.7	10.0	11.3	3.8	4.5	10.0	7.8	7.1
・ Transport and storage	1.8	6.9	10.7	4.4	4.2	12.2	12.5	7.9	7.6
・ Accommodation and food services	3.3	1.0	3.7	4.1	6.7	2.8	2.2	2.3	3.3
・ Information and communication	11.9	26.6	24.4	8.6	22.2	13.3	8.0	12.1	15.9
・ Financial and insurance activities	18.8	18.4	12.6	14.8	5.1	6.2	10.8	11.8	12.3
・ Real estate	1.7	1.8	1.8	1.9	2.0	2.1	2.2	2.2	2.0
・ Professional, scientific and technical activities	30.6	15.8	29.9	4.8	-5.8	5.4	0.5	6.8	11.0
・ Administrative and support service activities	-1.8	0.4	8.6	5.1	23.8	12.2	6.0	4.7	7.4
・ Public administration and defence	-6.3	-0.7	-5.0	15.9	9.1	7.8	3.9	4.6	3.7
・ Education	9.5	9.2	6.4	5.6	7.4	4.3	4.8	6.3	6.7
・ Human health and social work activities	5.5	7.4	3.3	5.3	11.4	8.8	8.1	4.7	6.8
・ Arts, entertainment and recreation	6.4	3.0	7.3	7.7	11.0	5.7	5.7	6.2	6.6
・ Other service activities	5.8	5.9	6.0	6.2	6.4	6.5	6.7	6.9	6.3
・ Activities of households as employers	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7
・ FISIM, unallocated	6.8	20.0	7.9	22.6	1.2	0.1	9.7	11.7	10.0

Notes: r: revised, p: provisional
Source: NBS, MoFP, November 2016, National Account of Tanzania Mainland 2007 - 2015

On the other hand, the government has been active in promoting the public-private partnership (PPP) to induce private entities into the traditionally often publicly implemented sectors. The PPP policy was enacted in 2009, followed by the introduction of the Act in 2010 and the Regulation in 2011, and setting-up of PPP Finance Unit in the Ministry of Finance and Coordination Unit in TIC. This series of establishments of new policy instruments corresponds to the preparation and implementation of the second growth-oriented national development policy: National Strategy for Growth and Reduction of Poverty II (NSGRP II) (or MKUKUTA II) as well as the declaration of Kilimo Kwanza. Although the

PPP drive has expected some increase in foreign direct investment (FDI), there has been limited expansion in FDI since 2008 as shown in Table 2.7.2. Major FDI activities have been in mining and quarrying, manufacturing, and financial subsectors. The inflow showed overall expansion but with considerable fluctuation over the period.

Table 2.7.2 Trend of FDI (Flow and Stock) (USD in Million)

Activity	Flows						Stock					
	2008	2009	2010	2011	2012	2013	2008	2009	2010	2011	2012	2013
Mining and quarrying	669.8	385.1	909.9	406.5	889.3	520.4	3,714.1	4,099.2	5,009.1	5,415.5	6,304.8	6,825.2
Manufacturing	277.6	214.5	157.1	217.3	563.7	386.6	870.7	1,085.2	1,242.3	1,459.5	2,023.3	2,409.9
Financial and insurance	81.7	95.9	95.5	121.1	148.1	752.2	416.3	512.2	607.6	728.7	876.8	1,629.0
Electricity and gas	1.0	2.1	290.5	209.4	618.3	37.3	24.7	26.8	317.3	526.7	1,145.0	1,182.3
Accommodation	129.7	35.9	21.1	165.6	5.4	47.0	388.7	424.6	445.7	611.3	616.8	663.8
Wholesale and retail trade	21.1	-16.9	36.9	114.5	-35.2	123.5	372.0	355.1	392.0	506.5	471.3	594.8
Information and communication	127.6	185.1	83.5	-98.3	-420.1	195.9	532.4	717.4	801.0	702.7	282.6	478.5
Agriculture	21.2	29.0	22.9	31.4	11.2	10.3	202.3	231.3	254.2	285.6	296.8	307.1
Professional activities	-0.7	0.5	213.0	6.1	20.1	-0.1	1.1	1.6	214.6	220.6	240.7	240.6
Construction	-3.7	14.9	-23.5	30.7	-28.1	13.8	119.5	134.4	110.9	141.5	113.4	127.2
Real estate activities	26.5	1.5	1.5	12.0	23.4	-0.6	79.7	81.2	82.8	94.7	118.1	117.5
Transportation and storage	2.7	3.9	4.0	10.4	-1.0	19.5	28.8	32.7	36.7	47.1	46.1	65.6
Other service activities	1.4	1.4	-0.8	1.1	3.9	22.9	3.8	5.2	4.4	5.5	9.4	32.3
Education	0.4	0.3	1.6	1.8	0.5	2.2	2.0	2.3	3.9	5.7	6.2	8.4
Grand Total	1,383.3	953.1	1,813.3	1,229.4	1,799.6	2,130.9	6,945.6	7,898.7	9,711.9	10,941.3	12,740.9	14,871.8

Source: Bank of Tanzania, NBS, 2013 and 2014, Tanzania Investment Report

Apart from general investments by private sector, in the PPP drive, the government envisioned more specific joint venture with private companies. Their focus is placed on infrastructure (road, rail, port, airport, and power) and agricultural sectors. This government intention was explicitly materialized in the BRN initiative which aims at rapid completion of clearly targeted projects in the six priority sectors. However, as described in Section 2.5.1, the attempt produced only limited results. As such, while the national economy is steadily expanding, the government still needs to carry out various reforms to attract private sector into its national development.

2.8 Basic Infrastructure

2.8.1 Transport

(1) Road Networks

The Tanzania National Roads Agency (TANROADS) - an executive agency under the Ministry of Works, Transport, and Communications - came into operation in July 2000 and is the agency responsible for the maintenance and development of the trunk and regional road network in Tanzania Mainland. The total classified road network in Tanzania Mainland was estimated to be 86,472 km based on the Road Act 2007, which has expanded to 108,946 by 2015. The Ministry of Works through TANROADS is managing the national road network of about 35,000 km, comprising 12,786 km of trunk road and 22,214 km of regional road. The remaining network of 73,946 km of urban, district, and feeder roads is under the responsibility of the President's Office Regional Administration and Local Government (PO-RALG). Table 2.8.1 shows the road network status of Tanzania Mainland from 2010 to 2015.

Table 2.8.1 Road Network in Kilometres by Status, Tanzania Mainland (km), 2010 – 2015

Item	2010	2011	2012	2013	2014	2015
1. National Roads						
1.1 Trunk Roads (paved)	5,377	5,377	6,219	6,292	6,565	7,342
1.2 Trunk Roads (unpaved)	6,822	6,822	5,987	5,912	6,221	5,444
1.3 Regional Trunk Roads (paved)	780	780	1,067	1,082	1,240	1,321
1.4 Regional Roads (unpaved)	20,490	20,490	20,990	21,047	20,974	20,893
Subtotal (1)	33,469	33,469	34,263	34,333	35,000	35,000
2. Local Roads						
2.1 Local Roads (paved)	842	746	1,031	966	988	1,326
2.2 Local Roads (paved)	56,798	52,603	53,348	52,241	51,676	72,620
Subtotal (2)	57,640	53,349	54,379	53,207	52,664	73,946
Total	91,109	86,818	88,642	87,540	87,664	108,946

Source: TANROADS/PO RALG, 2015 Tanzania in Figures, NBS, June 2016

(2) Railways

There are two railway operators in Tanzania, namely, the Tanzania Railways Corporation (TRC) and the Tanzania-Zambia Railway Authority (TAZARA).

TRC operates 2,600 km of 1,000 mm narrow gauge track including the central line between Kigoma and Dar es Salaam which carries international freight and passengers in transit from Burundi, the DR Congo, and Rwanda to Dar es Salaam, and the Mwanza Branch Line carries freight and passengers between Uganda and Dar es Salaam. TRC also operates the Tanga Line from Tanga to Arusha with a link line to Rubu for connection to Dar es Salaam.

TAZARA operates 1,860 km of 1,067 mm narrow gauge track (matching Zambian/Southern African networks) between Dar es Salaam and New Kapiri Mposhi in Zambia, of which 969 km is in Tanzania and 891 km in Zambia. TAZARA currently handles exports/imports of both Tanzania and Zambia, as well as Malawi, DR Congo, the great lakes region, South Africa and Zimbabwe.

There may be a big room for both railway operators to improve the management and customers' services. For instance, TAZARA Line has a designed capacity of five million tons of freight per annum but remains the same as low performance. Table 2.8.2 shows the freight and passengers transported by railway in Tanzania Mainland

Table 2.8.2 Freight and Passengers Transported by Railway, Tanzania Mainland, 2010-2015

Item	2010	2011	2012	2013	2014	2015
1. Tanzania Railways (TRC)						
1.1 Freight (thousand tons)	265	138	154	185	190	211
1.2 Passengers (thousand)	284	227	339	373	295	405
2. Tanzania Zambia Railways (TAZARA)						
2.1 Freight (thousand tons)	540	248	259	245	208	130
2.2 Passengers (thousand)	758	414	678	654	536	436

Source: Ministry of Works, Transport and Communication, 2015 Tanzania in Figures, NBS, June 2016

Construction of a 207 km of 1,435 mm standard gauge line linking Dar es Salaam with Morogoro will start in May 2017 and is expected to open in October 2019 as the first phase of a long-term proposed 2,561 km standard gauge regional network to be extended to Rwanda and Burundi.

The governments of Zambia and Tanzania are reportedly seeking Chinese loans to finance rehabilitation of the 1,860 km TAZARA railway.

(3) Port

The coastline of Tanzania Mainland is approximately 800 km long, extending from the Kenyan border in the north to the Mozambican border in the south. The major seaports (Dar es Salaam, Tanga, and Mtwara) handle not only Tanzania's cargo, but also transit goods to land-locked countries of Burundi, Democratic Republic of Congo, Malawi, Rwanda, Uganda, and Zambia. The seaport of Dar es Salaam handles about 15 times as much trade as the rest of the Tanzanian seaports. In addition to the seaports, there are lake ports such as Mwanza, Bukoba, and Musoma in Lake Victoria, Kigoma and Kasanga in Lake Tanganyika, and Itungi and Mbamba Bay in Lake Nyasa. It can be seen in Table 2.8.3 that the volume of cargo handled at the above three ports is steadily increasing at the annual rate of about 11% for the last five years.

Table 2.8.3 Cargoes and Passengers Transported by Marine, Tanzania Mainland, 2010-2015

Item	2010	2011	2012	2013	2014	2015
1. Dar es Salaam Port						
1.1 Ships Calls	-	1,510	1,427	1,463	1,600	1,520
1.2 Cargo (thousand DWT)	8,815	9,920	10,867	13,515	14,476	14,558
1.3 Passengers (thousand)	-	1,009	1,343	1,292	1,441	1,620
2. Tanga Port						
2.1 Ships Calls	-	146	212	142	136	83
2.2 Cargo (thousand DWT)	377	500	644	384	750	693
2.3 Passengers (thousand)	-	23	13	2	0	0
3. Mtwara Port						
3.1 Ships Calls	-	60	111	558	599	198
3.2 Cargo (thousand DWT)	170	214	235	188	358	259
3.3 Passengers (thousand)	N/A	N/A	N/A	N/A	N/A	N/A

Note: DWT = Dead Weight Tonnes
Source: Ministry of Works, Transport and Communication, 2015 Tanzania in Figures, NBS, June 2016

It is notable to add that the development of Bagamoyo Special Economic Zone (SEZ) includes a new construction of Mbegani Seaport.

(4) Airports

There are currently 26 airports including four international airports in the mainland of Tanzania. The four international airports are Dar es Salaam (Julius Nyerere), Kilimanjaro, Mwanza, and Mbeya (Songwe). Only international airports have runways over 3,000 m long, which have a capacity to handle 128 tons Boeing 757-200 and 135 tons Boeing 757-300. Most of other small airports are capable of handling light passenger-cargo aircrafts. Table 2.8.4 shows air transport, domestic, and international passengers (in thousand) in Tanzania

Table 2.8.4 Air Transport, Domestic and International Passengers (in thousand), Tanzania

Item	2010	2011	2012	2013	2014	2015
1. International Passengers						
1.1 Julius Nyerere I.A.	870	1,004	1,100	1,137	1,192	1,251
1.2 Kilimanjaro I.A.	283	317	330	368	362	333
1.3 Abeid Amani Karume I.A.	216	275	309	367	409	409
1.4 Mwanza I.A.	16	21	20	18	9	6
Subtotal (1)	1,385	1,617	1,759	1,890	1,972	1,999
2. Domestic Passengers						
2.1 Julius Nyerere I.A.	610	734	868	1,077	1155	1141
2.2 Kilimanjaro I.A.	141	253	236	318	307	318
2.3 Abeid Amani Karume I.A.	325	381	390	440	438	388
2.4 Mwanza I.A.	201	290	365	420	402	427
Subtotal (2)	1,277	1,658	1,859	2,255	2,302	2,274
3. Other Airport Passengers	355	357	439	483	604	579
Total (1)+(2)+(3)	1,632	2,015	2,298	2,738	4,878	4,852

Note: Songwe International Airport was opened and operational in December 2012.
Source: Ministry of Works, Transport and Communication, 2015 Tanzania in Figures, NBS, June 2016

The number of passengers is constantly increasing with the annual growth rate of about 8% for international and 10% for domestic for the last five years.

2.8.2 Power Supply

Tanzania Electric Supply Company Limited (TANESCO) is a parastatal organisation under the Ministry of Energy and Minerals. The company generates, transmits, distributes, and sells electricity to Tanzania Mainland and sells bulk power to the Zanzibar Electricity Corporation (ZECO). TANESCO owns most of the electricity generating, transmitting, and distributing facilities in Tanzania Mainland as shown in Table 2.8.5

Table 2.8.5 Installed Capacity, Electricity Generated and Sales, Tanzania, 2010 – 2015

Item	Unit	2010	2011	2012	2013	2014	2015
1. Installed Capacity							
1.1 Grid System Installed Capacity	MW	1,003.5	1,270.7	1,438.2	1,501.2	1,521.9	1,516.2
2. Maximum Demand							
2.1 Grid System Maximum Demand	MW	832.6	829.0	851.4	898.7	934.6	988.3
2.2 Grid System	GWh	5,183.1	5,050.4	5,339.6	5,758.3	6,029.0	6,188.0
2.3 Off-grid System	GWh	76.1	83.6	149.9	178.5	191.8	201.0
3. Generation							
3.1 Import from Neighbouring Countries	GWh	57.5	61.6	60.9	60.2	61.0	70.5
4. Sales							
4.1 Small Customers	GWh	389.7	328.8	320.8	280.6	217.4	148.8
4.2 Middle Customers	GWh	1,330.4	1,270.8	1,508.0	1,749.1	1,890.6	2,082.7
4.3 Big Customers	GWh	2,152.2	2,151.6	2,301.0	2,570.4	2,595.3	2,721.1
4.4 Zanzibar	GWh	175.4	277.3	298.6	218.7	348.5	344.6

Source: Source: Tanzania Electricity Supply Company (TANESCO), 2015 Tanzania in Figures, NBS, June 2016

According to the Power System Master Plan Updated 2016, a total installed generation capacity is planned to expand to 5,011 MW (excluding renewable and import) by 2020 which is 3.3 times bigger than the existing installed capacity.

2.8.3 Water Supply

In Tanzania, provision of water supply and sanitation services is done through Water Supply and Sanitation Authorities (WSSAs) which are regulated by the Energy and Water Utilities Regulatory Authority (EWURA); and Community Owned Water Supply Organisations (COWSOs), which are regulated by the Ministry of Water and Irrigation (MoWI). A new Water Supply and Sanitation Act, Cap 272 came into operation in August 2009, and provides clear division of responsibilities between MoWI, WSSAs, and EWURA. EWURA currently regulates 130 WSSAs, which provide water supply and sanitation services in regional and district headquarters, small towns, and national projects water authorities. Meanwhile, COWSOs are responsible for rural water supply.

The World Health Organisation (WHO)/ United Nations Educational, Scientific and Cultural Organisation (UNESCO) Joint Monitoring Program (JMP) for water supply and sanitation updated the estimates on the use of water supply and sanitation facilities in Tanzania in 2015 as shown in Table 2.8.6

Table 2.8.6 Estimates on the Use of Water Supply and Sanitation Facilities, 1990-2015

URBAN WATER					
Estimated coverage 2015 update					
Year	Total improved	Piped onto premises	Other improved	Other unimproved	Surface water
1990	92%	31%	61%	5%	3%
1995	89%	30%	59%	8%	3%
2000	86%	29%	57%	11%	3%
2005	83%	29%	54%	14%	3%
2010	80%	28%	52%	17%	3%
2015	77%	28%	49%	20%	3%

URBAN SANITATION				
Estimated coverage 2015 update				
Year	Improved	Shared	Other unimproved	Open defecation
1990	6%	6%	86%	2%
1995	11%	11%	76%	2%
2000	16%	16%	66%	2%
2005	21%	21%	56%	2%
2010	26%	26%	46%	2%
2015	31%	31%	36%	2%

RURAL WATER					
Estimated coverage 2015 update					
Year	Total improved	Piped onto premises	Other improved	Other unimproved	Surface water
1990	45%	0%	45%	30%	25%
1995	45%	1%	44%	31%	24%
2000	45%	2%	43%	32%	23%
2005	45%	3%	42%	33%	22%
2010	45%	4%	41%	34%	21%
2015	46%	6%	40%	34%	20%

RURAL SANITATION				
Estimated coverage 2015 update				
Year	Improved	Shared	Other unimproved	Open defecation
1990	7%	3%	80%	10%
1995	7%	3%	78%	12%
2000	7%	3%	77%	13%
2005	8%	4%	74%	14%
2010	8%	4%	73%	15%
2015	8%	4%	71%	17%

TOTAL WATER					
Estimated coverage 2015 update					
Year	Total improved	Piped onto premises	Other improved	Other unimproved	Surface water
1990	54%	6%	48%	25%	21%
1995	54%	7%	47%	26%	20%
2000	54%	8%	46%	27%	19%
2005	55%	10%	45%	28%	17%
2010	55%	11%	44%	29%	16%
2015	56%	13%	43%	30%	14%

TOTAL SANITATION				
Estimated coverage 2015 update				
Year	Improved	Shared	Other unimproved	Open defecation
1990	7%	4%	80%	9%
1995	8%	5%	77%	10%
2000	9%	6%	75%	10%
2005	11%	8%	70%	11%
2010	13%	10%	65%	12%
2015	16%	12%	60%	12%

Notes: *(Water Supply) Surface water= river, dam, lake, pond, etc., Other unimproved= unprotected dug well, unprotected spring, cart with small tank/drum, etc. Other improved= public taps or standpipes, tube wells or boreholes, protected dug wells and spring, etc. Pipe onto premises= piped household water connection located inside the user's dwelling, plot or yard, Total improved= Piped onto premises + Other improved*
(Sanitation) Open defection= human faeces are disposed of in fields, forest, open body of water, etc., Other unimproved= Unimproved facilities include pit latrines without a slab or platform, etc., Shared= Sanitation facilities of an otherwise acceptable type shared between two or more households, Improved= Flush/pour flush to: - piped sewer system, - septic tank, - pit latrine; Ventilated improved; Pit (VIP) latrine; Pit latrine with slab, Composting toilet

Source: *United Republic of Tanzania: Estimates on the Use of Water Sources and Sanitation Facilities (1990 - 2015), WHO/UNESCO Joint Monitoring Program (JMP) for Water Supply and Sanitation, Updated June 2015*

As for the performance of COWSOs, data is limited. Water utilities performance of WSSAs is evaluated on a sample basis as shown in Table 2.8.7.

Table 2.8.7 Selective Key Performance Indicators of WSSAs, Tanzania, 2013/14 - 2015/16

Item	2013/14	2014/15	2015/16
1. National and Region (25 out of 33 WSSAs)			
1.1 Total water connection (No.)	494,573	528,960	577,391
1.2 Population directory served with water (%)	54%	57%	57%
1.3 Non-revenue water (%)	44%	44%	42%
1.4 Population connected to sewerage network (%)	8%	7%	6%
2. District (69 out of 73 WSSAs)			
2.1 Total water connection (No.)	82,600	89,064	94,631
2.2 Population directory served with water (%)	40%	40%	41%
2.3 Non-revenue water (%)	40%	38%	42%
2.4 Population connected to sewerage network (%)	N/A	N/A	N/A
3. Township (15 out of 24 WSSAs)			
3.1 Total water connection (No.)	12,707	15,291	18,008
3.2 Population directory served with water (%)	41%	45%	37%
3.3 Non-revenue water (%)	41%	35%	36%
3.4 Population connected to sewerage network (%)	N/A	N/A	N/A

Note: Kahama WSSA is a district water supply and sanitation authority but has been included here because it is operating as a Regional WSSA.
Source: 1) Water Utility Performance Review Report for the FY2015/16, Regional and National Project Water Utilities, Energy and Water Utilities Regulatory Authority (EWURA), December 2016
2) The same for Districts and Township Water Utilities, Energy and Water Utilities Regulatory Authority (EWURA), December 2016

Judging from the above selective key performance indicators, there is no significant improvement except the number of total water connection.

2.8.4 Communications

Tanzania has two fixed-line operators (Tanzania Telecommunication Company Limited (TTCL) and Zantel) and seven operational mobile networks. With four major operators - Vodacom, Airtel (formerly Zain), Tigo, and Zantel - mobile penetration has expanded to 80%. Along with the expansion of mobile networks, internet services penetration has reached to 40% with the higher growth rate than that of mobile penetration in the last five years as shown in Table 2.8.8

Table 2.8.8 Estimated Number of Subscription on Telephones and Internet Users in Tanzania

Item	2011	2012	2013	2014	2015	2016
1. Telecom Services						
1.1 Fixed Lines	161,063	176,367	164,999	151,274	142,819	129,597
1.2 Mobile	25,666,455	27,450,789	27,442,823	31,862,656	39,665,600	40,044,186
Subtotal (1)	25,827,518	27,627,156	27,607,822	32,013,930	39,808,419	40,173,783
Penetration	59%	61%	61%	71%	79%	80%
2. Internet Services						
2.1 Fixed Wireless	968,088	777,461	1,056,940	1,913,082	662,882	1,218,693
2.2 Mobile Wireless	3,665,680	6,031,323	7,493,823	11,320,031	16,280,943	18,014,358
2.3 Fixed Wired	677,450	712,095	761,508	984,198	319,698	629,474
Subtotal (2)	5,311,218	7,520,878	9,312,272	14,217,311	17,263,523	19,862,525
Penetration	12%	17%	21%	29%	34%	40%

Source: Tanzania Communication Regulatory Authority, Quarterly Communications Statistics Report, December 2016

It is notable that mobile money services such as M-Pesa, Tigo Pesa, and Airtel Money are rapidly expanding over the country because of i) bridging the vast distances among people, enabling much lower thresholds for profitable service provision, enhancing convenience of service, reducing delivery times, and making payments for services such as electricity and make international money transfers.

2.8.5 Economic Development Corridors

Tanzania has broadly four economic development corridors: TAZARA Corridor, Central Corridor, Tanga Corridor, and Mtwara Corridor. Table 2.8.9 summarizes the regional coverage and major transport infrastructures by each economic development corridor.

Table 2.8.9 Regional Coverage and Major Transport Infrastructures by Economic Development Corridor

Development Corridor	Region Covered	Major Roads	Railway	Port and Airport
TAZARA (SAGCOT)	Dar es Salaam, Pwani, Morogoro, Iringa, Njombe, Ruvuma, Mbeya, Katavi and Rukwa	Dar es Salaam - Morogoro – Iringa – Mbeya – Tunduma	・ TAZARA Line	・ Dar es Salaam Port ・ Julius Nyerere I.A. ・ Songwe I.A.
Central	Dodoma, Singida, Tabora, Kigoma, Shinyanga, Simiyu, and Mwanza	Dar es Salaam –Morogoro – Dodoma – Tabora – Kigoma – Mwanza	・ TRC Central Line ・ TRC Mwanza Line ・ TRC Mpanda Line	・ Kigoma Lake Port ・ Mwanza Lake Port ・ Mwanza I.A.
Tanga	Tanga, Kilimanjaro, Arush, Manyara, Mara and Kagera	Dar es Salaam – Chalinze – Tanga – Moshi – Arusha – Singida – Nzega - Mwanza	・ TRC Tanga Line ・ TRC Link Line	・ Tanga Port ・ Kilimanjaro I.A.
Mtwara	Lindi and Mtwara	Dae es Salaam – Lindi – Mtwara	・ None	・ Mtwara Port

Source: JICA Project Team

TAZARA development corridor, also known as Southern Agriculture Growth Corridor of Tanzania (SAGCOT), has been initiated by the government to promote commercial agriculture in accordance with SAGCOT plan targeting the year of 2030. In such an approach as SAGCOT, it is expected for other corridors to accelerate the regional economy including the agricultural sector.

Chapter 3 Present Conditions of Water Sector

3.1 General

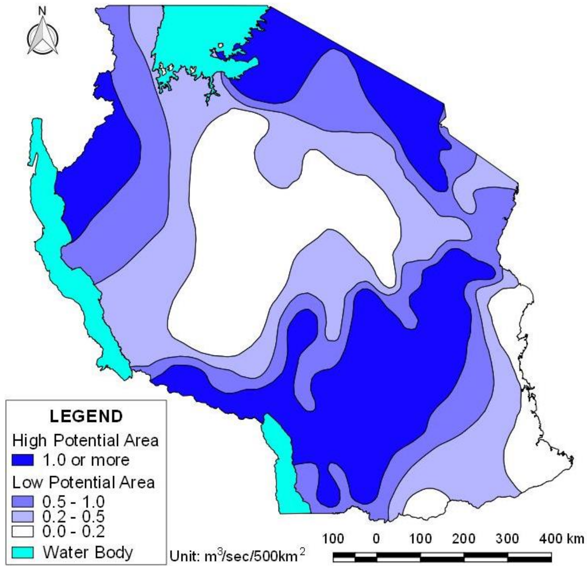
(1) Necessity of Water Resources Study in National Irrigation Master Plan 2018

Water resources is thought to be one of the possible bottlenecks in irrigation development in the National Irrigation Master Plan 2018 (NIMP2018). In order to appropriately evaluate irrigation potential, it is essential to understand water resources availability spatially and seasonally.

Since the Integrated Water Resources Management and Development Plans (IWRMDP) have been formulated by the Ministry of Water and Irrigation (MoWI) as described later, the NIMP2018 project will fully utilize those information in making water resources assessment required for the NIMP2018.

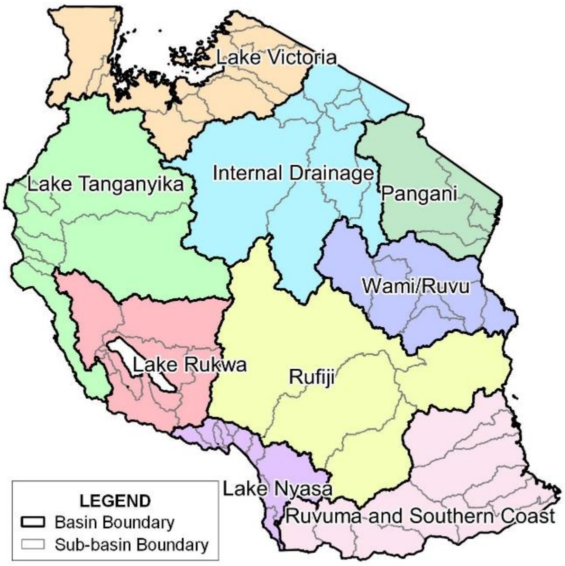
(2) Outline of the Water Resources Assessment in National Irrigation Master Plan 2002

The National Irrigation Master Plan 2002 (NIMP2002) study assessed the water resources potential mainly from the factors including macroscopic water balance, specific runoff, flow regime, and groundwater. The water resources potential was then assessed from the three points of view, namely: 1) quantitative potential of water in natural condition, 2) allowable water quantity under the artificial control, and 3) seasonal steadiness of water availability. The water resources potential estimated in the NIMP2002 is presented in Figure 3.1.1.



Source: Prepared by the JICA Project Team based on NIMP2002

Figure 3.1.1 Water Resources Potential Estimated in NIMP2002



Source: JICA Project Team based on Information by MoWI

Figure 3.1.2 Basin and Sub-basin Boundaries

(3) Basin and Sub-basin Boundary

The mainland of Tanzania is divided into nine basins and further divided into 71 sub-basins as presented in Figure 3.1.2. Basic information on the nine basins are summarised in Table 3.1.1. Since water resources management and development are undertaken on the basis of river basins, the study on water resources in the NIMP2018 also made a basin-wise or sub-basin-wise. The catchment areas of respective sub-basins to be used in this study are based on the information provided by MoWI.

Table 3.1.1 Basic Information of Nine Basins

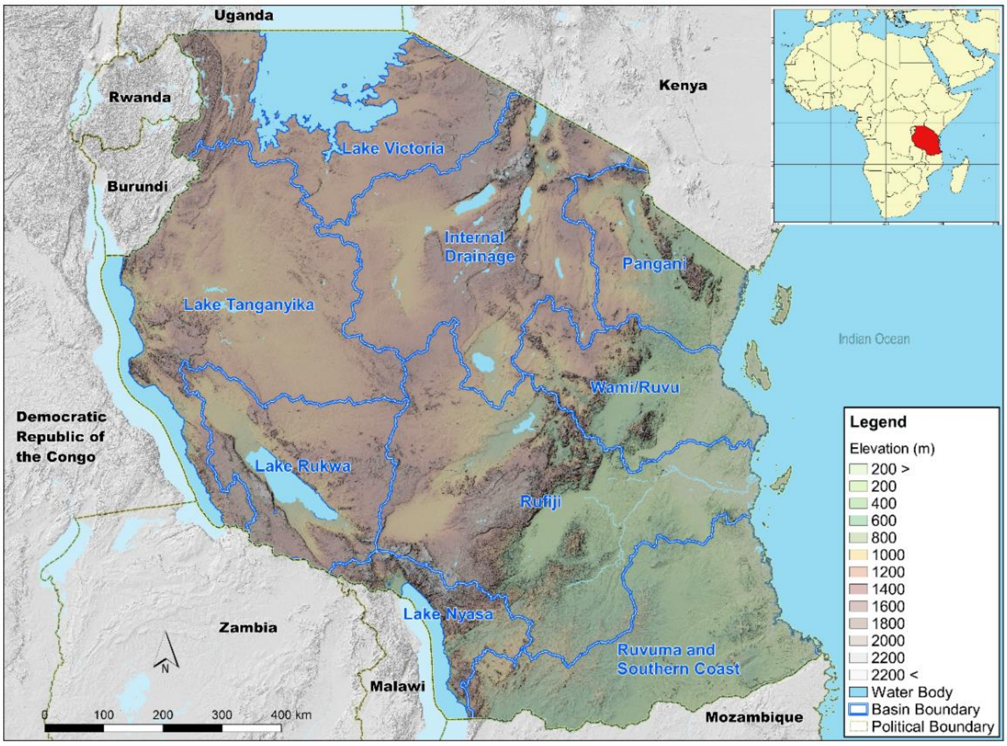
No.	Basin Name	Basin Code*1	Catchment Area (km^2)*2	Nos. of Sub-basin	Drainage System
I	Pangani	PG	59,102	4	Indian Ocean
II	Wami / Ruvu	WR	66,295	7	Indian Ocean
III	Rufiji	RF	183,791	4	Indian Ocean
IV	Ruvuma and Southern Coast*3	RV	105,582	10	Indian Ocean
V	Lake Nyasa	LN	27,594	10	Indian Ocean
VI	Lake Rukwa	LR	74,965	7	Endorheic basin
VII	Lake Tanganyika	LT	149,500	7	Atlantic Ocean
VIII	Lake Victoria	LV	85,630	13	Mediterranean Sea
IX	Internal Drainage	ID	143,100	9	Endorheic basin
---	Total	---	895,559	71	---

*Notes: *1. Basin code used in this report is provided by the NIMP2018 study and it is not an official code.*
**2. Catchment areas are based on the respective IWRMDPs and LVBC reports described in Subsection 3.4.1. It is noted that the total of catchment areas is different from the mainland area.*
**3. The Ruvuma and Southern Coast basin is simply called as "Ruvuma basin" hereafter referred in this report.*
Source: Prepared by the JICA Project Team based on information provided by MoWI

3.2 Natural Conditions

3.2.1 Geographical Features

Tanzania is located just south of the equator, lying mostly between latitudes 1° and 12°S, and longitudes 29° and 41°E. Its mainland has an area[1] of 883,600 km^2. Tanzania has complex topographical features extending from a narrow coastal belt of the western Indian Ocean with sandy beaches to an extensive plateau with altitude ranging from 1,000 to 2,000 m above mean sea level. Tanzania has several fresh water bodies, including Lake Victoria, the largest in Africa; Lake Tanganyika, the longest and deepest in Africa; and Lake Nyasa. Figure 3.2.1 below presents topographic map depicting the above features.



Source: JICA Project Team based on the SRTM data

Figure 3.2.1 Topographic Map with Basin Boundaries

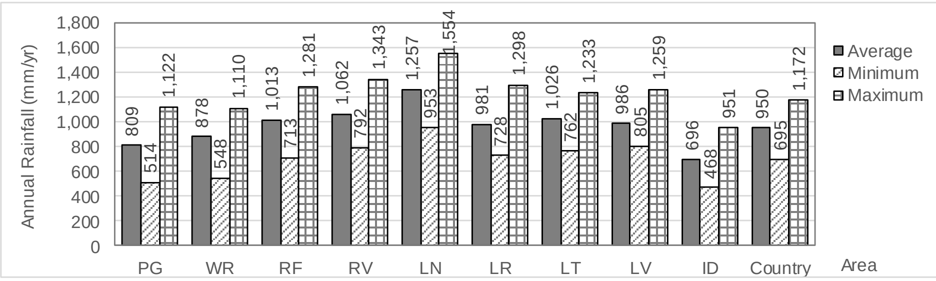
[1] Tanzania in Figures 2015 (National Bureau of Statistics, January 2016)

3.2.2 Hydrometeorological Features

(1) Rainfall

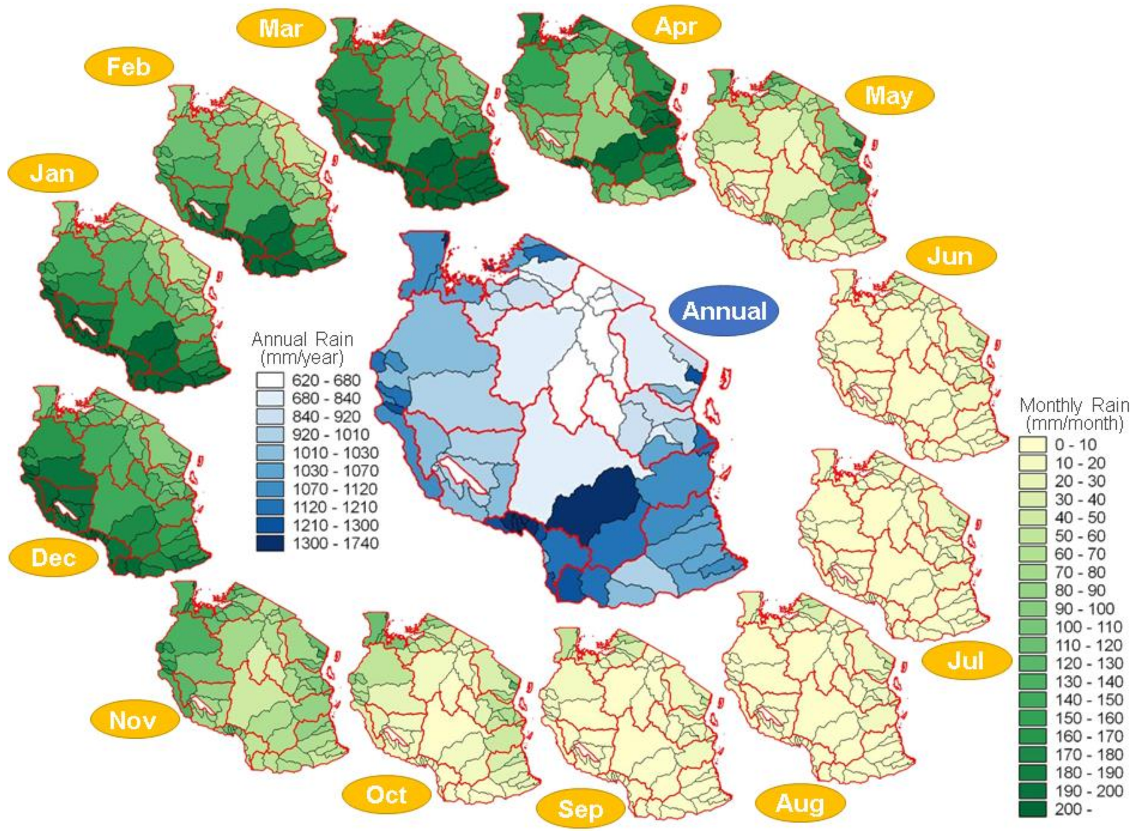
According to the Tanzania Meteorological Agency (TMA)[2], the climate of Tanzania is characterised by two main rain seasons, namely: the long rains (*Masika*) that fall from mid-March to end-May and the short rains (*Vuli*) that begin in mid-October and continues to early December.

Figure 3.2.2 presents the annual mean rainfall for 30 years from 1981 to 2010 by basin, while Figure 3.2.3 presents the annual and monthly mean rainfall for the same period by sub-basin. The highest rainfall is observed in the month of March with a national average of 172 mm/month. In addition to the seasonal distribution, both Figure 3.2.2 and Figure 3.2.3 show spatial unevenness. Some of the sub-basins receive relatively high rainfall of more than 1,500 mm/yr, although national average is 950 mm/yr.



Source: *Prepared by the JICA Project Team based on CHIRPS data provided by CHG[3]*

Figure 3.2.2 Annual Rainfall Data by Basin (1981-2010)



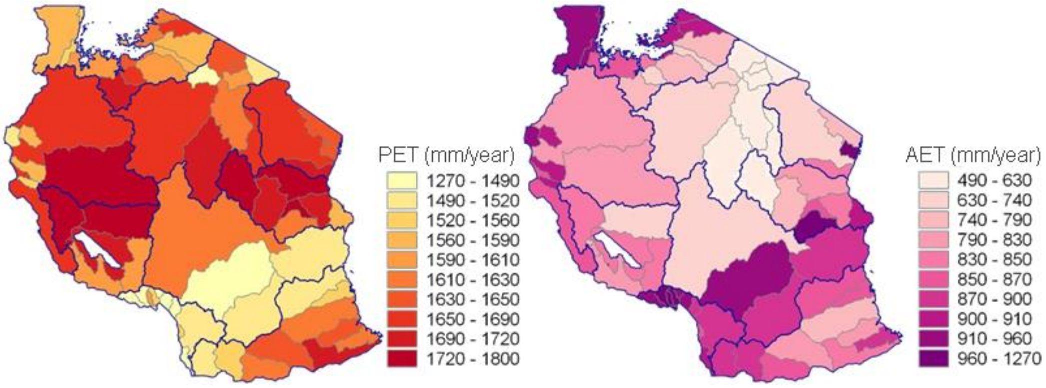
Source: *Prepared by the JICA Project Team based on CHIRPS data provided by CHG*

Figure 3.2.3 Annual and Monthly Rainfall by Sub-basin (1981-2010)

[2] Climate Change Projection for Tanzania, ISBN 978-9987-9981-0-5. pp.2 (Tanzania Meteorological Agency)
[3] Climate Hazards Group InfraRed Precipitation with Station Data (CHIRPS), Climate Hazards Group (CHG)

(2) Evapotranspiration

Figure 3.2.4 presents the potential evapotranspiration (PET) and actual evapotranspiration (AET). The national averages of PET and AET are 1,633 mm/yr and 771 mm/yr, respectively. Relatively high PET is observed in the Wami/Ruvu, Lake Rukwa, and Lake Tanganyika basins, where air temperature is higher. On the other hand, higher AET is observed in the Rufiji, Lake Nyasa, and Lake Victoria basins, where rainfall is higher.

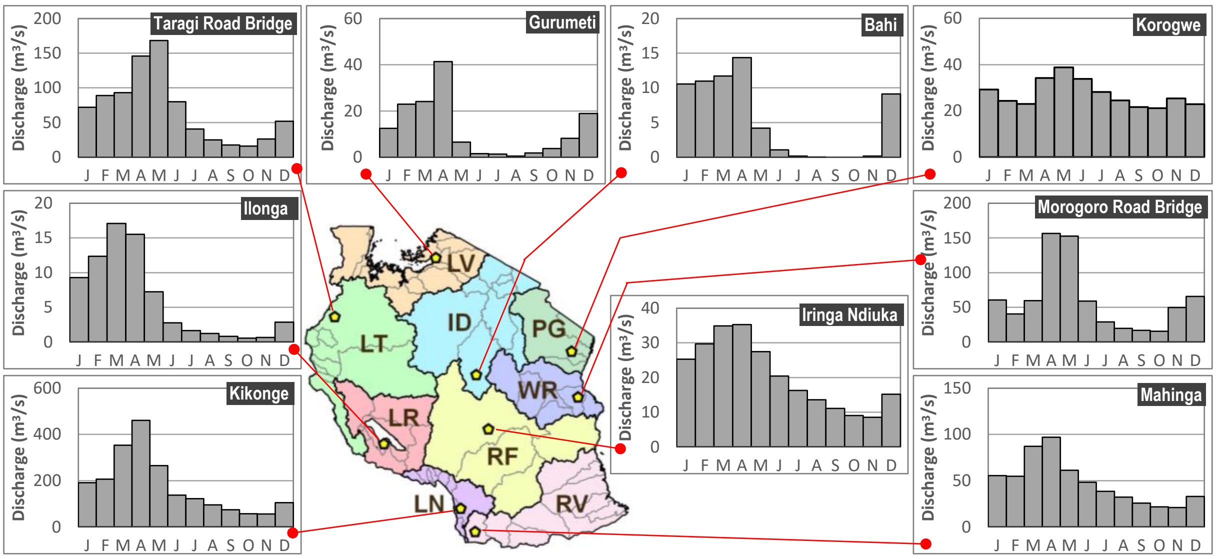


Source: Prepared by the JICA Project Team based on PET and AET data provided by CGIAR-CSI[4]

Figure 3.2.4 Annual PET and AET by Sub-basin (1950-2000)

(3) Hydrology

Figure 3.2.5 presents the mean monthly river discharge at some selected monitoring stations representing the respective nine basins. Basic information of the stations is presented in Appendix A. Although the data are a bit old and actual hydrological phenomena usually differ depending on the locations even in the same basin, the hydrographs below reasonably represent hydrological features.



Source: Prepared by the JICA Project Team based on the discharge data provided by the Global Runoff Data Centre (GRDC)

Figure 3.2.5 Mean Monthly Discharge at Selected Stations

[4] Consultative Group on International Agricultural Research (CGIAR) Consortium for Spatial Information (CSI)

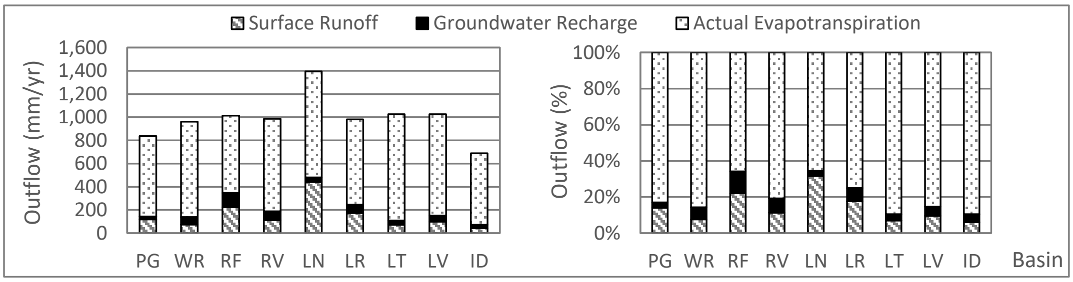
3.2.3 Macroscopic Water Balance in the Country

Prior to assessment of water resources potential, it is essential to understand a general feature of water balance in the entire Tanzania. In considering a hydrological cycle, inflow is defined as rainfall, while outflow is divided into surface runoff, groundwater recharge and actual evapotranspiration. The result is summarised in Table 3.2.1 and Figure 3.2.6.

Table 3.2.1 Macroscopic Water Balance by Basin

No.	Basin	Catchment Area (km^2)	Inflow (mm/yr)	Outflow (mm/yr)		
			Rainfall*1	Surface Runoff*2	Groundwater Recharge*3	Actual Evapo-transpiration*4
I	Pangani	59,102	838	118	25	695
II	Wami / Ruvu	66,295	961	73	64	823
III	Rufiji	183,791	1,013	223	123	667
IV	Ruvuma	105,582	987	111	79	797
V	Lake Nyasa	27,594	1,394	442	39	913
VI	Lake Rukwa	74,965	981	173	71	737
VII	Lake Tanganyika	149,500	1,026	71	37	918
VIII	Lake Victoria	85,630	1,027	99	52	877
IX	Internal Drainage	143,100	689	42	31	616
Total (km^2) / Ave. (mm/yr)		895,559	955	128	64	763

*Notes: *1. Rainfall is provided by the IWRMDP reports and LVBC report (or CHIRPS (CHG) data for Nos. III, VI and VII).*
**2. Surface runoff is 2015 data presented in the IWRMDP reports and LVBC report. Details are described in Subsection 3.7.1(1).*
**3. Groundwater recharge is provided by the IWRMDP reports and LVBC report. Details are described in Subsection 3.7.1(2).*
**4. AET is estimated by deducting surface runoff and groundwater recharge from rainfall.*
Source: JICA Project Team based on the abovementioned data



Note: The left-side figure is shown in mm/yr and the right-side figure is shown in percentage (%).
Source: JICA Project Team based on the data mentioned in Table 3.2.1 above

Figure 3.2.6 Macroscopic Water Balance by Basin

3.3 Relevant Policies and Strategy

(1) Tanzania Development Vision 2025

The Tanzania Development Vision 2025 aims at achieving a high quality livelihood for its people, attaining good governance through the rule of law, and developing a strong and competitive economy. Water is positioned as one of the most important agents to enable the country to achieve its objectives of both social and economic development, such as eradicating poverty, attaining water and food security, and sustaining biodiversity and sensitive ecosystems.

(2) National Water Policy

The first National Water Policy (NAWAPO) was developed in 1991. In response to many changes in circumstances surrounding the water sector, thereafter, the government revised the policy in 2002 with the main objective of developing a comprehensive framework for sustainable development and management of the nation's water resources. NAWAPO 2002 states key considerations on priority on water use and the utilization of transboundary water resources.

(3) National Water Sector Development Strategy 2006-2015

The National Water Sector Development Strategy 2006-2015 (NWSDS) sets out how the NAWAPO 2002 will be implemented to achieve its targets. NWSDS has been developed to support re-alignment of the water-related aspects of other key sectoral policies with NAWAPO, and to provide a focus on specific roles of the various actors through clearly defining roles and responsibilities and hence, the removal of duplications and omissions.

(4) Water Sector Development Programme 2006-2025

The Water Sector Development Programme 2006-2025 (WSDP) follows a sector wide approach to planning (SWAP) with an overall objective of strengthening sector institutions for integrated water resources management and improve access to water supply and sanitation services.

Because of the long-term nature of the program, its implementation is done in phases of five years each. Currently, Phase II is being implemented for the period 2014/15-2018/19. As part of the WSDP Phase II, IWRMDPs for the respective nine basins are to be formulated.

(5) Water Resources Management Act, 2009

In order to provide the enabling legislative framework for implementing NAWAPO and NWSDS, the Water Resources Management Act No. 11 of 2009 (WRMA) was enacted in 2009. The WRMA provides new legislative framework in order to realise the integrated water resources management and development with the initiative of administratively and financially autonomous Basin Water Boards (BWB) and participation of water users.

3.4 Existing Plans and Studies

3.4.1 IWRMDP

(1) Basic Information on IWRMDP Formulation

As part of the WSDP for the period 2006-2025, MoWI has been formulating IWRMDP for the respective nine basins with a planning horizon of 2035.

The IWRMDPs were formulated with due consideration to the projected irrigation water demand for 2035 by inquiring necessary information from each zonal irrigation office (ZIO), according to the MoWI.

(2) Status of IWRMDP Formulation

As summarised in Table 3.4.1, water resources assessment and/or formulation of IWRMDP for three basins have not yet been completed. In case of the Lake Victoria basin, even assessment study has not commenced yet. However, the Lake Victoria Basin Commission (LVBC) conducted a study for Lake Victoria Basin Water Resources Management Plan - Phase 1 in 2014 (hereinafter called the LVBC study). The study assessed available water resources and projected future water demand by sub-basin for the entire catchment area covering the Lake Victoria basin of Tanzania. NIMP2018 utilizes the result of LVBC study instead of IWRMDP for the Lake Victoria basin.

Table 3.4.1 Status of IWRMDP Formulation in Nine Basins

No.		I	II	III	IV	V	VI	VII	VIII	IX
Basin Name (Basin Code)		Pangani (PG)	Wami/ Ruvu (WR)	Rufiji (RF)	Ruvuma (RV)	Lake Nyasa (LN)	Lake Rukwa (LR)	Lake Tan-ganyika (LT)	Lake Victoria (LV)	Internal Drainage (ID)
Status (Fund Source*)	WR Assessment	Complete (WB)	Complete (JICA)	Complete (WB)	Complete (WB)	Complete (WB)	Complete (WB)	Complete (WB)	Not yet (GoT)	Complete (WB)
	Formulation of IWRMDP	Not yet (TBD)	On-going (WB)	Complete (WB)	Complete (WB)	Complete (WB)	Complete (WB)	Complete (WB)	Not yet (GoT)	Complete (WB)

Notes: WR: Water Resources, WB: World Bank, JICA: Japan International Cooperation Agency, GoT: Government of Tanzania, TBD: To be determined
Source: JICA Project Team based on interview with MoWI

(3) Water Balance Method by Basin

The IWRMDPs for the nine basins have been/ will be prepared by different consultant firms after much discussion with the respective basin water offices (BWOs). Although the term of references (TORs) for their consulting services are similar among the basins, the respective firms adopted different methodologies. There has been no document that compares or summarises the differences in their methods. It is necessary to look over the study results horizontally in the NIMP2018 considering its target area of entire Tanzania mainland, while due consideration of regional characteristics is also important in water resources planning. The basic conditions in terms of input for water balance calculation are summarised in Table 3.4.2.

Table 3.4.2 Basic Conditions of Water Balance Calculation

(No.) Basin Code	Water Balance Calculation Basis	Supply Side: Surface Runoff: Estimation*1 2015	2025	2035	Reliability of Water Utilization	Period of Used Hydro Data	Ground-water: Considered in Water Balance	Demand Side (Sectors considered in balance calculation): Domestic & Institute	Industry & Mining	Irrigation	Livestock	Wildlife	Tourism	Fisheries & Aquaculture	Hydropower	Environment Flow
(I) PG	Monthly long-term*2	O	O	O	Mean runoff	1952-2011	Yes	✓	✓	✓	✓	✓	✓	---	---	✓
(II) WR	Monthly (selected year)	O	X	X	1/10 drought year runoff	1951-1980	Yes	✓	✓	✓	✓	---	---	✓	---	✓
(III) RF	Monthly long-term	O	Gr	Gr	Mean runoff	1950-2011	Yes	✓	✓	✓	✓	---	---	---	✓*3	✓
(IV) RV	Monthly long-term*2	O	O	O	Mean runoff / 80% dependable	1959-1994	Yes	✓	---	✓	✓	✓	---	---	---	✓
(V) LN	Monthly (mean value)	O	O	O	Mean runoff	1950-2012	Yes	✓	✓	✓	✓	---	---	---	✓*3	✓
(VI) LR	Monthly long-term	O	Gr	Gr	Mean runoff	1956-2013	No	✓	✓	✓	✓	---	---	---	---	✓
(VII) LT	Annual	O	O	O	Mean runoff	1974-2002	Yes	✓	✓	✓	✓	✓	✓	---	✓	✓
(VIII) LV	Annual	O	X	X	Mean runoff	1967-2013	No	✓	✓	✓	✓	---	---	✓	---	---
(IX) ID	Monthly long-term	O	O	O	Mean runoff	1953-1999	Yes	✓	✓	✓	✓	✓	✓	✓	✓*3	✓

*Notes: *1. The symbols "O" / "X" / "Gr" denote "estimated" / "not estimated" / "presented in a form of hydrograph", respectively.*
**2. Although the reports do not clearly mention, it is presumably long-term basis computation.*
**3. Although hydropower water demand is estimated, it is treated as non-consumptive water in water balance calculation.*
Source: Summarised by the JICA Project Team based on the LVBC study and IWRMDPs reports

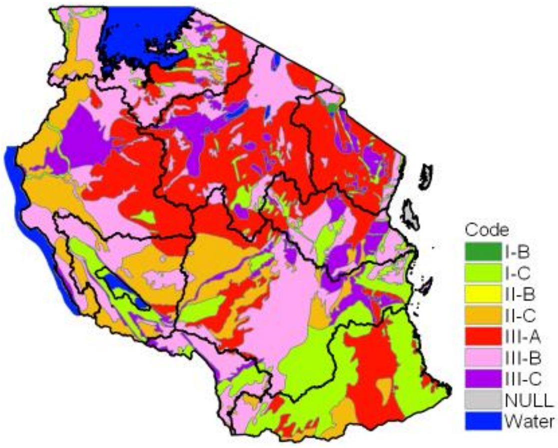
3.4.2 Other Studies Related to Water Resources

(1) Groundwater

Aside from the groundwater assessment made by the respective IWRMDP studies, some information on country-wise groundwater assessments were obtained from the previous studies as follows:

(a) Groundwater Productivity Map, Sub-saharan Africa Hydrological Assessment

Figure 3.4.1 shows the distribution of productive aquifer in the mainland of Tanzania. Most of the northern parts are low to fairly productive formations. On the other hand, highly and moderately productive aquifers are distributed mainly in the southern part of the country.



Code	Aquifer Productivity	Amount
I-B	Highly productive aquifer	10-50 l/s
I-C	Moderately productive aquifer	0.1-15 l/s
II-B	Moderately productive aquifer	5-20 l/s
II-C	Locally productive aquifer	0.1-10 l/s
III-A	Low to fairly productive aquifer	> 1 l/s and < 4 l/s
III-B	Low yielding formations	0-1 l/s
III-C	Unproductive aquifer	0 l/s
Null	No data	---
Water	Water body	---

Source: Sub-saharan Africa Hydrological Assessment (SADCC Countries), World Bank, and UNDP
Note: The original map provided in a Tiff format was digitized and coloured by the JICA Project Team.

Figure 3.4.1 Groundwater Productivity Map

(b) Assessment of Groundwater Availability and its Current and Potential Use and Impacts

The IWMI (2010)[5] assesses groundwater availability, potential use and impacts in Tanzania by reviewing existing reports and data. According to the report, groundwater has not been extensively used for irrigation largely due to the lack of detailed information.

(2) Environmental Flow Requirement

(a) Draft Guideline on Environmental Flow Assessment

The MoWI is currently preparing a draft guideline on environmental flow assessment (EFA). The draft guideline introduces a general review of methodologies in four major groups: i) hydrology-based methodologies; ii) hydraulic rating methodologies; iii) habitat simulation methodologies; and iv) holistic methodologies.

(b) Practical Example of EFA

The Comprehensive EFAs are only available in the Ruvu River basin[6] and the Kilombero River basin[7] so far done by collaborative body with technical and financial assistance from the United States Agency for International Development (USAID). Both assessments were made after the completion of

[5] IWMI (International Water Management Institute), 2010, Assessment of Groundwater Availability and Its Current and Potential Use and Impacts in Tanzania
[6] Environmental Flow Recommendations for the Ruvu River Basin, Tanzania (USAID, 2014)
[7] Environmental Flows in the Rufiji River basin Assessed from the Perspective of Planned Development in the Kilombero and Lower Rufiji Sub-basins (USAID, 2016)

IWRMDPs for Wami/Ruvu and Rufiji basins, respectively. In general, a detailed EFA study covers only a particular river basin. For this reason, the said assessments do not cover the entire basin areas of Wami/Ruvu and Rufiji.

(3) Climate Change

TMA reports[8] climate change projections for Tanzania. The conclusions are summarised as follows:

- The country is projected to experience consistent and sustained warming from 2025 to 2100, with the warming being more pronounced over the south-western highland and over the western parts, where a warming of up to 3.8 °C is projected by 2100.
- Although less confidence can be placed in model output for rainfall changes, most of the models suggest an increase in mean annual rainfall of up to 11% in 2100, particularly over the north-eastern highland.
- Seasonal rainfalls for every three months are projected to decrease or increase depending on areas and seasons.

3.5 Water Resources Structures

(1) Existing Dams

A list of both man-made and natural existing reservoirs was collected from MoWI. The list contains 694 dams and the total capacity excluding hydropower plant (HPP) dams is 425.9 MCM as summarised in Table 3.5.1. Since the list was prepared for the purpose of dam safety study, small-scale dams and water pans are not included in the list.

Table 3.5.1 Number and Reservoir Capacity of Existing Dams

Basin[*1]	Nos. of Dams				Reservoir Capacity (MCM)
	All Dams in the List				
		Dams with Positional Information[*2]			
			Dams with Capacity Data		
				Excluding HPP[*3]	Excluding HPP
Pangani	131	120	118	117	49.1
Wami Ruvu	157	136	134	134	40.9
Rufiji	67	67	67	65	79.8
Ruvuma	62	59	58	58	19.1
Lake Tanganyika	35	34	34	34	50.3
Lake Victoria	139	129	127	127	78.5
Internal Drainage	103	87	84	84	108.2
Total	694	632	622	619	425.9

*Note: *1. Although the Lake Nyasa and Lake Rukwa basins have storage dams, an inventory survey has not been conducted in the basins.*
**2. The dams with questionable coordinates data that indicate different position from the basin or district mentioned in the list were excluded in the second column and later because the coordinates data are not able to correctly identify sub-basin.*
**3. There are only three reservoir type hydropower plants (HPP), namely: Nyumba ya Mungu Dam (600 MCM) in Pangani Basin, Mtera Dam (3,200 MCM) and Kidatu Dam (125 MCM) in Rufiji Basin. All of them are single purpose dams for hydropower.*
Source: 1. List of existing dams (As of November 2016, MoWI)
2. Power System Master Plan 2016 Update (Dec. 2016, Ministry of Energy and Minerals)

(2) Planned Dams

The IWRMDP studies for the respective basins proposed 69 dams in total except for hydropower single purpose dams. These proposals include new construction and heightening of existing dykes. Among

[8] Climate Change Projection for Tanzania, ISBN 978-9987-9981-0-5. pp.37 (Tanzania Meteorological Agency)

these, the MoWI has completed the construction designs of three major dams, namely: Kidunda, Farkwa, and Ndembera (Lugoda) dams.

On the other hand, Tanzania Electric Supply Company Limited (TANESCO)[9] has 23 projects for large- and medium-scale HPP according to the Power System Master Plan 2016 Update. Out of these, the Kikonge HPP is the only multi-purpose dam for hydropower and irrigation purposes. The project is in collaboration between the National Irrigation Commission (NIRC) and TANESCO.

The total reservoir capacity of the above planned 70 dams is 8,723 MCM, although the allocation for each sector is not mentioned in the reports. The list of planned dams is presented in Attachment-3.5.1.

3.6 Water Resources Management at the Basin Level

The JICA Project Team conducted field visit in the course of study for the principal purpose of data collection from the BWOs. Since the purpose of visit is the collection of data that are hardly obtainable through the existing reports, the visit areas were limited to four basins, namely: the Pangani, Wami/Ruvu, Rufiji, and Lake Victoria basins. The major findings obtained through interviews with BWOs and the field surveys are listed below.

(1) Hydrological Monitoring

- It was found in the Pangani, Rufiji, and Lake Victoria basins that some malfunctioning devices are left unrepaired.
- Pangani BWO has current meters and Q-liner, which is a type of Acoustic Doppler Current Profiler (ADCP), and conducts discharge measurement regularly. However, rating curves have not been updated since the initial development in 1994.

(2) Data Management in BWO

- Each BWO uses either HYDATA[10] or DSS[11] as database for hydrological data. The data are stored in different database and format depending on the BWO.
- Groundwater data, such as list of boreholes, are not well prepared and updated by BWOs. Besides, each BWO uses a different format and has so many missing data.

(3) Water Use Management

- Neither BWO nor water users monitor the actual amounts of water abstraction. In addition, BWO is not able to verify water abstraction applied by water users due to lack of data, such as available amount of water at an intake point, actual water abstraction, etc.
- Although water use permit needs to be granted on a seasonal basis, the Pangani and Lake Victoria BWOs grant the permits throughout the year.
- BWOs recognize many non-approved water users in their basin. Consequently, appropriate water fee is not collected from those users.

[9] TANESCO is a parastatal organisation under the Ministry of Energy and Minerals.
[10] HYDATA is a database and analysis system for processing the hydrometeorological data, including river water levels and flows, reservoir, lake and tank levels and storages, rainfall, and so forth.
[11] Decision Support System (DSS) is a comprehensive information, modeling, and decision support software for basin management.

3.7 Water Resources Assessment

3.7.1 Estimation of Water Resources

(1) Surface Water Resources

(a) Approach for Utilizing the Previous Study Results

Many of the IWRMDP and LVBC study reports do not present numerical data of the estimated monthly surface runoff. Some reports present only annual basis data, but others present monthly basis data in a form of hydrograph, which is hardly referable in the NIMP2018 study. Thus, there was a need to re-generate monthly surface runoff data by using available information clearly mentioned in the reports as well as supplementally applying public hydrological data. The details of method of re-generating mean monthly surface runoff are explained in Appendix A.

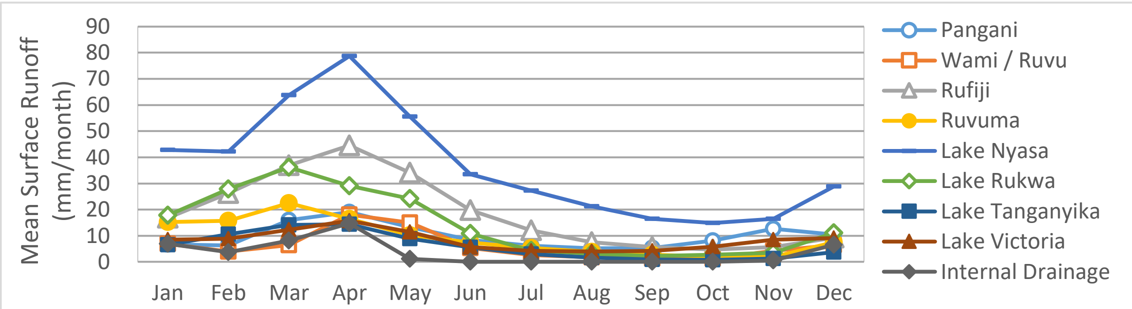
(b) Result of Re-generating Mean Monthly Surface Runoff

Table 3.7.1 and Figure 3.7.1 present the summary of mean monthly surface runoff by basin for 2015.

Table 3.7.1 Mean Monthly Surface Runoff by Basin for 2015

Basin	Area (km^2)	Surface Runoff (mm/month for each month and mm/yr for total)													Rain (mm/yr)	RC*1
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total		
Pangani	59,102	6.7	6.3	16.0	19.0	13.3	8.3	6.2	5.3	5.4	8.2	12.7	10.4	117.8	809	0.15
Wami / Ruvu	66,295	6.9	4.0	6.5	18.1	15.0	5.3	2.6	1.7	1.3	1.2	4.3	6.5	73.4	878	0.08
Rufiji	183,791	16.8	26.3	36.9	44.5	34.1	19.8	12.1	7.6	5.8	4.7	5.6	9.2	223.3	1,013	0.22
Ruvuma	105,582	15.2	15.7	22.5	16.5	10.2	7.4	5.3	3.9	2.7	2.0	1.9	7.6	110.8	1,062	0.10
Lake Nyasa	27,594	42.7	42.2	63.7	78.7	55.5	33.5	27.2	21.3	16.5	14.9	16.4	28.9	441.7	1,257	0.35
Lake Rukwa	74,965	17.8	27.9	36.2	29.1	24.2	10.8	4.3	3.1	2.3	2.7	3.5	11.1	173.2	981	0.18
Lake Tanganyika	149,500	6.5	10.6	14.2	14.3	8.9	5.5	3.0	1.6	0.9	0.7	1.2	3.7	71.2	1,026	0.07
Lake Victoria	85,630	8.5	8.9	12.3	15.8	11.4	5.7	4.2	4.0	4.3	5.8	8.6	9.1	98.6	986	0.10
Internal Drainage	143,100	6.9	3.8	8.1	14.8	1.2	0.0	0.0	0.0	0.0	0.0	0.5	6.6	41.8	696	0.06
Average	---	12.0	14.8	21.6	24.8	16.7	9.3	5.8	4.1	3.2	3.2	4.4	8.3	128.2	950	0.13

*Note: *1. Since rainfall data is average for 30 years from 1981 to 2010, the above runoff coefficients (RC) are only for reference.*
Source: Re-generated by the JICA Project Team based on the IWRMDP reports and the LVBC study report

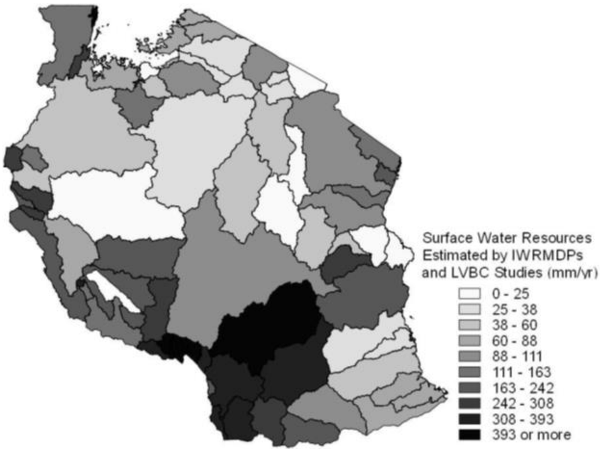


Source: Re-generated by the JICA Project Team based on the IWRMDP reports and the LVBC study report

Figure 3.7.1 Mean Monthly Surface Runoff by Basin for 2015

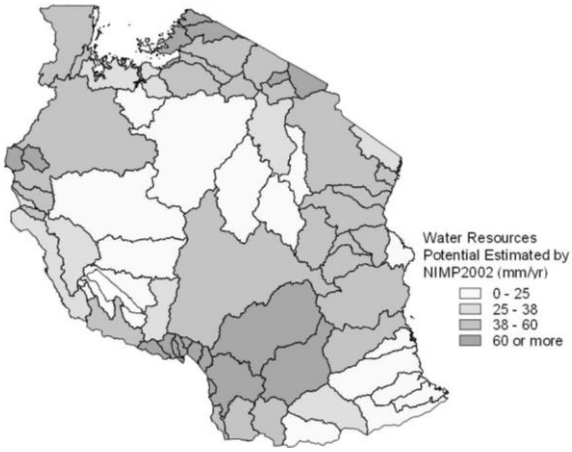
The annual surface water for 2015 by sub-basin is presented in Figure 3.7.2. Besides, water resources potential estimated by NIMP2002, which is presented with the unit of $m^3/sec/500\ km^2$ in Figure 3.1.1 at the beginning of this chapter, is converted to the unit of mm/yr and presented in Figure 3.7.3 by sub-basin. Since the maximum potential value of NIMP2002 is given as 1.0 $m^3/sec/500\ km^2$, which is equivalent to 63 mm/yr, Figure 3.7.3 is able to show only up to 63 mm/yr. Although there is such a difference, both maps indicate relatively high water potential in the Rufiji, Lake Nyasa, and Lake

Tanganyika basins compared with the others from a broader perspective.



Source: JICA Project Team based on the IWRMDP & LVBC reports

Figure 3.7.2 Surface Water Resources for 2015 Compiled by NIMP2018

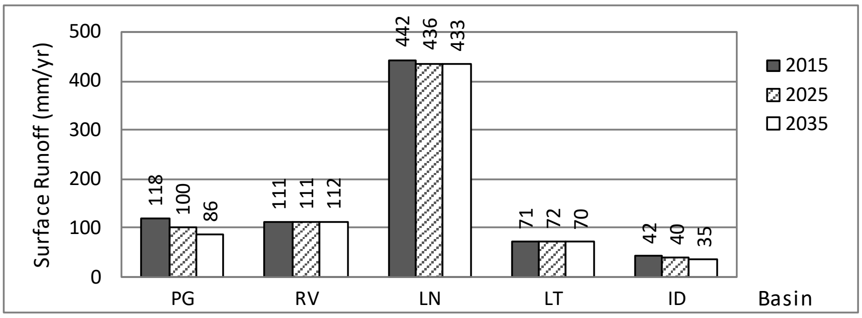


Source: JICA Project Team based on NIMP2002

Figure 3.7.3 Water Resources Potential Compiled by NIMP2002

(c) Impact of Climate Change

Runoff data with climate change effect is available only for five basins. The annual surface runoff for the five basins is presented in Figure 3.7.4. It was found that the rates of increase or decrease from 2015 to 2035 in the Ruvuma (RV), Lake Nyasa (LN), and Lake Tanganyika (LT) basins fall within 2%. On the other hand, the decrease rates are relatively large in the Pangani (PG) and Internal Drainage (ID) basins with the rates of 27% and 17%, respectively.



Source: Prepared by the JICA Project Team based on the IWRMDP reports

Figure 3.7.4 Surface Runoff with Climate Change by Basin

In view of uncertainty of climate change phenomena as well as the relatively small change rates obtained from the above five basins, it would be acceptable for the NIMP2018 study to apply the 2015 surface runoff data for the years 2025 and 2035 in the remaining four basins.

(2) Groundwater Resources

(a) Approach for Utilizing the Previous Study Results

Groundwater resources potential have been assessed in the IWRMDPs studies for the respective basins and the LVBC study. Prior to determining sustainable yield of groundwater resources, firstly, annual groundwater recharge was estimated in all the basins with different methods. However, since there was considerable difference in recharge data between basins, groundwater recharge for the four basins were further reviewed and re-assessed. The basic methods of recharge estimation by each basin and the details of re-assessment are explained in Appendix A.

(b) Result of Re-assessing Groundwater Data

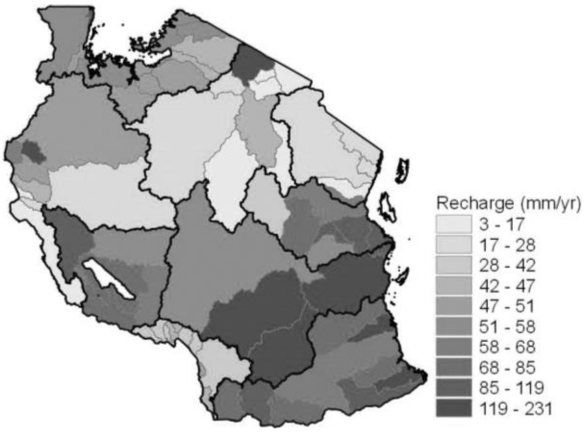
As a result of compiling and re-assessing groundwater (GW) data as above, finally, annual groundwater recharge and sustainable yield of groundwater resources are obtained as given in Table 3.7.2.

Table 3.7.2 Annual Recharge and Sustainable Yield

Basin	Area (km²)	Annual GW Recharge		Sustainable Yield of GW Resources	
		(MCM/yr)	(mm/yr)	(MCM/yr)	(mm/yr)
Pangani	59,102	1,466	25	587	10
Wami / Ruvu	66,295	4,273	64	1,139	17
Rufiji	183,791	22,533	123	9,021	49
Ruvuma	105,582	8,307	79	3,238	31
Lake Nyasa	27,594	1,070	39	107	4
Lake Rukwa	74,965	5,341	71	2,136	28
Lake Tanganyika	149,500	5,511	37	2,755	18
Lake Victoria	85,630	4,424	52	1,327	15
Internal Drainage	143,100	4,421	31	884	6
Total	895,559	84,322	94	21,195	24

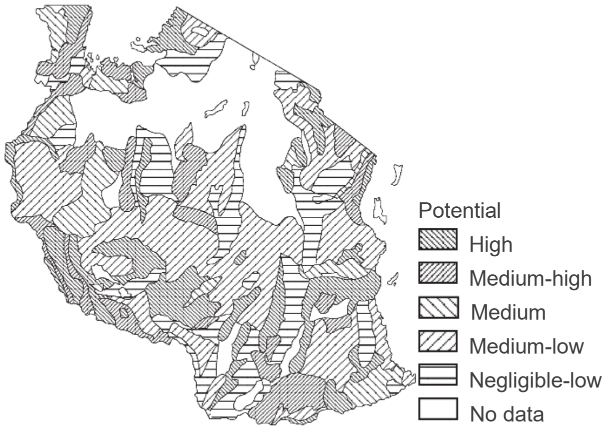
Source: Prepared by the JICA Project Team based on the IWRMDP and LVBC study reports

The annual groundwater recharge by sub-basin is presented in Figure 3.7.5. On the other hand, the NIMP2002 qualitatively assessed groundwater from the viewpoint of hydro-geological features and presents only the general outline of groundwater potential as presented in Figure 3.7.6. Comparing the two maps, almost similar tendency can be seen. Both maps indicated that groundwater potential in the Rufiji, Ruvuma and Lake Rukwa basins are higher than one in the other basins.



Source: JICA Project Team based on IWRMDPs & LVBC reports

Figure 3.7.5 Annual Groundwater Recharge Complied by NIMP2018



Source: NIMP2002

Figure 3.7.6 Groundwater Potential Compiled by NIMP2002

3.7.2 Estimation of Water Demand

(1) Consumptive Water Use

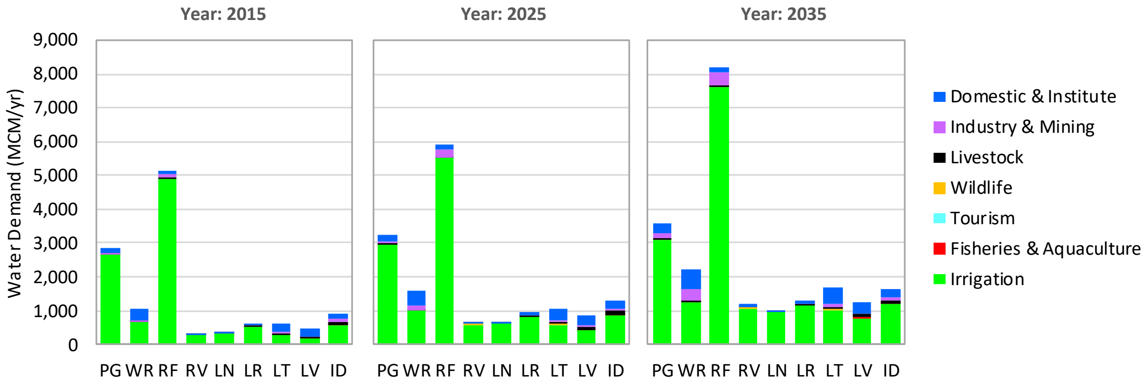
(a) Calculation Basis by Basin

Water demand with different time horizon has been projected in the IWRMDP and LVBC studies. The sectors considered in the respective basins are different depending on the natural and social conditions of the basin. Basically, there are seven sectors for consumptive water uses as shown in Figure 3.7.7.

Since the estimates were made by different consultant firms with due consideration of characteristics of the basin as well as their experiences, in some cases, different methods have been adopted. The major differences in calculation basis between basins are briefed in Appendix A.

(b) Summary of Water Demand by Basin

The water demand by sector by basin for the years 2015, 2025, and 2035 are summarised in Figure 3.7.7. The bar chart graphs offer an indication of the differences between basins and between sectors. As seen in the figure, the irrigation sector accounts for more than 80% of the total water demand, while the wildlife, tourism, and fisheries and aquaculture sectors account for quite small percentages. The projected irrigation areas for 2015, 2025, and 2035 in this water demand estimation are 488,268 ha, 717,054 ha, and 1,046,422 ha, respectively, in total for all the nine basins.



Source: Prepared by the JICA Project Team based on the IWRMDP and LVBC study reports

Figure 3.7.7 Annual Water Demand by Basin for 2015, 2025, and 2035

The numerical figures for the years 2015, 2025, and 2035 corresponding to Figure 3.7.7 are presented in Table 3.7.4, Table 3.7.5, and Table 3.7.6, respectively, in the Subsection 3.7.3(2).

(2) Environmental Flow Requirement

(a) Background

The environmental flow requirement (EFR) is non-consumptive requirement of water. However, it should be considered as part of water resources management in order to preserve normal functions of river flow. In formulating the NIMP2002, no regard was given to EFR possibly because the concept of EFR has not become general yet at that time particularly in developing countries.

As stated in Subsection 3.4.2, currently the Environmental Water Requirements Assessment Guidelines (hereinafter called the EWR Guidelines) is being prepared by the MoWI. Since the existing IWRMDPs have been formulated before the finalization of EWR Guidelines, the EFR studies carried out in the IWRMDPs are not always fully compliant with the EWR Guidelines. In some basins, detailed EFR studies had been conducted before the IWRMDPs and in that cases the results of previous EFR studies were reflected to the IWRMDPs. In the other cases, EFR was assessed with possible methods.

The basic methods of assessing EFR by each basin are briefed in Appendix A.

(b) Summary of Estimated EFR by Basin

In some assessment methods, EFR is estimated based on natural surface runoff. In that case, the future EFR may be changed in accordance with the change of surface runoff due to climate change. However, the EFR for the years 2025 and 2035 was estimated only in the Pangani, Lake Nyasa, and Lake Victoria basins. The NIMP2018 will use the 2015 EFR for the years 2025 and 2035 if unobtainable from the reports.

The monthly EFR estimates for 2015 are summarised into annual basis as presented in Table 3.7.3. The ratio of EFR to surface runoff water ranges from 0.23 to 0.53 except for the Wami/Ruvu basin, where the theoretically desirable EFR that was estimated in the previous study was downwardly adjusted in the IWRMDP study from the viewpoint of actual hydrological conditions.

Table 3.7.3 Annual EFR by Basin for 2015

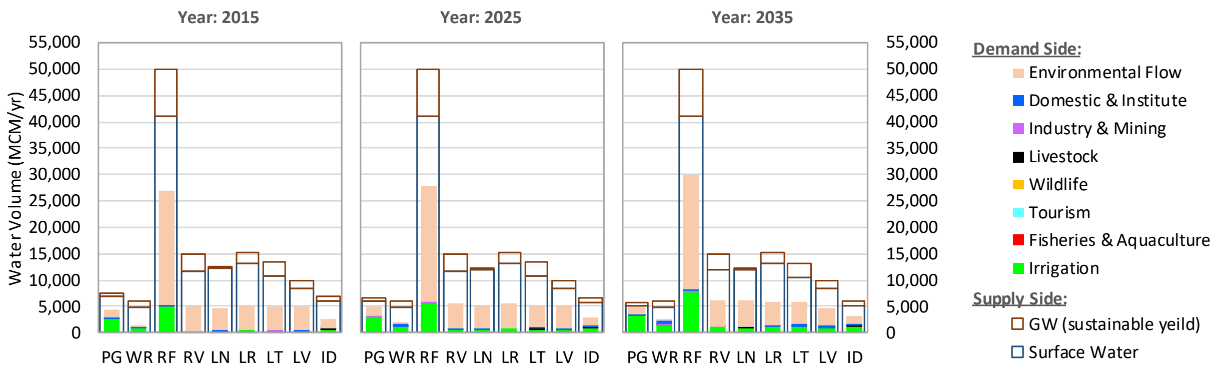
Basin	Catchment Area	Surface Water (SW)		Environmental Flow Requirement (EFR)		Ratio EFR / SW
	km²	MCM/yr	mm/yr	MCM/yr	mm/yr	
Pangani	59,102	6,963	118	1,622	27	0.23
Wami / Ruvu	66,295	4,865	73	298	4	0.06
Rufiji	183,791	41,049	223	21,850	119	0.53
Ruvuma	105,582	11,700	111	4,801	45	0.41
Lake Nyasa	27,594	12,188	442	4,161	151	0.34
Lake Rukwa	74,965	12,982	173	4,674	62	0.36
Lake Tanganyika	149,500	10,641	71	4,271	29	0.40
Lake Victoria	85,630	8,439	99	4,400	51	0.52
Internal Drainage	143,100	5,985	42	1,599	11	0.27
Total	895,559	114,812	128	47,676	53	0.42

Source: *Prepared by the JICA Project Team based on the IWRMDP and LVBC study reports*

3.7.3 Assessment of Water Stress

(1) Summary of Annual Estimates

The monthly water resources, the monthly EFR, and the monthly water demand estimated in the previous sections 3.7.1 and 3.7.2 are summarised on an annual basis in Figure 3.7.8. The numerical figures for the years 2015, 2025, and 2035 corresponding to Figure 3.7.8 are presented in Table 3.7.4, Table 3.7.5, and Table 3.7.6, respectively, in Subsection 3.7.3(2).



Note: *Groundwater in the graph indicated sustainable yield of groundwater resources.*
Source: *Prepared by the JICA Project Team based on the IWRMDP and LVBC study reports*

Figure 3.7.8 Summary of Annual Water Resource and Water Demand by Basin

(2) Assessment based on Water Exploitation Index

For the purpose of understanding the severity of water stress by basin, water exploitation index (WEI) was calculated as percentage of total consumptive water demand to internal renewable water resources, which consist of surface runoff and annual groundwater recharge. The result is presented in the following tables as well as Figure 3.7.9. The figures in the tables are rounded to an integer. Several international organisations including Organization for Economic Co-operation and Development (OECD) define the situation as “under severe water stress” in case the annual WEI exceeds 40%. It was found from the tables and figure that the Pangani basin is almost under severe water stress even in the current condition and the water stresses of all the basins will progressively increase towards 2035.

Table 3.7.4 Summary of Annual Water Resource and Water Demand by Basin for 2015

Basin	Water Resources (MCM/yr)			EFR (MCM/yr)	Water Demand (MCM/yr)								Annual WEI (%)
	SW	GW-S	GW-R		Dom	Ind	Irr	Liv	Wil	Tou	Fis	Total	
PG	6,963	587	1,466	1,622	157	36	2,657	12	0	0	0	2,862	34%
WR	4,865	1,139	4,273	298	345	61	656	15	0	0	0	1,076	12%
RF	41,049	9,021	22,533	21,850	69	131	4,905	19	0	0	0	5,124	8%
RV	11,700	3,238	8,307	4,801	50	0	254	7	25	0	0	335	2%
LN	12,188	107	1,070	4,161	34	11	309	11	0	0	0	365	3%
LR	12,982	2,136	5,341	4,674	54	2	532	13	0	0	0	600	3%
LT	10,641	2,755	5,511	4,271	215	63	273	25	16	1	0	592	4%
LV	8,439	1,327	4,424	4,400	206	15	163	73	0	0	0	456	4%
ID	5,985	884	4,421	1,599	176	89	561	87	4	0	0	917	9%
Total	114,812	21,195	57,345	47,676	1,306	407	10,309	261	45	1	1	12,329	7%

Note-1: SW = Surface Water, GW-S = Groundwater (sustainable yield), GW-R = Groundwater (recharge), EFR = Environmental Flow Requirement, Dom = Domestic & Institute, Ind = Industry & Mining, Irr = Irrigation, Liv = Livestock, Wil = Wildlife, Tou = Tourism, Fis = Fisheries & Aquaculture
Note-2: WEI (water exploitation index) here is calculated as percentage of total water demand to internal renewable water resources, which consist of surface runoff and groundwater recharge.
Source: Prepared by the JICA Project Team based on the IWRMDP and LVBC study reports

Table 3.7.5 Summary of Annual Water Resource and Water Demand by Basin for 2025

Basin	Water Resources (MCM/yr)			EFR (MCM/yr)	Water Demand (MCM/yr)								Annual WEI (%)
	SW	GW-S	GW-R		Dom	Ind	Irr	Liv	Wil	Tou	Fis	Total	
PG	5,881	587	1,466	1,655	204	56	2,959	14	1	0	0	3,234	44%
WR	4,865	1,139	4,273	298	441	142	993	19	0	0	0	1,595	17%
RF	41,049	9,021	22,533	21,850	110	245	5,504	33	0	0	0	5,891	9%
RV	11,755	3,238	8,307	4,801	61	0	568	8	36	0	0	673	3%
LN	12,041	102	1,070	4,545	39	11	606	11	0	0	0	668	5%
LR	12,982	2,136	5,341	4,674	83	3	832	16	0	0	0	934	5%
LT	10,750	2,755	5,511	4,271	318	67	578	30	29	13	0	1,037	6%
LV	8,439	1,327	4,424	4,466	322	23	430	84	0	0	6	865	7%
ID	5,654	884	4,421	1,599	206	95	869	107	4	0	0	1,282	13%
Total	113,417	21,189	57,345	48,159	1,784	642	13,338	323	70	13	7	16,179	9%

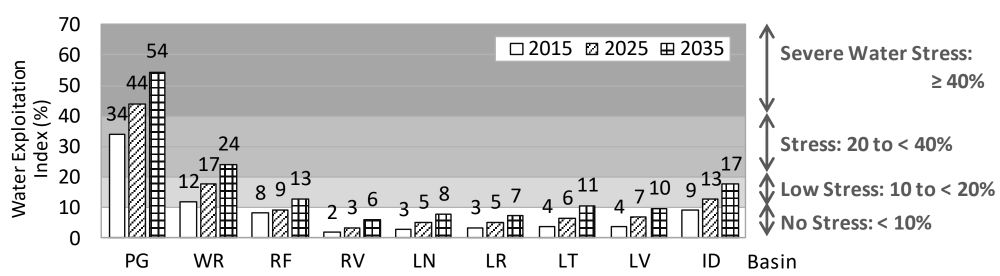
Note: Same as Table 3.7.4
Source: Prepared by the JICA Project Team based on the IWRMDP and LVBC study reports

Table 3.7.6 Summary of Annual Water Resource and Water Demand by Basin for 2035

Basin	Water Resources (MCM/yr)			EFR (MCM/yr)	Water Demand (MCM/yr)								Annual WEI (%)
	SW	GW-S	GW-R		Dom	Ind	Irr	Liv	Wil	Tou	Fis	Total	
PG	5,099	587	1,466	1,667	294	155	3,110	16	1	0	0	3,577	54%
WR	4,865	1,139	4,273	298	552	355	1,268	25	0	0	0	2,201	24%
RF	41,049	9,021	22,533	21,850	149	363	7,619	58	0	0	0	8,188	13%
RV	11,794	3,238	8,307	4,801	76	0	1,056	12	47	0	0	1,191	6%

Basin	Water Resources (MCM/yr)			EFR (MCM/yr)	Water Demand (MCM/yr)								Annual WEI (%)
	SW	GW-S	GW-R		Dom	Ind	Irr	Liv	Wil	Tou	Fis	Total	
LN	11,959	96	1,070	5,019	50	12	938	12	0	0	0	1,012	8%
LR	12,982	2,136	5,341	4,674	110	4	1,164	21	0	0	0	1,298	7%
LT	10,474	2,755	5,511	4,271	520	75	986	37	52	27	0	1,699	11%
LV	8,439	1,327	4,424	3,514	335	24	772	96	0	0	17	1,245	10%
ID	4,981	884	4,421	1,599	229	102	1,177	131	4	0	0	1,644	17%
Total	111,641	21,184	57,345	47,693	2,315	1,090	18,091	408	104	27	18	22,056	13%

Note: Same as Table 3.7.4
Source: Prepared by the JICA Project Team based on the IWRMDP and LVBC study reports



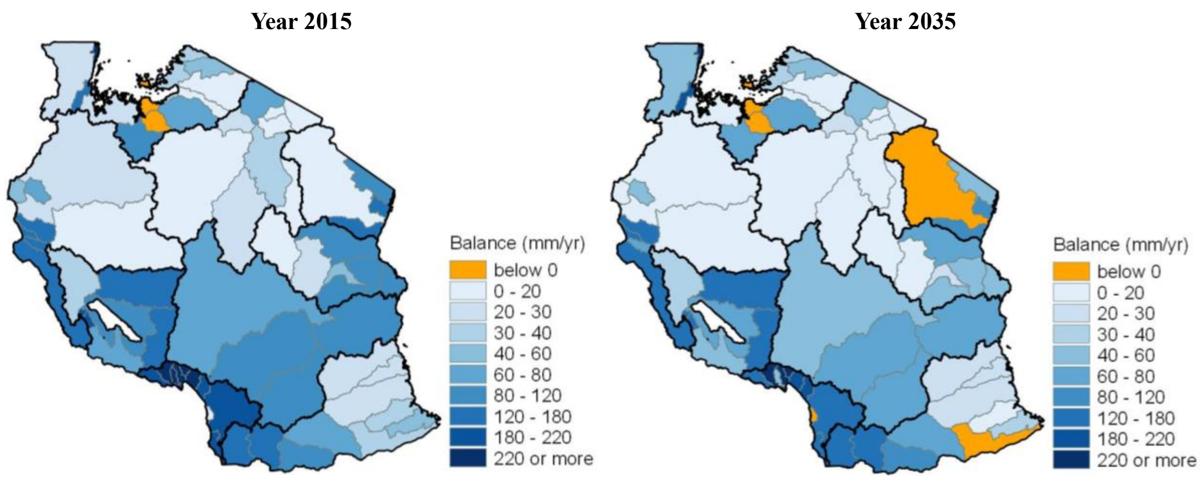
Source: Prepared by the JICA Project Team based on the IWRMDP and LVBC study reports

Figure 3.7.9 WEI by Basin

(3) Assessment based on Annual Water Balance Calculation

Prior to monthly water balance calculation to be made in Section 7.2, annual water balance by sub-basin was calculated under the limited assumption. Considering the fact that groundwater use is still supplementary supply side factor, in this section, water balance was calculated by deducting EFR and all water demand from surface water by sub-basin. The calculation result is presented in Figure 3.7.10.

The legend of below 0 (zero) in the figure means that the EFR and/or water demand are not satisfied by surface water even in annual calculation. Out of the six sub-basins with the balance below zero, the four sub-basins are not recoverable with groundwater supply. In that case, EFR and/or water demand need to be reviewed and adjusted unless inter-boundary transfer of water is considered.



Note: Groundwater use has not been considered in this calculation.
Source: Prepared by the JICA Project Team based on the IWRMDP and LVBC study reports

Figure 3.7.10 Annual Water Balance by Sub-basin

3.8 Challenges in Water Sector

The following challenges were identified through reviewing the IWRMDP reports as well as discussing with the MoWI:

(1) Water Demand Management

The biggest challenge in water sector is the localized seasonal water shortages especially during peak irrigation periods. The situation surrounding water resources has become more difficult due to climate change effect as well as increase in water demands for various sectors. It is important to consider managing the water demands to ensure sustainability of water resources.

(2) Limited Availability of Long-term Hydrological Data

As summarised in Table 3.4.2, the IWRMDPs for some basins were formulated by using non-latest hydrological data due to the limited availability of long-term data. This issue could be attributed to the insufficient hydrological monitoring activities as well as non-systematic data management at basin level.

(3) Undefined Reliability of Water Utilization in IWRMDPs

In general, reliability of water utilization is considered in water resources planning. In many cases, the reliabilities of 1/10-yr for domestic and other sectors and 1/5-yr for irrigation sector are adopted. However, in preparing the IWRMDPs, a long-term mean runoff was utilized as water resources potential in all the basins except for the Wami/Ruvu basin. It is not always necessary to consider the reliability in the form of 1/5-yr or 1/10-yr. However, it is important to understand the reliability in considering the necessity of newly developing water resources.

(4) Careful Consideration on Transboundary Water Use

Abstraction of water from transboundary lakes is not explicitly mentioned in the IWRMDP reports. However, NIRC expect water use particularly in the Lake Victoria. Considering the fact that the lake water is derived partially from rainfall onto the territory of Tanzania, the water may be used for irrigation in Tanzania even after the water flow into the lake. In this regard, water use from transboundary lakes may be one of the conceivable measures subject to agreements among the concerned countries.

Chapter 4 Present Conditions of Agriculture Sector

4.1 General

Irrigation is generally used as a part of agricultural activity, hence, it needs to be in line with the farming system at each site. Here in the Tanzania mainland, the land is vast and has a variety of natural, environmental, and socioeconomic conditions. It means that a wide range of farming systems is practiced according to the farmland conditions at individual sites.

To revise the National Irrigation Master Plan 2002 (NIMP2002), it is indispensable to understand the present agriculture in the mainland. Based on the understanding of the present agriculture together with the data analysis results of other sectors, model cropping patterns on irrigated farmland for the National Irrigation Master Plan 2018 (NIMP2018) are presented in Chapter 7. To grasp the current agriculture features of the Tanzania mainland, various data including agricultural statistics by region/zone were collected and summarised below.

4.2 Topographic Features and Agricultural Ecological Zone

4.2.1 Topographic Features

The mainland of Tanzania comprises nearly 880,000 km^2, about 100,000 km^2 are mountains and waste; another 150,000 km^2 are national parks and game reserves.[1] Apart from a narrow coastal strip, most of Tanzania is above 200 metres. Vast plains and plateaux contrast with spectacular physical features including Mt. Kilimanjaro (5,895 m), Lake Tanganyika (the world's second deepest lake with 1,470 m maximum depth), and the East African Rift Valley. A western branch of the rift runs along the western frontier and is marked by lakes of Tanganyika and Rukwa. The eastern branch is the Great Rift Valley, from the Kenya border in the region of lakes of Eyasi, Natron, and Manyara to Lake Nyasa. The Central Plateau, covering over a third of the country, lies between the two branches of the rift. Although it has numerous lakes, Lake Victoria, the world's second largest freshwater lake, is not part of the Rift Valley. There are no large rivers but two great rivers of Africa arise in Tanzania: the Nile and the Congo. The watersheds of these rivers do not meet and are separated by the Central Plateau. All the main rivers, Ruvuma, Rufiji, Wami, and Pangani drain to the Indian Ocean. The Kagera flows to Lake Victoria. Minor rivers flow into depressions in the Rift Valley.

4.2.2 Agroecological Zone

The Ministry of Agriculture (MoA) provides a variety of maps and one of them is an agroecological zone (AEZ) map. The country is composed of nine agroecological zones and their distributions by region are tabulated below. Given these diverse natural conditions, Tanzania shows a broad range of agricultural activities with greater potentials for further development.

[1] Information here mainly owes to FAO, 2006, "Country Pasture/Forage Resources Profiles: United Republic of Tanzania"..

Table 4.2.1 List of AEZ

No.	Agroecological Zone	Regions
1	Coast Plains	Tanga, Pwani, Lindi, Mtwara, DSM
2	Eastern Plateaux and Mountain Blocks	Arusha, Kilimanjaro, Manyara, Pwani, Morogoro, Iringa, Lindi, Mtwara, Ruvuma, Dodoma
3	High Plains and Plateaux	Iringa, Mbeya, Njombe, Ruvuma
4	Volcanoes and Rift Depressions	Mara, Arusha
5	Central Plateaux (Plains)	Mwanza, Simiyu, Singida, Dodoma, Tabora, Iringa, Mbeya, Katavi
6	Rukwa - Ruaha Rift Zone - Alluvial Flats	Rukwa, Iringa, Mbeya, Tabora
7	Inland Sedimentary Sediments	Lindi, Ruvuma, Morogoro
8	Ufipa Plateau	Rukwa
9	Western Highlands	Kagera, Kigoma

Source: MALF, "AGRO-ECOLOGICAL ZONES" summarised by the JICA Project Team

4.3 Land Holding

The "2014/15 Annual Agricultural Sample Survey" (2014/15 AASS) done by MALF revealed that, in the Tanzania mainland, there were a total of 11,073,679 operators engaged in either farming or livestock keeping and both of them during the 2014/15 agriculture year as shown in Table 4.3.1.

Table 4.3.1 Number of Operators Engaged in Crop Farming, Livestock Keeping, or Both Crop and Livestock Farming by Region (2014/15)

Region	Crop Farming Only (A)	Crops and Livestock (B)	Operators Engaged in Crop Farming (C)= (A)+(B)	Livestock Keeping Only (D)	Total (E)= (C)+(D)	Crop Farming (%) (A)/(E)	Crops and Livestock (%) (B)/(E)	Operators Engaged in Crop Farming (%) (C)/(E)	Livestock Keeping (%) (D)/(E)
Dodoma	243,735	267,900	511,635	22,151	533,786	45.7	50.2	95.9	4.1
Arusha	60,917	128,706	189,623	30,489	220,112	27.7	58.5	86.1	13.9
Kilimanjaro	140,394	136,447	276,841	10,687	287,528	48.8	47.5	96.3	3.7
Tanga	463,880	99,219	563,099	4,490	567,589	81.7	17.5	99.2	0.8
Morogoro	158,918	97,831	256,749	9,224	265,973	59.7	36.8	96.5	3.5
Pwani	275,732	46,590	322,322	12,569	334,891	82.3	13.9	96.2	3.8
Dar-es-salaam	17,598	3,248	20,846	1,009	21,855	80.5	14.9	95.4	4.6
Lindi	583,733	54,563	638,296	12,762	651,058	89.7	8.4	98.0	2.0
Mtwara	225,642	209,727	435,369	24,134	459,503	49.1	45.6	94.7	5.3
Ruvuma	388,378	44,239	432,617	0	432,617	89.8	10.2	100.0	0.0
Iringa	180,991	133,362	314,353	9,773	324,126	55.8	41.1	97.0	3.0
Mbeya	375,651	315,263	690,914	11,213	702,127	53.5	44.9	98.4	1.6
Singida	194,836	219,697	414,533	17,882	432,415	45.1	50.8	95.9	4.1
Tabora	477,214	239,727	716,941	5,396	722,337	66.1	33.2	99.3	0.7
Rukwa	151,352	135,895	287,247	4,586	291,833	51.9	46.6	98.4	1.6
Kigoma	521,283	137,475	658,758	3,895	662,653	78.7	20.7	99.4	0.6
Shinyanga	228,097	289,795	517,892	12,478	530,370	43.0	54.6	97.6	2.4
Kagera	436,970	150,938	587,908	3,307	591,215	73.9	25.5	99.4	0.6
Mwanza	390,936	445,564	836,500	26,056	862,556	45.3	51.7	97.0	3.0
Mara	166,418	205,035	371,453	11,283	382,736	43.5	53.6	97.1	2.9
Manyara	177,038	163,758	340,796	3,406	344,202	51.4	47.6	99.0	1.0
Njombe	203,077	46,069	249,146	10,849	259,995	78.1	17.7	95.8	4.2
Katavi	179,707	98,143	277,850	0	277,850	64.7	35.3	100.0	0.0
Simiyu	126,298	249,297	375,595	8,111	383,706	32.9	65.0	97.9	2.1
Geita	324,427	225,876	550,303	2,494	552,797	58.7	40.9	99.5	0.5
Mainland	6,693,222	4,144,364	10,837,586	236,093	11,073,679	60.4	37.4	97.9	2.1

Note: Data of newly established Songwe Region (2016) are not available. It is included in Mbeya.
Source: NBS, September 2016, "2014/15 Annual Agricultural Sample Survey"

Among the 25 regions in the mainland, Mwanza has the largest number of operators that are only engaged in farming; and both farming and livestock keeping have 836,500 operators, followed by Tabora with 716,941 and Mbeya with 690,914. On the other hand, actual numbers are not so large but almost all the operators are only engaged in farming; and both farming and livestock keeping in Ruvuma, Katavi, and Geita. Although livestock keeping is less common than farming in most of the regions, i.e., Arusha, Mtwara, Singida are considered to be major livestock keeping areas.

The area of land in farms was also measured by ownership and region. Tabora, Dodoma, and Tanga are the top 3 in terms of total land in farms. Analytically, the size of the land rented from others in a region is supposed to be almost equal to the size of the land rented to others in that region, however, some of them are so different (e.g., in Geita, the land rented from others is only 40,851 ha but the size of land rented to others is 108,430 ha, which is 2.5 times larger than the size of land rented from others.) It is possible that some lands are rented out to those operators who live in the neighbouring regions, but it is reasonable that these cases are few. Because there is no clear tendency among the regions, it is impossible to presume why this significant discrepancy occurs.

Mean area of land per farming operator is calculated by region using the above number of operators that are only engaged in farming and both farming and livestock keeping. Mean area of land per farming operator in the mainland is 1.60 ha. Among the 25 regions, mean area of land per one farming operator in Simiyu, Manyara, and Tabora regions is more than 2.6 ha while the mean figure is less than 1.0 ha in the four regions, namely; Katavi, Kagera, Njombe, and Ruvuma.

Table 4.3.2 Area of Land in Farms by Ownership and Region (2014/15)

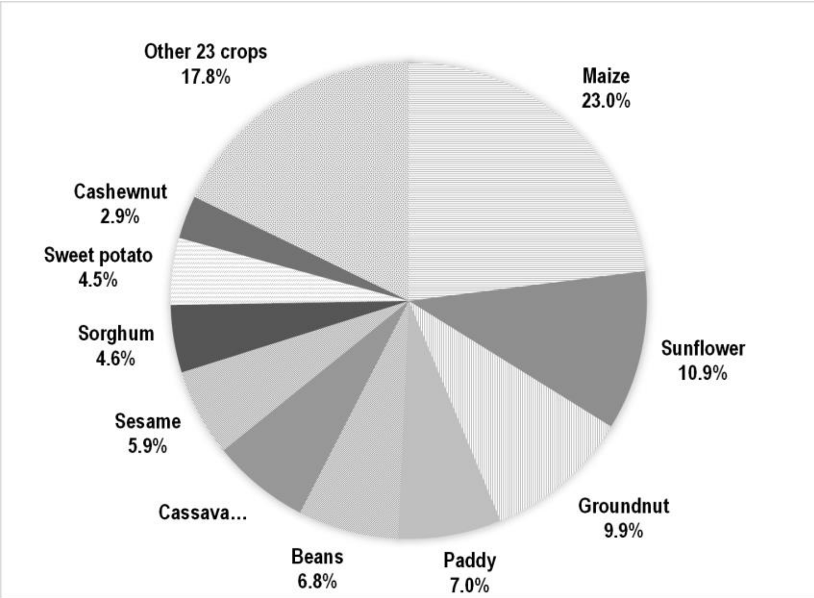
Region	Land Owned (ha)	Land Rented from Others (ha)	Land Rented to Others (ha)	Total Land in Farms (ha)	Mean Area of Land per Farming Operator (ha)	Land Rented from Others (%)	Land Rented to Others (%)
Dodoma	1,292,275	85,186	146,382	1,231,079	2.41	6.9%	11.9%
Arusha	327,246	13,157	18,918	321,485	1.70	4.1%	5.9%
Kilimanjaro	311,760	31,867	46,335	297,292	1.07	10.7%	15.6%
Tanga	1,197,709	20,960	29,128	1,189,541	2.11	1.8%	2.4%
Morogoro	562,174	65,502	69,009	558,667	2.18	11.7%	12.4%
Pwani	515,976	4,688	1,704	518,960	1.61	0.9%	0.3%
Dar es salaam	35,709	1,088	480	36,317	1.74	3.0%	1.3%
Lindi	795,842	6,864	3,446	799,260	1.25	0.9%	0.4%
Mtwara	698,041	7,515	22,915	682,641	1.57	1.1%	3.4%
Ruvuma	377,527	6,242	966	382,803	0.88	1.6%	0.3%
Iringa	461,384	26,250	103,181	384,453	1.22	6.8%	26.8%
Mbeya	727,226	69,116	6,560	789,781	1.14	8.8%	0.8%
Singida	815,574	54,253	36,464	833,363	2.01	6.5%	4.4%
Tabora	1,895,153	107,616	110,497	1,892,271	2.64	5.7%	5.8%
Rukwa	396,243	16,847	6,616	406,474	1.42	4.1%	1.6%
Kigoma	756,800	26,883	13,884	769,800	1.17	3.5%	1.8%
Shinyanga	1,119,507	57,934	111,928	1,065,512	2.06	5.4%	10.5%
Kagera	444,221	9,909	2,565	451,565	0.77	2.2%	0.6%
Mwanza	869,564	38,666	56,043	852,187	1.02	4.5%	6.6%
Mara	453,023	13,596	6,842	459,777	1.24	3.0%	1.5%
Manyara	998,808	96,244	170,917	924,135	2.71	10.4%	18.5%

Region	Land Owned (ha)	Land Rented from Others (ha)	Land Rented to Others (ha)	Total Land in Farms (ha)	Mean Area of Land per Farming Operator (ha)	Land Rented from Others (%)	Land Rented to Others (%)
Njombe	215,927	5,042	5,691	215,278	0.86	2.3%	2.6%
Katavi	281,859	7,016	81,970	206,905	0.74	3.4%	39.6%
Simiyu	1,160,701	94,124	81,437	1,173,388	3.12	8.0%	6.9%
Geita	956,908	40,851	108,430	889,329	1.62	4.6%	12.2%
Mainland	17,667,157	907,416	1,242,308	17,332,263	1.60	5.2%	7.2%

Source: NBS, September 2016, "2014/15 Annual Agricultural Sample Survey"

4.4 Crop Production and Farming System

4.4.1 Crop Production

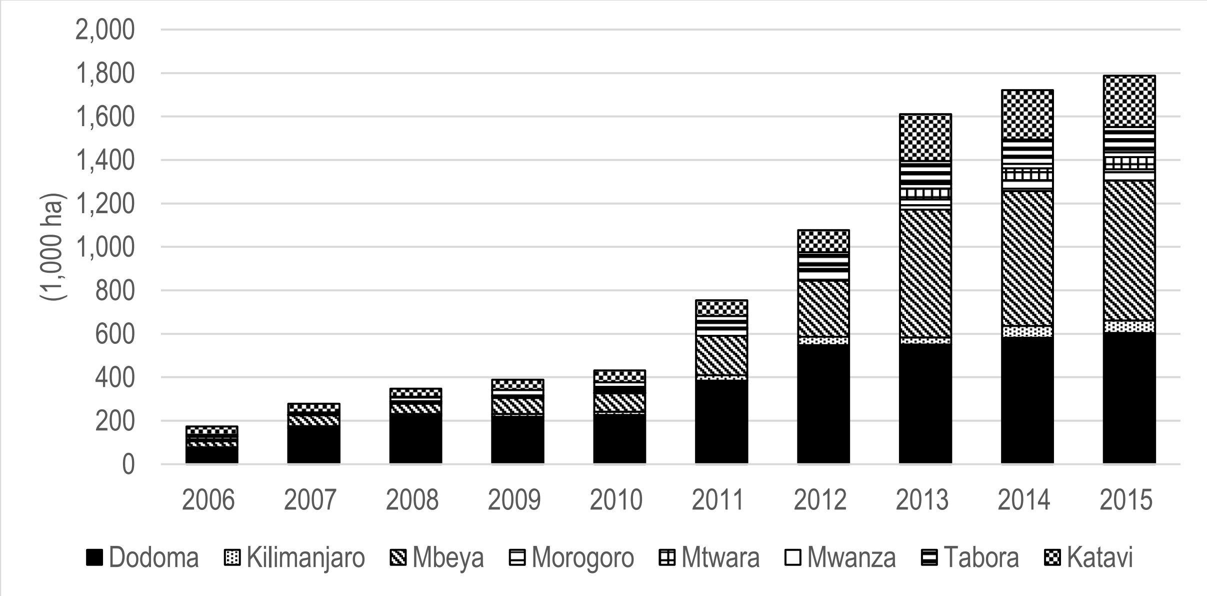


Source: Statistical data collected from Statistics Unit, MALF

Figure 4.4.1 Major 10 Crops in terms of Planted Area (2014/15)

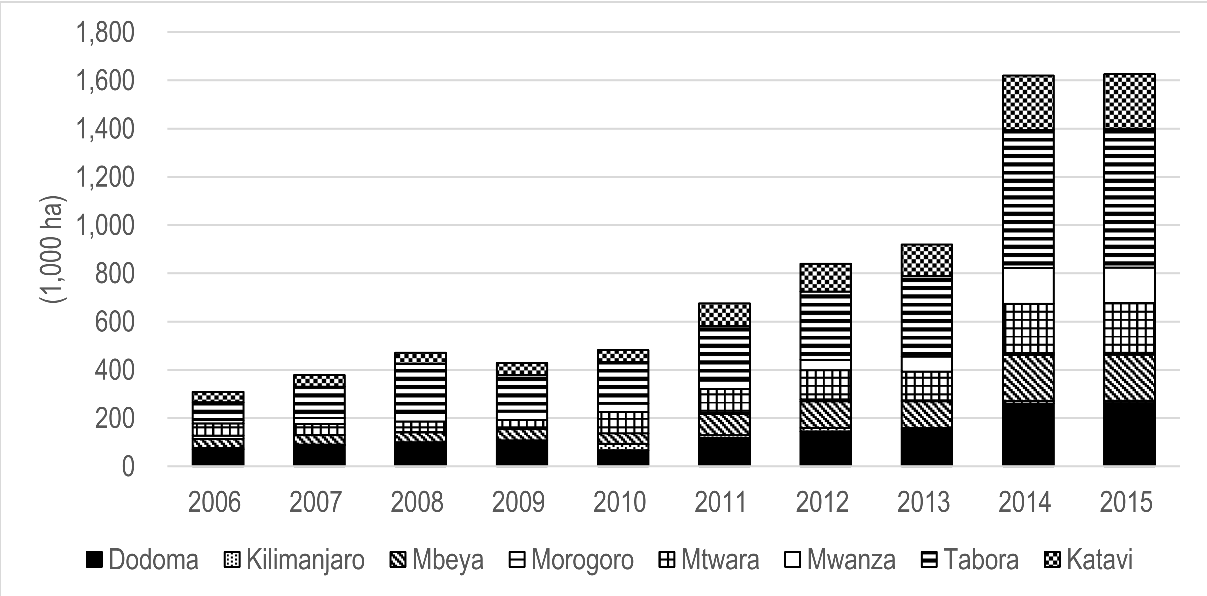
The statistical data obtained from the Statistics Unit, MALF, include planted area, production, and yield of 39 crops. After excluding six crops, which have no area and production data for the agriculture year 2014/15, the remaining 33 crops data were analysed. Maize has the largest planted area with 3.79 million ha occupying 23% of the national planted area followed by two oil crops, sunflower (1.79 million ha) and groundnut (1.63 million ha). Paddy is the fourth largest planted area crop with 1.15 million ha. Beans (1.12 million ha), cassava (1.09 million ha), sesame (0.98 million ha), sorghum (0.76 million ha), sweet potato (0.75 million ha), and cashew nut (0.48 million ha) are the other crops among the top 10 crops. These ten crops represent over 82% of the total planted area and other 23 crops occupy only less than 18%.

Among the top 10 crops, there are three cereal crops (maize, paddy, and sorghum) as well as three oil crops (sunflower, groundnut, and sesame) in addition to two tuber crops, i.e., cassava and sweet potato. Recently, the planted areas of the three oil crops are rapidly expanding as shown in figures below. In 2015, the groundnut planted area was five times bigger than the area in 2006. As for the sunflower and sesame, their area of expansion is more rapid, about ten times more than the areas in 2006. However, main production zones are different by crop. Dodoma and Mbeya zones are major production areas for sunflower but Tabora zone is crucial for groundnut production. As for sesame, Mtwara zone is the leading production area. In general, area of the other eight crops increased during the last decade but they have no clear tendencies similar to these oil crops.



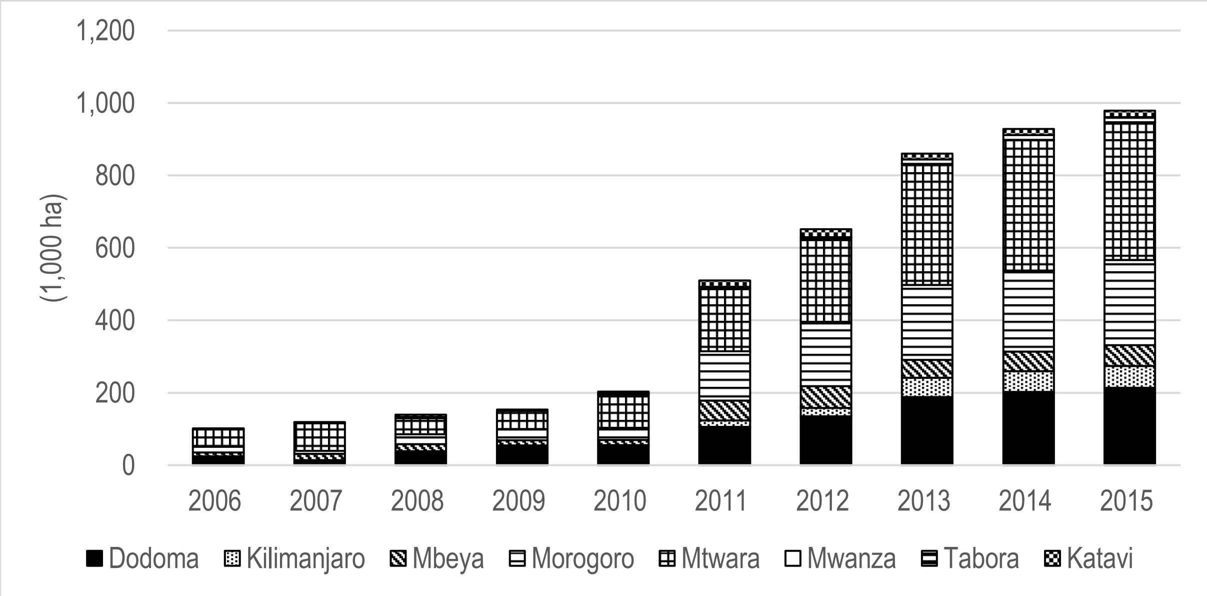
Source: Statistical data collected from the Statistics Unit, MALF

Figure 4.4.2 Change of Sunflower Planted Area by Zone (2006-2015)



Source: Statistical data collected from the Statistics Unit, MALF

Figure 4.4.3 Change of Groundnut Planted Area by Zone (2006-2015)



Source: Statistical data collected from the Statistics Unit, MALF

Figure 4.4.4 Change of Sesame Planted Area by Zone (2006-2015)

4.4.2 Farming System

(1) Cropping Intensity by Region

Current cropping intensities are estimated by region and season based on the 2014/15 AASS data, which are considered as the latest planted area statistics by crop and region.

Table 4.4.1 Planted Area and Cropping Intensity by Region and Season

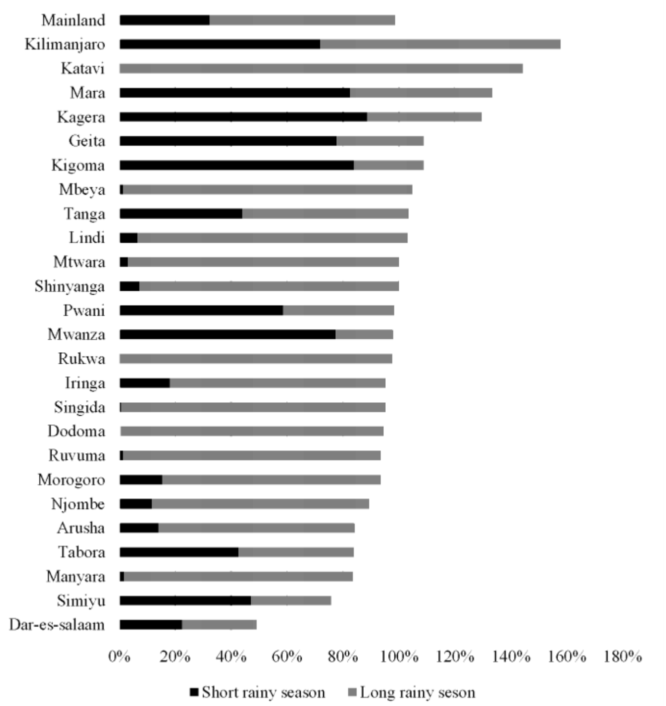
Region	Total Land in Farms (ha) (A)	Planted Area (ha)			Cropping Intensity		
		Short Rainy Season (B)	Long Rainy Season (C)	Total Area Planted (D=B+C)	Short Rainy (B/A)	Long Rainy (C/A)	Total (D/A)
Dodoma	1,231,079	3,560	1,160,914	1,164,474	0.3%	94.3%	94.6%
Arusha	321,485	45,309	225,384	270,693	14.1%	70.1%	84.2%
Kilimanjaro	297,292	214,285	255,525	469,810	72.1%	86.0%	158.0%
Tanga	1,189,541	521,462	708,898	1,230,360	43.8%	59.6%	103.4%
Morogoro	558,667	85,133	436,765	521,898	15.2%	78.2%	93.4%
Pwani	518,960	304,942	204,907	509,849	58.8%	39.5%	98.2%
Dar es salaam	36,317	8,191	9,676	17,867	22.6%	26.6%	49.2%
Lindi	799,260	51,257	773,104	824,361	6.4%	96.7%	103.1%
Mtwara	682,641	19,778	663,601	683,379	2.9%	97.2%	100.1%
Ruvuma	382,803	5,235	352,584	357,819	1.4%	92.1%	93.5%
Iringa	384,453	69,603	296,969	366,572	18.1%	77.2%	95.3%
Mbeya	789,781	11,686	816,621	828,307	1.5%	103.4%	104.9%
Singida	833,363	5,146	788,572	793,718	0.6%	94.6%	95.2%
Tabora	1,892,271	807,694	783,344	1,591,038	42.7%	41.4%	84.1%
Rukwa	406,474	1,856	395,094	396,950	0.5%	97.2%	97.7%
Kigoma	769,800	646,181	192,035	838,216	83.9%	24.9%	108.9%
Shinyanga	1,065,512	75,185	990,341	1,065,526	7.1%	92.9%	100.0%
Kagera	451,565	400,093	185,562	585,655	88.6%	41.1%	129.7%
Mwanza	852,187	658,906	174,282	833,188	77.3%	20.5%	97.8%
Mara	459,777	378,536	234,261	612,797	82.3%	51.0%	133.3%
Manyara	924,135	15,407	757,817	773,224	1.7%	82.0%	83.7%
Njombe	215,278	24,831	167,989	192,820	11.5%	78.0%	89.6%
Katavi	206,905	0	298,859	298,859	0.0%	144.4%	144.4%

Region	Total Land in Farms (ha) (A)	Planted Area (ha)			Cropping Intensity		
		Short Rainy Season (B)	Long Rainy Season (C)	Total Area Planted (D=B+C)	Short Rainy (B/A)	Long Rainy (C/A)	Total (D/A)
Simiyu	1,173,388	551,647	336,020	887,667	47.0%	28.6%	75.6%
Geita	889,329	689,580	279,484	969,064	77.5%	31.4%	109.0%
Mainland	17,332,263	5,595,503	11,488,608	17,084,111	32.3%	66.3%	98.6%

Note: Songwe is included in Mbeya. Short rainy season: from October to January, Long rainy season: from February to May
Source: National Bureau of Statistics, URT, Sep. 2016, 2014/15 Annual Agricultural Sample Survey Report

Average cropping intensity in short rainy season was 32.3%. The regions with high intensity in short rainy season are located around Lake Victoria (Kagera, Kigoma, Mara, Geita, and Mwanza). The regions with low intensity were mainly located in the Dodoma and Mbeya zones. Average cropping intensity in long rainy season was 66.3%. The regions with high intensity in long rainy season are in the south and south west (Katavi, Mbeya, Rukwa, Mtwara, and Lindi). The regions with low intensity were in the Mwanza and Tabora zones.

Total cropping intensity varied from 49% in Dar es Salaam to 158% in Kilimanjaro and average cropping intensity in the mainland was 99%. Katavi (144%) and Mara (133%) follow Kilimanjaro. Both Kilimanjaro and Mara had relatively high intensities in the short rainy season while Katavi recorded 144% only in long rainy season with 0% in short rainy season. Those regions with more than 100% cropping intensity accounted to 11 out of 25 regions. There were six regions with more than 105% (Kilimanjaro, Katavi, Mara, Kagera, Geita, and Kigoma) and many regions with high cropping intensity had high intensity in the short rainy season except for Katavi and Mbeya.



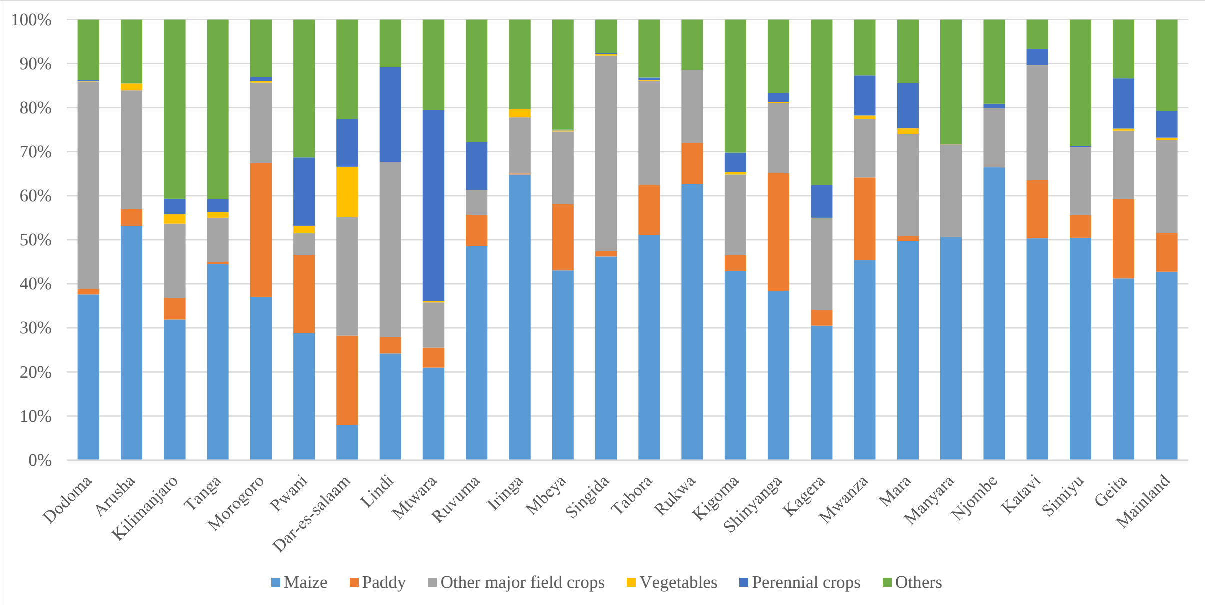
Source: National Bureau of Statistics, URT, Sep. 2016, 2014/15 Annual Agricultural Sample Survey Report

Figure 4.4.5 Cropping Intensity by Region (2014/15)

On the other hand, Simiyu (76%) and Manyara (84%) were those with low intensity after Dar es Salaam. There were six regions with less than 90% cropping intensity (Dar es Salaam, Simiyu, Manyara, Tabora, Arusha, and Njombe).

(2) Cropping Patterns

Cropping patterns were analysed by region with the same data, 2014/15 AASS. The planted data of 17 crops were categorized into six groups: (1) maize, (2) paddy, (3) other major food and oil crops (sunflower, groundnut, beans, sesame, sorghum and sweet potato), (4) vegetables (tomato, okra, onion, watermelon, pumpkin, cabbage and amaranths), (5) perennial crops (cassava and cashew nut), and (6) others. (The total planted area of these 17 crops in each region represented 59-93% of the total planted area. Therefore, it is considered that these data are representative crops in each region.)



Note: Songwe is included in Mbeya.
Source: National Bureau of Statistics, URT, Sep. 2016, 2014/15 Annual Agricultural Sample Survey Report

Figure 4.4.6 Current Cropping Pattern by Region (2014/15)

As a whole, 42.8% of planted area was cropped with maize on the mainland in 2014/15, followed by other major food and oil crops at 21.1%. Together with paddy (8.8%), these three categories which include essential food crops for the Tanzanian people represented nearly three quarters, 72.7% of planted area in 2014/15.

Maize was popularly planted in Njombe, Iringa, and Rukwa, where it covered more than 60% of planted area. Paddy was widely planted in Morogoro (30.3%) and Shinyanga (26.7%). In Dar es Salaam, 11.5% of planted area was occupied by vegetables, which was the highest among the regions. Although the farmland area size was relatively small in Dar es Salaam, many vegetables were being supplied to the population in the capital instead maize planted area represented the least (8%) among all the regions. After Dar es Salaam, Kilimanjaro recorded the second largest but it was only 2.1%. Mtwara and Lindi were characterized by the concentration of perennial crops, at 43.3% and 21.5%, particularly, cashew nut planted area of 221,000 ha and 158,000 ha, respectively.

(3) Farming System

Tanzania has a considerable variation in the farming systems due to the various differences in climatic and agro-ecological conditions. Rainfall patterns in Tanzania are generally classified into two categories; namely; unimodal and bimodal[2]. Unimodal refers to areas with one rainy season and bimodal refers to those with two rainy seasons. The unimodal rainy season occurs between October/November and April/May (*Msimu*) and is common to the southern, south-western, central, and western areas of the country. In bimodal areas, the long rainy season is experienced between March and June (*Masika*) and

[2] FEWS NET, August 2005, "Tanzania Food Security Update"

the short rains occur between October and January (*Vuli*). Bimodal areas are located in the northern coast, North-Eastern Highlands and Lake Victoria areas. Because of these rainfall patterns, agricultural statistics are normally described in two-year form such as 2014/15. There are ten major farming systems in Tanzania as shown below.

Table 4.4.2 Major Farming Systems in Tanzania

No.	Farming System	Location of the System	Remarks
1	Banana/Coffee/ Horticulture System	Kagera, Kilimanjaro, Arusha, Kigoma and Mbeya regions	Tree crops, high intensive land use, volcanic soils with high fertility, land scarcity
2	Maize/Legume System	Rukwa, Ruvuma, Arusha, Kagera, Shinyanga, Iringa, Mbeya, Kigoma, Tabora, Tanga, Morogoro, Kahama, Biharamulo	Land not scarce, shifting cultivation, maize and legumes, beans and groundnuts intercropped, Arabica coffee
3	Cashew/Coconut/Cassava System	Coast Region; Eastern Lindi and Mtwara	Low rainfall, low soil fertility, cassava, coconut and cashew, land is not scarce, shifting cultivation
4	Rice/Sugarcane System	Alluvial river valleys	Rice and sugarcane
5	Sorghum/Bulrush millet/Livestock System	Sukuma land; Shinyanga and rural Mwanza	Sorghum, millet, maize and cotton, oilseeds and rice, intense population pressure, declining soil fertility
6	Tea/Maize/Pyrethrum System	Njombe and Mufindi districts in Iringa Region	Tea, maize, Irish potatoes, beans, wheat, pyrethrum, wattle trees and sunflower
7	Cotton/Maize System	Mwanza, Shinyanga Kagera, Mara, Singida, Tabora and Kigoma, Morogoro, Coast, Mbeya, Tanga, Kilimanjaro and Arusha	Cotton, sweet potatoes, maize, sorghum and groundnuts, intensive cultivation, livestock kept
8	Horticulture-based System	Lushoto District; Tanga Region, Morogoro rural; Morogoro Region and Iringa rural in Iringa Region	Vegetables, (cabbages, tomatoes, sweet pepper, cauliflower, lettuce, and indigenous vegetables) and fruits, (pears, apples, plums, passion fruits, and avocado), maize, coffee, Irish potatoes, tea, and beans
9	Wet-rice and irrigated System	River valleys and alluvial plains, Kilombero, Wami Valleys, Kilosa, Lower Kilimanjaro, Ulanga, Kyela, Usangu and Rufiji	
10	Pastoralists and Agropastoralist System	Semi-arid areas i.e., Dodoma, Singida, parts of Mara and Arusha; Chunya districts, Mbeya and Igunga District in Tabora	Deep attachment to livestock and simple cropping system, shifting cultivation of sorghum millet, moderate population density 30 per km^2, limited resource base and poor and variable rainfall

Source: Global Yield Gap Atlas, http://www.yieldgap.org/tanzania, Accessed on 13 December 2016

4.5 Agricultural Research

In September 2016, the National Assembly passed the Tanzania Agricultural Research Institute Act 2016. It seeks to promote crop protection and make effective administration of trade, commerce, and export of agricultural produces. The draft legislation is also expected to push budget allocation for research activities to at least one percent of the gross domestic product (GDP).

This act established the Tanzania Agricultural Research Institute (TARI) as a corporate body and provides with respect to its functions, powers, administration, etc. The act also established the Agricultural Research Development Fund and provided for registration of agricultural research projects and service providers. According to the act, there are 16 agricultural research institutes across the country, see Table 4.5.1.

Table 4.5.1 List of 16 Tanzania Agricultural Research Institutes

S/ N	Former Name of the Institute	Name of the Centre	Location
1	Ilonga Agricultural Research Institute	TARI-Ilonga Centre	Kilosa, Morogoro
2	Mlingano Agricultural Research Institute	TARI-Mlingano Centre	Muheza, Tanga
3	Kibaha Sugarcane Research Institute	TARI-Kibaha Centre	Kibaha, Pwani
4	Mikocheni Agricultural Research Institute	TARI-Mikocheni Centre	Kinondoni, Dar es Salaam
5	KATRIN Agricultural Research Institute	TARI-Ifakara Centre	Kilombero, Morogoro
6	Dakawa Agricultural Research Institute	TARI-Dakawa Centre	Mvomero, Morogoro
7	Makutupora Veticultural Research Institute	TARI-Makutupora Centre	Dodoma
8	Hombolo Agricultural Research Institute	TARI-Hombolo Centre	Chamwino, Dodoma
9	Ukiriguru Agricultural Research Institute	TARI-Ukiriguru Centre	Misungwi, Mwanza
10	Maruku Agricultural Research Institute	TARI-Maruku Centre	Bukoba, Kagera
11	Selian Agricultural Research Institute	TARI-Selian Centre	Meru, Arusha
12	Tengeru Agricultural Research Institute	TARI-Tengeru Centre	Meru, Arusha
13	Naliendele Agricultural Research Institute	TARI-Naliendele Centre	Mtwara, Urban Mtwara
14	Uyole Agricultural Research Institute	TARI-Uyole Centre	Mbeya
15	Kifyulilo Experimental Station	TARI-Kifyulilo Centre	Mufindi, Iringa
16	Tumbi Agricultural Research Institute	TARI-Tumbi Centre	Uyui, Tabora

Source: Tanzania Agricultural Research Institute Act, 2016

Priority crop commodities for research by zone are summarised below. Maize is a priority commodity in all the seven zones while rice is so in the six zones. Sorghum and cassava are priority crops in five zones followed by beans in four zones.

Table 4.5.2 Priority Crop Commodities for Research by Zone

S/N	Zone	Regions	Research Institutes	Priority Crop Commodities
1	Central	Dodoma, Singida	Makutupora (Zonal HQ), Hombolo	Maize, Sunflower, Sorghum, Pearl Millet, Groundnuts
2	Eastern	Dar es Salaam, Morogoro, Pwani, Tanga	Ilonga (Zonal HQ), Ifakara, Dakawa, Kibaha, Mikocheni, Mlingano	Maize, Rice, Cassava, Sugarcane, Sorghum, Cotton, Phaseolus Bean, Coffee, Soil research centre (Mlingano)
3	Lake	Kagera, Mara, Mwanza, Shinyanga, Simiyu, Geita	Ukiriguru (Zonal HQ), Maruku	Maize, Banana, Sorghum, Cotton, Sweet potato, Rice, Cassava, Beans, Coffee
4	Northern	Arusha, Kilimanjaro, Manyara	Selian (Zonal HQ), Tengeru	Phaseolus beans, Maize, Pigeon peas, Onions, Sunflower, Banana, Wheat, Cabbages, Lima bean, Mangoes, Finger millet, Cassava, Sweet potato, Barley, Safflower, Tomatoes, Carrots, Irish potatoes, Sorghum, Rice, Cowpeas, Coffee, Spices.
5	Southern	Lindi, Mtwara	Naliendele	Sesame, Maize, Rice, Cassava, Sorghum, Cashewnut, Pigeon pea, Groundnut
6	Southern Highlands	Iringa, Katavi, Mbeya, Njombe, Rukwa, Ruvuma	Uyole (Zonal HQ), Kifyulilo	Maize, Rice
7	Western	Kigoma, Tabora	Tumbi	Maize, Rice, Plantains, Cassava, Coffee, Beans, Tobacco, Groundnuts, Agroforest

Source: Interview to Division of Research and Development, MALF, and http://www.erails.net/TZ/drd/drd-mafc/research-network-of-drd/

Details of some main research institutes[3] are described below.

TARI-Ilonga Centre
Established in 1943 as a Central Research Centre to improve cotton production in the Eastern Cotton Growing Area and later in 1989, it embarked into food crops for the Eastern Zone of Tanzania. The institute has seven commodity research sub-programs namely: maize, grain legumes (cowpea, green gram, soybean and pigeon peas), sorghum and millets, oilseeds (sunflower, sesame and groundnuts), cotton, soil and natural resource and crop protection. One of the oldest

[3] Information of this part mainly owes to "http://www.erails.net/TZ/organisation/".

research institutes in Tanzania. Coordinates research activities for research institutes of MALF in the Eastern Zone.
TARI-Mlingano Centre
Established in 1934 with the objective to conduct research for improvement of sisal yield. Since then Mlingano has been a well-known institute for sisal growers. Nearly, all sisal varieties grown in the country were developed at Mlingano. At present, Mlingano has a collection of over 120 varieties of sisal (the largest collection in the world). Nearly all activities in the country related to land evaluation and land use planning, fertilizer recommendations, agro-ecological zones and soil analysis have had a connection with this institute.
TARI-Ifakara Centre
Founded in September 1963 under the provision of an agreement between the two governments of Tanganyika and the Federal Republic of Germany. After the establishment of commodity research programs in 1975, the institute was mandated to coordinate rice research activities in Tanzania. Although rice is cultivated all over the country, the regions where rice is produced more includes Eastern zone (Morogoro and Coast regions), Southern highlands (Mbeya and Rukwa) and Lake zone (Shinyanga, Mwanza and Mara). After 2000, research activities mainly concentrated on rice and spices. However, in collaboration with other institutes, the station acts as a testing site for other crops such as maize, oil seeds (groundnuts, sesame, soybeans, sunflower), sugarcane, cowpeas, pigeon peas, and chickpeas. The rice research program has been working on improving varieties with best response to production attributes and more specifically by selecting breeding lines which are resistant to rice yellow mottle virus (RYMV) to meet farmers' priorities. In 2008, the institute was chosen to be the headquarters of the Regional Rice Centre of Excellence of the Eastern Africa Agricultural Productivity Program.
TARI-Ukiriguru Centre
The oldest research station and the main cotton research centre in Tanzania. As a native authority seed farm, it was opened in December 1930, and agricultural research activities began in November 1932 with the selection of varieties of sorghum, groundnuts, and cotton. The Empire Cotton Growing Corporation, at the request of the Ministry of Agriculture, began some research at Ukiriguru in 1939. When the Tanzanian Research services were reorganised into four zones in 1956, Ukiriguru became the centre for the Western Zone which consisted of Mwanza, Singida, Shinyanga, Tabora, Mara, Kagera and Kigoma regions. A formal program for training of junior agricultural staff was established in 1939, but the research and training wing were in 1974 split into separate units under a director and a principal, respectively.
TARI-Tengeru Centre
The history dates back to 1942, when a group of Polish refugees settled there during the 2nd World War, starting a dairy and beef cattle farm. In 1952, the Ministry of Agriculture took over the land and established a research and training institute. The research function became the Northern Research Centre, specialising in coffee and agricultural mechanisation. Seed testing began there in 1961, and two years later the Seed Testing Laboratory became a member of the International Seed Testing Association.
TARI-Naliendele Centre
Established in 1970 as a scientific institution of the ministry on a strong base of cashew research development shifted from Nachingwea and is now one of the world leaders in cashew research, boasting of a research database that could be useful not only to Eastern and Central Africa, but to a wider audience, including researchers from other countries interested in cashew. It coordinates cashew and oilseed crops at the national level and collaborates within and outside Tanzania in verifying research outputs. The institute consists of eight programs, namely: cashew research, oilseeds, roots and tubers, cereals and legumes, socio-economics, soils and land use, zonal research-extension-farmer linkage and zonal communication.

There are also several parastatal research institutes by subject as described below.

i) Tanzania Coffee Research Institute (TaCRI), Kilimanjaro
ii) Tea Research Institute of Tanzania (TRIT), Dar es Salaam
iii) Tobacco Research Institute of Tanzania (TORITA), Tabora
iv) Tropical Pesticides Research Institute (TPRI), Arusha

Some important policy statements on research and development in the National Agriculture Policy (October 2013) are shown below.

i) The agricultural research system shall be reformed to enhance the participation of a wide spectrum of stakeholders in identifying and setting research priorities.
ii) National research agenda on agriculture shall be regulated and coordinated.
iii) Public-Private Partnership (PPP) in research activities shall be facilitated.
iv) In collaboration with R&D institutions, research on irrigation and development of appropriate

smallholder agricultural mechanization and agro-processing technologies shall be promoted.

4.6 Agricultural Extension Services

In the Agricultural and Livestock Policy (1997), decentralization of the public agricultural extension services and transfer of administrative responsibility to Local Government Authorities (LGAs) were included. As a result of the year 1997 decentralization processes, agricultural extension services were divided into two; local government and central government. The major activities of the central government cover policy formulation, preparation of guideline and supervision while the local governments become the implementers of improved technology under supervision of the ministry. The National Agriculture Policy (October 2013) also stipulated the need for the government to deliver extension services to (primarily small-scale) farmers at the village level and to strengthen agricultural extension services to increase production, productivity, and profitability.

The MALF[4] is now formulating eight extension guidelines (e.g., Farmer field school guideline including how to implement extension guideline and ward resource centre guideline). The guidelines will be disseminated to local governments for implementation.

According to the Extension Services Section, MALF, there are currently 8,756 extension officers working at the field in addition to 63 extension officers working at the HQ, as of December 2016. In 2007, there were only 3,379 extension officers so the number of officers increased more than double during the recent ten years. However, the ministry's targets to have some 20,000 extension officers. (At each village, there is at least one extension officer and one extension officer at each ward.) So far various efforts have been made but there are still insufficient extension officers at the field due to the limited budget.

In order to fill the gap of deficit in extension officers, the following approaches are being applied.

- Training the lead farmers by using farmer field school (One-week training at the Training Centre and then they will train other fellow farmers).
- Farmer to farmer extension approach (From 1 to 1, from 1 to several farmers).
- Exchange visit approach (Invite farmers from other areas).
- Farmer field day (One farmer who learned at the learning field teach what he learned to other five farmers. The ministry also supports improved seeds, fertilizer, and farm machinery work for one model plot. Many farmers are invited to the plot at least twice– planting and harvesting. It happened that some 250 farmers came to the plot).
- Ward resource centre (So far 224 training centres are opened for extension staff).
- Agricultural exhibition (Once a year in August at one of the seven zones. In 2016, it was held in Lindi).
- Local radio program for Q&As.
- Planning to have a help desk where farmers can contact directly to the ministry through mobile

[4] Interview results with Crop Development Division, Extension Services Section, on 15 December 2016

phones asking for extension services (in collaboration with a private firm).

Some of the policy statements on extension services in the National Agriculture Policy 2013 are:

i) Extension services shall be transformed to ensure provision of quality services with increased private sector participation;
ii) Farmers' education and publicity services shall be strengthened for effective linkage and dissemination of technologies and information; and
iii) Specific commodity extension services shall be promoted and strengthened.

4.7 Farm Input Supply

(1) Seeds

Until the early 1990s, the Tanzanian government had a monopoly on the seed sector[5]. The 1989 National Seed Industry Development Programme started breaking state control in the seed sector, allowing private seed companies to operate in the country. Since then, the private sector started maize seed production and trade as well as importing maize and sorghum hybrid seed. Other seeds (sorghum, rice, legumes, and some open pollinated maize) are produced by small local seed companies or by a parastatal seed organisation, the Agricultural Seed Agency (ASA, rice in particular). Because Tanzania tries to support the development of a strong private sector, it also applies to the seed sector. Hence, the private sector (agro-dealers and seed companies) is increasingly involved in the promotion and demonstration of improved varieties, field days, etc.

At present, there are a variety of actors from public, private sector, as well as civil society in the Tanzanian seed sector. The public sector is involved in the primary chain functions as shown below.

- Genetic resource management: National Plant Genetic Resource Centre
- Variety development: Research organizations of MALF and universities
- Basic seed and certified seed production and distribution: ASA
- Quality control: Tanzania Official Seed Certification Institute (TOSCI)

The private seed companies produce and sell certified and basic seed. Agro-dealers are involved in the retail of certified seed produced by various seed companies. Individual farmers or farmer organisations are both on the end-user side of the seed chains but can also work for various seed production on contract. Several non-governmental organisations (NGOs) support farmers through training on seed production and marketing.

The formal seed system mainly consists of public agricultural variety development and early generation seed production, certified seed multiplication by public and private seed companies, marketing by registered agro-dealers and agricultural offices. Certified seed is normally available for maize, sorghum, beans, and rice, as well as vegetables and some oil crops.

[5] Information of this part mainly owes to (1) ASARECA/KIT, 2014, "Tanzania Seed Sector Assessment: A Participatory National Seed Sector Assessment for the Development of an Integrated Seed Sector Development (ISSD) Programme in Tanzania. April 2014, Entebbe, Uganda" and (2) World Bank, 2012, "Agribusiness Indicators: Tanzania, Agriculture and Environmental Services".

In Tanzania, there are 54 registered seed companies, which are also members of Tanzania Seed Trade Association, as well as some 1,500 registered agro-dealers. The registered seed companies and ASA produce and import certified seed of hybrid and open pollinated varieties. Majority of improved seeds are cereals and cash crops, vegetables and some pulses. In 2011/12, more than 25% of all required maize seeds, half of all vegetable seeds, and almost 80% of all cash crop seeds (cotton, tobacco, etc.) originated from the formal seed system. All other crops largely relied on the informal seed system. Only for rice, sorghum, wheat and sunflower production, some certified seeds are being used.

The 2010/11 National Panel Survey found that just 16.8% of households used improved seed. A large percentage of farmers retain seed from their prior year cereal or legume crop for planting and are less likely to buy new seeds every year. Nearly 70% of farmers pointed out the reason for not using improved seeds in the past as its higher cost. Despite the increase in availability of improved seed, only 27% of cropped area for maize was estimated to be used as improved seed in 2010. For rice, this proportion is very low, with only 1% of cropped area estimated to be planted with improved seed.

(2) Fertilizer

In Tanzania, the National Agricultural Input Voucher Scheme (NAIVS) started in 2008, which was a government input subsidy in response to the sharp rise in global grain and fertilizer prices[6]. The main aim of the program was to raise maize and rice production, and thus preserve Tanzanian households and national food security. In total, about USD 300 million had been invested in providing more than 2.5 million smallholder farmers with a 50% subsidy on a one acre package of maize or rice seed, and chemical fertilizer.

The program helped Tanzanian smallholders harvest more than 2.5 million tons of additional maize and rice grain. Independent surveys confirmed that farmers receiving subsidized maize seed and fertilizer increased their maize yields by an average of 433 kg per acre. Farmer receiving subsidized rice seed and fertilizer increased their average paddy yields by 263 kg per acre. However, the NAIVS program had multiple logistical challenges and ended in 2013/14 cropping season.

In the National Agriculture Policy 2013, the fertilizer use in Tanzania is summarised as follows:

> "The Agricultural Sector Review of 2008/2009 revealed that, over the last 12 years, the comparison of demand and supply of fertilizers shows there was a gap of about 33%. In Tanzania, only 10 kg of fertilizer is used per hectare as compared with as high as 50 kg per hectare in South Africa, while the Southern Africa Development Community average is 16 kg/hectare and Vietnam is 365 kg/hectare."

Recent fertilizer use data are not available but the World Development Indicators (2014) include change of fertilizer consumption (kg per hectare of arable land) from 2003 to 2012 as shown in Table 4.7.1.

Table 4.7.1 Change of Fertilizer Consumption (2003-2012)

Year	2003	2006	2009	2010	2011	2012
Fertilizer consumption (kg per hectare of arable land)	4.46	5.40	7.52	6.57	7.98	4.40

Source: World Development Indicators (WDI), November 2014

[6] Information of this part mainly owes to the World Bank, February 2014, "Tanzania Public Expenditure Review National Agricultural Input Voucher Scheme (NAIVS)".

The data indicated even less figures than the figure in NAP 2013 and the consumption per hectare in 2012 decreased as compared with that of 2011. In addition, the Household Budget Survey of 2011/12 surveyed percentage of plots applied with organic and inorganic fertilizer by sex of head and area.

Table 4.7.2 Percentage (%) of Plots Applied with Fertilizers by Sex of Head and Area, 2011/12

Item	Dar es Salaam			Other Urban Areas			Rural Areas			Mainland		
	Male headed	Female headed	Total	Male headed	Female headed	Total	Male headed	Female headed	Total	Male headed	Female headed	Total
Organic fertilizer	34.0	1.1	29.3	12.4	10.6	12.0	12.0	9.9	11.5	12.2	9.9	11.7
Inorganic fertilizer	6.4	7.1	6.5	22.8	27.2	23.8	8.1	6.0	7.7	9.4	8.2	9.1

Source: NBS, July 2014, Household Budget Survey 2011/12

Both types of fertilizers were not popularly applied, only 9-12% of plots. As compared with the rural area, plots with fertilizer application increased in urban areas. More male-headed households applied both fertilizers in their plots than female-headed households in general. These data indicated that application of both organic and inorganic fertilizer is still at a low level among the farmers in spite of various efforts/measures introduced by the government.

4.8 Marketing

(1) Rice

As for irrigation, rice[7] is the most important crop in Tanzania and there are multiple horizontal and vertical links from the producer to the consumer. The rice value chain involves: primary producers, traders in paddy and milled rice, processors, wholesalers, retailers, and consumers. Most actors are not specialized and their functions are related to various segments of the value chain. The value chain is fragmented, uncoordinated, disorganised, and uncontrolled.

Production is dominated by a large number of small-scale producers and a large number of middlemen operate across the country. There are also enormous number of small processors and individual sellers who supply restaurants, cafés, and street vendors (or otherwise put products on the market for the consumer). The horizontal and vertical linkages of the value chain are generally weak and uncompetitive.

Rice is an important staple food and is consumed in both urban and rural areas. The urban area of greater Dar es Salaam is the principal end market and accounts for about 60% of the national consumption. Quality differentiation is limited mainly to the amount of broken rice present, to whether it is aromatic or non-aromatic and to whether it is local or imported.

There are also regional preferences among consumers and rice is often labelled as being from regions that are perceived by consumers as special qualities:

- Rice from Kyela is considered to be the best, followed by rice from Mbeya;
- Morogoro rice is viewed as good quality, but inferior to Kyela and Mbeya; and
- Shinyanga rice is viewed as low quality as it is not aromatic.

Annual per capita rice consumption increased from 20.5 kg in 2001 to 25.4 kg in 2011. Increased rice

[7] Information of this part mainly owes to FAO (R. Trevor Wilson and I. Lewis), 2015, “The Rice Value Chain in Tanzania - A Report from the Southern Highlands Food Systems Programme”.

consumption is both the result of population growth and an increasing preference among higher income urban households for rice. It is easier to prepare and a symbol of increased social and economic status as compared with sorghum and maize.

Officially, export of rice is very limited and is principally to neighbouring countries (Uganda, Rwanda, Kenya and Burundi, and occasionally to Malawi and Zambia). Tanzanian official export figures varied very much with official data from the importing countries. Informal trade bypassing customs posts is quite considerable and official data seemed to be under reported. The export markets are located in the main producing areas, and are very close to the borders with the importing countries. Good quality Tanzanian rice is in high demand in these markets but is not always available as a result of export bans and high export tariffs imposed by the Tanzanian authorities.

(2) Maize

Maize[8] is the staple food for the majority of Tanzanians. Most maize (80%) is produced by small-scale farmers and is grown both for subsistence and as a cash crop. Between 65-80% of harvested maize is consumed within the producing households: only 20-35% enters commercial channels.

Despite the importance of maize to Tanzania, the value chain is fragmented and poorly coordinated. There are many layers and inefficient connections between producers and consumers. Trust, reliable information systems, and the benefits of economies of scale are not well established. The majority of marketed maize is delivered to local collection hubs, accumulated by traders who sell on to local, regional, and urban markets. Some is also sold to processors and grain traders who accumulate and export. This works to the advantage of larger-scale operators in the business and to the disadvantage of most farmers. There are only a limited number of larger roller mills that produce high quality flour products, and all operate below capacity. Small-scale hammer mills are mainly used throughout the country to convert grain to low-cost and low-quality flour.

(3) Irish Potato

Irish potato[9] in Tanzania is essentially a food crop and consumed at household and through food service outlets like restaurants and cafés. About 90% of the national production comes from the Southern Highlands, especially from Iringa, Njombe, and Mbeya. The production system is mixed farming, rainfed based and exclusively by smallholder. Due to the recent increased demand, particularly in urban areas, potato production is expanding within the Southern Highlands Region, and is spreading into central (Morogoro) and north eastern (Kilimanjaro, Arusha, and Manyara) regions. Urban centres near Lake Victoria receive most of its potato importing from Kenya and Uganda and western urban centres rarely receive fresh potato due to poor road infrastructure.

The bulk of potato is sold into the market without grading and the marketing system is not well organised. Retailers and subsequent consumers pay high prices due to the high transaction costs of farmers and

[8] Information of this part mainly owes to FAO (R. Trevor Wilson and J. Lewis), 2015, "The Maize Value Chain in Tanzania - A Report from the Southern Highlands Food Systems Programme.".
[9] Information of this part mainly owes to the "Southern Agricultural Growth Corridor of Tanzania - Appendix IV: Value Chain and Market Analysis (Draft)" obtained from http://www.sagcot.com/resources/downloads-resources/.

traders. Marketing of potato in the Southern Highlands is unregulated and producers and traders have developed long-term relationships that are built on trust. The relationships and the systems in general appear to work and there are equitable gains among chain actors. Village traders/brokers get only about 2% of the end market price because they have no substantial investment apart from their time/labour.

4.9 Livestock and Fisheries

4.9.1 Livestock

In December 2016, livestock statistics by animal and district/region were collected from Monitoring and Evaluation Section, PPD, Livestock and Fisheries Department, MALF. The summarised data are shown in Table 4.9.1.

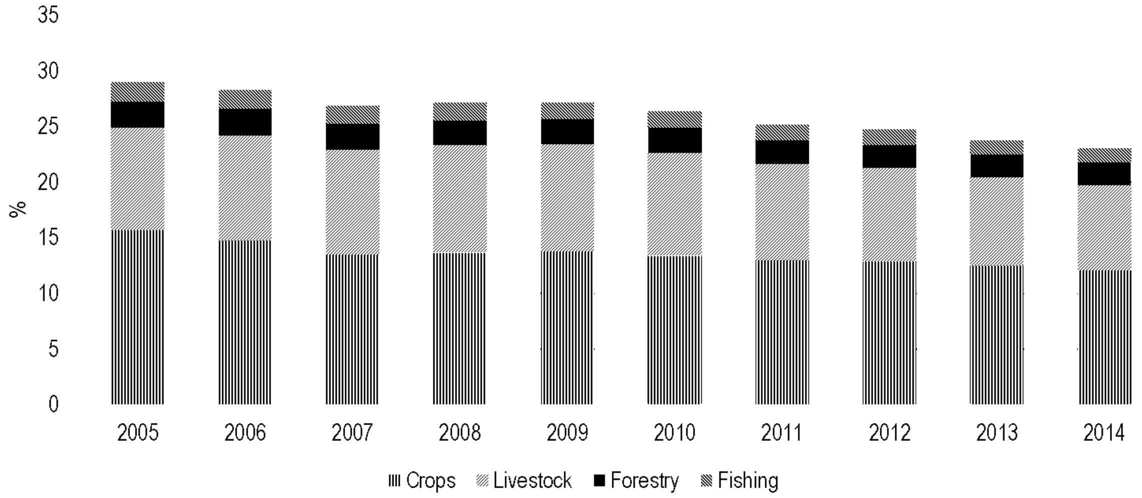
Table 4.9.1 Livestock Data by Animal and Region (As of August 2012)

Region	Number				Distribution			
	Cattles	Goats	Sheep	Chicken	Cattles	Goats	Sheep	Chicken
Arusha	1,605,735	1,884,783	842,453	1,094,205	6.7%	12.6%	19.2%	3.1%
Dar es salaam	272,937	160,367	17,043	1,957,649	1.1%	1.1%	0.4%	5.5%
Dodoma	1,504,632	1,025,756	258,011	1,549,452	6.3%	6.9%	5.9%	4.3%
Geita	817,195	427,622	47,692	1,183,162	3.4%	2.9%	1.1%	3.3%
Iringa	664,272	201,648	43,147	1,131,241	2.8%	1.4%	1.0%	3.2%
Kagera	845,449	730,300	75,478	1,172,304	3.5%	4.9%	1.7%	3.3%
Katavi	363,036	177,808	25,703	550,571	1.5%	1.2%	0.6%	1.5%
Kigoma	506,929	361,526	53,137	796,001	2.1%	2.4%	1.2%	2.2%
Kilimanjaro	654,468	693,824	246,210	1,640,672	2.7%	4.7%	5.6%	4.6%
Lindi	264,163	98,328	6,968	1,125,695	1.1%	0.7%	0.2%	3.2%
Manyara	1,807,094	1,542,414	581,246	1,103,236	7.5%	10.3%	13.2%	3.1%
Mara	1,651,355	757,428	342,892	1,612,672	6.9%	5.1%	7.8%	4.5%
Mbeya	1,452,698	557,030	76,967	2,452,569	6.1%	3.7%	1.8%	6.9%
Morogoro	881,766	489,060	128,360	2,077,975	3.7%	3.3%	2.9%	5.8%
Mtwara	167,200	226,077	15,886	1,134,864	0.7%	1.5%	0.4%	3.2%
Mwanza	1,333,569	574,942	129,678	1,829,259	5.6%	3.9%	3.0%	5.1%
Njombe	267,681	113,681	21,747	851,730	1.1%	0.8%	0.5%	2.4%
Pwani	535,289	191,472	43,395	1,271,132	2.2%	1.3%	1.0%	3.6%
Rukwa	640,014	233,399	35,488	747,384	2.7%	1.6%	0.8%	2.1%
Ruvuma	465,058	315,626	25,828	1,456,422	1.9%	2.1%	0.6%	4.1%
Shinyanga	1,299,261	620,795	196,998	1,634,373	5.4%	4.2%	4.5%	4.6%
Simiyu	1,595,889	929,895	389,366	1,673,455	6.7%	6.2%	8.9%	4.7%
Singida	1,371,975	829,155	292,579	1,387,484	5.7%	5.6%	6.7%	3.9%
Tabora	2,227,637	953,991	269,456	2,477,071	9.3%	6.4%	6.1%	6.9%
Tanga	772,600	816,588	223,149	1,765,218	3.2%	5.5%	5.1%	4.9%
Mainland	**23,967,902**	**14,913,515**	**4,388,877**	**35,675,796**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Source: Statistical data collected from the Livestock and Fisheries Department, MALF

In total, there are about 24.0 million cattle, 14.9 million goats, 4.4 million sheep, and 35.7 million chickens in the mainland. Tabora, Manyara, Mara, Arusha, and Simiyu are the major raising areas since these five regions occupy 37% of the total cattle. There are also many goats and sheep in Arusha and Manyara where 23% of goats and 32% of sheep are kept in these two areas, respectively. Chicken is more evenly distributed than cattle, goat, and sheep but there are some regions (e.g., Katavi and Rukwa) where raising number of chicken is relatively smaller than other regions.

About 90% of the livestock population is of indigenous types, which are known for their low genetic potential in milk and meat production. In 2014, the livestock subsector still represented 7.6% of GDP at 2001 prices but it decreased from 9.2% in 2005.



Source: National Bureau of Statistics website, http://www.nbs.go.tz/nbstz/index.php/english/2015-09-24-23-59-10

Figure 4.9.1 Shares of GDP (2001 Prices) by Economic Activity

4.9.2 Fisheries

Tanzania is endowed with fishery resources, both marine and inland[10]. Freshwater fisheries cover 62,000 km^2 including the shared waters of the great lakes, namely Victoria, Tanganyika, and Nyasa. The country has also other small natural lakes, man-made lakes, river systems, and many wetlands with fisheries potential.

The industry has been dominated by small-scale fishermen and fish farmers who normally uses traditional technology. According to the Fisheries Sector Development Strategy (2010), the fisheries sector provided substantial employment, income, livelihood, foreign earnings, and revenue to the country. It employs more than 4,000,000 people engaged in fisheries and fisheries-related activities while more than 400,000 fisheries operators are directly employed in the sector. It is an important economic subsector of the Tanzanian economy. In 2014, the growth rate of fisheries subsector was 2.0% and was 5.5% in 2013. The contribution of fishing activities to GDP almost remained constant with a slight change of 0.1%. In 2010, the share of fishing activities was 1.5% before decreasing to 1.4% in 2011 and 2012; it further decreased to 1.3% in 2013 and 2014.

Table 4.9.2 shows catchment volume and values by water body from 2012 to 2015. Since 2013, both catchment volume and values remained almost at the same level. In 2012, Lake Victoria represented over 70% of catchment volume and values but it occupied about two-thirds of both data since 2013. In 2013, several new water bodies started fish production but the decrease of distribution to Lake Victoria mainly resulted from the increase of catchment volume and values at Lake Tanganyika (from 8-9% to

[10] Information of this part mainly owes to (1) MALF, December 2010, "Fisheries Sector Development Strategy" and (2) URT, May 2016, "Agricultural Sector Development Programme Phase Two (ASDP2)".

15-16%). Catchment on rivers is very limited, namely, just 1% of the total catchment and values.

Table 4.9.2 Fisheries Production Data by Water Body

Year	2012		2013		2014		2015	
Water Bodies	Catches (ton)	Values (TZS)	Catches (ton)	Values (TZS)	Catches (ton)	Values (TZS)	Catches (ton)	Values (TZS)
Lake Victoria	240,256	872,822,786	234,530	938,119,720	236,287	980,591,752	237,097	983,954,580
Lake Tanganyika	31,568	101,018,955	59,912	233,276,569	59,281	237,123,929	54,161	216,642,255
Lake Nyasa	11,305	35,044,470	9,913	38,165,050	9,387	35,669,080	10,095	38,362,449
Lake Rukwa	4,196	13,428,174	3,661	13,911,800	3,040	11,550,480	3,221	12,239,083
Mtera Dam	744	2,380,026	913	3,285,000	504	1,812,687	598	2,152,860
Nyumba ya Mungu Dam	993	3,375,884	246	921,375	233	873,759	258	967,014
Lake Kitangiri	1,412	3,812,961	295	1,033,900	213	850,000	213	870,307
Lake Singidani			136	462,094	117	479,123	120	490,314
Lake Kindai			69	234,260	59	243,267	57	232,899
Lake Burunge			41	141,795	6	21,914	6	24,189
Minor waters (Lake Babati, Lake Eyasi, Lake Jipe)			390	1,460,625	194	724,851	192	786,136
River Kilombero			4,902	17,891,205	4,742	17,307,971	3,903	15,947,330
Small-scale Marine	50,592	166,954,953	52,846	195,529,127	51,912	207,649,600	52,723	210,892,897
Total	**341,066**	**1,198,838,208**	**367,854**	**1,444,432,520**	**365,974**	**1,494,898,413**	**362,645**	**1,483,562,313**

Source: Statistical data collected from Livestock and Fisheries Department, MALF

4.10 Agricultural Cooperatives

In Tanzania, cooperatives[11] were first introduced into the cash crop growing at the beginning of the early 1920s. In 1933, the first cooperative union in the country, the Kilimanjaro Native Cooperative Union, was registered with its eleven affiliated primary cooperatives. Cooperatives increased rapidly in the country with support from the government. Marketing cooperatives also expanded their business tremendously in the early 1960s. The number of cooperatives exceeded 1,600 in 1966 and reached 2,500 in 1974.

However, radical changes in government policy on cooperatives occurred after the introduction of socialism to all macroeconomic and social programs. In 1976, all primary cooperatives were abolished by the government and their crop marketing functions were taken over by communal villages. At the same time cooperative unions were also abolished and their functions were taken over by parastatal crop authorities, which had to buy crops directly from villages. However, the crop authorities failed in buying peasant crops and in providing price incentives, and their activities for the supply of farm inputs and credit were not well functioned. Facing this serious situation, the government formally announced the re-introduction of cooperatives and cooperative unions in 1982. However, the damage was too heavy. Cooperatives lost much of their property and highly trained manpower during the abolition period.

Saving and credit cooperatives (SACCOS) were not as many as the crop marketing cooperatives in the pre-abolition period. However, SACCOS grew rapidly after the 1980s and as institutions they have

[11] Information of this part mainly owes to (1) ILO (Sam Maghimbi), 2010, "Cooperatives in Tanzania mainland: Revival and growth" and (2) University of Helsinki, 2013, "Cooperatives as a tool for poverty reduction and promoting business in Tanzania"

remained more stable than the crop marketing cooperatives. In the 1980s and 1990s when most crop marketing cooperatives collapsed, the SACCOS continued to survive. The Cooperative Development Policy (2002) led to the 2003 Cooperative Societies Act. The Cooperative Rules of 2004, which are part of the Act, provided an elaborate list and definition of the various kinds of cooperatives which can be established. As of June 2016, there are about 4,400 SACCOS in the country while the number of crops cooperatives is about 2,900.

Table 4.10.1 Number of Cooperatives by Type and Region (As of June 2016)

S/N	Region	Crops	Irrigation	Bee Keeping	Fishery	Livestock	SACCOS	Con-sumers	Unions	Fede-ration	Others	Total
1	Arusha	52	4	-	-	28	351	8	1	-	15	459
2	Dar es Salaam	34	-	-	3	-	719	17	3	1	120	897
3	Dodoma	28	2	7	-	2	168	-	-	-	21	228
4	Geita	158	-	9	5	5	281	-	1	-	73	532
5	Iringa	85	-	1	2	3	149	-	1	-	96	337
6	Kagera	250	-	-	-	4	82	1	3	-	6	346
7	Katavi	11	-	2	-	-	27	-	2	-	2	44
8	Kigoma	79	-	3	1	-	151	1	1	-	22	258
9	Kilimanjaro	49	32	-	1	14	234	298	2	-	35	665
10	Lindi	117	2	-	-	-	104	3	1	-	10	237
11	Manyara	56	-	1	-	16	101	-	1	-	8	183
12	Mara	83	1	2	1	8	217	2	2	-	41	357
13	Mbeya	202	18	-	29	28	139	5	6	-	36	463
14	Morogoro	49	-	2	-	2	139	-	4	1	14	211
15	Mtwara	261	-	-	-	-	60	-	2	-	14	337
16	Mwanza	198	-	-	14	-	189	3	1	-	20	425
17	Njombe	85	-	1	-	5	120	-	2	-	9	222
18	Pwani	79	2	-	4	5	74	-	3	-	13	180
19	Rukwa	37	-	-	4	5	88	4	-	-	-	138
20	Ruvuma	98	-	-	-	1	86	-	6	-	-	191
21	Shinyanga	184	-	-	-	6	255	-	2	-	24	471
22	Simiyu	154	-	-	-	6	53	1	-	-	-	214
23	Singida	94	-	9	2	2	107	1	2	-	16	233
24	Tabora	397	7	16	6	10	329	7	3	-	8	783
25	Tanga	68	8	1	3	27	223	1	2	-	32	365
	TOTAL	**2,908**	**76**	**54**	**75**	**177**	**4,446**	**352**	**51**	**2**	**635**	**8,776**

Source: Statistical data collected from Cooperative Development Commission

In Tabora, there are nearly 400 crops cooperatives which occupied 51% of the regional total number. Mtwara has 261 crops cooperatives, which is the second largest number among the 25 regions, representing 77% of the total regional number, 337 cooperatives. Kagera is similar to Mtwara, 250 crops cooperatives occupying 72% of the regional total, 346. On the other hand, crops cooperatives are not so popular in Katavi (11 crops cooperatives) and Dodoma (28 crops cooperatives), which is smaller than Dar es Salaam, 34 crops cooperatives.

4.11 Agricultural Processing

The manufacturing production index, a rate that measures changes in commodities production in real terms over time (1985=100), is summarised in Table 4.11.1. Over the six years from 2007 to 2012, the index of food, beverages, and tobacco gradually increased. Rapid growth was observed in activities of wood and wood products, paper and paper products as well as fabricated metal products. On the contrary, the performance of textiles, leather, and chemicals and plastic products decreased during the same period.

Table 4.11.1 Manufacturing Production Index of Tanzania (1985=100, 2007-2012)

Year	2007	2008	2009	2010	2011	2012	Average Increase Rate over 5 Years
Food, beverages & tobacco	388.8	351.3	375.5	407.0	397.8	455.3	3.21%
Textiles & leather	667.8	285.5	229.3	243.5	228.5	201.5	-21.31%
Wood & wood products	82.0	263.5	246.5	248.3	347.8	707.3	53.87%
Chemicals & plastic products	183.5	107.3	124.8	137.5	144.5	140.0	-5.27%
Basic metal products	152.3	177.0	203.5	236.0	270.3	293.8	14.04%
Non-metallic products	387.0	415.5	458.8	526.0	536.0	574.0	8.20%
Paper & paper products	42.8	310.3	295.3	317.3	343.5	359.8	53.08%
Fabricated metal products	13.5	74.3	72.0	76.3	81.5	104.0	50.43%
Other manufacturing industries	227.0	297.8	385.3	433.5	575.8	582.5	20.74%

Source: E Manuel A. M Waigomole, Journal of Social and Economic Policy, Vol. 11, No. 2, December 2014, pp. 145-157, Manufacturing Sector as an Engine of Growth in Tanzania: A Critical Approach,

Table 4.11.2 indicates the number of agro-processing[12] establishments that employ more than 10 workers in 2009. Agro-processing subsector occupied more than one-third of total manufacturing establishments with more than ten employees.

Table 4.11.2 Number of Agro-processing Establishments by Activity (2009)

Industrial Activity	No. of Establishments	Percentage
Processing and preserving of meat	1	0.4%
Processing and preserving of fish, crustaceans and molluscs	13	5.3%
Processing and preserving of fruit and vegetables	3	1.2%
Manufacture of vegetable and animal oils and fats	34	13.9%
Manufacture of grain mill products, starches and starch products	58	23.8%
Manufacture of other food products	91	37.3%
Manufacture of prepared animal feeds	6	2.5%
Manufacture of beverages	35	14.3%
Manufacture of tobacco products	3	1.2%
Subtotal of Agro-processing	244	100.0%
Total of Manufacturing	686	-
Percentage of Agro-processing to Total Manufacturing	35.6%	-

Source: The Agro-Food Industry Measurement - FAO-UNIDO Expert Group Meeting in Rome, Italy, November 2015

The agricultural processing subsector is the largest manufacturing subsector in terms of contribution to production and employment based on the Tanzania Industrial Competitiveness Report 2015. Hence, the subsector was identified as a priority area for achieving sustainable industrial development in the national policy framework. Because of (1) its relatively rich natural resources, (2) labour-intensive nature, and (3) low technology required in production process, it seems that the subsector has a comparative advantage as compared with other subsectors.

However, value added of the subsector has been growing slowly and there has been a reduction in the number of workers between 2008 and 2010. For instance, the tobacco products and processing/ preserving of fish, etc., sectors lost 20% and 27% of its workers, respectively, in the same period as

[12] Information of this part mainly owes to (1) Ministry of Industry, Trade and Investment of the United Republic of Tanzania, 2016, “Tanzania Industrial Competitiveness Report 2015,” and (2) Fadhili S. Khalfani, Tanzania National Bureau of Statistics, 23-24 November 2015, “The Agro-Food Industry Measurement - FAO-UNIDO Expert Group Meeting in Rome, Italy”.

shown below.

Table 4.11.3 Employment Distribution in Agricultural Processing Subsector (2008-2010)

Industrial activity	Share of Employment in 2010	Change between 2008 and 2010
Sugar	33%	8%
Tobacco products	8%	-20%
Softdrinks, mineral waters	7%	1%
Grain mill products	7%	28%
Cocoa, chocolate, and sugar confectionery	6%	-11%
Processing/preserving of fish, etc.	4%	-27%
Vegetable and animal oils and fats	3%	31%
Malt liquors and malt	2%	3%
Distilling, rectifying and blending of spirits	2%	8%
Bakery products	1%	8%
Other agro-processing	26%	-12%
Total	100%	

Source: Ministry of Industry, Trade and Investment, Tanzania Industrial Competitiveness Report 2015

Among the various industrial activities, sugar production has the largest share, 33%. Rapid growth in employment is observed in the activities of grain mill products and vegetable and animal oils and fats. This trend accords with the recent production increase of cereal and oil crops in the MALF statistics.

Table 4.11.4 Number of Persons Engaged by Industrial Activity and Sex (2009)

Industrial Activity	Male	Female	Total	Female %
Processing and preserving of meat	21	17	38	44.7%
Processing and preserving of fish, crustaceans and molluscs	1,384	443	1,827	24.2%
Processing and preserving of fruit and vegetables	72	72	144	50.0%
Manufacture of vegetable and animal oils and fats	1,166	461	1,627	28.3%
Manufacture of grain mill products, starches and starch products	2,313	880	3,193	27.6%
Manufacture of other food products	22,047	8,030	30,077	26.7%
Manufacture of prepared animal feeds	90	49	139	35.3%
Manufacture of beverages	4,518	932	5,450	17.1%
Manufacture of tobacco products	2,665	1,150	3,815	30.1%
Total Agro-Food Manufacturing	34,276	12,034	46,310	26.0%
Total Manufacturing	67,607	29,474	97,081	30.4%
Percentage of Agro-Food to Total Manufacturing	50.7%	40.8%	47.7%	-

Source: The Agro-Food Industry Measurement - FAO-UNIDO Expert Group Meeting in Rome, Italy, November 2015

Although the industrial activity categories are not same as those in the tables shown so far, the data in Table 4.11.4 indicate that, as of 2009, agro-food manufacturing activities occupied about a half of the total employees in the manufacturing sector. This means that agricultural processing subsector was quite important and significant for the Tanzanian industry sector as well as it provided many job opportunities for people including women.

4.12 Agricultural Credit and Rural Finance

Rural financing is an important stimulant for technology adoption because it mitigates challenges encountered by farmers who face seasonal cash fluctuations and it allows immediate consumption for future benefits. Rural finance and credit systems are considered to be very significant and indispensable for improved technology use, such as fertilizer and high yielding varieties of seed.

In Tanzania, what has been commonly referred to as agricultural credit[13] typically means supply led loans packaged into inputs supplies. The single marketing chain linking primary cooperative societies, marketing boards and state-owned banks, acted as a promoter for such loans. Agricultural credit packaged in this way has decreased following the reforms of input delivery systems and the restructuring of state-owned banks.

Following the privatization policies during latter half of 1990s, the National Microfinance Bank (NMB) which has a broad national branch network, and the Cooperative Rural Development Bank (CRDB) were established, and these banks made efforts since then to provide credits to agricultural sector. The level of credit provision to the agricultural sector against the whole country is shown in the table below. For the 11-year period until 2015, the average share of agricultural lending in the whole country is about 11%. Parallel to the overall expansion of domestic lending, the amount of credits to agricultural sector is increasing. But the pace of expansion is dropping since 2012.

Table 4.12.1 Amount of Lending to Agricultural Sector by Commercial Banks (2005-2009)

Year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Amount of lending to agricultural sector (TZS billion)	177	292	328	541	501	757	1,011	983	1,017	1,156	1,258
Amount of lending in the whole country (TZS billion)	1,425	2.094	2.976	4,376	4,806	5,798	7.399	8.722	10.153	11.267	13,746
Share of agricultural lending in the whole (%)	12.4	13.9	11.0	12.4	10.4	13.1	13.7	11.3	10.0	10.3	9.1

Source: FAO Statistics, Agricultural Credit (http://www.fao.org/economic/ess/investment/credit/en/)

Financial institutions that cater various financial products such as credit and savings are still heavily urban biased in Tanzania. As of 2011, there were 32 commercial banks (which offer checking or other demand deposit accounts) and 18 other financial institutions in Tanzania. The former includes CRDB, NMB, National Bank of Commerce (NBC), Akiba, Barclays and EXIM Bank, among others. All but one of these are headquartered in Dar es Salaam. The latter include community and cooperative banks such as the Njombe Community Bank and Kagera Farmers Cooperative Bank, and are headquartered around the country. The latter financial institutions usually have a development focus.

Thus, vast rural areas in Tanzania still remain seriously underserved. The very few financial institutions (banks) are found in rural areas, and mainly provide services to civil servants and salary earners. Rural small producers have a harder time accessing these financial institutions, and have to walk long distances to branches. According to the National Sample Census of Agriculture 2007/2008, only 2.4% of the total agricultural households borrowed money for agricultural activities. The reasons for not acquiring credit include the following: (1) no knowledge on how to get credit for agriculture, 31.1%, (2) credit is not available, 18.3 %, and (3) no knowledge about credits, 18.0 %. For the households who borrowed money in 2007/08 in Tanzania, the main agricultural credit providers to them were (1) cooperatives which

[13] Information of this part mainly owes to (1) Temu, A. E., Nyange, D., Mattee, A. Z. and Kashasha, L. K., 2005, "Assessing Rural Services, Infrastructure and their Impact on Agricultural Production, Marketing and Food Security in Tanzania Final Donor Report of a Research Project funded under IFPRI Eastern African 2020 Vision Network" and (2) IFAD, October 2011, "Rural Financial Services Programme and Agricultural Marketing Systems Development Programme - Interim Evaluation".

provided credit with 28%, (2) family, friends or relatives with 23%, and (3) savings and credit, 19%.

Household Budget Survey 2011/12 also indicated low accessibility of credit in rural areas. Overall, in the mainland, 21% of households reported running a business. Households living in rural areas were much more likely to run their own business (62%) while Dar es Salaam has the lowest (13%). The main source of start-up capital of those who run businesses was summarised as below.

Table 4.12.2 Percentage of Household Businesses by Main Source of Start-up Capital and Area, 2011/12

Source of Capital	Rural Areas	Dar es Salaam	Other Urban Areas	Tanzania Mainland
Proceeds from agricultural production	46.5	1.8	13.7	32.4
Own savings	23.6	66.5	50.8	36.2
Gift from family/friends	8.0	14.1	14.6	10.5
No need	6.2	0.5	1.1	4.1
Loan from family/friends	4.7	7.0	6.1	5.4
Other	4.7	3.0	4.9	4.5
Proceeds from non-agricultural production	2.7	0.3	1.0	2.0
From inheritance	2.1	1.8	2.1	2.0
Sale of assets owned	0.7	0.5	1.1	0.8
Loan from SACCOS	0.5	2.4	2.2	1.2
Loan from banks	0.3	2.2	2.3	1.0
Total	100.0	100.0	100.0	100.0

Source: Household Budget Survey 2011/12, NBS, July 2014

In rural areas, agricultural production was the dominant source with 46.5% of household business owners. While the household members who secured loans from SACCOS and banks for starting their business investments in Dar es Salaam and other urban areas accounted 4.5%, those who did in rural areas represented only 0.8%, less than one-fifth. Up to now, there still very limited number of rural residents seemed to have access to finance institutions.

4.13 Private Sector in Agricultural Sector

In the following, private sector situation is described from viewpoints of production/processing and investment and development.

4.13.1 Private Sector in Production and Processing

Patterns of private companies' engagement in agricultural production and processing vary according to types of crops. In food crops such as maize, rice and cassava, because farmers produce primarily for their own consumption, they are mostly produced by smallholder farmers, and the degree of processing is low. It sometimes said that such farmers are also private actors. But this is not what usually meant by the word. In this type of crop, so-called middlemen or traders are major private actors, buying crops on farm and carry them to wholesale markets. These stakeholders (farmers, middlemen, traders, and millers) interact each other at numerous local settings, constituting a highly fragmented value chain. There are no significant value chains in food crop subsector which are controlled by a single player, either millers or retailers.

As for cash crops, there are several cases where private companies manage the production and processing. Such crops as tea, cotton, tobacco and sugarcane often observe a contract farming type of arrangement organised by a processor, private firm. In tea production, private firms advance into large scale plantation operation where farmers become just employees of the firm. At another end of the spectrum of cash crop production arrangement, coffee and cashew nut are produced by more independent farmers. Processors or middlemen purchase the commodity from individual or group of farmers and send to international market after processing. There are some occasions where private processors enter into the contract farming arrangement. Rice is sometimes produced solely for market sales (i.e., cash crop). In such a case, production turns to be of large-scale plantation where the company occupies large plot and operate capital intensive production. In the subsector of cash crop, there is a trend especially for the last several years that private players gradually expand their roles along value chains. As described in the next section, when the government promotes private sector involvement in agricultural development, it is likely to involve cash crops such as rice or sugarcane.

Vegetables are also good cashable crops. But because of perishability, any scalable value chain management requires some level of investment. Therefore, at present the crops are typically produced by individual or small group of farmers and purchased and carried by middlemen to markets. There are however, a few examples of active private companies forming an out-grower relation (contract farming) with farmers. They are emerging in specific niches as exporting to neighbouring countries or marketing of high value vegetables.

In the subsector of oil seeds such as sunflower and groundnut whose production have expanded rapidly last several years, traders or processors (oil extractors) often organise farmers into a group and set up contractual relationship with the farmers. The organisers often supply seeds and other inputs and purchase the harvest from member farmers. However, at present, the scale of such arrangements is still small and the value chain is characterized by limited activities of private companies.

There are few large-scale private operations in milk production and distribution. Such private companies organise farmers and manage collection, processing, packaging, distribution, and retailing. The extent of such operation is widening. However, conventional livestock commodities such as meat and egg are still handled by a traditional mode where individual farmers/ keepers produce, process (slaughter) and bring to nearby markets, although there are a few exceptions of large-scale operators.

As described above, there are in general only limited engagements by private sector in agricultural production and processing. They are played by middlemen and traders as used to be in the past. However, for a few specific crops such as horticulture, oil seeds, and dairy products, where demands are expanding rapidly, there are increasing, if not of full scale, activities of private companies. Due to these activities, value chains of the crops are gradually improving with respect to efficiency and product quality. However, for more tangible impacts of private sector involvement, one still needs to look for large-scale private engagement, which is typically brought about by foreign direct investments (FDI).

4.13.2 Private Sector in Agricultural Investment and Development

Basic policy of private sector involvement in agricultural sector was already claimed by a form of “PPP” in the 2001 Agricultural Sector Development Strategy. This policy was placed into action by the first

ASDP (2006/07 – 2013/14). Parallel to this, the government declared a proclamation "Kilimo Kwanza (Agriculture first)", followed by such initiatives as SAGCOT (2011 – present) and Big Result Now (BRN) (2013/14 – 2015/16). These actions were primarily intended to solicit foreign investments in Tanzania's development process, in particular into the process of transforming agriculture from subsistence to commercial undertaking.

According to the data of FDI since 2008, major destinations of FDI inflow are sectors of mining and quarrying, manufacturing, finance and insurance, and electricity and gas. Unfortunately, despite the government initiatives above, agricultural sector is not included in the major targets, receiving less than 3% of whole FDI both in terms of inflow and accumulation. Worse, the share has declined in 2012 and 2013 indicating decreasing trend.

Table 4.13.1 Stock and Flows of FDI by Activity, 2009 – 2013 (USD in Million)

Activity	FLOWS						STOCK					
	2008	2009	2010	2011	2012	2013	2008	2009	2010	2011	2012	2013
Mining and quarrying	669.8	385.1	909.9	406.5	889.3	520.4	3,714.1	4,099.2	5,009.1	5,415.5	6,304.8	6,825.2
Manufacturing	277.6	214.5	157.1	217.3	563.7	386.6	870.7	1,085.2	1,242.3	1,459.5	2,023.3	2,409.9
Financial and insurance	81.7	95.9	95.5	121.1	148.1	752.2	416.3	512.2	607.6	728.7	876.8	1,629.0
Electricity and gas	1.0	2.1	290.5	209.4	618.3	37.3	24.7	26.8	317.3	526.7	1,145.0	1,182.3
Accommodation	129.7	35.9	21.1	165.6	5.4	47.0	388.7	424.6	445.7	611.3	616.8	663.8
Wholesale and retail trade	21.1	-16.9	36.9	114.5	-35.2	123.5	372.0	355.1	392.0	506.5	471.3	594.8
Information and communication	127.6	185.1	83.5	-98.3	-420.1	195.9	532.4	717.4	801.0	702.7	282.6	478.5
Agriculture	21.2	29.0	22.9	31.4	11.2	10.3	202.3	231.3	254.2	285.6	296.8	307.1
Professional activities	-0.7	0.5	213.0	6.1	20.1	-0.1	1.1	1.6	214.6	220.6	240.7	240.6
Construction	-3.7	14.9	-23.5	30.7	-28.1	13.8	119.5	134.4	110.9	141.5	113.4	127.2
Real estate activities	26.5	1.5	1.5	12.0	23.4	-0.6	79.7	81.2	82.8	94.7	118.1	117.5
Transportation and storage	2.7	3.9	4.0	10.4	-1.0	19.5	28.8	32.7	36.7	47.1	46.1	65.6
Other service activities	1.4	1.4	-0.8	1.1	3.9	22.9	3.8	5.2	4.4	5.5	9.4	32.3
Education	0.4	0.3	1.6	1.8	0.5	2.2	2.0	2.3	3.9	5.7	6.2	8.4
Grand Total	1,383.3	953.1	1,813.3	1,229.4	1,799.6	2,130.9	6,945.6	7,898.7	9,711.9	10,941.3	12,740.9	14,871.8

Source: Bank of Tanzania, NBS, 2013 and 2014, Tanzania Investment Report

Table 4.13.2 Stock and Flows of FDI by Activity, 2009 – 2013 (%)

Activity	FLOWS (Share by Activities)						STOCK (Share by Activities)					
	2008	2009	2010	2011	2012	2013	2008	2009	2010	2011	2012	2013
Mining and quarrying	48.4	40.4	50.2	33.1	49.4	24.4	53.5	51.9	51.6	49.5	49.5	45.9
Manufacturing	20.1	22.5	8.7	17.7	31.3	18.1	12.5	13.7	12.8	13.3	15.9	16.2
Financial and insurance	5.9	10.1	5.3	9.9	8.2	35.3	6.0	6.5	6.3	6.7	6.9	11.0
Electricity and gas	0.1	0.2	16.0	17.0	34.4	1.8	0.4	0.3	3.3	4.8	9.0	7.9
Accommodation	9.4	3.8	1.2	13.5	0.3	2.2	5.6	5.4	4.6	5.6	4.8	4.5
Wholesale and retail trade	1.5	-1.8	2.0	9.3	-2.0	5.8	5.4	4.5	4.0	4.6	3.7	4.0
Information and communication	9.2	19.4	4.6	-8.0	-23.3	9.2	7.7	9.1	8.2	6.4	2.2	3.2
Agriculture	1.5	3.0	1.3	2.6	0.6	0.5	2.9	2.9	2.6	2.6	2.3	2.1
Professional activities	-0.1	0.1	11.7	0.5	1.1	0.0	0.0	0.0	2.2	2.0	1.9	1.6
Construction	-0.3	1.6	-1.3	2.5	-1.6	0.6	1.7	1.7	1.1	1.3	0.9	0.9
Real estate activities	1.9	0.2	0.1	1.0	1.3	0.0	1.1	1.0	0.9	0.9	0.9	0.8
Transportation and storage	0.2	0.4	0.2	0.8	-0.1	0.9	0.4	0.4	0.4	0.4	0.4	0.4
Other service activities	0.1	0.1	0.0	0.1	0.2	1.1	0.1	0.1	0.0	0.1	0.1	0.2
Education	0.0	0.0	0.1	0.1	0.0	0.1	0.0	0.0	0.0	0.1	0.0	0.1
Grand Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: Computed by the JICA Study Team from the original data (Bank of Tanzania, NBS, 2013 and 2014, Tanzania Investment Report)

Further observations are made by looking into the details of the outputs of BRN (agriculture)[14]. This initiative was aspired by the government with clear goal of rapid changes by intensive interventions by the government and mobilization of foreign investments. Agricultural BRN consisted of three components: 25 large-scale private sector agricultural investments (plantation type operation), 78 private sector led irrigation management, and 275 warehouse rehabilitation/construction and their operation, all of which were expected to complete in three years from 2013/14. Among the components, the 25 investments were particularly noted with high expectation that agricultural modernization would soon be achieved. Unfortunately, however, until now, there have not been many achievements except for four projects that secured partial transfer of land title to investors. The results are summarised in Table 4.13.3.

Table 4.13.3 Outputs of BRN (Agriculture) as of June 2016

Activity	Status (as of June 2016)
Development of 25 Commercial Farms	Only four projects had some progress: ・ Bagamoyo, (Bagamoyo DC), (Sugarcane): Land title was acquired by investor. ・ Mkulazi, (Morogoro DC), (Sugarcane): Land title was acquired by investor. ・ Lukulilo (Rufiji DC), (Rice): Land title was acquired by investor. ・ Kitengule (Karagwe DC), (Sugarcane): Land title was acquired by investor. Other 21 projects are still in the process of finding interested investors.
78 Privately Managed Irrigation Schemes	Out of 78 schemes, 39 have been given some supports (funds for facility rehabilitation or training, etc.). However even the 39 schemes are still incomplete due to not-sufficient funds for rehabilitation etc.
275 Warehouse management	Out of 275 warehouses, 75 have been given some support (funds for warehouse rehabilitation, equipment or training).

Source: Prepared by the JICA Project Team

As described above, mobilisation of private sector has been limited in agricultural sector. In the current economic situation of the country where the national economy has been growing steadily at a sound rate, the policy of private sector mobilization is very timely and suitable. However, as actual attempts revealed, the country needs to overcome several challenges to really effectively attract foreign investments.

The greatest challenge is the land title and ownership. Even now vast majority of Tanzanian land is subject to traditional village ownership or customary arrangement. The government is making efforts to accelerate land registration, but the undertaking so far covers only 10% of total area, as of 2015. Without clear measurement and records of land ownership, large-scale investments especially those by foreign companies are handicapped by uncertainty of the transfer of land title.

Another challenge is the securing agreements with and compensation to local people. Although investors usually take great care of supplying information and explaining the project to stakeholders, the latter often feel it indispensable to have consultation or negotiation opportunities with investors. Moreover, the stakeholders sometimes show concerns when politicians and government officials are involved in such occasions. If such consultation is not sufficient, investment project sometimes encounters difficulties in securing necessary agreements with stakeholders along the process of implementation.

In addition to the two issues above, investment into Tanzania is subject to other difficulties such as inefficient administrative process of permits and licenses, prolonged time for procurement, unexpected

[14] BRN has 6 components: Infrastructure, energy, water, agriculture, education, and financial mobilisation.

change in policies (export ban), inconsistency among policies and regulations, and inadequacy of public infrastructure like road and electricity. According to the World Bank "Ease of Doing Business Rank" (June 2016)[15], Tanzania is positioned at 132 out of 190 countries. The government needs to carry out further reforms and improvements in order to attract private investments into agricultural sector.

[15] World Bank, 2016 June, Doing Business Ranking, access to http://www.doingbusiness.org/rankings

Chapter 5 Present Conditions of Irrigation Sector

5.1 General

Since the current National Irrigation Master Plan 2002 (NIMP2002) was prepared in 2002, there have been many changes in the circumstances surrounding the irrigation sector for the last 15 years, such as the government development policies, government administrative system and regulations, climate change, and global economy. The National Irrigation Commission (NIRC) is currently leading the irrigation development and management in the mainland of Tanzania as an independent government agency established in 2015 under the Ministry of Water and Irrigation (MoWI). The NIRC reportedly has achieved the development target set out in the current NIMP2002 by 2014/15, and is now facing a challenge to formulate the next long term irrigation development plan towards the future.

This part reviewed the present conditions, problems, and constrains in the irrigation sector, which provide the basis for the formulation of National Irrigation Master Plan 2018 (NIMP2018).

5.2 National Irrigation Policy and Act

(1) National Irrigation Policy 2010

The National Irrigation Policy 2010 (NIP2010) was officially published in February 2010 in response to the recommendation of the present NIMP2002. The outline of NIP2010 is summarised in Table 5.2.1.

Table 5.2.1 Outline of National Irrigation Policy 2010

Item	Description	
1. Vision	A sustainable and dynamic irrigation sector that is a driving force in transforming agriculture into a stable, highly productive, modernised, commercial, competitive, and diversified sector which generates higher incomes; increases food security and stimulates economic growth.	
2. Mission	To facilitate a participatory demand driven irrigation development through Integrated Water Resources Management to enhance water use efficiency for increased and sustainable agricultural production, productivity and profitability to ensure food security, poverty reduction, and national economic development.	
3.1 Objectives	The main objective is to ensure sustainable availability of irrigation water and its efficient use for enhanced crop production, productivity, and profitability that will contribute to food security and poverty reduction.	
3.2 Major Subjects	・ Investment for irrigation development in Tanzania ・ Management of irrigation schemes ・ Irrigation research and development ・ Institutional capacity ・ Financing mechanism ・ Cross-sectoral issues	・ Cross-cutting issues ・ Institutional arrangement for policy implementation ・ Legal and regulatory framework for accelerated development of the irrigation sector ・ Coordination, monitoring, and evaluation

Sources: NIRC, 2010, NIP

It is noted that the Strategic Environmental and Social Assessment (SESA) for NIP2010 and NIMP2002 was conducted in 2011.

(2) National Irrigation Act 2013

The National Irrigation Act 2013 (NIA2013)[1] was publicly issued in January 2014 as the legal grounds

[1] http://www.lrct.go.tz/download/Laws-of-Tanzania.../ActNo-5-2013.pdf

to implement NIP2010. NIA2013 is comprised of 10 parts and 75 sections. The Irrigation Regulations 2015 (IR2015) was made under Section 74 of NIA2013 and the Government published it on 11th September 2015. IR2015 is comprised of 108 sections to supplement NIA2013. The outline of NIA2013 is shown in Table 2.5.3.

(3) Draft National Irrigation Development Strategy

The draft National Irrigation Development Strategy (NIDS-draft) was once drawn up in November 2013 to incorporate NIP2010 into the development strategy. The outlines of NIDS-draft are shown in Table 2.5.3. However, the final version has not come out yet until now. According to the NIRC, the NIDS-draft will be reviewed and finalized upon receiving the final report on the NIMP2018.

5.3 Definition of Irrigation and Irrigation Schemes

It is first important to understand the definition of irrigation-related technical terms introduced in NIP2010 and NIA2013, which are often defined in the context of Tanzania.

5.3.1 Definition of Irrigation

Irrigation is generally defined as a method to control applications of water required to crops to supplement rainfall. However, it includes a farmer-made traditional irrigation in Tanzania as shown in Table 5.3.1

Table 5.3.1 Definition of Irrigation

Technical Term	NIA2013	FAO
Irrigation	The application of a specific amount of water at a location in order to meet the requirements of a crop growing at that location in amounts that are appropriate to the crop's stage of growth, it can also involve the application of water in amount necessary to bring soil to the desired moisture level prior to crop planting. *1	Controlled applications of water to supplement the rainfall (note that flooded land is not termed 'irrigated' unless the water is in some way controlled).
Irrigation Area	An area irrigated or capable of being irrigated either by gravitational flow or by lift irrigation or by any other method so declared by the Minister responsible for land under the provisions of Section 16 of this Act.	(Area actually irrigated) The area which is actually irrigated at least once in a given year. Often, part of the equipped area is not irrigated for various reasons such as lack of water, absence of farmers, land degradation, damage, and organisational problems. It only refers to physical areas, meaning that irrigated land that is cultivated twice a year is counted once.
Irrigation Potential	Total area which is technically feasible, economically and financially profitable, socially viable and environmentally acceptable that is irrigated or capable of being irrigated on the basis of water availability, land availability and suitability. *1	Area of land which is potentially irrigable. Country/regional studies assess this value according to different methods, for example some consider only land resources suitable for irrigation, others consider land resources plus water availability, others include in their assessment economic aspects (such as distance and/or difference in elevation between the suitable land and the available water) or environmental aspects, etc. Whatever the case, it includes the area already under agricultural water management.

*Note: *1= The same defined in Irrigation Policy 2010*
Source: National Irrigation Act 2013 and FAO Glossary http://www.fao.org/nr/water/aquastat/irrigationmap/glossary.pdf

5.3.2 Definition of Irrigation Schemes

The irrigation schemes defined in NIP2010 is summarised as Table 5.3.2. As it is a feature of Tanzania, there are so many traditional irrigation systems built and operated by farmers.

Table 5.3.2 Definition of Irrigation Schemes

Technical Term	NIP2010
Irrigation Scheme	The area where crops are grown under irrigation through any method including flood recession; gravity or pump fed canal systems supplying either surface or groundwater; water harvesting and pressurised systems such as drip and sprinkler. Irrigation schemes include traditional schemes, rehabilitated or upgraded schemes, new smallholder investment and purely private commercial investment.
Scale of Irrigation Scheme	(a) Smallholders' Irrigation Schemes: are schemes with area of 500 ha or below; (b) Medium Scale Irrigation Schemes are schemes having area between 500 ha and 2,000 ha; (c) Large Scale Irrigation Schemes are schemes with areas of over 2,000 ha. Although it is difficult to develop strict rules for categorising irrigation into classes based on area, the above three classes of irrigation schemes will be adopted.
Traditional Irrigation Scheme	An irrigation scheme with irrigation system comprising of temporary infrastructure and/or facilities that are not technically constructed/installed.
Upgraded/Improved Irrigation Scheme	An existing irrigation scheme that is subjected to works resulting into better irrigation infrastructure and performance.
Rehabilitated Irrigation Scheme	An irrigation scheme initially developed or improved but then rehabilitated after its previous infrastructure had worn out or damaged.
Developed Irrigation Scheme	An irrigation scheme that is provided with technically constructed or installed irrigation infrastructure and facilities.
New Irrigation Scheme	An irrigation scheme that is developed in an area that has never been provided with irrigation infrastructure. The new irrigation scheme is further divided into (a) smallholder scheme and (b) commercial scheme.
Gravity-fed Irrigation Schemes	Schemes whereby farmers have diverted water from a surface water source be it a perennial, intermittent or ephemeral stream; a small, medium or large dam or any other source of water and convey it to the command area by gravity via a system of canals or conduits.
Pumped Irrigation Schemes	Schemes whereby water is pumped from a source which may include a river stream, a well, a borehole, a water reservoir and convey it to the command area under pressure. The method for irrigation at the scheme could be surface, drip, or sprinkler system.
Rainwater Harvesting (RWH) Irrigation Schemes	Schemes whereby farmers construct water retaining bunds, harvest rainwater and store the water at the foot of mainly paddy crop. Despite their simple technology, such schemes are significant in production of rice in Tanzania.
Micro Irrigation Schemes	Schemes whereby farmers draw water from a source by hand and use it mainly for vegetables and high value crops. They include cases where water is harvested from roof tops and stored in tanks and where farmer's pond the water diverted from a stream and convey it to their fields through a piped network where it is applied to the crops through drip emitters or low pressure sprinklers (sometimes called localised irrigation). These types of schemes include those developed using the bucket drip irrigation kits or the treadle pumps.
Flood Recession Irrigation Schemes	These are the schemes established by farmers whereby crops, usually paddy, are grown on flood plain of the rivers and are watered by the frequent flooding of the river.
Wetland Irrigation Schemes	These are the schemes developed by farmers in valley-bottoms whereby the soils are inundated by surface or ground water sufficient to support a prevalence of vegetable or aquatic life that requires saturated or seasonally saturated soil conditions for growth and reproduction.
Backyard Irrigation	This refers to a small garden under irrigation around a house using water from domestic supply system or water harvested from roof tops.

Source: NIRC, NIP 2010

Based on Table 5.3.2, a matrix to show the relationship between the category of irrigation schemes and irrigation methods is developed as follows. First of all, the traditional schemes will be upgraded and improved with some extension of irrigation area if any. In this case, a drastic increase of irrigation area cannot be expected in comparison with new irrigation scheme development. Therefore, new irrigation schemes are also needed to develop in parallel to the improvement in order to expand the irrigation area.

As shown in the Table 5.3.3, the irrigation development under NIMP2018 would be four categories; traditional, improved, extension or new.

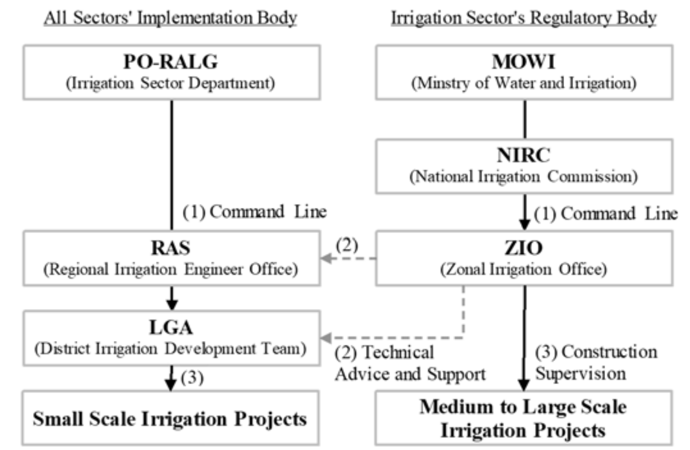
Table 5.3.3 Matrix of Irrigation Category and Irrigation Method

Irrigation Method	Traditional	Developed		
		Improved	Extension	New
Gravity-fed Irrigation	○	●	●	●
Pumped Irrigation	○	●	●	●
RWH Irrigation	○	●	●	●
Micro Irrigation	-	-	●	●
Flood Recession Irrigation	○	●		
Wetland Irrigation	○	●		
Backyard Irrigation	○	●		

Note: ○= Traditional scheme, ●= Developed scheme
Source: JICA Project Team

5.4 Government Administrative Organisation for Irrigation Development and Management

As illustrated in the Figure 5.4.1, there are two chains of command for irrigation development and management. One is for small scale irrigation projects under President's Office Regional Administration and Local Government (PO-RALG). After the decentralization of the government administration, the Local Government Authorities (LGA) bears the responsibility of development and management of small scale irrigation project. In this case, the funds (DIDF) will be transferred from the Ministry of Finance and Planning (MOFP) to the LGA based on the approved annual budget by PO-RALG. The other is for medium and large-scale irrigation projects under NIRC who is fully responsible for implementation of the irrigation development projects. In this case, the funds (NIDF) will be transferred from MoFP to NIRC/ZIO according to the approved annual budget. NIRC/ZIO will also support LGA technically in implementation of small scale irrigation projects.



Source: JICA Project Team

Figure 5.4.1 Government Organisation Structure for Irrigation Development and Management

(1) NIRC

NIRC is established under Section 3 of the NIA2013 as an independent department of the government under the ministry responsible for irrigation. The NIRC is a government agency and its day to day activities are managed by the director general under the guidance of the governing board of ten members. Thus, it is the government's effort to address the current agricultural practices that have in most cases been characterised by crop production influenced by erratic and unreliable rainfalls. The development of the irrigation sector has an unprecedented opportunity to facilitate the Tanzania agriculture sector to be transformed from subsistence to a modern and highly commercial sector. The government is currently giving high priority into irrigation development which is emphasized within the national policy frameworks. The government is also giving high priority to the management of the nation's water resources. This offers strong synergies between the water and irrigation sectors in irrigation development.

(a) Mandate and Functions of NIRC

The NIRC is mandated for coordination, promotional and regulatory functions in the development of the irrigation sector, which is briefly as Table 5.4.1.

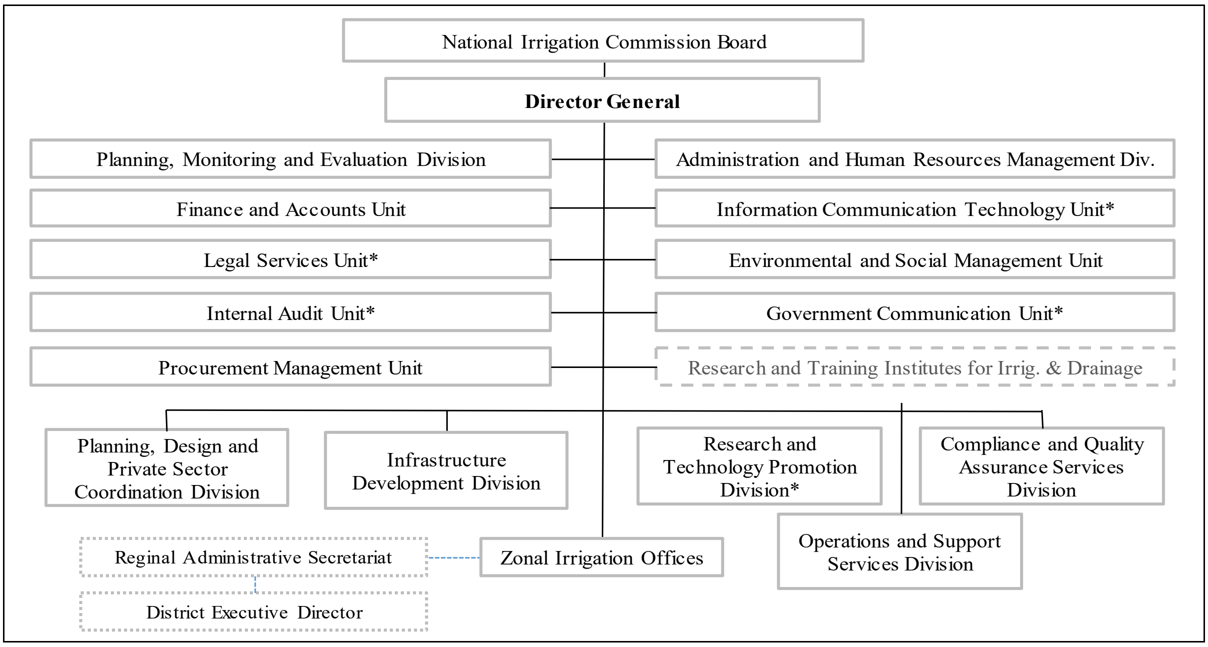
Table 5.4.1 Mandate and General Functions of NIRC

Type of Services	General Functions
Administrative management services	・ Advise the government on the implementation and review of the national irrigation policy, strategy, national irrigation master plan and related legislation; ・ Represent the government in the national and international fora and collaborate with both local and international firms and organisations in all matters pertaining to irrigation development and management; ・ Coordinate all interventions in irrigation sector conducted by the development partners and other stakeholders; ・ Promote and maintain cooperation in irrigation and drainage with similar bodies in other countries and with international bodies connected with irrigation and drainage; and ・ Advise the minister on declaration of irrigation areas.
Technical services	・ Plan, carryout studies, design, construct, supervise and administer implementations of the irrigation projects; ・ Register and maintain a register of all irrigators; ・ Promote institutional linkages training programs and support the recruitment of persons for purposes of employment in connection with the irrigation sector; ・ Build capacity of the irrigators for effective participation at all levels in irrigation planning, implementation, operation and management; ・ Undertake and coordinate research, disseminate appropriate technologies emanating from the research findings and provide technical support services on irrigation; ・ Promote development of multipurpose water storage facilities for irrigation purposes and other social economic activities; ・ Regulate all matters related to irrigation development and to oversee collaborations among different players in the development of irrigation and drainage; ・ Approve construction of irrigation works, standards and guideline for development and management of irrigation and drainage; ・ Promote efficient water use in irrigation systems and ensure compliance with the integrated water resources management approach in irrigation development; and ・ Advise the government in all matters relating to development and management of irrigation sector in the country.

Source: The Functions and Organisation Structure of the National Irrigation Commission, (Approved by the President on 12th February, 2015), President's Office, Public Service Management, Dar es Salaam, February 2016

(b) Organisation Structure and General Functions of NIRC

The NIRC's organisation is broadly divided into two parts: administrative management and technical support for irrigation development and management, the former has two divisions and seven units, and the latter has five divisions as shown in the Figure 5.4.2.



*Note: *= Vacant post as of March 2017*
Source: NIRC, 2016, The Functions and Organisation Structure of the National Irrigation Commission, (Approved by the President on 12th February, 2015), President's Office, Public Service Management, Dar es Salaam, February 2016

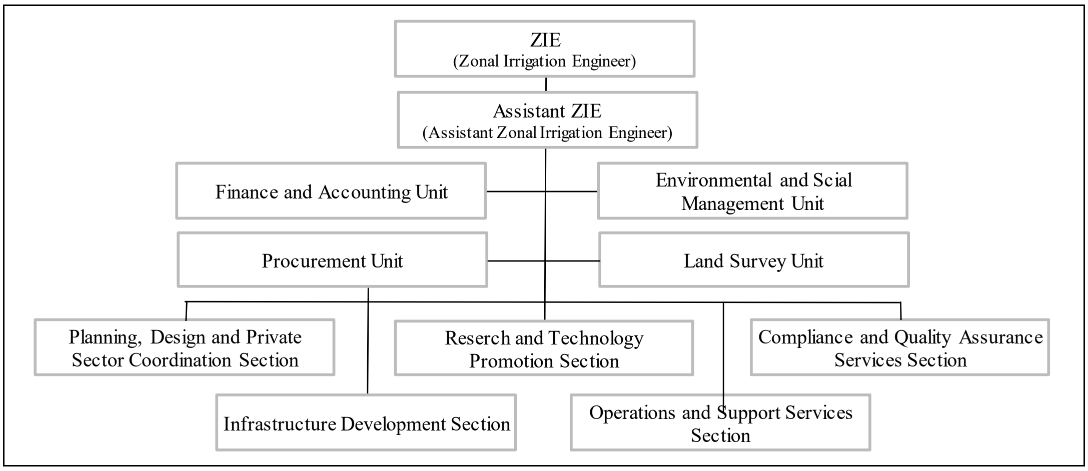
Figure 5.4.2 Organisation Structure of NIRC

(2) ZIO

There will be eight ZIOs established for providing irrigation technical backstopping closer to LGAs and stakeholders. These are Morogoro ZIO, Mwanza ZIO, Katavi ZIO, Dodoma ZIO, Mbeya ZIO, Tabora ZIO, Mtwara ZIO, and Kilimanjaro ZIO at present. According to NIA2013, ZIOs will be changed into a new Regional Irrigation Office (RIO) to be established in each region in future. It is now a transition period for the organisational reform.

(a) Organisation Structure of ZIO

The ZIO organisation is almost similar to that of NIRC. Usually a ZIO comprises three to four administrative management units and five technical supporting section under the control of Zonal Irrigation Engineer (ZIE) and Assistant ZIE as indicated in the Figure 5.4.3.



Source: NIRC, 2016, The Functions and Organisation Structure of the National Irrigation Commission, (Approved by the President on 12th February, 2015), President's Office, Public Service Management, Dar es Salaam, February 2016.

Figure 5.4.3 Organisation Structure of ZIO

(b) Mandate and General Functions of ZIO

The general functions of ZIO are summarised in the Table 5.4.2.

Table 5.4.2 Mandate and General Functions of ZIO

Type of Services	Mandate and General Functions
Administrative management services	・Provide administrative and human resources management services. ・Provide finance and accounts services. ・Provide logistics and procurement services, etc.
Technical services	・Perform as irrigation experts the project identification and formulation, feasibility study and detailed design, tendering and project management for medium and large-scale irrigation development projects (500 ha or above). ・Assist LGAs irrigation staff in the project identification and formulation, feasibility study and detailed design, tendering and project management for small scale irrigation development projects (below 500 ha). ・Assist LGAs in the formulation of irrigator's organisations. ・Ensure dissemination and utilisation of operation and maintenance manuals and other irrigation guidelines. ・Mainstream environmental and social safeguards in irrigation and drainage plans and designs. ・Undertake data collection for irrigation data bank. ・Promote of water saving irrigation technologies, renewable energies for irrigation and drainage purposes, Integrated Water Resources Management (IWRM) in collaboration with basin water boards regarding irrigation water use permits. ・Liaise between the commission headquarters, region, districts, LGAs and the private sector on irrigation matter, etc.

Source: *The Functions and Organisation Structure of the National Irrigation Commission, (Approved by the President on 12th February, 2015), President's Office, Public Service Management, Dar es Salaam, February 2016*

As many LGAs are facing a shortage of irrigation staffs in number and capacity, ZIO is often assisting LGAs in the engineering works, such as feasibility study, detailed design, and project management on condition that the fund is provided by LGAs.

(3) RIO

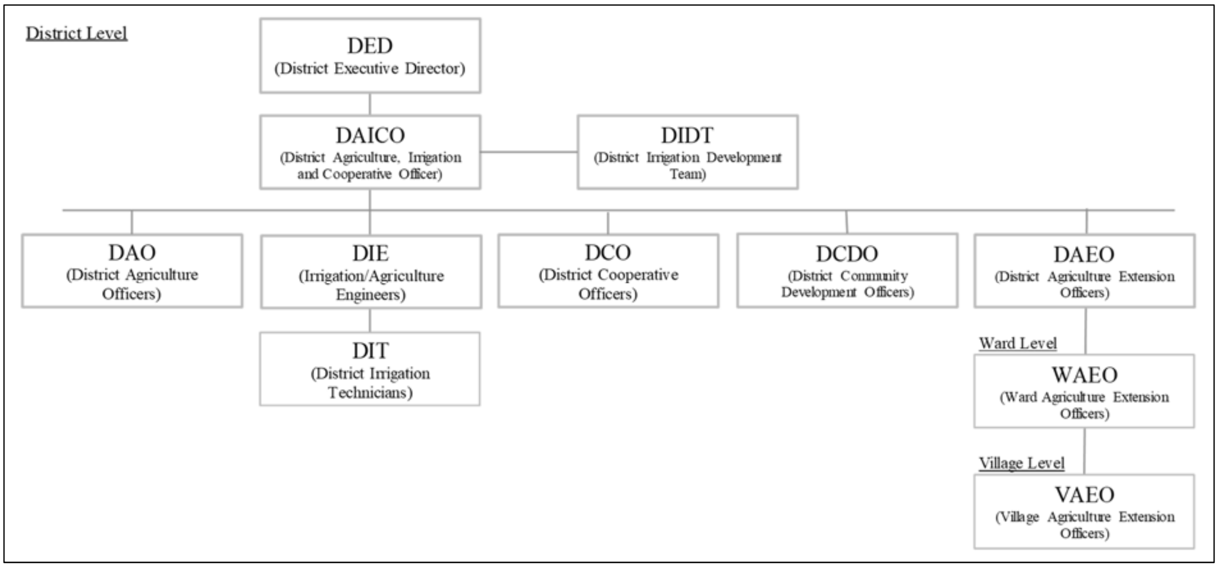
As stipulated in the NIA, ZIOs will be absorbed into a new RIO. It intends to make closer communication and provide finely tuned technical support to LGAs. Having discussed in the above however, ZIO will continue its functions until RIO would be established in the regions. At this moment, the Regional Irrigation Engineer (RIE) has mandated as a coordinator between LGAs to PO-RALG, including but not limited i) to scrutinise the annual irrigation development plan and budget submitted by LGAs and submit it to PO-RALG if acceptable and ii) to monitor the physical progress and financial progress based on the plan and budget approved by PO-RALG. The funds will be transferred into the specific bank accounts of the respective LGAs from MOFP. At the same time, a copy of issue of notification will be forwarded to RIE of RAS.

As LGA is not a chain of command of ZIO/NIRC, ZIO is often obliged to request RIE to guide LGAs to provide data and information whenever necessary.

(4) DAICO Office at LGA Level

LGA is responsible for small scale irrigation development (500 ha or below). The head of district council, District Executive Director (DED) who has the authority to make the final decision including payments to the contractors. However, in practice, the District Agriculture, Irrigation and Cooperatives Officer (DAICO) in each district council office oversees all agriculture development and management activities including irrigation development in his/her district with support of his/her staffs. The District Irrigation Engineers (DIEs) and District Irrigation Technicians (DITs)[2] usually work on irrigation-related engineering services, formulation of Irrigators' Organisation (IOs) and capacity building trainings to IOs. When necessary, the District Community Development Officer (DCDO), District Agriculture Extension Officer (DAEO), Ward Agriculture Extension (WAEO), and Village Agriculture Extension Officer (VAEO) will provide trainings to IOs.

Whenever making an important decision for the district irrigation development, DAICO will organise the District Irrigation Development Team (DIDT) consisting of DIE, DIT, DCDO, DAEO, District Agriculture Officer (DAO), District Planning Officer, District Cooperative Officer (DCO), District Procurement Officer, etc. in compliance with CGL (Comprehensive Guidelines for Irrigation Scheme Development under District Agricultural Development Plan). The organisational structure of DAICO office is shown in Figure 5.4.4..



Source: Mbarali DC edited by JICA Project Team

Figure 5.4.4 Organisation Structure of DAICO Office (Example)

It is stated in the NIA that the District Irrigation Department (DID) shall be established to strengthen the implementation capacity of LGAs for irrigation development and management.

LGAs are now working on community development planning at village level in participatory manner by using the Opportunities and Obstacles to Development (O&OD) technique. A Village Development Plan (VDP) of O&OD will be integrated finally with the District Agriculture Development Plan (DADP) In this process, the development funds tend to be allocated thinly and broadly in accordance with the VDP. That is why no clear development effect of DADP could be seen. From now on, LGAs will allocate the DADP funds to implement a development plan with selection and concentration under the comprehensive and strategic district development policy.

The Local Government Development Grant (LGDG) will be a main fund source for the district

[2] As academic qualification, irrigation engineers hold a bachelor's degree in engineering and are capable of designing irrigation facilities and schemes. Irrigation technicians are supposed to complete an ordinary diploma in irrigation and support the irrigation engineers in project implementation such as construction management.

agriculture and irrigation development, which includes i) District Agriculture Development Grant (DADG), ii) Agriculture Extension Development Grant (AEDG), and iii) Agriculture Capacity Building Grant (ACBG). LGAs could implement, at his discretion, small irrigation schemes by using DADG of LGDG. Apart from that, there are irrigation development funds on a project basis; District Irrigation Development Fund (DIDF) for implementation of small scale irrigation schemes (500 ha or below) and National Irrigation Development Fund (NIDF) for implementation of medium and large-scale irrigation schemes (over 500 ha). The former will be transferred from MoFP to the LGAs concerned whereas the latter from MoFP to NIRC/ZIOs.

5.5 Irrigation Development Performance

5.5.1 NIRC's Budgets and Expenditures

Table 5.5.1 shows the approved annual budget and expenditure of NIRC for the last five fiscal years. It indicates that the percentage of expenditure against the approved budget for development is 21.1% on the average, declining from 46.7% in 2012/13 to 9.4% in 2016/17. Similarly, the operation expenditure has drastically decreased to TZS 300 million in 2016/17 from TZS 751 million in 2012/13. It implicates that most of NIRC's staff might be compelled to wait for works in their offices because of small fund disbursement for development and operation especially during 2015/16 and 2016/17.

Table 5.5.1 Budget and Expenditure of NIRC

Type of Fund	Item	2012/13	2013/14	2014/15	2015/16	2016/17
Development NIDF (Local and Foreign)	Total Approved Budget (1)	16,414	26,392	33,933	53,395	35,370
	Local	11,000	10,000	15,000	6,000	6,000
	Foreign	5,414	16,392	18,933	47,395	29,370
	Total Expenditure (2)	7,672	8,490	10,659	5,131	3,341
	Local	2,258	3,400	0	0	2,240
	Foreign	5,414	5,090	10,659	5,131	1,101
	Percent of (2) / (1)	46.7%	32.2%	31.4%	9.6%	9.4%
Recurrent Operation and Salary	Operation	751	699	671	382	300
	Personal Emolument	NA	NA	NA	2,806	4,207

Note: "NA" indicates the data for irrigation staffs is not available because it was part of the total MAFC salary as NIRC was under MAFC.
Source: NIRC, 2017

5.5.2 Irrigation Development

Irrigation area in the mainland of Tanzania has reached 461,326 ha by 2014/15 as shown in Table 5.5.2.

Table 5.5.2 Irrigation Area Developed in the Past 10 Years

Item	Unit	2005/06	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15
Cumulative Irrigation Area	ha	264,388	273,945	289,245	310,745	331,490	345,690	354,602	363,514	450,392	461,211
Annual Increment	ha	-	9,957	15,300	21,500	20,745	14,200	8,912	8,912	86,878	10,819

Source: NIRC, 2016

Irrigation area is estimated based on the data from each ZIO who compiled the data reported by LGAs in his/her jurisdiction. It should be noted that the irrigation area in the mainland is reported to be 277,820 ha in the National Sample Census of Agriculture 2007/08[3], and 325,276 ha in the Annual Agricultural Sample Survey Report 2014/15[4]. There is a significant gap in data of NIRC, i.e., 11,425 ha in 2007/08 and 136,050 ha in 2014/15, respectively.

The irrigation area by various parameters is calculated based on the NIRC database updated as of December 2015, which is discussed hereunder.

(1) Irrigation Area by Development Category

Kilimanjaro Zone (31%) is the largest in irrigation area, followed by Mbeya (22%), Morogoro (20%), Mwanza (11%), Dodoma (8%), Mtwara (4%) and Tabora (4%). By irrigation category, the improved schemes account for 75% of the total irrigation area, 21% by traditional scheme and 4% by RWH scheme. It is characterized that improved and traditional schemes are more observed in Kilimanjaro, Morogoro, and Mbeya, while RWH schemes are more developed in Mwanza, Dodoma, and Tabora as shown in Table 5.5.3

Table 5.5.3 Irrigation Schemes by Irrigation Category (As of December 2015)

Irrigation Zone*1	Improved		Traditional		RWH		Total		
	No.	Area (ha)	No.	Area (ha)	No.	Area (ha)	No.	Area (ha)	(%)
Dodoma	157	31,295	66	2,931	28	2,792	251	37,018	(8%)
Kilimanjaro	508	114,590	418	28,209	2	64	928	142,863	(31%)
Mbeya	212	69,966	163	29,743	8	63	383	99,772	(22%)
Morogoro	106	81,868	63	9,482	2	204	171	91,554	(20%)
Mtwara	62	9,375	103	10,402	5	445	170	20,222	(4%)
Mwanza	180	28,986	84	8,120	105	13,915	369	51,021	(11%)
Tabora	55	10,029	42	6,010	46	2,722	143	18,761	(4%)
Total	1,280	346,109 (75%)	939	94,897 (21%)	196	20,205 (4%)	2,415	461,211 (100%)	(100%)

*Note: *1= Total number of Irrigation Zone is currently eight (8) but Katavi Zone is not operational yet.*
Source: NIRC Irrigation Database, 2015 updated version based on 2009 Database

(2) Irrigation Area by Water Source

As for the irrigation area by water source, the vast majority is river (88%), followed by RWH (6%), spring (3%), dam (2%) and others (0.4%). There is a tendency in water source for irrigation that three zones (Kilimanjaro, Mbeya, and Morogoro) depend largely on river, while the rest of the four zones depend on other sources such as RWH, spring, dam, lake, and Groundwater (GW). As shown in Table 5.5.4.

Table 5.5.4 Irrigation Area by Water Sources (As of December 2015)

Irrigation Zone	River		Dam		GW		Lake*1		Spring		RWH*2		Total		
	No.	Area (ha)	No.	Area (ha)	No.	Area (ha)	No.	Area (ha)	No.	Area (ha)	No.	Area (ha)	No.	Area (ha)	(%)
Dodoma	150	28,843	18	2,498	14	527	1	25	38	2,572	30	2,553	251	37,018	(8%)
Kilimanjaro	878	131,272	6	2,534	1	10	1	100	38	8,881	4	66	928	142,863	(31%)
Mbeya	360	98,914	3	1,245	5	110	-	-	1	10	14	213	383	99,772	(22%)
Morogoro	145	90,563	4	454	13	60	2	35	-	-	7	442	171	91,554	(20%)
Mtwara	147	16,468	3	350	4	380	-	-	5	830	11	2,194	170	20,222	(4%)

3 NBS, April 2012, National Sample Census of Agriculture 2007/08, Small Holder Agriculture, Volume II: Crop Sector-National Report. The number of samples was 51,226 in total.
4 MALF, September 2016. This is a first annual agricultural sample survey in Tanzania. The number of samples was 21,210 in total.

Irrigation Zone	River		Dam		GW		Lake*1		Spring		RWH*2		Total		
	No.	Area (ha)	No.	Area (ha)	No.	Area (ha)	No.	Area (ha)	No.	Area (ha)	No.	Area (ha)	No.	Area (ha)	(%)
Mwanza	144	28,404	15	1,708	28	51	51	976	-	-	131	19,882	369	51,021	(11%)
Tabora	199	13,778	12	1,440	-	-	-	-	1	40	21	3,503	143	18,761	(4%)
Total	1,933	407,522 (88%)	61	10,229 (2%)	65	1,138 (0.2%)	55	1,136 (0.2%)	83	12,333 (3%)	218	28,853 (6%)	2,415 (100%)	461,211	(100%)

*Note: *1= Lake includes a lagoon, *2= RWH includes a rain water*
Source: NIRC Irrigation Database, 2015 updated version based on 2009 Database

(3) Irrigation Area by Ownership

Eighty-three percent of irrigation schemes are managed by smallholders against 16% by private commercial farms. Private commercial farms are operating more in Morogoro, Kilimanjaro, Mwanza, and Mbeya as shown in Table 5.5.5.

Table 5.5.5 Irrigation Schemes by Ownership (As of December 2015)

Irrigation Zone	Government		Smallholder		Commercial		Total		
	No.	Area (ha)	No.	Area (ha)	No.	Area (ha)	No.	Area (ha)	
Dodoma	2	15	223	34,299	26	2,704	251	37,018	(8%)
Kilimanjaro	6	1,053	823	124,138	99	17,672	928	142,863	(31%)
Mbeya	4	457	361	89,403	18	9,912	383	99,772	(22%)
Morogoro	11	3,046	146	56,653	14	31,855	171	91,554	(20%)
Mtwara	-	-	170	20,222	-	-	170	20,222	(4%)
Mwanza	1	5	360	38,671	8	12,255	369	51,021	(11%)
Tabora	2	235	141	18,526	-	-	143	18,761	(4%)
Total	26	4,811 (1%)	2,224	382,002 (83%)	165	74,398 (16%)	2,415	461,211 (100%)	(100%)

Source: NIRC Irrigation Database, 2015 updated version based on 2009 Database

The private commercial farms include the ex NAFCO farms[5], which were sold off by the government during the 1990s to 2000s in compliance with the government privatisation policy.

(4) Irrigation Area by Irrigation Type

Gravity irrigation is mainstream in Tanzania, accounting for 92% in terms of irrigation area. Out of the irrigation area of 20,872 ha, pump irrigation occupies 70% in Mwanza, and 25% in Morogoro zones. The Table 5.5.6 shows the Irrigation Area by Irrigation Type.

Table 5.5.6 Irrigation Area by Irrigation Type (As of December 2015)

Irrigation Zone	Gravity		Gravity +Pump		Pressurised		Pump		Total (%)		
	No.	Area (ha)	No.	Area (ha)	No.	Area (ha)	No.	Area (ha)	No.	Area (ha)	(%)
Dodoma	236	36,342	2	35	7	520	6	121	251	37,018	(8%)
Kilimanjaro	689	140,468	4	97	11	1,781	18	517	928	142,863	(31%)
Mbeya	371	95,855	1	300	5	3,202	6	415	383	99,772	(22%)
Morogoro	130	75,150	2	8,220	4	3,057	35	5,127	171	91,554	(20%)
Mtwara	168	20,118	-	-	1	100	1	4	170	20,222	(4%)
Mwanza	261	36,331	-	-	5	110	103	14,580	369	51,021	(11%)
Tabora	140	18,403	-	-	1	250	2	108	143	18,761	(4%)
Total	2,201	422,667 (92%)	9	8,652 (2%)	34	9,020 (2%)	171	20,872 (4%)	2,415	461,211 (100%)	(100%)

Source: NIRC Irrigation Database, 2015 updated version based on 2009 Database

5 National Agriculture and Food Cooperation (NAFCO), the farms include such as Kapunga rice farm (3,200 ha) and Mbarali rice farm (3,000 ha).

(5) Irrigation Area by Irrigation Method

Surface irrigation is mainstream in Tanzania, covering 92% of the irrigation area. New water saving irrigation technology such as sprinkler, drip, and centre pivot irrigation has been introduced to five zones other than Mtwara and Tabora zones. The largest irrigation area is Kilimanjaro for surface irrigation, sprinkler irrigation in Morogoro, drip irrigation in Kilimanjaro, and centre pivot irrigation in Mwanza as shown in Table 5.5.7.

Table 5.5.7 Irrigation Area by Irrigation Method (As of December 2015)

Irrigation Zone	Surface		Sprinkler		Drip		C-Pivot		Others		Total (%)		
	No.	Area (ha)	No.	Area (ha)	No.	Area (ha)	No.	Area (ha)	No.	Area (ha)	No.	Area (ha)	(%)
Dodoma	247	36,833	-	-	4	185	-	-	-	-	251	37,018	(8%)
Kilimanjaro	909	133,835	2	170	17	8,858	-	-	-	-	928	142,863	(31%)
Mbeya	367	95,876	5	688	11	3,208	-	-	-	-	383	99,772	(22%)
Morogoro	168	81,004	3	10,550	-	-	-	-	-	-	171	91,554	(20%)
Mtwara	170	20,222	-	-	-	-	-	-	-	-	170	20,222	(4%)
Mwanza	326	38,699	2	185	39	135	1	12,000	1	2	369	51,021	(11%)
Tabora	143	18,761	-	-	-	-	-	-	-	-	143	18,761	(4%)
Total	2,330	425,230 (92%)	12	11,593 (2%)	71	12,386 (3%)	1	12,000 (3%)	1	2 (0%)	2,415	461,211 (100%)	(100%)

Source: NIRC Irrigation Database, 2015 updated version based on 2009 Database

5.6 Participatory Irrigation Water Management and IOs

5.6.1 History of Irrigation Development and Management

The years between 1700s and 1800s in Tanzania, there were an existence of pockets of well-defined irrigated cultures in the current administrative regions of Morogoro, Ruvuma, Iringa, Mbeya, Arusha, and Kilimanjaro (Mwanitu Kagubila 1993). These systems, later known as "traditional irrigation systems", have survived until today. They were owned, controlled, and managed by smallholder farmers themselves. In each system, there were furrow committees. Originally, the system was owned by clans. Later, they changed and were renamed as "village irrigation system" due to their importance to the economic life of each household.

In 1993 there were about 200,000 ha under irrigated agriculture, with about 600 irrigation schemes functions at different levels. About 80% of those schemes were owned, controlled and managed by the small-scale farmers themselves. The remaining 20% were a combination of the parastatal large scale types under the National Agriculture and Food Corporation (NAFCO), Sugar Development Corporation (SUDECO) and large and small privately owned ones. The pace of rehabilitation of traditional irrigation schemes increased in late 1990s, the organisation and management also changed especially in the establishment of orrigation committees. There are two different organisations in Tanzania; Water Users Association (WUA) and IO. WUA is formed by all types of water users from one source (usually large river) while IO is a sub-set of WUA with a specific use of water for irrigation.

5.6.2 Procedure of District Irrigation Plan

Currently the irrigation activities at the LGAs are led by the District Agricultural, Irrigation, and Cooperative Officer (DAICO). The DAICO is normally assisted by an irrigation or agricultural engineer. The district receives technical advice from the Zonal Irrigation Office. For the purposes of irrigation planning, a team is established at the district, known as District Irrigation Development Team (DIDT). The composition of the team includes an irrigation/agricultural engineer, agricultural extension officer, community development officer, planning officer, cooperative officer and land officer.

The district irrigation plans are conducted following the Comprehensive Guidelines (CGL). The Guidelines stipulates that application of all irrigation schemes should be made by village governments taking into account the real demand of farmers through a methodology known as O&OD. The guidelines have several steps, whereby following such steps, from long lists of identified schemes from different villages and latter wards, priority irrigation schemes for development in a district are established by the DIDT.

The Irrigation schemes formulated by the DIDT are validated by the ZIO through a Zonal Review Committee (ZRC). Thereafter, the schemes are submitted to the Council Management Team (CMT) for soliciting budget for implementation. In case budget is not available in full then phase wise development is instituted where implementation is separated into several packages considering progressive expansion of the irrigation and drainage canal network.

5.6.3 IOs

According to the NIRC data[6], there are 458 IOs in mainland Tanzania, and yet only eight IOs are registered under the NIA regulations. Conventionally, there are two types of irrigators' organisations: Irrigators Associations (IA) and Irrigators Cooperatives (IC). Besides these registered irrigators, there are traditional irrigators groups engaged in smaller scale irrigation practice. Normally, irrigators in an irrigation scheme form a group, which can be categorized as one of the above. The main characteristics of IA and IC are shown in Table 5.6.1.

Table 5.6.1 Types and Characteristics of Irrigators' Organisations

Type	Registration	Membership	Main Function	Land Title	Water Use Permit	Main Source of LGA Support	Major Challenge
IA	NIRC*	Compulsory	Water management, O&M	Individual/ Group	Permit obtained at BWO	Technical: DAICO office/AEO Management: CDO	- Incentives for group activities. -Administrative / financial management
IC	TCDC/ NIRC	Voluntary	Water Management, O&M, Cooperative Activities	Individual/ Group	Permit obtained at BWO	Technical: DAICO office/AEO Management: Cooperative Officer	- Involvement of non-members in O&M activities.

*Note: * After the negotiation between the NIRC and MoHA, mandate of IA registration is transferred to the NIRC*
Source: JICA Project Team

IAs and ICs have several differences in their objectives and features. First, IAs maintain compulsory membership as a rule among all irrigators in the irrigation scheme while ICs are voluntarily formed groups. That is, there might be non-member irrigators in an irrigation scheme managed by an IC. Second, IAs' activities are in principle limited to O&M and water management of irrigation schemes. Besides such activities, ICs are also engaged in collective activities of production, input purchase, harvesting, processing, marketing and distribution (so-called business practice). In general, the IC members are regarded to be more committed to group activities, pursuing profit out of collective actions.

[6] DOSS and DCQA, NIRC (as of June 2016).

Yet their major challenge is how to urge non-member irrigators to pay for operational costs, such as O&M and water use permit.

The NIA Regulations (2015) allows ICs to be registered under the NIA by obtaining a certificate of compliance while remaining as a cooperative established under the Cooperative Societies Act (CSA, 2013) only if they abide by the NIA. Yet there is a need for further adjustments between the NIA and CSA, such as compulsory or voluntary membership, fees, and audit conditions.

LGA's support system for ICs and IAs also differ. For ICs, district cooperative officers are assigned to monitor their activities, providing training on financial management and annual auditing. That is partly why cooperatives are considered to be better in financial management than the associations. For IAs, community development officers often provide the support as part of their role for supporting group activities. Technical support is provided by irrigation technicians or extension officers with a background on irrigation for both IAs and ICs. In reality, however, few LGAs can afford to attach technicians to each irrigation scheme, and the supports of zonal officers are provided mainly in the construction phase. As such, LGA's support system to IO is especially weak in O&M as well as technical inputs to crop production and marketing.

5.6.4 Operation and Maintenance

For the past years, through different programs including the Agricultural Sector Development Programme (ASDP), more efforts have been put in allocating funds for irrigation infrastructure development where several irrigation schemes have been improved, but fewer efforts have been put in ensuring the software part for irrigation facilities (i.e., operation and maintenance) is being emphasised. However, there are few irrigation schemes which are well managed in terms of O&M, these include: Mombo irrigation scheme in Korogwe District, Tanga Region, Igomelo irrigation scheme, Madibira irrigation scheme in Mbarali District, Mbeya Region, and Dakawa Irrigation scheme in Mvomero District, Morogoro Region.

In these well managed schemes, farmers prepare budgets for operation and maintenance funds. Farmers make contributions to this fund either by paying cash or contributing crop harvests worth the monetary required amounts. Water distribution to different parts of the scheme is made by observing the schedule which have been prepared and agreed among the farmers. Normally, the distribution is made by a paid water person; guidelines are put for him or her to observe in order to eliminate the element of biasness during water distribution. The money collected in the O&M fund is used to pay for the water person, basic office management needs of the IO and repairs of the irrigation facilities.

Recently, there have been efforts of inculcating the importance of O&M of irrigation schemes to IOs through the TANCAID project by utilizing the CGL[7]. Currently there are four schemes which are being used as O&M demo sites. These schemes are: Ulyanyama irrigation scheme in Sikonge District, Tabora Region, Nyida irrigation scheme in Shinyanga District, Shinyanga Region, and Msemembo irrigation scheme in Manyoni District, Singida Region, Lemkuna irrigation scheme in Simanjiro District, Manyara Region. The main activities of these schemes are the transparency among the leaders and members, having O&M plan which covers all activities including time for meetings, record keeping, availability

[7] Refer to Table 8.3.5 in Chapter 8.

of Constitution which is adhered, and strong IO leaders.

After the utilisation of the CGL in schemes, the IOs themselves start preparing O&M plan, making budget as per O&M form, collect O&M fee, transparency and accountability of IOs, conducting meetings as per O&M plan and writing reports to LGAs. The LGAs will follow-up, provide technical backstopping to IOs, and write reports to the Zonal Irrigation Offices as well as to NIRC headquarters. NIRC headquarters through the Capacity Development for the Promotion of Irrigation of Scheme Development under the District Agricultural Development Plan (TANCAID) project provides technical backstopping and follow-ups.

Box 5.6.1：Water Use Fees and Irrigation Service Fees

IO is obliged to register at Basin Water Office (BWO) as water users, and at NIRC as irrigation beneficiary, respectively.

(1) Water Use Fees: The current water use fee structure is set by the Revised Act 2002 as shown in the table below. In addition, it is stipulated that the water use fee is paid to the BWOs.

Table 5.6.2 Fees according to Water Utilisation (General) Amendment Regulation 2002

Item of Water Use	Application Fees (USD)	User Fee (USD)	
		Flat Rate	Increment Rate
Domestic / Livestock	40	35	0.035/100 m^3, above 3.7 lit/s
Small-scale Irrigation	40	35	0.035/100 m^3, above 3.7 lit/s
Fish Farming	40	35	0.035/100 m^3, above 3.7 lit/s
Large-scale Irrigation	150	70	0.070/100 m^3, above 3.7 lit/s
Industrial	150	35	0.035/100 m^3, 1.10 lit/s
Commercial	150	35	0.15/100 m^3, 0.94 lit/s
Mining	150	-	0.17/100 m^3

Source: Water Rights and Water Fees in Rural Tanzania, (https://ageconsearch.umn.edu/bitstream/158013/2/H040605.pdf)

(2) Irrigation Service Fees: Various fees shown in the table below are set by the Irrigation Act, Regulation 2015. Also, these fees are set to pay to the NIRC.

Table 5.6.3 Fees for IOs based on Irrigation Act, Regulation 2015

Matter	Fee (TZS)
1. On application for registration	15,000
2. Registration fee	60,000
3. Annual fee	100,000
4. On notification change of constitution / by-laws	25,000
5. On notification charge of name for irrigators organisation	25,000
6. Surcharge for delay to furnishing annual reports to the Commission	100,000
7. Delay of paying annual fee	40,000
8. Application for certificate of compliance	15,000

Source: Irrigation Act, Regulation 2015, 2nd Schedule

In addition to the above, according to the Irrigation Act 2013 norm, irrigation members and non-members are required to pay O&M fee set by IOs, or Irrigation Act 2013 recommends paying IOs a minimum of 5% of the average harvest.

5.7 Field Observation and Findings by JICA Project Team

JICA Project Team visited six (6) Zones intensively from the end of January 2017 to the beginning of March 2017, except the Mtwara Zone and Katavi Zone. The team had several meetings with ZIE and their staff, DED and DAICO, IO and farmers to learn the present situation, challenges and future development plans, etc. This is followed by site visits to irrigation schemes arranged in each Zone. Major observation and findings related to irrigation development in each Zone are summarised in Table 5.7.1.

Table 5.7.1 Field Observation and Findings by the JICA Project Team

Major Division	Minor Division	Observation and Findings
I. Observation and Findings Related to Existing Irrigation Schemes		
Project Formulation and Design Stages	Design Standards and Criteria	There are no national design standards and criteria for irrigation scheme design, which are required to maintain a quality of design.
	Documents and Back Up Data Keeping	Documents and data are not properly kept at NIRC, zonal and district offices. Proper documents and data keeping system would be useful for future improvement work. Common understanding of technical terms related to irrigation areas would be important for scheme development and NIRC database.
	Definition of Technical Terms	LGA staff and IO members understand the meaning of "Potential Irrigation Area" as the area can be irrigated.
	Inadequate Study on Available Water for Irrigation	Through discussion with a zonal engineer, the team found that the study on available water for irrigation is made not in a scientific manner but in an empirical way. In one irrigation scheme, the design was made without data and technical calculation.
	Lack of Drainage Canals	In many irrigation schemes, drainage canals are often neglected in design and construction. The main reason may be farmers refuse to give their lands for drainage canals not to reduce cultivation areas. However, a drainage canal system is crucial for sustainable irrigation system particularly in wet land.
	Sedimentation is a Serious Problem especially in Reservoirs and Canals	In general, sediment load is decided without actual measurement in a river. Usually, engineers estimate sediment load by applying an empirical equation which is described in a textbook, or they do not take it into account at all. An estimate of sedimentation needs to be conducted carefully to avoid abandonment of an irrigation scheme.
	Difference between Developed Area and Irrigated Area	It is often observed that the actual irrigated area is smaller than the developed area. It might be caused by insufficient water or uncompleted irrigation facilities. Thus, farmers might be discouraged to participate in operation and maintenance activities.
Project Implementation	Poor Performance of Contractors	Many defects were observed especially in reinforced concrete work and in compaction of embankments. For example, protective covering for reinforcement bars is not enough, and reinforcement bars are exposed from concrete. Several pieces of wooden form remain in the concrete. Water leakage from the decayed wooden form remained was reported at intake structure under the Inala embankment. Many gullies were found in embankment slopes of dams. The cause of the problem would be loose compaction of embankment material. In relation to the poor performance, supervision by zonal or district office would be a problem. It seems that the supervisor was not in place when the concrete was placed.
	Project Committee	As for O&M, the CGL guides IO's Project Committee to use a "PC checklist," which allows its members, who are non-professional, to supervise simple construction works. With the PC checklist, the PC members can support LGA or ZIO irrigation staff for supervision. Under the circumstances where NIRC or LGAs cannot afford to attach officers for construction, it is recommended that the training for construction supervision is properly conducted from LGA/ZIO technical staff to the PCs and utilize them.
	Completion of Scheme	In many cases, an irrigation scheme used to be constructed partially. Consequently, irrigation area was reduced from the original plan. This reduction of farm land discourages farmers very much. Each scheme needs to be completed as soon as possible.
Project O&M and Water Management	High Electricity Charge for Irrigation and	Among irrigation schemes the team visited, three schemes receive the supply of electricity form TANESCO for pump operation. Two schemes, namely, Chinangari and Nyatwali, are in operation. However, pumps were not fully utilised because of

<table>
<tr><th>Major Division</th><th>Minor Division</th><th>Observation and Findings</th></tr>
<tr><td></td><td>Drainage Pumps</td><td>high electricity charges.</td></tr>
<tr><td></td><td>Utilisation of Solar Power System</td><td>Related to the electric pump, the team observed two solar pump systems. First one is operating in the lower Moshi upland area of Rau ya Kati system. Another scheme is Serengeti in Bunda District. Both solar pumps are working properly without trouble. A solar pump system would be useful for small horticulture schemes.</td></tr>
<tr><td></td><td>Lack of O&M Fee</td><td>The following table calculates the ratio between the total O&M fee and assumed construction cost:
<table>
<tr><th>Name of Scheme</th><th>Name of IO</th><th>No. of Member</th><th>Irrigation Area (acre)</th><th>O&M Fee (acre/year)</th><th>O&M Total (TZS)</th><th>O&M ration in Const. cost</th></tr>
<tr><td>Igomelo</td><td>Igomelo Irrigators Org.</td><td>382</td><td>800</td><td>25,000</td><td>20 million</td><td>0.95 %</td></tr>
<tr><td>Dakawa</td><td>UWAWAKUDA</td><td>850</td><td>5,000</td><td>74,000</td><td>370 million</td><td>2.80 %</td></tr>
<tr><td>Kikafu Chini</td><td>UWAKICHI</td><td>759
(farmer 1500)</td><td>1,125</td><td>17,470
(average)</td><td>19.7 million</td><td>0.66 %</td></tr>
<tr><td>Chinangarli</td><td>CHABUMA</td><td>296</td><td>300</td><td>360,000</td><td>22.2 million</td><td>2.80 %</td></tr>
<tr><td>Irienyi</td><td>UWAIRO</td><td>170</td><td>300</td><td>50,000</td><td>8.5 million</td><td>1.07 %</td></tr>
</table>
Note: In this estimate, construction cost is assumed to be 3,000 US$/ha. IO data are the result of interview survey.
Source: RNIMP Team based on interview survey</td></tr>
<tr><td></td><td>O&M by IOs</td><td>In operation of modern irrigation systems, gates should be closed when floods occur in order to not intake flood flow which contains considerable sand, silt, and clay. However, most of the irrigation systems in Tanzania use flood flow as a water source. Consequently, sedimentation is inevitable, resulted in serious problems. IOs should remove deposited materials from canal sections as part of routine maintenance work. As for a canal design, designers should consider providing a sand trap structures for easy removal of deposited materials.</td></tr>
<tr><td></td><td>Lack of Water Management Tools and Water Management</td><td>In order to save water and get good produce, water management is one key technology. For proper water management, measuring devices or staves shall be provided. However, no devices and staves were found in all the schemes the team visited except Dakawa Scheme (under improvement).</td></tr>
<tr><td>IO</td><td>Registration of IO</td><td>There are three forms of farmers group; (i) Groups registered to NIRC, (ii) Groups registered to MoHA as Associations, and (ii) Groups registered as Cooperatives. Under NIA2013, IOs shall register to NIRC with necessary fees. So far, the number of IOs registered under NIA2013 is reported as only eight (8) out of 458 formerly registered as association or cooperative.</td></tr>
<tr><td></td><td>Capacity Building of IOs</td><td>During the site visits, the LGA staff pointed out necessity of capacity building of IO management members especially for financial accounting.</td></tr>
<tr><td></td><td>Strengthening of By-law</td><td>In the case that land ownership belongs to farmers, IO management staff encounter difficulty in controlling farmers. For instance, in Uyanyama case, three farmers took land issues to court. (Recently, IO won the case.) Many IOs plan to strengthen their constitutions and by-laws.</td></tr>
<tr><td colspan="3">II. Observation and Findings Related to Future Irrigation Development</td></tr>
<tr><td>General</td><td>Potential Irrigation Scheme</td><td>Tabora Zonal Office have identified many potential irrigation schemes which have not yet been developed. NIMP2018 needs to include those identified potential schemes into the scheme list. Therefore, the team recognizes the necessity of data collection on potential schemes for future development, which have been identified but not yet developed in the other zonal offices as well.</td></tr>
<tr><td></td><td>Study by Nile Basin Initiative</td><td>Under the Nile Basin Initiative program (NELSAP) feasibility studies were conducted on Mara and Ngono valley basins. Development of large irrigation schemes were studied. Water demand of the aforesaid schemes would be necessary to take into account in a future development plan.</td></tr>
<tr><td></td><td>Water Harvesting Technology</td><td>There are many small earth dams especially in the jurisdiction of Tabora and Mwanza Zonal Offices, where water is scarce. Small earth dams as a water harvesting facility would be a useful tool to secure agricultural production.</td></tr>
<tr><td></td><td>Lake Water Use</td><td>Use of Victoria Lake water for irrigation is one of the key strategies in Mwanza Zonal Office.</td></tr>
<tr><td></td><td>Traditional Irrigation Scheme as a Potential Area</td><td>There are many traditional irrigation schemes with vast areas. If new water sources such as groundwater and RWH ponds could be found, these schemes would become promising potential schemes.</td></tr>
</table>

Major Division	Minor Division	Observation and Findings
III. Other Observation and Findings		
General	Definition of Traditional Irrigation Scheme	Traditional irrigation scheme is defined in the National Irrigation Policy 2010 as "an irrigation scheme with irrigation system comprising of temporary infrastructures and/or facilities that are not technically constructed/installed." The team visited one of the traditional irrigation systems in Simbo village. The system utilizes rainwater which flows down from the upstream area by forming so-called a "sheet flow". There is no canal and division structure. Water flows from a farm plot to a farm plot. Judging from the manner of water use, it seems to be a "Rain-fed Scheme". Accordingly, it is necessary to pay attention that traditional irrigation schemes might include "Rain-fed Schemes".
	Basin Water Board Member	ZIE is not a member of the Basin Water Board, although the irrigation sector is a major water user. ZIE should be a member of the Basin Water Board as a representative of giant water users.

Source: JICA Project Team (Jan. to Mar. 2017)

5.8 Irrigation Human Resources

5.8.1 Demand Side

(1) NIRC

If compared with the data in 2011 (the Division of Irrigation and Technical Services (DITS) of the MoWI at that time), the number of engineers (irrigation, agricultural, mechanical, civil and environmental) of the NIRC have decreased from 91 to 81. The number of land surveyors have also decreased from 16 to 11. While there were two hydrologists in 2011, there is none in 2018. Under the current condition, the ZIOs' supports to the LGAs for small-scale irrigation development are rather extensive and stretched. The ZIO engineers attentively support the LGAs along project formulation and implementation. In other words, the ZIOs practically function as a consultant for the LGAs. Meanwhile, the number of LGAs cover ranges from 17 to 31 for each ZIO even under the eight-zone system. Together with the problem of aging technical staff, excessive workload of NIRC poses a serious threat to NIMP 2018 implementation.

Table 5.8.1 shows the allocation of irrigation/agricultural engineers, irrigation technicians and other technical staff at the NIRC headquarters and ZIOs.

Table 5.8.1 NIRC Technical Staff Allocation (As of February 2018)

	HQ	Dodoma	Kilima-njaro	Mbeya	Moro-goro	Mtwara	Mwanza	Tabora	Katavi
Irrigation/ Agricultural Engineer	10	9	6	14	12	8	8	7	1
Irrigation Technician	0	5	5	0	4	1	3	4	0
Others	54	15	20	14	18	4	10	9	4
Total	64	29	31	28	34	13	21	20	5

Source: Data obtained from NIRC (February 2018).

(2) LGA

LGAs are the main implementers of small-scale irrigation development. Yet they are understaffed with technical officers in the irrigation sector. It is not the case that each LGA secures at least one engineer or one technician. 37% of all LGAs (66 out of 180 LGAs[8]) do not have an irrigation/agricultural engineer or an irrigation technician. With regard to engineers, 116 out of 180 LGAs (64%) have no irrigation/agriculture engineers. As the LGA's capacity in irrigation development is low, most of the technical tasks along the irrigation development process is commissioned to the zonal office as mentioned above. For the establishment of District Irrigation Department, as suggested in NIA, will require an intensive investment under such circumstances.

Table 5.8.2 shows the allocation of irrigation/agricultural engineers, irrigation technicians and other technical staff at the LGA level.

Table 5.8.2 LGA Irrigation Staff Allocation (As of February 2017)

	Dodoma	Kilima-njaro	Mbeya	Moro-goro	Mtwara	Mwanza	Tabora	Katavi
Number of LGAs	22	25	22	20	23	31	20	17
Irrigation/ Agricultural Engineer	14	13	13	14	10	14	7	8
Irrigation Technician	12	48	35	21	15	22	8	14

Source: Data obtained by JICA Project Team with the support of NIRC (February 2017).

(3) Region

There are few experts assigned at the Regional Secretariats to provide technical advice to LGAs in the irrigation sector. As such, the regions only function as an administrative supervisor of LGAs when there is a miscommunication between zones and LGAs.

(4) IO

Only a few LGAs can afford to attach technicians to each irrigation scheme, and the support of zonal officers are mainly in the construction phase. As such, the support system of LGA to IOs is especially weak during operation and maintenance in accordance with the CGL as well as technical input to their production and marketing activities up to the level of perceiving the benefit of maintaining irrigation schemes properly.

(5) Private Sector

There are only a few local engineering firms specialising in irrigation development[9]. Hence, the demand for irrigation engineers or technicians are not high among private engineering firms. This is partly due to the fact that the ZIOs undertake most of the consulting works for small-scale irrigation scheme construction, and thus, there is little market demand or incentive for private sector involvement. As for the contractors, there are several civil contractors which have been awarded with LGA-level irrigation constructions. However, there are few contractors specialised in irrigation development. As a result, civil contractors do not selectively employ irrigation engineers or technicians but merely as "civil engineers/technicians".

5.8.2 Supply Side

There are several educational and training institutes which provide irrigation engineers and technicians.

[8] The number of LGAs excludes those which are not yet operational, i.e., Dar es Salaam City, Ubungo MC, Kigamboni MC, Kibiti DC, and Songwe DC. Hence the total is 180.
[9] According to the ERB, there are only two local firms registered for irrigation engineering field. There are 211 registered local engineering firms and 86 foreign firms in Tanzania (as of December 2016).

Table 5.8.3 shows the current degree and diploma courses aimed directly at developing irrigation human resources. Intake capacity of diploma courses is less than half of degree courses, that is, more engineers are produced than technicians at present. It should also be noted that the numbers are on an intake capacity basis, and actual supply of engineers and technicians are less than the figures shown in Table 5.8.3.

Table 5.8.3 Degree and Diploma Courses for Irrigation Engineers and Technicians (2016/17)

Skill Level	Institution	Course	Admission Capacity
Engineer	ATC	B. Eng. in Civil and Irrigation Engineering	66
	WI	B. Sc. in Water Resources and Irrigation Engineering	300
	SUA	B. Sc. in Agricultural Engineering	65
		B. Sc. in Irrigation and Water Resources Engineering	65
	UDSM	B. Sc. in Agricultural Engineering and Mechanization	30
	Total		**526**
Technician	ATC	Ordinary Diploma in Civil and Irrigation Engineering	75
	WI	Ordinary Diploma in Irrigation Engineering	120
	MATI Igurusi	Ordinary Diploma in Irrigation	62
	Total		**257**

Note: The figures are on an annual admission capacity basis.
Source: Data from Tanzania Commission for Universities (TCU) and individual education and training institutes

5.9 Research and Development

5.9.1 Arusha Technical College

Arusha Technical College (ATC) is under the jurisdiction of the Ministry of Education and Vocational Training (MoEVT) and specialises in civil and irrigation engineering. There is a small demo plot for showcasing various types of irrigation methods (drip, sprinkler, border, furrow, basin and pipe). Besides this, there is a plan to develop a training farm outside the campus, which will feature RWH, water reservoir and groundwater as sources of irrigation. The main concept of these farms is the introduction of water efficient irrigation methods in semi-arid areas in Tanzania.

5.9.2 Water Institute

Water Institute (WI) is a research, consultancy, and educational institution under the Ministry of Water and Irrigation. The WI provides bachelor's and diploma courses on water resources and irrigation, water supply and sanitation hydrology, and hydrogeology. The WI has laboratories on soil mechanics, hydrology, and water quality.

5.9.3 Sokoine University of Agriculture

Sokoine University of Agriculture (SUA), under the jurisdiction of MoEVT, deals with various disciplines of research topics in the agriculture sector. Especially, the College of Agriculture specializes in agricultural engineering and irrigation and water resources engineering. The SUA has a test field of about 100 ha in the main campus premise with an earth dam and drip irrigation demo plots. In addition, the university owns 1,500 ha land for test fields at Mazimbu campus. The university also has conducted the consultancy work on irrigation development.

5.9.4 The Nelson Mandela African Institution of Science and Technology

The Nelson Mandela African Institution of Science and Technology (NM-AIST) belongs to a network of Pan-African Institutions of Science and Technology and is a graduate university. Its Hydrology and Water Resources Engineering (HWRE) program conducts a series of studies on water accounting, water resources modelling and water productivity in irrigation. The institution also conducted a consultancy work on the reuse of waste water for irrigation, and an environmental flow assessment for an irrigation project.

5.9.5 National Irrigation Research and Training Centre

(1) National Irrigation Research and Training Centre Plan

The NIRC has a plan to establish a research and training institute to disseminate new technologies and knowledge newly acquired at the irrigation sites to irrigation staffs of NIRC, district officers, and private sectors. In the original plan, National Irrigation Research and Training Centre (NIRTC) was planned to be constructed in Dakawa Village, Mvomero District, Morogoro. The use of the proposed site is agreed with the local government.

The JICA Project Team inspected the proposed site in March 2017 to evaluate the original plan. In August 2017, NIRC proposed a new plan for the NIRTC due to the change of circumstances surrounding NIRC. In consequence of this change, the JICA Project Team re-evaluated the NIRTC plan based on the new plan.

(2) Comparison of Original and New Plans

Table 5.9.1 compares the new plan with the old plans.

Table 5.9.1 Comparison Table of the Old and New Site Plans

	Original Plan	New Plan
Location	Dakawa Village, 7 km from the Morogoro-Dodoma national road	Njedengwa Investment Area in Dodoma
Building Plan	Administration Block Dispensary Conference Hall Class rooms/Lecture Theatre Staff Quarters Rest House Cafeteria Gens Dormitories Ladies Dormitories Workshop	Administration Block 300 m^2 Library 150 m^2 Hostel/Research Flat 50 persons Experimental/Modelling Workshop 150 m^2 Lecture Theatre 100 persons Multi-purpose Room 100 persons Cafeteria 50 persons
Laboratory	i) Hydrology & Water Resources ii) Soil Mechanics iii) Irrigation & Water Management iv) Material Testing (Strength of materials) v) Remote Sensing & GIS vi) Technology Transfer	i) Water Resources 150 m^2 ii) Soil Mechanics 150 m^2 iii) Geo – Technical 150 m^2
Demonstration Allotment	Four (4) demonstration plots Detailed plan is not described in the planning report.	Four (4) demonstration plots Centre pivot irrigation model Sprinkler system irrigation model Drip irrigation system model Channel/canal irrigation system model
Project Cost Estimate	USD 13.94 Million (Fund Requirement; USD 13.64 million)	USD 13.94 Million (Fund Requirement; USD 13.64 million)

Remarks: NIRC has submitted JICA two times of the applications of Japanese ODA for the original plan.
Source: NIRC

Judging from the building plan of the new plan, it seems to narrow down the functions of the NIRTC. The number of laboratories was reduced to half of the old plan. In addition, there would be a possibility to reduce or remove the function for lodging because of the advantageous location that it is in, the Dodoma capital area.

(3) Comparison of Soft Components

The centre aims to compile the domestic and international research results, conduct research in collaboration with domestic and international research institutions as necessary, and conduct trainings to disseminate the appropriate technology obtained as a result.

For this purpose, in the original plan, nine (9) thematic areas were selected. Basically, this component would not be changed between the original and new plans as shown in Table 5.9.2.

Table 5.9.2 Nine Thematic Areas in Irrigation Research

Thematic Areas	
i) Agricultural Land and Water Resources Development	ii) Improvement of Water Productivity and Irrigation Water Use Efficiency
iii) Development and Utilisation of Appropriate Irrigation Technologies	iv) Effective and Efficient Farmers Organisations
v) Appropriate Irrigation Methods	vi) Appropriate Irrigation Lining Materials
vii) Suitable Environmental Management	viii) Socio-Economic and Cultural Management
ix) Improvement of Irrigated Soils Fertility	

Source: Proposal for Establishment of National Irrigation Research and Training Centre, NIRC

(4) Evaluation of New NIRTC Plan

(a) Evaluation of the Location

In the original plan, the NIRTC was planned to be constructed in a rather isolated area which was about 40 km away from Morogoro town. In the new plan, it will be constructed within the NIRC's plot, which is close to the Dodoma city area.

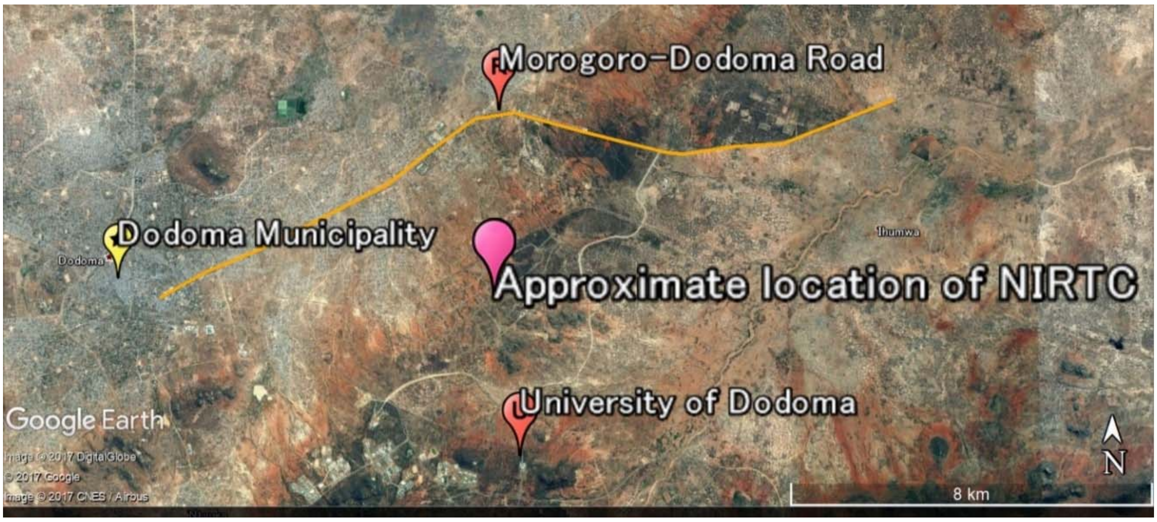
Since the proposed site is located within the NIRC's plot, it is expected that the knowledge of the experienced NIRC staff would be utilised for trainings.

As for lodging and restaurant facilities, there is a possibility to utilize neighbouring facilities.

(b) Evaluation of Water Source

Regarding water supply, water will be supplied from tanks shared with other agencies. There would be no original water source. The total area of the NIRC plot is about 7.9 ha, of which the area of the exhibition farm plots would be approximately 1.6 ha consisting of four farm blocks. In these exhibition farm plots, 1) sprinkler irrigation, 2) drip irrigation, 3) centre pivot irrigation, 4) surface water irrigation would be practiced. Judging from the irrigation methods, crops with low water consumption would be cultivated. The required water volume for irrigation would be about 60 tons per day (0.68 litters/second) in total at the peak time of water consumption. There would be a possibility that water would be able to be secured by measures such as reducing the required water volume by rotational irrigating within four farm plots, reducing the cultivation area according to the amount of water supplied, and installation of a water tank. In the future, however NIRC shall negotiate with the Water Supply and Sanitation

Authorities (WSSAs) in Dodoma to allocate sufficient water to NIRTC day and night times.



Source: Google Earth image@2017 Digital Globe, @2017 google, image@2017 CNES/Airbus (Map), NIRC for Location

Figure 5.9.1 Location Map of Proposed NIRTC

(c) Evaluation of Research Plan

Irrigation in Tanzania has various problems, for example, low irrigation efficiency, poor water management, and serious sedimentation in canals and reservoirs.

It is important to develop and disseminate the appropriate technologies suitable for each region in consideration of soil, geological and weather conditions, rather than applying technologies of foreign countries as they are.

The proposed research plan covers the necessary area of irrigation technology (see Table 5.9.2).

(d) Collaboration with Other Institutions

The NIRTC would not conduct research by themselves independently. Necessary technical documents and information would be collected, and researches would be conducted as necessary in collaboration with national and international institutions.

This NIRTCs plan is realistic and a possible way to improve irrigation technology in Tanzania.

(e) Overall Evaluation

Development and dissemination of technologies suitable for regions is essential for future irrigation development in Tanzania. The NIRTC has a role as a research and training institution capable of acquiring practical skills while NIRC and district staffs are in office. For districts and regions which are operated by limited number of irrigation staffs, it would be a good opportunity to effectively acquire skills avoiding long-term absence of staff.

It may be difficult for many irrigation staffs to master water saving technologies such as drips, sprinklers, central-pivots which are still not yet popular in Tanzania only by classroom lectures. Therefore, an experimental farm equipped with such facilities is required to develop their capacity for the mechanical appliances, installation and O&M. Also, a computer laboratory associated with GIS and CAD for design standardisation, a material laboratory equipped with testing apparatus for quality control of soil and concrete are equally important for NIRC.

Problems such as employment of many of the management and technical staffs and securing of water in the original plan would be highly expected to be improved by the new plan. As a conclusion, the JICA Project Team judges that the new plan is worth considering for realisation.

5.10 Donors' Support in Irrigation Sector

5.10.1 Japanese ODA in Irrigation Sector

(1) Small-Scale Irrigation Development Project

The SSIDP is a Japanese official development assistance (ODA) Loan Project, which started in July 2013 with the selection of consulting company, having the objective to improve the productivity of crops (especially rice) through construction and rehabilitation of irrigation facilities and provision of related equipment, thereby contributing to increasing income of farm households and poverty reduction. As of July 2017, the total disbursed amount has come to JPY 3,017 million against the total loan amount of JPY 3,443 million.

Table 5.10.1 Loan Allocation (L/A No. TA-P12)

Category	Loan Amount (JPY in Mil.)
(a) Civil Works and Equipment*1	2,941
(b) Consultancy Services*2	221
(c) Interest during Construction*2	1
(d) Contingencies*2	280
Total	3,443

Note: Terms of the loan, 6 years from 16th July 2013
*Payment method, *1= Advance Procedure, *2= Transfer Procedure*
Source: SSIDP Consultant (July 2017)

As for the civil works, 119 projects were originally listed up for irrigation development of 52,494 ha, later which was slightly revised to be 51,778 ha as shown in Table 5.10.2

Table 5.10.2 Target Irrigation Development by Zone

Irrigation Zone	Original Plan			
	No. of Projects	Irrigation Area (ha)		
		Existing	Extension	Total
Dodoma	13	1,780	1,660	3,440
Kilimanjaro	19	5,837	1,970	7,807
Mbeya	31	10,975	8,694	19,669
Morogoro	15	2,281	2,627	4,908
Mtwara	19	3,721	3,965	7,686
Mwanza	10	581	420	450
Tabora	12	4,552	1,475	6,027
Total	119	29,727	22,767	52,494

*Note: *= Batch-1 is nearly completed, Batch 2 is under construction and Batch-3 is under sub-project selection.*
It is planned that No. of Projects will be 119, and No. of contract lots will be 131. The reason why No. of contracts are increased is due to division of contract and/or phasing works in the same Batch and serious works of 1st and 2nd Batches.
Source: NIRC, 2017, Distribution material at SSIDP tripartite meeting held on 21st July 2017 (No. 29)

It is noted that, since the beginning of SSIDP's operation, a tripartite meeting chaired by NIRC has been conducted inviting JICA and the project consultants monthly to discuss problems and solutions encountered during the project operation.

Table 5.10.3 summarises the points to give feedback to future similar type of irrigation projects based on the SSIDP's operation so far.

Table 5.10.3 Feedback from the SSIDP's Operation

Dimension	Feedback from SSIDP
Technical Aspect	・ The CGL is a general guideline for implementation of small scale irrigation projects in Tanzania. Meanwhile a national standard design criteria/manual for irrigation is not available yet in Tanzania, designers often use a draft design manual prepared by Gibb Africa in 1999 or whatever they have. ← *A standard design criteria/manual needs to be prepared.* ・ It has been agreed that SSIDP targets the small-scale irrigation projects having irrigation area less than 500 ha. In reality, however, SSIDP often includes the projects that would be a part of medium and/or large-scale projects. ← *Definition of the target projects needs to be confirmed.* ・ The average budget available for SSIDP sub-projects is say TZS 300,000,000, which is less than half of ASDP budget ceiling of TZS 800,000,000. ← *Proper cost estimate will be required for full development.*
Financial Management Aspect	・ After 2013/14 when new contributions to the ASDP basket fund substantially ended, the Government fund allocation to ZIOs and LGAs (DAICO offices) has been suffering from serious shortage. The divergence between the budget allocation and the delay in disbursement are in a normal state, and in the year 2015/16 the allocation of budget was almost zero due to the result of the election which was going on. At present, the funds are secured only for some projects supported by donors including SSIDP projects and DP's projects. Many of the LGAs are facing serious fund shortage in daily operation. ← *It might happen in the future. So, not only construction budget but also special provision for operation fund for ZIO and LGA like as SSIDP needs to be considered in case of loan projects.* ・ There was a big gap between the physical and financial progress. This was mainly caused by i) time spent for preparation of payment statement by contractors, ii) delay in approval process by LGAs (DED), and iii) in some cases a temporary fund diversion for other purposes. ← *ZIO shall be involved in the routing monitoring process of the project implementation.*
Institution Aspect	・ NIRC is always facing chronic shortage of professional staffs, office space, capacity of administration and accounting units. ← *A low ratio of approved budget execution is a bottle neck to improve overall situation.*
Irrigation Development Aspect	・ Water storage facilities such as small dams and ponds will be quite useful especially in semi-dry zone and rainfed paddy areas to secure supplemental irrigation in wet seasons. According to the dam list of MoWI, there are more than 600 dams in Tanzania, most of which are small (H < 10 m and Q < 1.0 MCM). A charco dam; a kind of RWH pond, could be seen in many places in semi-dry zones of Tanzania. ← *A RWH pond including small dams shall be considered as a climate change adaptation measures.* ・ Mtwara is recently coming up for industry development; natural gas and cement production. Also, the road connection to Dar es Salaam has been drastically improved with the completion of the Mkapa bridge. Mtwara is a rice import region because it has been left behind irrigation development for a long time. ← *The above needs to be considered in process of development priority ranking.*

Source: JICA Project Team based on interview to SSIDP Consultant (July 2017)

(2) Project for Capacity Development for the Promotion of Irrigation Scheme Development under the District Agriculture Development Plans (DADPs) Phase 2: TANCAID2

(a) Objectives of TANCAID2

TANCAID has been implementing various activities since August 2015 as a four-year project. The project objectives are:

- Capacity building of the district staff in irrigation project through enhancement of project management ability from "project planning to implementation" to "operation and maintenance" of NIRC and through trainings by NIRC,
- Dissemination of CGL, which is prepared for appropriate implementation of irrigation

development and operation and maintenance, as a national standard, and

- Strengthening of organisation to improve the management system for irrigation development and to promote irrigation development.

(b) Outline of Activities

1) Target Area

A total of seven (7) schemes in three zones, namely, Dodoma, Tabora, and Mwanza, are selected as demonstration schemes. In addition, TANCAID2 provides guidance on project monitoring to 62 schemes of SSIDP batch 2 which did not utilise CGL. Moreover, several staff trainings are given to 40 schemes selected among 62 by NIRC.

2) Beneficiaries

Direct beneficiaries of trainings and guidance are zonal engineers of all zones and irrigation staffs of district in target schemes. Indirect beneficiaries are irrigators' organisations, which receive guidance by district irrigation staffs.

3) Activities

In order to improve the efficiency of management in the irrigation development and to make the procedure of scheme management to work homogeneously at an adequate level, the following activities are conducted.

i) Revisions of CGL as necessary
ii) Preparation of supporting technical manuals and standard designs
iii) CGL trainings to zones and districts staff
iv) Improvement of project monitoring sheets, and monitoring of projects
v) Establishment of monitoring and reporting system of NIRC for efficient operation

(c) CGL

CGL was prepared in 2010 by JICA experts based on the guideline published in 2004 by NIMP2002. During the project implementation period of TANCAID1, promotion of CGL was carried out nationwide. In June 2016, revised CGL was published incorporating experiences in demonstration schemes.
The revised CGL covers the four (4) fields.

- Volume 1: Formulation
- Volume 2: Implementation
- Volume 3: Operation and Maintenance
- Volume 4: Training

Among these four volumes, CGLs for "Formulation", "Implementation", and "Operation and Maintenance" are given legal status in the National Irrigation Act 2013.

(d) Lessons learned through the Activities

1) In adequate Budget Arrangement

In many development schemes, budgets are not adequately allocated. As a result, expected effects have not been demonstrated in many cases. Approved budget for irrigation development by the central government is not always disbursed fully and timely to the NIRC or local governments.

2) Lack of Consciousness to Observe the Law

Staffs at both national and local levels lack consciousness to observe rules and laws. Therefore, unified management work of irrigation schemes becomes difficult.

3) Insufficient Staff and Management organisation

The number of irrigation staff at the national and the district levels are insufficient, and organisational management systems have not been established.

4) Poor Ability of Contractor

Contractors, who are engaged in small scale irrigation construction works, lack experience, with none or very few irrigation technical staff. In addition, they lack consciousness of quality control of construction works. As a result, many faults are observed especially in concrete works.

(3) TANRICE2

(a) General

The technical cooperation projects supported by Japan originated in the 1970s, Kilimanjaro Region Agricultural Development Project. After that, five projects (Kilimanjaro Agricultural Development Centre (KADC) Project, The Kilimanjaro Agricultural Development Project (KADP), Kilimanjaro Agricultural Training Centre Project (KATC), KATC Phase II Project, and Technical Cooperation in Supporting Service Delivery Systems of Irrigated Agriculture (TANRICE)) had been consecutively implemented until 2012 by JICA. From the KATC project, irrigated rice was targeted across the country and upland rice was added as a target crop in TANRICE.

TANRICE2 is an abbreviation of “the Project for Supporting Rice Industry Development in Tanzania”. The ongoing six-year technical cooperation project started in November 2012 and will end in November 2018, covering the Tanzania mainland as well as Zanzibar. Overall goal of the project is set as “rice production is increased in the rice production areas across the county.” and its project purpose is defined as “rice farming technologies are adopted by farmers in the priority rice production areas.”

The project deals with not only irrigated rice but also upland and rain-fed lowland rice. It means that the crops covered by TANRICE2 are beyond irrigated land territory. Since 2012, numerous training courses on various rice farming technologies has been provided in many irrigation schemes, which in turn has contributed to improvement of cultivation methods and unit yield. The data summarised by TANRICE indicated that average rice unit yield level of 30 irrigation schemes improved by 42%, from 2.6 ton/ha to 3.7 ton/ha. This indicated that the training courses were so effective that the farmers trained could increase their harvest per unit area.

In principle, irrigation itself matters how to convey water, which is indispensable for crop growth, from water sources to crop land in a sustainable, efficient and economical manner. But when farming and water control technologies at crop land are relatively low, irrigation water cannot be used effectively, which in turn may cause waste of irrigation water. On the other hand, irrigation water availability is considered to be an essential prerequisite for some of the farming technologies such as unification of improved variety for planting and field water and fertilizer control. Without irrigation water, these technologies cannot be practiced on crop land, which makes impossible to achieve high productivity.

Taking the above into account, irrigation development and farming technology improvement/extension at the field level such as TANRICE2 are considered to be inseparable and/or reciprocal. In other words, irrigation development is regarded as a kind of infrastructure development while farming technology improvement/extension at the field level is considered as software and/or capacity development. Both subjects are closely interrelated and complementary.

(b) Lessons Learned through TANRICE and TANRICE2

Through the experience of TANRICE and TANRICE2, the following are derived as lessons:

In some irrigation schemes, it was observed that irrigation facilities were not well operated or maintained after completion of irrigation facilities construction. Proper operation and maintenance of the irrigation facilities by district officers and beneficiaries is important. In particular, the beneficiaries should be aware of that in case irrigation facilities were broken, district officers could still receive monthly salary, but other farmers will experience trouble because they could not cultivate paddy without irrigation water. That is why farmers should organise proper operation and maintenance (O&M) system for irrigation facilities by themselves.
At district level, proper institutional framework should be set up to facilitate effective irrigation facilities management because the ZIO is busy with planning, designing and supervising new irrigation schemes. In addition, with budget constraints at the central government, it seems to be impossible to manage individual irrigation schemes by the central government officers (ZIO). Hence district officers should fill the role of day-to-day O&M at each irrigation scheme, and ZIO and/or NIRC should take responsibilities in case of engineering matters such as facility repair works are necessary.
For Tanzania, irrigation agriculture is rather new; therefore, technologies and capacity development is indispensable for proper O&M of irrigation facilities. After the training, long term irrigation water provision will be possible, which in turn leads to long term function of irrigation facilities. Therefore, local capacity development for proper O&M is essential. Without the capable staff at the local level, any good-looking irrigation facilities will eventually lose their functions.

Source: JICA Project Team based on interview to TANRICE2 project

Considering the importance of proper and sustainable O&M for irrigation facilities to be constructed in the future, it is quite significant for the Project to formulate the NIMP2018 which fully takes account of capacity development of central/local government staff as well as institutional framework for facility O&M.

(c) Possibility of Cooperation with TANRICE2

TANRICE2 has provided many training courses for stakeholders of various irrigation schemes where facilities had been constructed to some extent. Lower Moshi area is one of good examples. After completion of the NIMP2018, irrigation facility development is supposed to start according to an action plan of the NIMP2018. Coincident with irrigation facility development, timely training courses for farming technology improvement should be provided to the farmers concerned to achieve synergistic effects of both activities from the beginning.

(4) ATC

Originally established as Technical College of Arusha in 1978, Arusha Technical College (ATC) was established in 2007. JICA has continuously supported its effort for civil and irrigation engineering program through dispatch of experts and AIHRD-Project (2014-). In 2016/17 academic year, ATC operates BSc. in Civil and Irrigation Engineering and OD in Civil and Irrigation Engineering with annual intake capacity of 66 and 75 students, respectively.

ATC can contribute to the achievement of NIMP2018 especially in the following areas:

- Provision of irrigation human resources: As NIMP2018 requires more irrigation engineers and technicians, ATC continues to be an indispensable source of human resource provision.
- Provision of short training courses: With the support of JICA, the college is equipped with demo plots of irrigation farming, open channel apparatus. Using these equipment and facilities, ATC can provide various training programs tailored to irrigation engineers, technicians, and irrigators.
- Research and development: Located in semi-arid area, ATC is suitable for research on water-saving irrigation. Thus, NIRC can commission ATC to conduct a research on water-efficient irrigation techniques.

5.10.2 Other Support in Irrigation Development by Development Partners

As already discussed, Development Partners (DPs) are putting more emphasis on agriculture value chain development from production and processing to marketing involving private sector who are considered as a key driver for agricultural transformation. Amid such circumstances, USAID and the World Bank (WB) are continuously supporting the irrigation infrastructure development with attention to soft components including but not limited to capacity building of IOs in planning and doing of agriculture business and water management.as shown in Table 5.10.4.

Table 5.10.4 Irrigation Development Projects supported by Other Development Partners

DP	Name of Project	Project Description
USAID	Irrigation and Rural Roads Infrastructure Project under Feed the Future (FTF) Initiatives (2011-2016)	The project has completed comprehensive feasibility studies (FS) to evaluate the development of four potential irrigation schemes (Kisegese, Udagaji, Mgugwe, and Mpanga-Ngalimila) in Kilombero Valley. Besides carrying out feasibility studies in Kilombero valley, the project decided to improve the Dakawa (pump) existing irrigation scheme of 2,000 ha. The work of the Dakawa irrigation scheme is under way while there is no further development of the schemes which have received feasibility studies.
WB	Japan Policy and Human Resources Development (PHRD) (2012-2016)	PHRD, which is granted by Japan, is implementing through WB's operation to support ASDP1 to (a) strengthen access to improved technologies, (b) improve access to markets and value addition/processing, (c) build capacity for irrigation development. Among others, PHRD puts emphasis on irrigated rice cultivation involving KATC and Ministry of Agriculture Training Institutions (MATI).
WB	Expanding Rice Production Project (ERPP) (2014-2017)	The project development objective is to increase the productivity and production of rice in targeted areas of Morogoro and Zanzibar. The project will expand and/or rehabilitate irrigation infrastructure at five irrigation schemes on the mainland, and eight irrigation schemes in Zanzibar. On the mainland, 325 ha of irrigated area will be rehabilitated and 315 ha will be expanded. In Zanzibar, 58 ha will be rehabilitated and 72.5 hectares will be expanded. The project will support the design of the irrigation infrastructure, the construction of the infrastructure, and the strengthening the irrigators' organisations to assure sustainable operation and maintenance of the irrigation works.
WB	Resilient Natural Resources Management for Tourism and Growth (REGROW) (2018-2024)	The project development objective is to improve management of natural resources and tourism assets in priority areas of southern Tanzania, and to increase access to alternative livelihood activities for targeted communities. REGROW will implement priority actions of the IWRMDP for the Great Ruaha Sub-basin, in collaboration with the Rufiji Basin Water Board (RBWB) and MoWI. Some of the activities will include investments in some identified irrigation schemes in order to improve their irrigation efficiencies so as to allow more water to flow downstream to meet other uses in the Mikumi National Park.

DP	Name of Project	Project Description
KF	Irrigation Development Project in Luiche Valley in Kigoma Region. (Envisaged to start in 2018)	The Luiche Delta is supplied with flood coming from Luiche River, which originates from Kasulu District. The river eventually enters Lake Tanganyika, creating behind it an enormous fertile land which is estimated to have about 3,000 ha of arable land suitable for conducting small and large scale modern irrigated agriculture. A dam is planned to be constructed in the upstream of the project area in order to impound water for irrigation as well as to control floods in the farm land.
AfDB	Songwe River Basin Development Programme (SRBDP) (2003-2014)	The SRBDP is a bilateral initiative between Malawi and Tanzania on the transboundary Songwe River. It was initiated in order to stabilise the meandering course of the River, as it forms the border between the two countries. The Lower Songwe River Tanzania (LSRT) irrigation scheme is on the left bank of the Songwe River in Kyela District and situated between the Songwe River and the Kiwira River. Its upper boundary is near the town of Kasumulu just downstream of the Kasumulu Bridge and the lower boundary a few km upstream of Lake Nyasa/Malawi. A feasibility level design for LSRT has been prepared. The net irrigation area is 3,005 ha with a cropping intensity of 200%. The major crop to be grown is rice which will take up over 150% of the cropping pattern. A business plan have been prepared with an aim of providing a clear direction on the business of the Songwe River Basin Commission, an institution mandated to co-ordinate the implementation of various projects over the ten-year period, 2015 to 2025.
AfDB	Kikonge Multipurpose Dam for Hydropower and Irrigation project (Planned from 2016)	The project is for construction of a dam for development of a hydropower scheme and an irrigation project on the Ruhuhu River in the south-west part of the country. The envisaged project infrastructures comprise i) an irrigation scheme of 4,000 ha including a diversion weir, the main canal, the downstream command areas, a mini hydropower plant and water supply systems to the local communities and ii) a hydropower scheme including a 120 m high dam, a storage reservoir of 6 billion m^3 capacity and 60 km long and a 300 MW power plant and the various appurtenant infrastructures. The project is currently under feasibility stage.
AfDB	Rice and Edible Oil Value Chain Development Project (ROVCD) (Planned from 2016)	The project will improve farm incomes, rural livelihoods, food security and contribute to poverty reduction through interventions along the whole value chain of rice and edible oil paying special focus on unemployed youth and women in the lake, central, northern, eastern and southern highland zones. AfDB will support the preparatory activities including feasibility study, detailed design, environmental and social management framework, potential markets and market access in 2017. The project implementation is planned to start in 2018, but approval of Tanzania's government for budget for preparatory survey is delaying.

Note: WB loan to the Catalysing the Future Agri-food Systems of Tanzania (CFAST) was finally cancelled.
Source: NIRC

Recently, a Memorandum of Understanding (MoU) was signed between Korea Rural Community Corporation (KRC) of South Korea and the Southern Agriculture Growth Corridor of Tanzania (SAGCOT) to support modern irrigation water schemes for rural farmers in Tanzania (17th August 2017). And also, China through Shanghai Municipal Agricultural Commission had agreed to bankroll the Agricultural Park at Kimamba in Kilosa District, including construction of irrigation infrastructure and dam in 2,400 ha farm (10th June 2017).

5.10.3 Issues for Future Irrigation Development

Table 5.10.5 summarises the issues for future irrigation development in Tanzania based on an interview with the development partners by the JICA Project Team. These issues shall be addressed in the formulation of NIMP2018.

Table 5.10.5 Issues to be addressed in Future Irrigation Development

Organisation	Key Issues
JICA*1	・ Water conflict with other sectors ・ Environmental and social consideration

Organisation	Key Issues
	・ Climate change resilience ・ Sedimentation ・ Incompletion of the projects due to fund shortage ・ Scattering of irrigation-related information and data ・ O&M supporting system ・ Shortage of irrigation human resources
EOJ	・ Paradigm shift from subsistence farming to profitable agriculture ・ Capacity building of IOs ・ National food security ・ Employment security for rural youth
WB	・ Climate smart irrigation development (drip and sprinkler, sub-surface dam, etc.) ・ Improvement of market access ・ Agriculture business planning by IOs
IFAD	・ Securing land tenure of smallholders against land grabbing ・ Linkage with agriculture value chain (business plan) on PPP basis ・ Water and land conflict among users (farming vs. livestock keeping) ・ Deregulation in import and export of agriculture commodities ・ Construction of quality irrigation systems
USAID	・ Environmental flow assessment (EFA) ・ Linkage with private sector in agriculture value chain ・ Water saving agriculture in semi-dry zone ・ Deregulation in import and export of political crops ・ Preparation of business plan (crop budget) ・ Improvement of market access roads ・ O&M fee collection
AFDB	・ Coordination with ASDP2 (especially, irrigation development in Lake Zone)
FAO	・ Improvement of productivity and profitability in agriculture ・ Strengthening of IOs in a sustainable manner ・ Agriculture statistics ・ Promotion of climate smart agriculture ・ Youth involvement in agriculture sector
DFID	・ Combination of green water (soil moisture and rainfalls) and blue water (river and lake water)

*Source: JICA Project Team based on interview to the relevant organisations, except *1) JICA Formulation of Detailed Plan for the Project on Revision of National Irrigation Master Plan, February 2016*

5.11 Challenges in Irrigation Sector

Challenges currently being faced in the irrigation sector is derived from the field survey, interviews to and discussions with various stakeholders, literature searching, etc. are summarised in the Table 5.11.1.

Table 5.11.1 Major Challenges in Irrigation Sector

Category	Challenges
Study and Design	・ Improper F/S and D/D available before implementation of sub-projects ・ Small budget available for F/S and D/D including geodetic survey and geological investigation ・ Vulnerability for drought and floods ・ Sedimentation problems ・ Low irrigation efficiency ・ Non-availability of design standards and manuals ・ Low awareness of CGL
Construction Supervision	・ Insufficient staff and daily operation cost ・ No timely reporting of physical and financial progress in construction works ・ Poor quality of works ・ No utilisation of construction management manuals, etc.
Budget and Fund Flow	・ Small development budget and further small disbursement, resulted in partial completion of works ・ Delay in payment to the contractor ・ No transparency in fund management

Category	Challenges
Institution and Human Resources Development	・ Irrigation organisation reform ・ Shortage of capable irrigation engineers and technicians ・ Limited number of new staff recruitment by the government and the private sector ・ Poor coordination with relevant government organisations and institutions
Capacity Building	・ Insufficient technical capacity of irrigation engineers and technicians ・ Inactive IOs and supporting system of IOs ・ Poor monitoring and evaluation system
O&M	・ Constant water shortage ・ No proper planning for O&M ・ No business planning by IOs ・ Poor collection of irrigation service fees

Source: JICA Project Team

Countermeasures for the above challenges will be discussed later in Chapter 8.

Chapter 6 Irrigation Database Update and Irrigation Scheme Mapping

6.1 General

6.1.1 Brief History of Irrigation Database

The irrigation database was initially developed in 2002 as part of the National Irrigation Master Plan 2002 (NIMP2002). In 2009, the irrigation dataset was updated and the interfaces of the database program were renewed. This database is called the "2009 database". The number of data collected by the 2009 database reached to around 2,800. These databases were created by utilising the Microsoft Access program.

Because the 2009 database was managed by one developer, a problem occurred that during that time, access to data by the National Irrigation Commission (NIRC) headquarters and Zonal Irrigation Office (ZIO) staff was difficult. In addition, since the person in charge of development of the database transferred to a section not related to database, it became more difficult to use the irrigation database.

Under such circumstances, NIRC requested the Japan International Cooperation Agency (JICA) to support the development of a new irrigation database which is user friendly and easy to use. In response to the request, JICA dispatched a database expert as a Capacity Development for the Promotion of Irrigation of Scheme Development under the District Agricultural Development Plan 2 (TANCAID2) short term expert in 2016.

The Information Communication Technology (ICT) unit of NIRC and the JICA expert of TANCAID2 developed a database called the "Model Database".

6.1.2 Model Database

The Model Database is a Microsoft Excel based database targeting selected six districts. Interface of the database, which is a collection of Excel sheets, is created utilising the Visual Basic for Application (VBA). Data collected by the district irrigation staff is stored in an excel sheet.

In the system design of the Model Database, the data collected in each district will be sent to a database officer in a zonal office by an e-mail, the officer will consolidate them. Data consolidated in a zone will be sent to the ICT unit by e-mail and will be consolidated again. The consolidated data sent from each zone will be the National Irrigation Database.

Moreover, the model database includes the irrigation scheme mappings by use of the GPS pointing survey.

6.1.3 TOR

The JICA Project Team is requested in the TOR of National Irrigation Master Plan 2018 (NIMP2018) to update the model database. The components of updating work are as follows:

i) Develop databases for zonal and NIRC HQs staff if necessary
ii) Collect irrigation data for nation-wide database

iii) Create irrigation scheme map
iv) Develop data sharing method (through e-mail, website, etc.)
v) Collect data on newly planned irrigation schemes
vi) Train database officers

6.2 Method and Procedure

6.2.1 Development of Database for Zonal and NIRC Headquarters Staffs

Updating of database work consists of two parts. They are:

- Updating irrigation schemes data
- Updating of interface for input, output and data storage

(1) Updating Irrigation Schemes Data

Updating data work was carried out by requesting the district irrigation staff to modify the list of the irrigation schemes' data after examining it. JICA Project Team prepared the scheme list by collecting available data. Table 6.2.1 summarises the data sources and their data numbers.

Table 6.2.1 List of Irrigation Scheme Data Collected

Data Source	Number of Data in Each Source
2002 NIMP2002	1,427
2009 Database	2,826
2015 Irrigation data kept by NIRC	2,415
2016 List of schemes on each zonal office	Total of 2,339

Source: JICA Project Team

(a) GPS Pointing Survey:

In order to confirm the existing irrigation schemes, a GPS pointing survey in the field was carried out by each district irrigation staff on the basis of the 2016 scheme list. Details of the GPS survey work are presented in section 6.3.2.

(b) Questionnaire Survey:

In the initial plan, data collection was planned for approximately 1,300 schemes selected based on 2009 database. However, during the data collection period, the JICA Project Team found many discrepancies in contents among the data sources. Therefore, the JICA Project Team decided to conduct scheme data survey for all schemes where a GPS survey was carried out after limiting the data items. For this purpose, questionnaire was prepared for district staffs. Details of this survey work is presented in section 6.3.2.

6.2.2 Irrigation Scheme Mapping of Selected Schemes

In the creation of the scheme map, at first, the JICA Project Team collected layout maps, sketches and other materials that are likely to be helpful. And then, by referring to the collected layout maps, sketches and GPS data, the JICA Project Team drew the scheme boundary, canals, etc., on Google Earth. Details are shown in the section 6.4.

6.2.3 Revision of Interface

The basic concept of the Excel based interface, which is applied in the Model Database, is not changed.

The Zonal and NIRC HQs interfaces are upgraded adding operation buttons for the data consolidation function and data processing. The details are discussed in Section 6.3

6.2.4 Website Development

In Tanzania, the e-Government Agency (eGA) under the Public Service Management of President's Office is managing the development of the website and is responsible for maintaining it. In connection to this, the project team consulted with eGA concerning the proposed NIRC website, and collected the necessary information such as guidelines. The details are described in section 6.5.

6.3 Update of Irrigation Database

Before starting data collection, the JICA Project Team took advantage of the opportunities of TANCAID training and conducted training for zone officers who are expected to become trainers for district officials.

6.3.1 Training for Update Database

Training was conducted for five days from 7th to 11th November 2016 in collaboration with TANCAID2 in Morogoro. The main objectives are to give training to the Zonal database officers, who will be in turn, trainers to the district staffs. The training program consisted of three sub programs. They are:

- New function of Zonal interface (Explanation of consolidation function as a draft basis)
- Creation of Scheme Layout (Method and procedure using GPS)
- Presentations by Database Officers (Simulation of training for district officers)

In day one and first half of day two, the training for database took place.

In the second half of day two, day three and day four, training for scheme mapping was conducted including a sample site visit to the Kiroka scheme, which is one of the Small-Scale Irrigation Development Project (SSIDP) project, in day three.

In the last day of day five, seven database officers presented their achievement. All of them performed well, and performances of some of them were very impressive.

In addition to the seven Zonal database officers, the technical working group members of TANCAID2 including four TANCAID2 experts also participated in this training. Therefore, the total number of participants reached to 37.

Table 6.3.1 Update Database Training Program

Date	Venue	Subject	Number of Participants
7th November 2016	VETA conference room in Morogoro	・Update database	37
8th November 2016	VETA conference room in Morogoro	・Update database ・Creation of Scheme Map	37
9th November 2016	Kiroka Irrigation Scheme	・Sample site survey	37
10th November 2016	VETA conference room in Morogoro	・Creation of Scheme Map	37
11th November 2017	VETA conference room in Morogoro	・Presentations by Zonal database officers	37

Source: JICA Project Team

6.3.2 GPS Pointing Survey

Aiming at measuring coordinates of all irrigation and dam schemes for GIS analysis and irrigation database, the GPS pointing survey was conducted from the end of January 2017 to the end of April 2017 but it was extended until August 2017 due to rains and other reasons. In this survey, two locations such as intake point and start point of irrigated farms were measured.

(1) Methodology

The GPS pointing survey has been conducted in the following manner:

- Collection of the irrigation database prepared by each ZIO. (December 2016)
- Arranging a plan to distribute GPS devices to each ZIO based on the numbers of schemes listed on the zonal database.
- Distribution of GPS devices and survey forms to each ZIO.
- Following up explanation in the workshop for creation of Scheme Maps.
- The list of schemes was revised by each district staff in the workshop.
- GPS pointing surveys by district staff at irrigation schemes.
- Collection of surveyed data directly from district staff or through the zonal database officer.

(2) Result of GPS Survey

The number of irrigation schemes submitted by each ZIO was 2,339 at the end of 2016, and then the revised number by the efforts of district staffs is 2,916. Moreover, the number of GPS pointing survey results submitted by the district staffs was 2,453 as of the end of August 2017. For the purpose of the GPS survey, the JICA Project Team distributed a total of 54 GPS devices to districts through the ZIOs.

The survey period was originally two months from the end of January 2017 to the end of March 2017, which was finally extended to August 2017. Unfortunately, there were reports from district irrigation staffs that survey works were not able to be conducted in several schemes because of poor access to sites due to rain. Consequently, the irrigation schemes, which exist but not surveyed, are excluded from the scheme list.

Table 6.3.2 Number of Irrigation Schemes

Name of Zone	Zonal Database (End of 2016)	Revised Number by LGA (April 2017)	GPS Data (August 2017)
Dodoma	309	319	289
Kilimanjaro	912	1,156	988
Mbeya	494	527	403
Morogoro	225	288	236
Mtwara	166	218	158
Mwanza	182	308	267
Tabora	51	100	112
Total	2,339	2,916	2,453

Source: JICA Project Team

At the final stage of discussion with NIRC made from February to March 2018, the number of irrigation schemes has increased to 2,947 because additional irrigation schemes submitted by NIRC and LGAs.

6.3.3 Data Collection by Questionnaire Survey

The project team distributed questionnaires with regard to basic irrigation scheme and dam information. Items tried to collect information by questionnaire are shown in Table 6.3.3.

Table 6.3.3 Items Tried to Collect Information by Questionnaire

Questionnaire items for irrigation scheme	・Location (Village name) ・Priority for development ・Reasons for requiring the scheme development ・Water source ・Existing category of irrigation scheme ・Intake method ・Irrigation method	・Present status ・Required type of work ・Utilization of CGL ・Irrigation area (potential, designed, developed, irrigated wet, irrigated dry) ・Scheme history (start year, completion year, improved, etc.) ・Ownership ・Beneficiaries/IO members
Questionnaire items for dam	・Location ・Type of dam ・Purpose of dam ・Dam dimensions ・Present status ・Required type of work	・Commanding irrigation schemes ・Irrigation area ・History of dam ・Beneficiaries

Source: JICA Project Team

Questionnaires were distributed to 162 district staffs through NIRC HQs and Zonal offices. The number of answers received is tabulated in Table 6.3.4.

Table 6.3.4 Number of Schemes: Questionnaire Survey

Name of Zone	Irrigation Schemes	Dam
Dodoma	193	30
Kilimanjaro	903	15
Mbeya	211	4
Morogoro	334	9
Mtwara	189	6
Mwanza	218	32
Tabora	134	35
Total	2,182	131

Source: JICA Project Team

6.3.4 Data Collection on New Schemes

In parallel with the data collection by questionnaire survey, NIRC summarised the following list of the well-prepared irrigation schemes which Pre-F/S or F/S were conducted by NIRC in the past.

Table 6.3.5 Summary of Earmarked Projects for Future Development/Improvement

S/No	Project	Type	Potential Area (ha)	District	Region	Zone
1	Bukirilo – Gwanupu Irrigation Project	Water saving Technology	50	Kibondo	Kigoma	Katavi
2	Participatory Dams Development Program in Semi-Arid Areas of Tanzania	Exisisting dams (30 Numbers)	13,444		Manyara, Dodoma, Singida, Mara, Tabora	Dodoma, Tabora, Mwanza
		Proposed new dams (128 Numbers)	97,648		Singida, Manyara, Mwanza, Mara, Geita, Shinyanga, kigoma, Tabora	Dodoma, Tabora, Mwanza
3	Euga Irrigation Scheme		400	Ulanga	Morogoro	Morogoro
4	Karema Irrigation		1,000	Mpanda	Katavi	Katavi

S/No	Project	Type	Potential Area (ha)	District	Region	Zone
	Scheme					
5	Kibaoni Irrigation scheme	Water saving Technology	50	Mpanda	Katavi	Katavi
6	Kitengule Irrigation Scheme	Water saving Technology	50	Karagwe	Kagera	Mwanza
7	Luiche Irrigation Project	Dam	3,000	Kigoma Municipal	Kigoma	Katavi
8	Lukuledi Irrigation Project		4,680	Lindi	Lindi	Mtwara
9	Madibira Phase II Project		3,600	Mbarali	Mbeya	Mbeya
10	Maleza Irrigation Project		7,500	Sumbawamga	Rukwa	Katavi
11	Promotion of Micro Irrigation System for Improved Crop Production for Smallholder Farmers in Tanzania	Water saving Technology	16,710	18 District Councils and 1 Municipality		
12	Muhongo Iriigation Project		1,500	Ngara	Kagera	Mwanza
13	Mwamapuli Irrigation Project	Dam	10,900	Mlele	Katavi	Katavi
14	Nanjembo irrigation Project		1,750	Chunya	Mbeya	Mbeya
15	Pawaga Irrigation Project		3,170	Iringa	Iringa	Mbeya
16	Ngongwa Irrigation Project	Water saving Technology	130	Maswa	Simiyu	Tabora
17	Songwe River Basin Development Project	Dam	3,005	Kyela	Mbeya	Mbeya
18	Yongoma Dam for supporting Ndungu Irrigation Scheme		1,600	Same	Kilimanjaro	Kilimanjaro
19	Luhanga Consolidated Rice Project	Dam	4,000	Mbarai	Mbeya	Mbeya
20	Ruhuhu Irrigation Project	Dam (Kikonge)	3,200	Nyasa/Ludewa	Ruvuma/Njombe	Mtwara/ Mbeya
Total Potential Area (ha)			177,387			

Source: NIRC

Irrigation schemes on the Table 6.3.5 are included in the database. These irrigation schemes are compiled by irrigation type in section 8.6.

6.3.5 Customization of Interface

(1) Re-naming of Terminology for the National Irrigation Database System

The concept of the Model Database, a collection of databases held in district offices, zonal offices, and NIRC headquarters, is defined as a national irrigation database. In this concept, a database of a district may be misunderstood as the National Irrigation Database (NID). In order to avoid such confusion, the project team defines the data set only consolidated and possessed by the NIRC's ICT unit as the National Irrigation Database.

Table 6.3.6 Comparison Table for Database Terminology

TANCAID2, Model Database	Project Team Definition
-	NID for user
Headquarters Database	NID
Zonal Database	Zonal interface Zonal data set for NID
District Database	District interface District data set for NID
-	Interface: A collection of Excel sheets for operation
-	Data set: An Excel sheet where the collected data is stored.

Note: For utilisation of database, interface, and database (or data set at zonal and district levels) are necessary.
Source: JICA Project Team

(2) Required Functions of Interfaces

In this project, four versions of interfaces will be prepared.

The ICT unit of NIRC headquarters is responsible for management and maintenance of the National Irrigation Database system. The ICT unit will have an interface with all functions.

Database officers in zonal and district offices will have authority to input the collected data and compile the stored data as an administrator. Therefore, they need to use an interface having data input and data compiling functions.

In addition, the Zonal staff requires a data consolidation function to compile data sent from districts offices.

User excluding administrators will require a data import function from website and a function of data output. As for irrigation scheme map, a function to use google earth based map will be added considering rather good condition of internet connection.

Differences among interfaces are summarised below.

Table 6.3.7 Comparison Table for Difference in Functions among Interface Versions

Function / Interface	Data Input/Modificatio	Output	Library	Map		Data Search	Data Storage	Data Import	Data Export	Data Consolidation	Data Compiling
				Map on Google Earth	Excel based Map						
ICT unit ver.	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
Zonal Office ver.	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	–
District Office ver.	✔	✔	✔	✔	✔	✔	✔	✔	✔	–	–
User ver.	–	✔	✔	✔	–	✔	✔	✔	–	–	–
Model Database	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	–

Note: ✔: function is equipped, : function is not equipped.
Data items stored in each office is the same as the National Irrigation Database.
Source: JICA Project Team

(3) Development of Data Sharing Method

(a) Irrigation Scheme Data Transmission

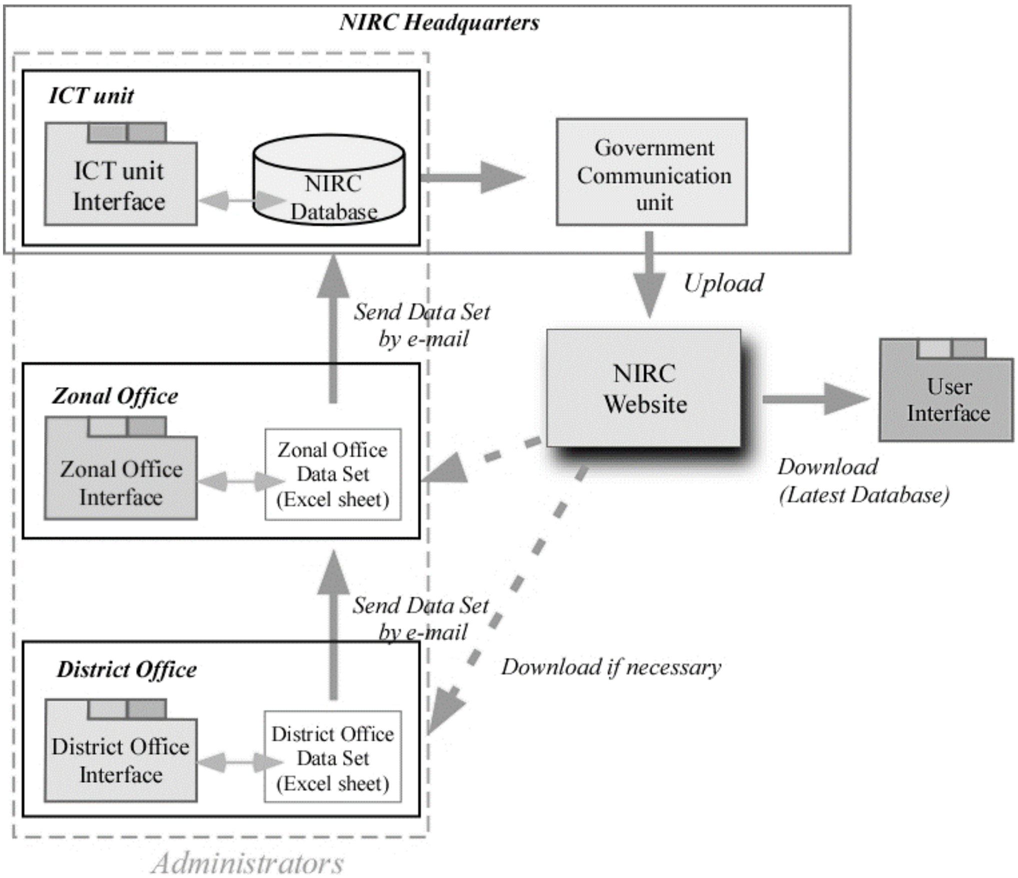
Expected size of one data set, which will be sent by district or zonal offices, would be less than one hundred kilo bites. Considering the communication situation of the Internet, data transmission by e-mail is considered to be the most realistic.

(b) Use of the National Irrigation Database

Currently, the easiest way to share the latest version of the database would be to utilise the expected NIRC website. The management section for the expected NIRC website will be the Government Communication (GC) unit to be established in NIRC. The latest version of database and interfaces would be uploaded by the ICT unit after getting approval from GC unit.

Users will be able to download the latest version of the database and interface from the NIRC website for their use in the future.

Figure 6.3.1 shows the proposed data sharing and NIRC website utilisation methods.



Source: JICA Project Team

Figure 6.3.1 Proposed Data Sharing and Website Utilisation Method

6.4 Irrigation Scheme Mapping of Selected Schemes

6.4.1 Background

At the same period when the model database was created, a method to make a scheme map was developed by the joint efforts of the NIRC ICT unit and TANCAID2 expert to fulfil the following necessity:

(1) Conformity with National Irrigation Act 2013

In the "National Irrigation Act 2013 PART III, Declaration of Irrigation Area and Land Classification, Clause 16 sub-section (3)", the "(a) map or plan showing the boundaries and extent of the lands proposed to be comprised in the area" is requested.

However, the topographical maps which are currently available are old ones created in the 1970s and are very difficult to obtain. For the preparation of a new map, a lot of time and budget will be required to conduct topography survey works.

From the legal point of view, a scheme map, which shows a scheme boundary with low cost, is required.

(2) Necessity of Scheme Monitoring

In a village resources map that is required to be created by CGL, it is difficult to confirm the boundary of the scheme. Moreover, since the map has no scale, it is impossible to manage the scheme in terms of quantity such as the irrigation area and the canal length.

As a tool, a scheme map with enough accuracy for scheme management is required.

(3) Necessity of Scheme Management and Planning

In a district office, the design drawings and design reports are not kept in most cases. Therefore, it is almost impossible to confirm the scheme area where the development is requested for the newly appointed irrigation staff in particular.

There is a high demand of a scheme map, which can measure the area easily with a certain accuracy, from the district staff.

6.4.2 GPS Mapping Workshop

In order to transfer the GPS mapping creation method, after the joint national workshop with TANCAID2 at Morogoro, training workshops for district officers were held in each NIRC zone with the schedule as shown below. Each workshop had three days program which included one day field work during the middle of the day. The database officer in each zonal office was the main lecturer with support from ICT unit of NIRC headquarters.

Table 6.4.1 Subject of GPS Workshop

Date	Zone	Venue		Number of Participants
		Workshop	Field work	
6th February – 8th February, 2017	Morogoro	Edema Conference Centre & Hotel in Morogoro	Irrigation scheme near Wami Dakawa S 6.455337 E 37.560483	18
15th February – 17th February, 2017	Kilimanjaro	Umoja Lutheran Hostel in Moshi	Irrigation scheme near Uchira S 3.4231717 E37.4612094	23

Date	Zone	Venue		Number of Participants
		Workshop	Field work	
20th February – 22nd February, 2017	Dodoma	VETA meeting room in Dodoma	Irrigation scheme near Kisalalo Bulu River S 5.886959 E 35.294088	23
1st March – 3rd March, 2017	Tabora	Moravian Church Hostel in Tabora	Inara irrigation scheme S 5.116765 E 32.934665	14
6th March – 8th March, 2017	Mwanza	Victoria Palace Hotel, La Kairo Hotel in Mwanza	Irrigation scheme near Magu S 2.616408 E 33.457895	36
20th March – 23rd March, 2017	Mtwara	Evengalical Lutheran Church in Mtwara	Kitele irrigation scheme S 10.353154 E 39.705285	18
27th March – 29th March, 2017	Mbeya	Mtenda Sunset Hotel in Mbeya	Mshewe Irrigation Scheme S 8.8485556 E 33.2816914	28

Source: JICA Project Team

6.4.3 Procedure to Making Irrigation Scheme Layout Map

The JICA Project Team is making an irrigation scheme layout map with the following procedures:

i) Collect existing irrigation scheme layout information
ii) Conduct training for zonal officers on how to draw irrigation scheme layout maps
iii) Conduct training for district officers on how to draw irrigation scheme layout maps
iv) Draft scheme layout maps by the JICA Project Team
v) Modify layouts by district officers
vi) Upload to NIRC websites

The following documents were collected as the basic information for drawing scheme layout maps:

- Design layout that was prepared by NIRC
- Scheme layouts in several reports
- Hand written sketch from IO, District offices,
- GPS coordinates from field visit

Example of the data is shown in Figure 6.4.1.

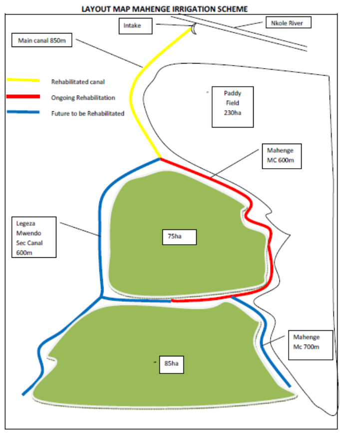
Based on the collected information, layouts were drawn with Google Earth Pro reference with satellite image, and saved in KML format. Prepared KML files will be integrated to National Irrigation Database System. The number of layout maps prepared by the Project is shown in Table 6.4.2.

Table 6.4.2 Number of Prepared Scheme Layout Maps

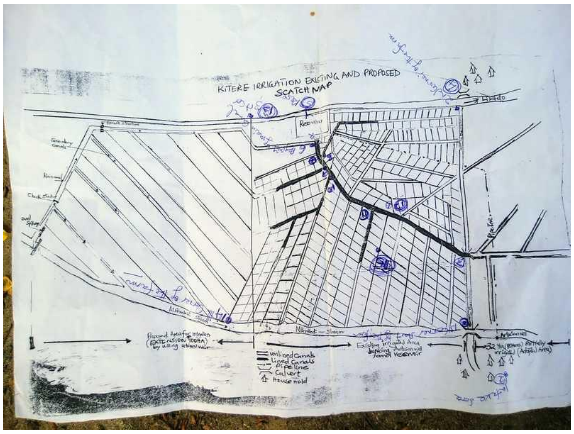
Zones	Number
Dodoma	44
Kilimanjaro	108
Morogoro	106
Mtwara	93
Mbeya	136
Tabora	49
Mwanza	66

Source: JICA Project Team

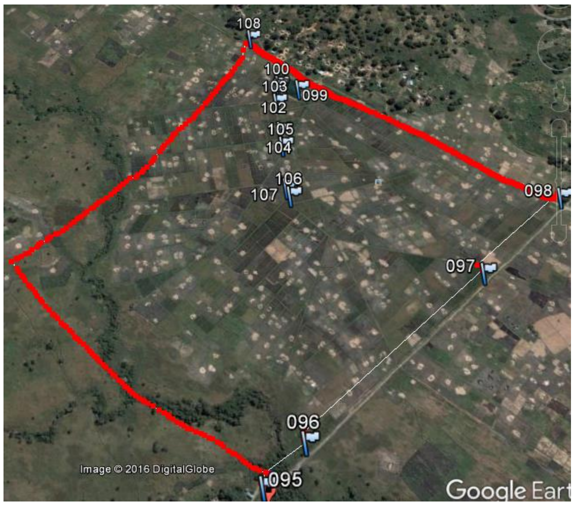
(a) Existing irrigation scheme map



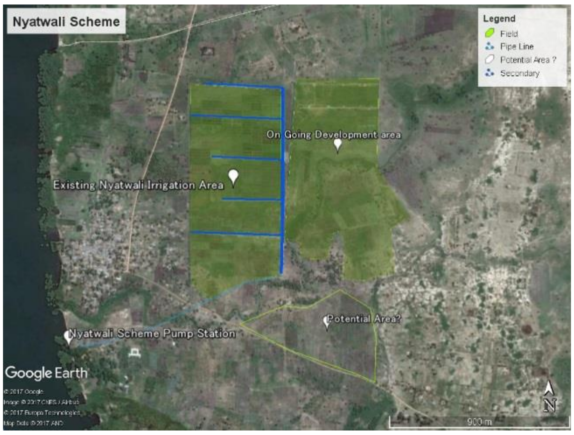
(b) Irrigation scheme map in several reports



(c) Hand written irrigation scheme map in a district office



(d) GPS coordinates map measured during a filed survey



(e) Nyatwali irrigation scheme map

(f) Inala irrigation scheme map

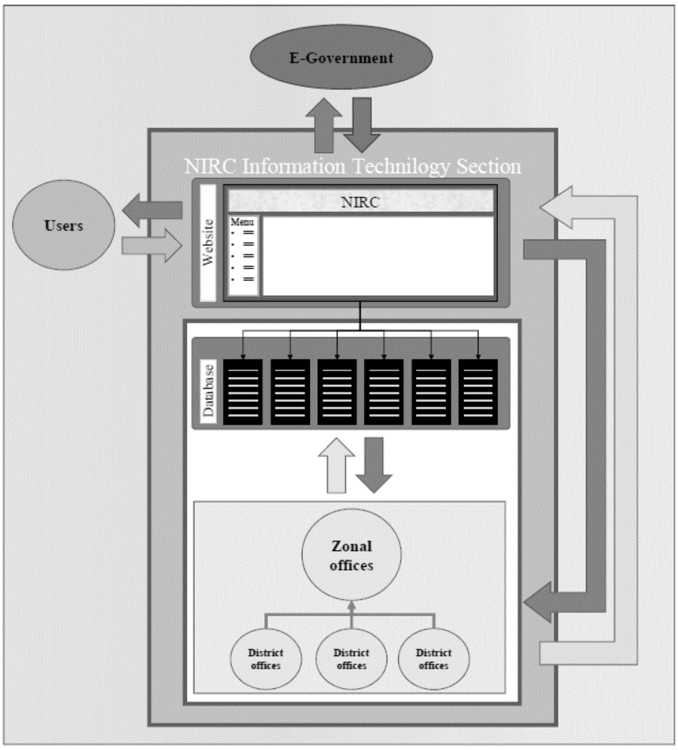
Source: JICA Project Team

Figure 6.4.1 Example of Irrigation Scheme Maps

6.5 Website Development

6.5.1 Website Guidelines

Figure 6.5.1 shows the flow chart of the website development as well as the database interaction among district offices, zonal offices, and NIRC. More details about database interaction and updating process is explained in Section 6.3. This section will focus on the NIRC website development process.



Source: JICA Project Team

Figure 6.5.1 Website Development Flow Chart

The NIRC as a governmental organisation is advised to develop and operate a website to give information and services provision to the public. The eGA is taking care of developing and maintaining the government websites in Tanzania. The websites, however, should be designed in accordance to the guidelines, and standards defined by the eGA and issued in technical guidelines. An important guideline: "Technical Standards and Guidelines for Governmental Websites" contains detailed information about the following:

- Website development process
- Website design
- Website content management
- Website hosting
- Web information security

Therefore, there are specific requirements that the NIRC should follow to develop a website. These are listed in Table 6.5.1

Table 6.5.1 Terms and Conditions of Government Website

Registering a domain name	The domain name should be unique and does not conflict with other domain names.
Uniform resource locator (URL) standards and naming conversion	Standards and naming conversion: a URL goes into more details than a domain name, which identifies specific web page, file, or document on the internet. It should be also unique and follow specific standards which are detailed in the technical manual.
Navigation elements and branding requirements	The navigation term refers to the menus and links which allow user to move from one page to another within the website. There are four main types of navigation
Global header navigation	It is used to describe important links which users tend to access very frequently
Top level navigation	It is a graphic image or text title at the top of web page that identifies the website. It is also a place for the government institution logo.
Body element or utility navigation	It includes navigations buttons like home, about us, publications, etc. It contains the main content area of each page.
Footer navigation	It contains navigation buttons like privacy policy statement, terms and conditions, disclaimer, and copyright.

Source: eGA

Whereas, branding pivotal to the government's goal of providing consistent, seamless look and feel of web presence. Branding includes sites architecture, navigation, layouts, graphics, colours, and fonts, minimum page elements, and consistent terminology, usage, and spelling.

For the website design guideline, there are also several points that should be taken into consideration during the design process including usability, discoverability, accessibility, compatibility with browsers, and responsive design.

To smoothen the process of creating the homepage of NIRC, the NIRC requested the eGA to build its website. Thus, an important meeting was conducted between the IT unit of NIRC and the eGA's team to discuss and select the preferred design as well as the contents of each webpage so that the eGA can proceed to create a proper website for NIRC which adheres to the above rules and guidelines. Figure 6.5.2 shows the initial design of NIRC homepage.

The NIRC site map consists of the following information:

Table 6.5.2 Navigation Menu and its Contents of NIRC Website

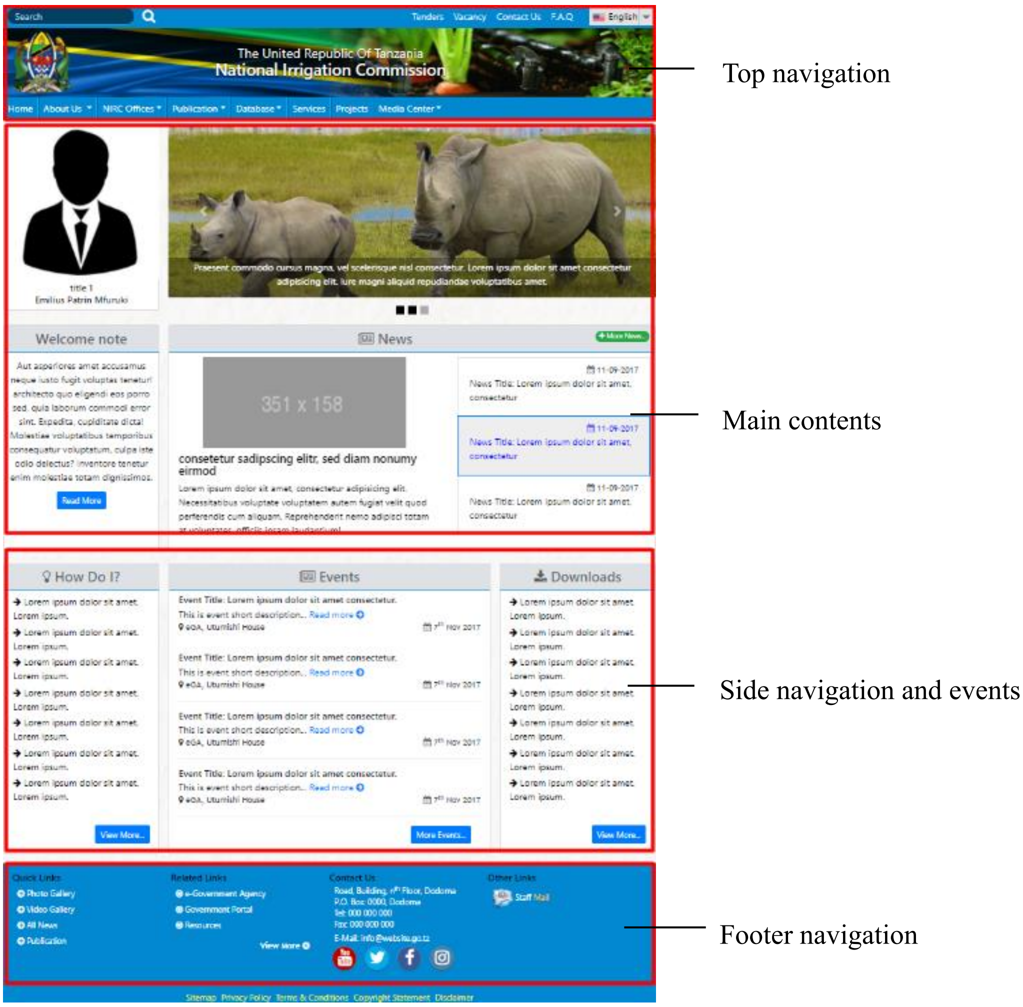
Navigation Menu	Contents
i) HOME	･ General
ii) About NIRC	･ Establishment History ･ Vision and Mission ･ Organisation Structure ･ Board Members ･ Departments ･ Units
iii) Zonal Offices	･ Zonal information
iv) Publications	･ Polices and Acts ･ Reports ･ Articles ･ Guidelines and Manuals
v) Irrigation Maps and Database	･ Irrigation Database ･ Irrigation Maps (GIS Web Map)
vi) Services	･ Services information
vii) Projects	･ Ongoing

Navigation Menu	Contents
	・ Completed
viii) Media Centre	・ Speeches ・ Press Release ・ Photo Gallery ・ Video Gallery

Source: NIRC and eGA

As shown in the menu above, the NIRC website will have database of irrigation schemes. In the contents management system (CMS) (back-end), NIRC will be able to enter Irrigation Data either by uploading the whole sheet or one entry after another. The data will be in Excel (.xls or .xlsx or .csv) formats. The excel template shall be provided by the NIRC.

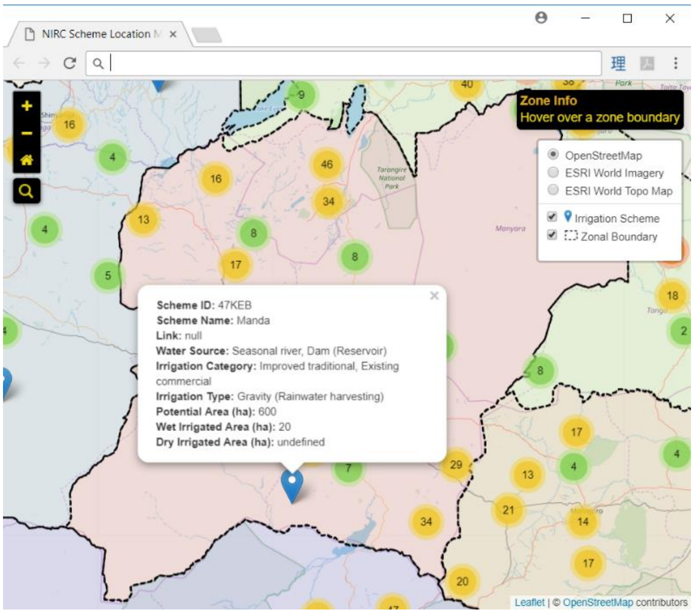
Under "Irrigation Map & Database" menu, web visitors shall be able to see an Irrigation Data Table. The Data Table shall have a search and filter capability. The information in the Data Table shall be able to be exported (and downloadable) onto Excel or PDF formats. The filtering capability should allow users to see data of their preference.



Source: eGA, 2014, Technical Standards and Guidelines for Governmental Websites, accessed to http://www.ega.go.tz/index.php/standards

Figure 6.5.2 Layout of the Navigation Element

The NIRC website will contain also an interactive GIS web map. The web map consists of a web map service (WMS) base maps that cover the entire globe, the NIRC zonal boundaries, and clusters of the irrigation schemes which have been collected using GPS devices. It also has a search toolbar to search for a specific irrigation by its identification (ID) code which has a similar ID code created in the irrigation scheme database. The web map enables a user to click on any of the zonal boundaries and it will zoom in to the extent of the target zone. There is also a navigation toolbar which consists of zoom in, zoom out, and home to zoom out to the extent of the Tanzania boundary. The irrigation schemes in the web map contain information about the Scheme ID, Scheme Name, Link, Water Source, Irrigation Category, Irrigation Type, Potential Area (ha), Wet Irrigated Area (ha), and Dry Irrigated Area (ha). Figure 6.5.3 shows the distribution of irrigation schemes in one selected zone and an attribute data associated with each irrigation scheme.



Source: JICA Project Team

Figure 6.5.3 A Web Map of Irrigation Scheme Locations

6.5.2 Website Management and Maintenance

The NIRC website will be developed by eGA according to government guidelines, standards and best practices, and eGA will handover it to NIRC[1]. However, since NIRC has its own server, collocation hosting arrangement with eGA will be put in place. This means they will provide room to host not only the software but also the hardware (server) required for the website to operate and enable the sharing of ICT and other resources.

The development cost for the NIRC website is about TZS 9 million, the cost of collation hosting option[2] will be TZS 25,000 and the maintenance of the website will be TZS 50,000 per year but its dependent on the number of users.

In NIRC, the website will be managed by two units: the Government Communication Unit will go through, verify, and approve all information needed to be uploaded to the website (contents updating), and the ICT Unit will deal with technical parts, i.e., software updating, regular maintenance.

[1] NIRC website was publicly opened in June 2018 after taking over from eGA. (http://nirc.go.tz/)
2 A hosting method that eGA manages NIRC's server in their server room.

Chapter 7 Review of Potential Irrigation Development Area

7.1 General

The potential irrigation areas are evaluated based on available water resources for irrigation. Then, a prioritization analysis is made for selecting irrigation schemes to be incorporated into the National Irrigation Master Plan 2018 (NIMP2018) along with the result of land suitability analysis.

7.2 Water Availability for Irrigation

7.2.1 Method and Procedure

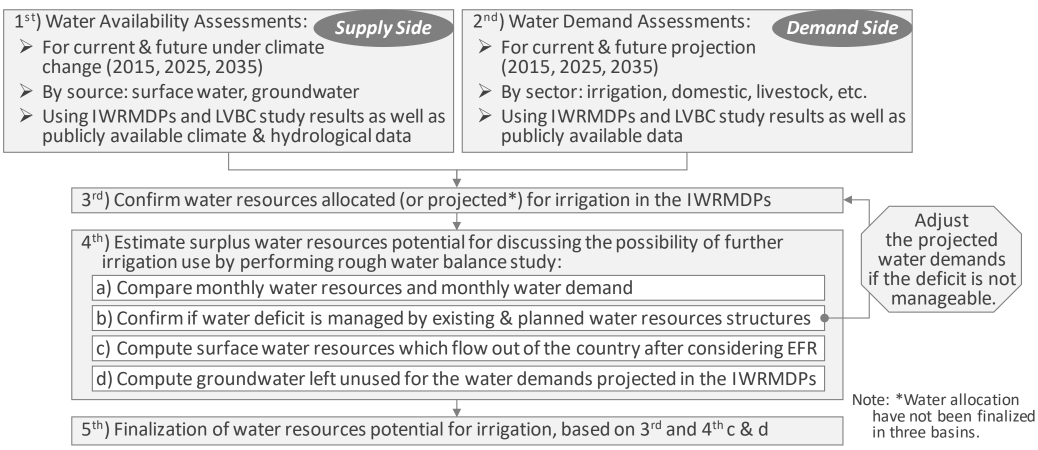
(1) Principle

According to the National Water Policy (NAWAPO), water uses other than basic human needs and environment purposes will be subject to social and economic criteria, which will be reviewed from time to time. Water is a finite and vulnerable resource which is under pressure and growing scarce as a result of increasing multi-sectoral demands due to the rapidly growing population. Under such difficult circumstances, water resources shall be utilized based on the principle of equity, right, and rationality.

The aforementioned Integrated Water Resource Management and Development Plans (IWRMDPs) have been formulated in accordance with NAWAPO including the said principle. From the standpoint of impartial utilization between sectors, even water resources left unused are not freely allocable for a specific sector. Consequently, the balanced IWRMDPs will be fundamental in preparing the NIMP2018. This means that the NIMP2018 has to harmonize with the water allocation determined in the IWRMDPs. On that basis, water resources remained unallocated to any sector is estimated as surplus water for reference in discussing the possibility of further irrigation use.

(2) Procedure

Figure 7.2.1 presents the key procedure of water resources assessment for estimating water available for irrigation purpose.



Source: JICA Project Team

Figure 7.2.1 Procedure of Water Resources Assessment

First of all, in the 1st and 2nd steps of Figure 7.2.1, the IWRMDP reports and the Lake Victoria Basin Commission (LVBC) study report were carefully reviewed for understanding the methodologies applied to the respective basins as well as compiling the study outputs in terms of surface water, groundwater, water demand for each sector and environmental flow, on a monthly and sub-basin basis. These processes are explained in Chapter 3.

After gathering the study outputs as well as confirming the water allocation to be used for the irrigation development plan of NIMP2018 in the 3rd step of Figure 7.2.1, surplus water resources potential was separately estimated for the purpose of discussing the possibility for further irrigation use. The estimation was made by performing a rough water balance study as listed in the 4th step of Figure 7.2.1.

As illustrated in Figure 7.2.1, water resources for irrigation were considered using a two-step process, namely 1) allocated water and 2) potential water, which are explained in the following sub-sections 7.2.2 and 7.2.3, respectively. The allocated water is to be used for the NIMP2018, while the potential water is presented as reference.

7.2.2 Allocated Water for Irrigation

(1) Approach for Determining Water for Irrigation

Water resources allocated for irrigation in the respective IWRMDPs can be considered secured and fully available for irrigation use by 2035. Irrigation areas to be proposed in the NIMP2018 will be elaborated within the water allocations, although some improvement of the irrigation system may be assumed in terms of cropping pattern, irrigation efficiency, etc.

However, the problem is that the IWRMDPs have not yet been formulated in the three basins, namely; Pangani, Wami/Ruvu, and Lake Victoria basins. This means that the projected irrigation water demands have neither been officially allocated nor secured. Therefore, it is necessary to review whether or not the water demands projected in the existing studies are realistically manageable for the three basins.

In addition, the annual water balance calculation made in Subsection 3.7.3 indicated that the projected water demands for 2035 are not met in four sub-basins, which are included in the Pangani, Lake Nyasa and Lake Victoria basins. Therefore, the irrigation demand for the Lake Nyasa basin needs to be additionally reviewed below.

(2) Review of Irrigation Water Demands for the Four Basins

(a) Pangani Basin

The result of the annual water balance calculation by sub-basin is summarized in Table 7.2.1. As seen in the table, the water demand in the Pangani River sub-basin will not be satisfied in 2025 and 2035 if environmental flow requirement (EFR) is deducted from surface water (SW). Even if groundwater (GW) is fully used, the deficit remains.

The deficit in the annual calculation means that any of the water storage facilities are not able to overcome the water shortage within the sub-basin unless water is supplied from the other sub-basins. However, from the topographic viewpoint, the water transfer from the surrounding sub-basins is not realistic.

Table 7.2.1 Annual Water Balance by Sub-basin for Pangani Basin

Sub-basin Name	Area (km^2)	SW (MCM/yr)			GW (MCM/yr)			Demand (MCM/yr)			EFR (MCM/yr)			SW - EFR - Dem (MCM/yr)		
		2015	2025	2035	2015	2025	2035	2015	2025	2035	2015	2025	2035	2015	2025	2035
Pangani River	43,652	4,832	4,096	3,524	466	466	466	2,685	2,976	3,209	1,511	1,544	1,557	636	**-424**	**-1,242**
Umba	8,205	934	733	611	71	71	71	133	154	190	19	19	19	782	559	401
Msangazi	5,085	687	601	543	31	31	31	12	54	102	1	1	1	674	546	440
Zigi-Mkulumuzi	2,159	510	452	422	18	18	18	33	49	76	91	90	90	387	312	256

Source: Prepared by the JICA Project Team based on the Pangani IWRMDP Study Report

On the other hand, the percentage of EFR to SW in the Pangani River sub-basin for 2035 is 44%. This is quite large compared with the other three sub-basins. However, the EFR of Pangani River sub-basin almost corresponds to the plant discharge required for hydropower generation at the existing New Pangani Falls HPP. Thus, the EFR is hardly able to be reduced.

It is particularly worth noting that one of the key features in the Pangani basin assessment is largely decreasing surface water by 27% from 2015 to 2035 due to climate change. The surface water might be reviewed at the planning stage, however, this is still an unclear factor at present. Even if the irrigation area is not further developed, the projected water demand for 2035 will not be satisfied. The envisaged future water deficit needs to be managed through more effective utilization of water resources in various sectors and/or alternative power generation means. If the deficit is managed only by the irrigation sector, the water resources allocated for irrigation sector in 2035 will be less than 78% of the 2015-based irrigation water demand, according to the monthly calculation made in the following Subsection 7.2.3.

Considering the severe situation of the Pangani River sub-basin, irrigation water use in the sub-basin cannot be increased from 2015 to 2025 and needs to be reduced by 22% from 2015 to 2035 by improving the irrigation system or reducing irrigation area. The NIMP2018 study will adopt the above-adjusted irrigation water in planning irrigation development for 2025 and 2035 for the sub-basin.

(b) Wami/Ruvu Basin

Although the IWRMDP for the Wami/Ruvu basin has not been formulated, a comprehensive water resources management and development plan was prepared in 2013 with the technical assistance of JICA. The Ministry of Water and Irrigation (MoWI) has positioned the plan as an assessment part of IWRMDP because climate change impacts have not been taken into account in the said plan.

The plan also proposed appropriate water resources development measures including new construction of 16 reservoirs and heightening of the existing five dykes, with careful consideration of the reliability of water utilization of 1/10-yr drought.

There is still a possibility of monthly water deficit if climate change impacts are considered. However, from the viewpoint of annual water balance presented in Table 7.2.2, the water deficit will be manageable within the basin. Therefore, the NIMP2018 study will adopt the projected water demands without changes.

Table 7.2.2 Annual Water Balance by Sub-basin for Wami/Ruvu Basin

Sub-basin Name	Area (km^2)	SW (MCM/yr)			GW (MCM/yr)			Demand (MCM/yr)			EFR (MCM/yr)			SW - EFR - Dem (MCM/yr)		
		2015	2025	2035	2015	2025	2035	2015	2025	2035	2015	2025	2035	2015	2025	2035
Kinyasungwe	16,509	289	289	289	129	129	129	118	182	279	0	0	0	171	107	9
Mkondoa	12,964	671	671	671	179	179	179	290	422	502	3	3	3	378	246	166
Wami	14,270	1,408	1,408	1,408	169	169	169	141	209	247	91	91	91	1,176	1,108	1,070
Upper Ruvu	7,623	2,252	2,252	2,252	102	102	102	79	108	127	116	93	93	1,766	1,511	1,121
Ngerengere	2,913	156	156	156	27	27	27	33	50	82	0	0	0			
Lower Ruvu	7,253	54	54	54	283	283	283	62	100	119	70	85	85			
Coast	4,763	35	35	35	250	250	250	353	525	845	17	26	26			

Note: The balance for the Upper Ruvu, Ngerengere, Lower Ruvu and Coast sub-basins are shown together because water demand in the lower sub-basins (Lower Ruvu and Coast) highly depend on the water supply from the upper sub-basins.
Source: Prepared by the JICA Project Team based on the Wami/Ruvu IWRMDP Study Report

(c) Lake Victoria Basin

The annual water balance is calculated in the same manner as the above basins. Out of the 13 sub-basins in the Lake Victoria basin, three sub-basins will have an annual deficit as presented in Table 7.2.3. However, the situation is considered still manageable within the basin by adjusting EFR and/or by water transfer between sub-basins. Since EFR has not been estimated for the Lake Victoria basin, the sanitation water demand using BOD5 is provided instead in the water balance calculation. As a result, the percentages of EFR to SW exceed 90% in some sub-basins. The basin has enough leeway to review the EFR. Therefore, the NIMP2018 study will adopt the projected water demands without changes.

Table 7.2.3 Annual Water Balance for Three Sub-basins in Lake Victoria Basin

Sub-basin Name	Area (km^2)	SW (MCM/yr)			GW (MCM/yr)			Demand (MCM/yr)			EFR (MCM/yr)			SW - EFR - Dem (MCM/yr)		
		2015	2025	2035	2015	2025	2035	2015	2025	2035	2015	2025	2035	2015	2025	2035
L.V. Islands	1,407	124	124	124	28	28	28	15	23	24	116	119	115	**-8**	**-19**	**-15**
Magogo-Moame	5,401	284	284	284	77	77	77	73	122	136	272	271	235	**-61**	**-109**	**-87**
Nyashishi	1,689	41	41	41	26	26	26	43	67	68	41	41	41	**-43**	**-67**	**-68**

Note: Calculation sheet for the remaining 10 sub-basins is presented in Appendix A.
Source: Prepared by the JICA Project Team based on the LVBC Study Report

(d) Lake Nyasa Basin

The annual water balance is calculated in the same manner as the above basins. Out of the ten sub-basins in the Lake Nyasa basin, the Muchuchuma sub-basin will have an annual deficit in 2025 and 2035 as presented in Table 7.2.4. Although the Lake Nyasa IWRMDP report also points out this situation, it does not clearly mention any interventions. According to the inventory survey conducted in the NIMP2018 for the purpose of updating the irrigation database, there is no existing scheme in the sub-basin. Irrigation development is less expected even in the future. Therefore, as with the case of the above Pangani River sub-basin, it is recommended to reduce the irrigation water use for 2025 and 2035 to 96% and 89% of 2015-based irrigation water demand, respectively, based on monthly calculation in the following sub-section 7.2.3.

Table 7.2.4 Annual Water Balance for Muchuchuma Sub-basin in Lake Nyasa Basin

Sub-basin Name	Area (km²)	SW (MCM/yr)			GW (MCM/yr)			Demand (MCM/yr)			EFR (MCM/yr)			SW - EFR - Dem (MCM/yr)		
		2015	2025	2035	2015	2025	2035	2015	2025	2035	2015	2025	2035	2015	2025	2035
Muchuchuma	670	143	141	141	3	3	3	93	100	107	47	53	59	3	**-12**	**-26**

Note: Calculation sheet for the remaining 9 sub-basins is presented in Appendix A.
Source: Prepared by the JICA Project Team based on the Lake Nyasa IWRMDP Study Rteport

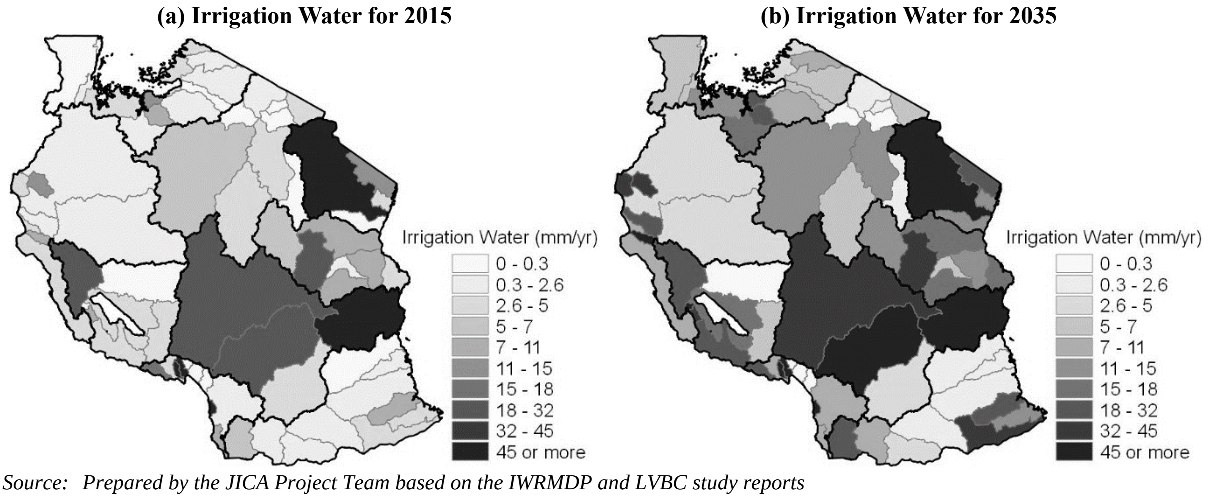
(3) Determined Water Allocation for Irrigation

As a result of the 3rd step process of Figure 7.2.1, monthly water resources for irrigation use by sub-basin have been determined. The allocated irrigation water is summarized in Table 7.2.5 by basin and Figure 7.2.2 by sub-basin. The NIMP2018 will utilize these figures for planning and irrigation development.

Table 7.2.5 Annual Irrigation Water by Basin by Target Year

Basin	Original Irrigation Water Demand (MCM/yr)			Determined Water for Irrigation [To be used for NIMP2018] (MCM/yr)			Remarks
	2015	2025	2035	2015	2025	2035	
Pangani	2,657	2,959	3,110	2,657	**2,724**	**2,234**	Changed from IWRMDP
Wami / Ruvu	656	993	1,268	656	993	1,268	
Rufiji	4,905	5,504	7,619	4,905	5,504	7,619	
Ruvuma	254	568	1,056	254	568	1,056	
Lake Nyasa	309	606	938	309	**595**	**913**	Changed from IWRMDP
Lake Rukwa	532	832	1,164	532	832	1,164	
Lake Tanganyika	273	578	986	273	578	986	
Lake Victoria	163	430	772	163	430	772	
Internal Drainage	561	869	1,177	561	869	1,177	
Total	10,309	13,338	18,091	10,309	**13,092**	**17,190**	

Source: Prepared by the JICA Project Team based on the IWRMDP and LVBC study reports



Source: Prepared by the JICA Project Team based on the IWRMDP and LVBC study reports

Figure 7.2.2 Allocated Water for Irrigation by Sub-basin

The monthly data by sub-basin is presented in Appendix A. The monthly allocation of irrigation water for the Ruvuma and Lake Victoria basins are determined based on cropping patterns proposed by the NIMP2018 because only annual irrigation water is presented in the previous study reports for those basins.

7.2.3 Potential Water for Irrigation

(1) Purpose of Estimating Potential Water for Irrigation

The abovementioned allocated water on a monthly and sub-basin basis for the target year of 2035 is to be used in formulating an irrigation development plan in the NIMP2018. On the other hand, the NIMP2018 Project Team is requested to present the potential of further irrigation development under the assumption that surplus water resources are fully used for irrigation. Thus, the purpose of estimating potential water for irrigation is to grasp the irrigation potential areas from the perspective of limitation of water resources.

(2) Handling of Potential Water for Irrigation

The potential water to be estimated in this subsection shall be basically treated as reference in the NIMP2018 for understanding the future potential of further irrigation development that will be incorporated into the plan after 2035. The potential water is defined as the water resources remained unused in the existing water resources plans by 2035. The potential water comprises two forms, namely; i) water exceeding environmental flow requirement among unused surface water flowing into sea or transboundary lakes, and ii) groundwater remained unused. It can be used not only for irrigation but also for the other sectors. Although the potential water is not basically used for irrigation development plan to be proposed in the NIMP2018, it may be partially used if the necessity of additional water use exceeding the allocated water arises.

(3) Approach for Estimating Potential Water for Irrigation

(a) Basic Data to be Used for Calculation

The following data that were compiled and/or estimated based on the IWRMDP and LVBC reports as well as provided by the MoWI are used in water balance calculation. All the data here are 2035 basis.

- Monthly water resources (surface water and groundwater) by sub-basin
- Monthly water demand and monthly environmental flow requirement (EFR) by sub-basin
- Storage capacities of the existing reservoirs and planned reservoirs proposed by IWRMDPs

(b) Key Considerations in Calculating Water Balance

Basic rules of how to supply water to each demand sector are considered as follows:

- The EFR needs to be secured only by surface water. This means that the potential water is not computed from a simple addition and subtraction method by sub-basin such as “surface water + groundwater – water demand – environmental flow”.
- The water demand is divided into “irrigation” demand and “the other” demands in advance. Groundwater is used only for “the other” demands in the calculation. The “irrigation” here indicates the allocated water for irrigation, which was determined in Subsection 7.2.2.
- Although the balance calculation is made basically by sub-basin, the surface water resources generated but unused in the upper sub-basins can be used in the lower sub-basins. Among all the 71 sub-basins, only eight sub-basins have a flow to downstream sub-basins.

Step-wise procedures of calculation considering the above rules are described in Appendix A.

(c) Output to be Yielded from the Calculation

From the above computation, the following water resources are regarded as potential water available for further irrigation development:

- Monthly water exceeding EFR among unused surface water flowing into sea or transboundary lakes; and
- Monthly groundwater remained unused for "the other" demands.

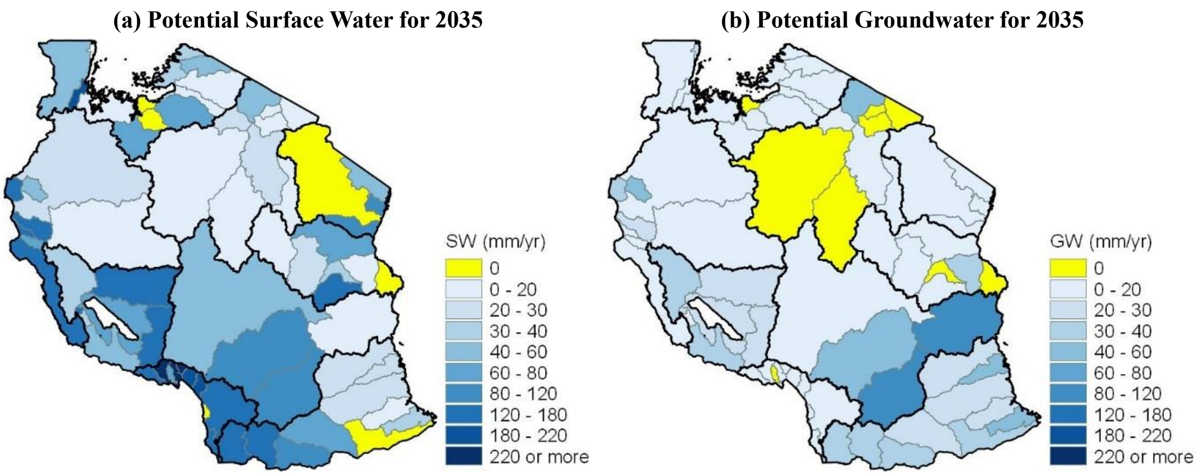
(4) Estimated Potential Water for Irrigation

The computation was made on a monthly and sub-basin basis. The result of estimating the potential water for irrigation is summarized into annual data and presented in Table 7.2.6 by basin and Figure 7.2.3 by sub-basin. The monthly data by sub-basin is presented in Appendix A.

Table 7.2.6 Estimated Potential Water for Irrigation by Basin for 2035

Basin	Catchment Area	Potential Surface Water		Potential Groundwater		Potential SW+GW	
	(km²)	(MCM/yr)	(mm/yr)	(MCM/yr)	(mm/yr)	(MCM/yr)	(mm/yr)
Pangani	59,102	1,097	19	220	4	1,317	22
Wami / Ruvu	66,295	2,731	41	775	12	3,505	53
Rufiji	183,791	11,485	62	8,548	47	20,032	109
Ruvuma	105,582	5,866	56	3,173	30	9,039	86
Lake Nyasa	27,594	5,957	216	103	4	6,060	220
Lake Rukwa	74,965	7,063	94	2,083	28	9,146	122
Lake Tanganyika	149,500	5,168	35	2,091	14	7,259	49
Lake Victoria	85,630	3,998	47	1,009	12	5,007	58
Internal Drainage	143,100	2,112	15	510	4	2,622	18
Total	895,559	45,477	51	18,511	21	63,988	71

Source: Prepared by the JICA Project Team based on the IWRMDP and LVBC study reports



Source: Prepared by the JICA Project Team based on the IWRMDP and LVBC study reports

Figure 7.2.3 Estimated Potential Water for Irrigation by Sub-basin for 2035

(5) Consideration for Utilizing the Potential Water

Due to the limitation of computation accuracy as well as extreme calculation conditions, it must be noted that the potential water estimated in the above clause (4) is not completely utilized for irrigation purposes realistically. Besides, careful attention should be paid particularly to the following matters in incorporating the potential water into the irrigation development plan.

- Assuming that the water storage facilities proposed in the IWRMDPs can cover only the water demand projected for the year 2035, additional irrigation areas shall be examined based on monthly water resources without storage effect. If favourable dam site for additional water storage is found in the future, the storage effect will be able to be considered.
- Increase in water demand for the sectors other than irrigation after 2035 have not been considered in estimating the above potential water in the above clause (4). If the estimated potential water is used for the irrigation water use planning after 2035, it is necessary to take into account the increase in water demands for the other sectors as well.
- When the potential surface water flows from upper sub-basin to lower sub-basin, the surface water resources can be withdrawn at either sub-basin.
- Groundwater was used only for the sectors other than irrigation in the above computation. On the other hand, the estimated potential groundwater could be fully used for irrigation, in theory. It is necessary to study whether the groundwater use for irrigation purpose is feasible or not.

7.3 Land Suitability for Agriculture

7.3.1 Method and Procedure

Sustainable agricultural development is one of the prime objectives in Tanzania. However, it is a complex process that requires balancing among available land resources, water resources, and target crops. In this section, land suitability (LS) assessment is conducted using GIS-based multi-criteria evaluation analysis to determine the suitability of a specific area for particular agricultural crops considering wide ranges of criteria.

The Analytical Hierarchy Process (AHP) method is one of the multi-criteria decision-making approaches introduced by Saaty (1977) which is commonly used in agricultural land suitability analysis. In the AHP methods, complex problems are structured hierarchically into criteria, sub-criteria, and alternatives from which the choice is to be made (Saaty, 1987). This method allows users to determine the weights of the parameters in the solution of a multi-criteria problem. To evaluate the criteria included in a level compared with other criteria included in the next hierarchy level, a scale ranking is made with the utilization of the preference scale introduced by Saaty (1977), illustrated in Table 7.3.1, that creates a pairwise comparison matrix and relies on the judgements of experts to derive priority scales.

Table 7.3.1 Scale and its Description

Intensity of importance	Definition	Explanation
1	Equal importance	Two activities contribute equally to the objective
3	Weak importance of one over another	Experience and judgment slightly favor one activity over another
5	Essential or strong importance	Experience and judgment strongly favor one activity over another
7	Demonstrated importance	An activity is strongly favored and its dominance demonstrated in practice
9	Absolute importance	The evidence favoring one activity over another is of the highest possible order of affirmation
2,4,6,8	Intermediate values between the two adjacent judgments	When compromise is needed

Intensity of importance	Definition	Explanation
Reciprocals	If activity *i* has one of the above numbers assigned to it when compared with activity *j*, then *j* has the reciprocal value when compared with *i*	

Source: Saaty, 1977, A Scaling Method for Priorities in Hierarchical Structures, Journal of Mathematical Psychology

The AHP provides mathematical measures to determine the consistency of judgment matrix. Based on the properties of the matrix, a consistency ratio (CR) can be calculated. In a matrix, the largest eigenvalue (λ_{max}) is always greater than or equal to the number of rows or columns (n). A consistency index (CI) that measures the consistency of pairwise comparisons can be written as:

$$CI = (\lambda_{max} - n) / (n - 1),$$

where CI is the consistency index, n is the number of elements being compared in the matrix, and λ_{max} is the largest or principal eigenvalue of the matrix. To ensure the consistency of the pairwise comparison matrix, the consistency judgment must be checked for the appropriate value of n using random index (RI) table. The CR coefficients are calculated according to the methodology proposed by Saaty (1994). The CR coefficient should be less than 0.1, indicating a positive evidence for informed judgment. CR can be calculated using the following formula:

$$CR = CI / RI,$$

Where CI is the consistency index, and RI is the random index calculated by Saaty (1994) and defined in Table 7.3.2.

Table 7.3.2 Random Index (RI) Table

n	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Random Index (RI)	0.00	0.00	0.58	0.90	1.12	1.24	1.32	1.41	1.45	1.49	1.51	1.48	1.56	1.57	1.58

Source: Saaty, 1994, How to Make a Decision: The Analytic Hierarchy Process, Interfaces

In LS analysis, the sub-criterion was classified into five classes ranging from 1 to 5 based on its suitability for agriculture land. The score of 1 indicates the least suitable while the score of 5 indicates the most suitable. Since the input parameters were collected from different sources, standardization into 1 to 5 was an essential step so that it made it possible to combine various parameters and get meaningful results. LS was calculated using the following formula:

$$LS = \sum_{i=1}^{n} WiXi$$

Where LS is the land suitability, *Wi* denotes the weight of the selected land suitability criteria, *Xi* indicates the assigned sub-criteria score of *i* land suitability criteria, and *n* denotes the total number of LS criteria.

In the NIMP2018, two agricultural crops were considered in LS analysis: paddy field and upland crops. For each of the two crops, three scenarios of LS analysis were evaluated: 1) using land resources only, 2) adding rainfall parameter (rainfed condition), and 3) irrigation priority (irrigation requirement).

There are several criteria that can be taken into consideration in LS for agriculture, however, in NIMP2018, ten criteria were considered for the land resources scenario. For rainfed and irrigation priority scenarios an additional precipitation criterion was added to become 11 criteria in total as shown in Table 7.3.3. The weightings and rankings of the 10 or 11 criteria were different among each scenario for both paddy field and upland crops which will be detailed in the following sections.

Table 7.3.3 List of Criteria Used in Each Scenario and Their Sources

Criteria	Land Suitability (Land Resource Only) Scenario	Land Suitability (Rainfed) Scenario	Irrigation Priority Scenario	Source
Soil Type	Y	Y	Y	FAO/IIASA/ISRIC/ISSCAS/JRC, 2012. Harmonized World Soil Database (version 1.2). FAO, Rome, Italy and IIASA, Laxenburg, Austria.
Soil Drainage	Y	Y	Y	
Soil Organic Carbon	Y	Y	Y	
Soil pH	Y	Y	Y	
Soil Depth	Y	Y	Y	FAO-UNESCO Soil Map http://ref.data.fao.org/map?entryId=c3bfc940-bdc3-11db-a0f6-000d939bc5d8&tab=about
Elevation	Y	Y	Y	Shuttle Radar Topographic Mission (SRTM) Data
Slope	Y	Y	Y	
Land Use	Y	Y	Y	Global Map-Global Land Cover (GLCNMO version 2)
Topographic Wetness Index (TWI)	Y	Y	Y	JICA Study Steam Based on Shuttle Radar Topographic Mission (SRTM) Data
Temperature	Y	Y	Y	Climate Hazards Group InfraRed Precipitation with Station (CHIRPS) Data Version 2.0. http://chg.geog.ucsb.edu/data/chirps/
Precipitation	N	Y	Y	

Note: Y: Yes, N: No
Source: JICA Project Team

7.3.2 Land Suitability for Paddy

There are three scenarios considered for LS for paddy field as mentioned earlier. In each scenario, the weightings and scorings should be prepared individually. However, since the land characteristics of the paddy field do not change, the values that define the scorings of sub-criteria will be same across all scenarios and only the weighting factors will be updated in each scenario which will be detailed in the following sub-sections. Table 7.3.4 shows the scorings of each sub-criteria used in the LS analysis for paddy field.

Table 7.3.4 List of Criteria, Sub-criteria and Their Scorings Used for Paddy Field

Criteria	Sub-criteria	Scoring		Scoring		Scoring	
		Scenario (1) Land Suitability (Land Resource Only)		Scenario (2) Land Suitability (Rainfed Condition)	Same Scoring as Scenario (1)	Scenario (3) Irrigation Priority (Irrigation Requirement)	Same Scoring as Scenario (1)
Soil Type	Cambisols; Luvisols		5				
	Fluvisols; Vertisols		4				
	Gleysols; Chernozems		3				
	Phaeozems; Planosols; Nitisols; Andosols; Ferralsols; Acrisols; Histosols; Arenosols; Solonetz		2				
	Lixisols; Leptosols; Regosols; Solonchaks		1				
Slope (°)	0 - 3		5				
	3 - 8		3				
	8 - 15		3				
	15 - 30		1				
	> 30		1				
Elevation (m)	> 2000		1				
	1500 - 2000		2				
	1000 - 1500		3				
	500 - 1000		4				
	≤ 500		5				

Criteria	Sub-criteria	Scoring	Scoring	Scoring
		Scenario (1) Land Suitability (Land Resource Only)	Scenario (2) Land Suitability (Rainfed Condition)	Scenario (3) Irrigation Priority (Irrigation Requirement)
Temperature (°C)	> 25	5	Same Scoring as Scenario (1)	Same Scoring as Scenario (1)
	20 - 25	3		
	≤ 20	1		
Land Use	Sparse vegetation; Paddy field; Bare area, unconsolidated (sand)	5		
	Shrub; Herbaceous; Herbaceous with sparse tree/shrub	4		
	Cropland; Cropland /other vegetation mosaic	3		
	Bare area, consolidated (gravel, rock)	2		
	Broadleaf evergreen forest; Broadleaf deciduous forest; Needleleaf evergreen forest; Needleleaf deciduous forest; Mixed forest; Tree open; Mangrove; Wetland; Urban; Snow / ice; Water bodies	1		
Soil Depth (cm)	150 – 300	5		
	100 – 150	4		
	50 – 100	3		
	10 – 50	2		
	≤ 10	1		
Soil Organic Carbon (% weight)	> 3.0	1		
	2.0 - 3.0	4		
	1.2 - 2.0	5		
	0.6 – 1.2	3		
	0.2 - 0.6	2		
	≤ 0.2	1		
Soil pH	< 4.5 and > 8.0	1		
	7.5 - 8.0	2		
	4.5 - 5.0 and 7.0 - 7.5	3		
	5.0 - 5.5 and 6.5 -7.0	4		
	5.5 - 6.5	5		
Soil Drainage	Very Poor	5		
	Poor	4		
	Imperfectly; Moderately Well	3		
	Well	2		
	Somewhat Excessive	1		
TWI	> 15.7	5		
	12.2 - 15.7	4		
	8.7 - 12.2	3		
	5.3 - 8.7	2		
	≤ 5.3	1		
Precipitation (mm/year)	> 2000		5	1
	1200 - 2000		4	3
	800 - 1200		3	5
	600 - 800		2	4
	≤ 600		1	2

Source: JICA Project Team

(1) Land Resource Scenario for Paddy Field

Table 7.3.5 shows the pairwise comparison matrix of ten criteria of land resource scenario used in LS analysis for the paddy field, the CI, and CR. A pairwise comparison was conducted using the JICA Project Teams' judgment to identify which criterion has more priority than the other. Table 7.3.6 illustrates the final ranking of the criteria weightings.

Table 7.3.5 Weighting Factors for Paddy Field Land Suitability (Land Resource Scenario)

Criteria	ST	S	E	T	LU	SD	SOC	S-pH	SDR	TWI	W	CI	RI	CR
ST	1	1	7	3	5	5	5	5	3	1	0.192	0.112	1.490	0.075
S	1	1	7	3	5	7	7	7	3	1	0.213			
E	1/7	1/7	1	1/3	1	1	1	1	1/3	1/9	0.029			
T	1/5	1/5	1	1	1	3	3	1	1/3	1/5	0.046			
LU	1/5	1/7	1	1	1	3	3	3	1/3	1/7	0.048			
SD	1/5	1/7	1	1/3	1/3	1	1	1	1/3	1/7	0.028			

Criteria	ST	S	E	T	LU	SD	SOC	S-pH	SDR	TWI	W	CI	RI	CR
SOC	1/5	1/7	1	1/3	1/3	1	1	1	1/3	1/7	0.028			
S-pH	1/3	1/3	3	1	1/3	1	1	1	1/5	1/9	0.037			
SDR	1	1	9	3	3	3	3	5	1	1/3	0.136			
TWI	1	1	9	5	7	7	7	9	3	1	0.244			

Note: (ST: Soil Type, S: Slope, E: Elevation, T: Temperature, LU: Land Use, SD: Soil Depth, SOC: Soil Organic Carbon, S-pH: Soil pH, SDR: Soil Drainage, TWI: Topographic Wetness Index, W: Weighting)
Source: JICA Project Team

Table 7.3.6 Priority Ranking of Weightings (Land Resource Scenario)

Criteria	Weighting	Priority Ranking
TWI	0.244	1
Slope	0.213	2
Soil Type	0.192	3
Soil Drainage	0.136	4
Land Use	0.048	5
Temperature	0.046	6
Soil pH	0.037	7
Elevation	0.029	8
Soil Organic Carbon	0.028	9
Soil Depth	0.028	10

Source: JICA Project Team

From Table 7.3.6, it shows the TWI, slope, soil type, and soil drainage have more influence than other criteria in controlling LS for the paddy field. These four criteria comprise 78.5% of the total weight while the remaining six criteria make up only 21.5%.

In general, the values of the output LS analysis are between 1 and 5. These values were normalized to a scale of 0 and 100 percent using the following equation:

$$LS_{\text{norm}} = \frac{x - min(x)}{max(x) - min(x)} \times 100$$

Where LS_{norm} is the normalized LS values between 0 and 100 percent, *x* is the original LS values before normalization, *min(x)* is the minimum value of LS, and *max(x)* is the maximum value of LS. The final LS data were classified into five equal classes: Very low (0 - 20%), Low (21% - 40%), Moderate (41% - 60%), High (61% - 80%), and Very high (81% - 100%).

In this study, the land use/cover map of 2008 was used. It was created using Moderate Resolution Imaging Spectroradiometer (MODIS) satellite data of approximately 500 m spatial resolution - 1 pixel = 500m × 500m - (GLCNMO version 2, 2008). It is composed of eight classes: forest, cropland, other natural vegetation, bare area/sparse vegetation, wetland, urban, water, and protected area as shown in Table 7.3.7. However, among the eight classes of the land use data, four classes were considered in the land suitability analysis: cropland, other natural vegetation, bare area/sparse vegetation, and wetland. These four classes represent the potential agriculture land which make up 255,074 km^2 (25,507,443 ha) and represent 27.2% of the total mainland of Tanzania as shown in Table 7.3.8. The other four land use/cover classes were excluded from the land suitability analysis because agricultural activities are not permitted in these classes.

Table 7.3.7 Acreage of Land Use/Cover in Tanzanian Mainland

Class	Total (km^2)	Total (ha)	Total (%)
Forest	302,396	30,239,605	32.3
Other natural vegetation	164,557	16,455,683	17.6
Cropland	84,707	8,470,708	9.0
Wetland	5,240	523,987	0.6
Bare area/ Sparse vegetation	571	57,065	0.1
Urban	151	15,142	0.02
Water	60,846	6,084,583	6.5
Protected Area	319,093	31,909,306	34.0
Total	**937,561**	**93,756,079**	**100.0**

Source: JICA Project Team

Table 7.3.8 Acreage of Potential Agriculture Area in Tanzania Mainland

Class	Total (km^2)	Total (ha)	Total (%)
Other natural vegetation	164,557	16,455,683	17.6
Cropland	84,707	8,470,708	9.0
Wetland	5,240	523,987	0.6
Bare area/ Sparse vegetation	571	57,065	0.1
Potential Agriculture Land	**255,074**	**25,507,443**	**27.2**

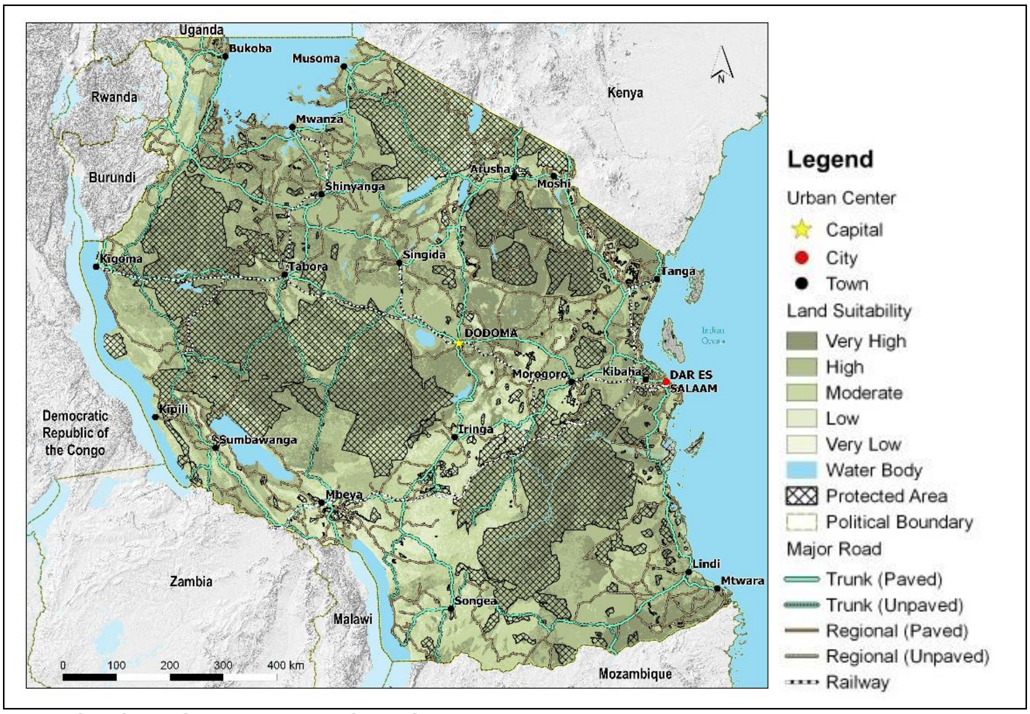
Source: JICA Project Team

The resultant LS for paddy field within the potential agriculture land based on the above criteria shows that the total area of very high and high suitability classes is 196,765 km^2 (19,676,514 ha) which represents 77% of potential agriculture land area as illustrated in Table 7.3.9 and constitutes 21% of the total mainland area of Tanzania. On the other hand, there are 58,309 km^2 (5,830,929 ha) located in moderate, low, and very low suitability that represent 23% of the potential agriculture land and 6.2% of the Tanzanian mainland. Figure 7.3.1 shows the land suitability for paddy field (land resource scenario).

Table 7.3.9 Acreage of Land Suitability of Paddy Field (Land Resources) within Potential Agriculture Land in Tanzania Mainland

Class	Very Low (ha)	Low (ha)	Moderate (ha)	High (ha)	Very High (ha)	Total (ha)
Other natural vegetation	2,112	517,145	2,799,859	6,865,860	6,270,707	16,455,683
Cropland	3,102	478,336	1,875,036	3,065,557	3,048,677	8,470,708
Wetland	2,853	42,280	101,270	322,992	54,592	523,987
Bare area/ Sparse vegetation	293	228	8,415	24,347	23,782	57,065
Potential Agriculture Area	**8,360**	**1,037,989**	**4,784,580**	**10,278,756**	**9,397,758**	**25,507,443**

Source: JICA Project Team



Note: Political Boundary means National Boundary
Source: JICA Project Team

Figure 7.3.1 Land Suitability Map for Paddy Field (Land Resource Scenario)

(2) Land Suitability Rainfed Scenario for Paddy Field

LS was assessed by adding the rainfall criteria (rainfed condition) to check the regions that are highly suitable for paddy field. Since the number of factors considered for rainfed scenario is different – 11 parameters in this scenario - compared with land resource scenario, the weightings should be recalculated to consider the precipitation criteria. Table 7.3.10 and Table 7.3.11 show the calculated weighting factors and the priority ranking of each criterion, respectively.

Table 7.3.10 Weighting Factors for Paddy Field Suitability (Rainfed and Irrigation Scenarios)

Criteria	ST	S	E	P	T	LU	SD	SOC	S-pH	SDR	TWI	W	CI	RI	CR
ST	1	1	7	1	3	5	5	5	5	3	1	0.165	0.072	1.480	0.049
S	1	1	7	1	3	5	7	7	7	3	1	0.181			
E	1/7	1/7	1	1/5	1/3	1	1	1	1	1/3	1/9	0.026			
P	1	1	5	1	3	5	7	7	7	5	3	0.203			
T	1/3	1/3	3	1/3	1	1	3	3	1	1/3	1/5	0.049			
LU	1/5	1/5	1	1/5	1	1	3	3	3	1/3	1/7	0.042			
SD	1/5	1/7	1	1/7	1/3	1/3	1	1	1/3	1/3	1/7	0.021			
SOC	1/5	1/7	1	1/7	1/3	1/3	1	1	1/3	1/3	1/7	0.021			
S-pH	1/5	1/7	1	1/7	1	1/3	3	3	1	1/5	1/9	0.030			
SDR	1/3	1/3	3	1/5	3	3	3	3	5	1	1/3	0.077			
TWI	1	1	9	1/3	5	7	7	7	9	3	1	0.185			

Note: (ST: Soil Type, S: Slope, E: Elevation, P: Precipitation, T: Temperature, LU: Land Use, SD: Soil Depth, SOC: Soil Organic Carbon, S-pH: Soil pH, SDR: Soil Drainage, TWI: Topographic Wetness Index, W: Weighting)
Source: JICA Project Team

Table 7.3.11 Priority Ranking (Rainfed and Irrigation Scenarios)

Criteria	Weighting	Priority Ranking
Precipitation	0.203	1
TWI	0.185	2
Slope	0.181	3

Criteria	Weighting	Priority Ranking
Soil Type	0.165	4
Soil Drainage	0.077	5
Temperature	0.049	6
Land Use	0.042	7
Elevation	0.026	8
Soil pH	0.030	9
Soil Depth	0.021	10
Soil Organic Carbon	0.021	11

Source: JICA Project Team

In rainfed scenario, precipitation has the most important factor with the highest priority that comprises about 20% among other priority factors as shown in Table 7.3.11.

As explained earlier, there is no change in sub-criteria scorings used for both rainfed and land resource scenarios except for the precipitation parameter which was added in the rainfed case. The precipitation parameter was given a high scoring of 5 for rainfall amount of more than 2,000 mm/year and a scoring of 1 for rainfall amount of less than 600 mm/year as shown in Table 7.3.4 (Scenario 2).

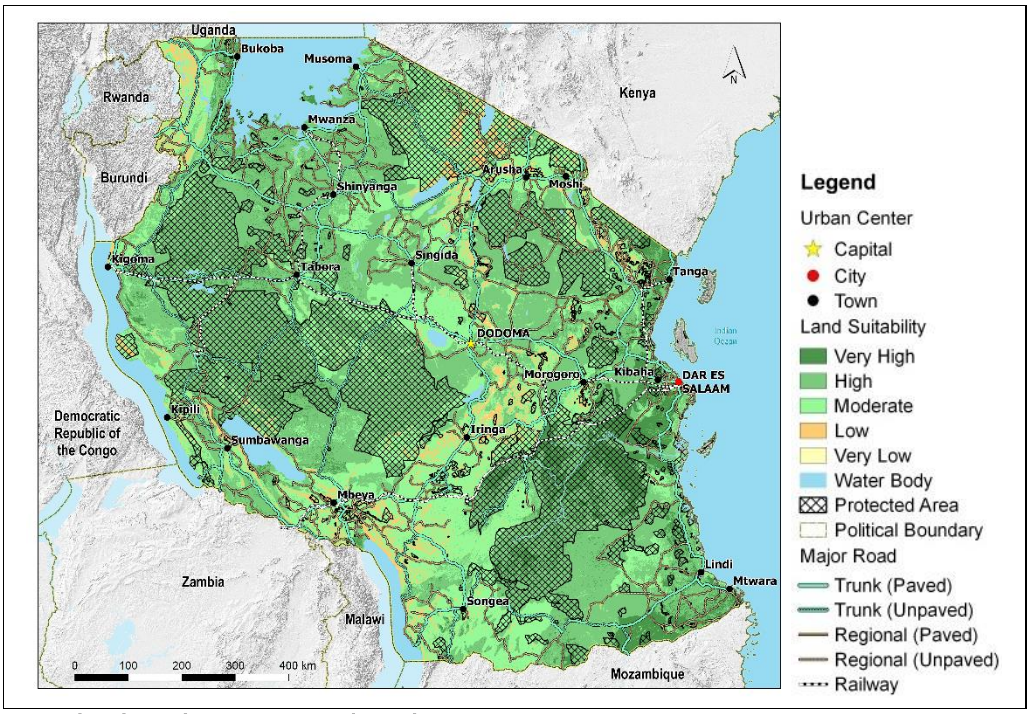
Similar to land resource scenario, this scenario focuses on land suitability within the potential agriculture land. It is worth noting that the total area of potential agriculture land does not change which represents 25,507,443 ha. However, the acreage of land suitability classes within potential agriculture land does change. The results, as shown in Table 7.3.12 and Figure 7.3.2, indicate that very high and high suitability within a potential agriculture land represent 165,095 km^2 (16,509,471 ha) that make up 64.7% of the total area of potential agriculture land suitable for paddy field in rainfed condition and 17.6% of the total area of the mainland of Tanzania. On the other hand, moderate, low, and very low classes represent 35.3% of the total area of potential agriculture land and 9.6% of total mainland area. In this scenario, the area of very high and high classes of LS within the potential agriculture land was reduced by 3,167,043 ha (12.3%) compared with the land resource scenario when the precipitation parameter was added.

The reduction of 3,167,043 ha is attributed to the precipitation distribution. About 14% of Tanzania mainland receives a rainfall amount of more than 1200 mm/year which is very limited when compared with the 86% of the country that receives rainfall amount of less 1200 mm/year as illustrated in Table 7.3.13.

Table 7.3.12 Acreage of Land Suitability of Paddy Field (Rainfed Condition) within Potential Agriculture Land in Tanzania Mainland

Class	Very Low (ha)	Low (ha)	Moderate (ha)	High (ha)	Very High (ha)	Total (ha)
Other natural vegetation	4,304	499,156	5,279,579	9,237,783	1,434,861	16,455,683
Cropland	4,143	363,965	2,467,954	4,483,148	1,151,498	8,470,708
Wetland	5,779	52,029	291,787	172,558	1,834	523,987
Bare area/ Sparse vegetation	0	1,962	27,314	24,303	3,486	57,065
Potential Agriculture Area	**14,226**	**917,112**	**8,066,634**	**13,917,792**	**2,591,679**	**25,507,443**

Source: JICA Project Team



Note: Political Boundary means National Boundary
Source: JICA Project Team

Figure 7.3.2 Land Suitability Map for Paddy Field (Rainfed Scenario)

Table 7.3.13 Rainfall Distribution Used in Land Suitability

Rainfall Amount (mm/year)	Area (ha)	Area (%)
≤ 600	6,975,032	7.4
600 - 800	17,147,698	18.3
800 - 1200	56,505,069	60.1
1200 - 2000	13,223,398	14.1
> 2000	92,150	0.1
Total	93,943,346	100.0

Source: JICA Project Team

(3) Irrigation Priority Scenario for Paddy Field

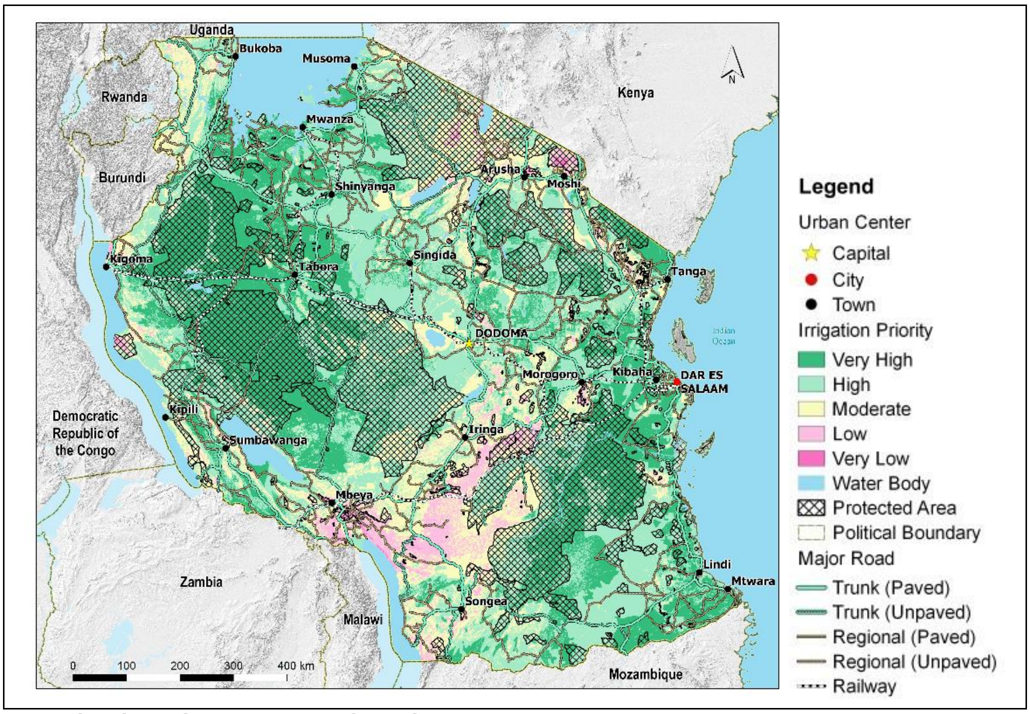
The number of criteria as well as the weighting factors used in the irrigation priority are same as that used in rainfed scenario as shown in Table 7.3.10. The only difference between the two scenarios is the evaluation of the precipitation parameter. In the case of irrigation priority, it is assumed that the land which receives an amount of rainfall of more than 2,000 mm/year does not require additional water as irrigation. While the land that receives an amount of rainfall between 800 mm/year and 1,200 mm/year needs additional water amount as irrigation but that needed water amount is less than that in land with a rainfall between 600 mm/year and 800 mm/year and less than 600 mm/year, respectively. On the other hand, the land that receives rainfall amount between 1,200 mm/year and 2,000 mm/year may still needs additional water in the form of irrigation when needed, but it is not of high priority. Therefore, a scoring value of 5 was given to the amount of precipitation between 800 mm/year and 1,200 mm/year and a scoring value of 1 was given to the amount of rainfall of more than 2,000 mm/year as shown in Table 7.3.4 (Scenario 3).

Table 7.3.14 shows the acreage of land suitable for irrigation priority for paddy field within the 25,507,443 ha of potential agriculture land. It is found that the total land area located within very high and high irrigation priority is 200,433 km^2 (20,043,339 ha), which represents 78.6% of the potential agriculture land and 21.4% of the country's mainland area. Whereas the total area of land located within moderate, low, and very low irrigation priority was reduced to 54,641 km^2 (5,464,104 ha), compared to both land resource and rainfed scenarios, representing 21.4% of the potential agriculture land and 5.8% of the total mainland area. This gives an indication that there are more potential lands when considering irrigation priority (78.6%) for paddy cultivation compared to rainfed case (64.7%). Therefore, proper and efficient irrigation systems shall be provided. Figure 7.3.3 illustrates the irrigation priority map for paddy fields.

Table 7.3.14 Acreage of Irrigation Priority of Paddy Field within Potential Agriculture Land in Tanzania Mainland

Class	Very Low (ha)	Low (ha)	Moderate (ha)	High (ha)	Very High (ha)	Total (ha)
Other natural vegetation	1,357	299,232	3,039,690	8,389,699	4,725,705	16,455,683
Cropland	1,310	318,959	1,639,646	3,626,538	2,884,255	8,470,708
Wetland	907	33,481	102,148	356,610	30,841	523,987
Bare area/ Sparse vegetation	287	1,148	25,939	22,946	6,745	57,065
Potential Agriculture Area	**3,861**	**652,820**	**4,807,423**	**12,395,793**	**7,647,546**	**25,507,443**

Source: JICA Project Team



Note: Political Boundary means National Boundary
Source: JICA Project Team

Figure 7.3.3 Irrigation Priority Map for Paddy Field

The increase of 3,533,868 ha of very high and high classes, when compared with the rainfed scenario, is attributed to the precipitation distribution. The lands which receive rainfall amounts between 600 mm/year and 1,200 mm/year represent 78.4% of the total mainland, as shown in Table 7.3.13, and the rainfall amounts were given the highest scores of 4 and 5 to give these lands a higher priority than other lands that receive the amount of water of less than 600 mm/year or more than 1200 mm/year.

The irrigation priority scenario proves that supporting rainfall with proper irrigation systems will increase the potential agricultural land when compared with rainfall only as in the case of rainfed scenario. Therefore, providing proper and efficient irrigation systems is highly recommended.

7.3.3 Land Suitability for Upland Crops

There are also three scenarios considered for LS for upland crops. Each scenario differs in weightings but shares the same scores because the land characteristics of upland crop do not change. Since some of the land characteristics are more suitable for upland crops than paddy field, it was necessary to change the scorings of sub-criteria to identify those that are most suitable for upland crops. Table 7.3.15 shows the sub-criteria used in upland crops and their scorings.

Table 7.3.15 List of Criteria, Sub-criteria and Their Scorings Used for Upland Crops

Criteria	Sub-criteria	Scoring		Scoring		Scoring	
Soil Type	Cambisols; Luvisols; Vertisols; Chernozems; Phaeozems; Nitisols; Andosols; Ferralsols	Scenario (1) Land Suitability (Land Resource Only)	5	Scenario (2) Land Suitability (Rainfed Condition)	Same Scoring as Scenario (1)	Scenario (3) Irrigation Priority (Irrigation Requirement)	Same Scoring as Scenario (1)
	Acrisols; Histosols		4				
	Fluvisols; Gleysols; Arenosols		3				
	Planosols; Solonetz		2				
	Lixisols; Leptosols; Regosols; Solonchaks		1				
Slope (°)	0 - 3		5				
	3 - 8		4				
	8 - 15		3				
	15 - 30		2				
	> 30		1				
Elevation (m)	> 2000		1				
	1500 - 2000		2				
	1000 - 1500		3				
	500 - 1000		4				
	≤ 500		5				
Temperature (°C)	> 26		3				
	20 - 26		5				
	15 - 20		4				
	12 - 15		2				
	≤ 12		1				
Land Use	Sparse vegetation; Bare area, unconsolidated (sand); Cropland; Cropland /other vegetation mosaic		5				
	Shrub; Herbaceous; Herbaceous with sparse tree/shrub		4				
	Paddy field		3				
	Bare area consolidated (gravel, rock)		2				
	Broadleaf evergreen forest; Broadleaf deciduous forest; Needleleaf evergreen forest; Needleleaf deciduous forest; Mixed forest; Tree open; Mangrove; Wetland; Urban; Snow / ice; Water bodies		1				
Soil Depth (cm)	150 – 300		5				
	100 – 150		4				
	50 – 100		3				
	10 – 50		2				
	≤10		1				
Soil Organic Carbon (% weight)	> 3.0		1				
	2.0 - 3.0		4				
	1.2 - 2.0		5				
	0.6 – 1.2		3				
	0.2 - 0.6		2				
	≤ 0.2		1				
Soil pH	< 4.5 and > 8.0		1				

Criteria	Sub-criteria	Scoring	Scoring	Scoring
	7.5 - 8.0	2		
	4.5 - 5.0 and 7.0 - 7.5	3		
	5.0 - 5.5 and 6.5 -7.0	4		
	5.5 - 6.5	5		
Soil Drainage	Well	5		
	Moderately Well	4		
	Imperfectly	3		
	Somewhat Excessive	2		
	Very Poor; Poor	1		
TWI	> 15.7	5		
	12.2 - 15.7	4		
	8.7 - 12.2	3		
	5.3 - 8.7	2		
	≤ 5.3	1		
Precipitation (mm/year)	> 2000		5	1
	1200 - 2000		4	3
	800 - 1200		3	5
	600 - 800		2	4
	≤ 600		1	2

Source: JICA Project Team

(1) Land Resource Scenario for Upland Crops

There are ten parameters considered for the land resource scenario similar to paddy field, and the weights of which criterion has more influence than the other was assessed based on the JICA Project Team's judgment. Table 7.3.16 shows the calculated weighting factor for each criterion. As illustrated in Table 7.3.17, TWI, soil drainage, temperature, and soil pH, are the main influencing factors in LS for upland crops comprising 68.3% of the total weight. Whereas slope and elevation have the least influence in LS analysis for upland crop.

Table 7.3.16 Weighting Factors for Upland Crop Suitability (Land Resource Scenario)

Criteria	ST	S	E	T	LU	SD	SOC	S-pH	SDR	TWI	W	CI	RI	CR
ST	1	3	3	1/3	1	1	1	1	1/3	1/5	0.066	0.072	1.490	0.048
S	1/3	1	1	1/7	1/3	1/3	1/3	1/3	1/5	1/7	0.026			
E	1/3	1	1	1/7	1/3	1/3	1/3	1/3	1/5	1/7	0.026			
T	1	3	3	1	3	3	3	1	1	1/3	0.121			
LU	1	3	3	1/3	1	3	3	1	1/3	1/3	0.087			
SD	1	3	3	1/3	1/3	1	1	1/3	1/3	1/3	0.056			
SOC	1	3	3	1/3	1/3	1	1	1/3	1/3	1/3	0.056			
S-pH	3	5	5	1	1	3	3	1	1/3	1/3	0.120			
SDR	5	7	7	1	3	3	3	3	1	1	0.209			
TWI	5	7	7	3	3	3	3	3	1	1	0.234			

Note: (ST: Soil Type, S: Slope, E: Elevation, T: Temperature, LU: Land Use, SD: Soil Depth, SOC: Soil Organic Carbon, S-pH: Soil pH, SDR: Soil Drainage, TWI: Topographic Wetness Index, W: Weighting)
Source: JICA Project Team

Table 7.3.17 Ranking Priority for Upland Crops (Land Resource Scenario)

Criteria Layer	Weighting	Priority Ranking
TWI	0.234	1
Soil Drainage	0.209	2
Temperature	0.121	3
Soil pH	0.120	4
Land Use	0.087	5
Soil Type	0.066	6
Soil Depth	0.056	7
Soil Organic Carbon	0.056	8
Slope	0.026	9

Criteria Layer	Weighting	Priority Ranking
Elevation	0.026	10

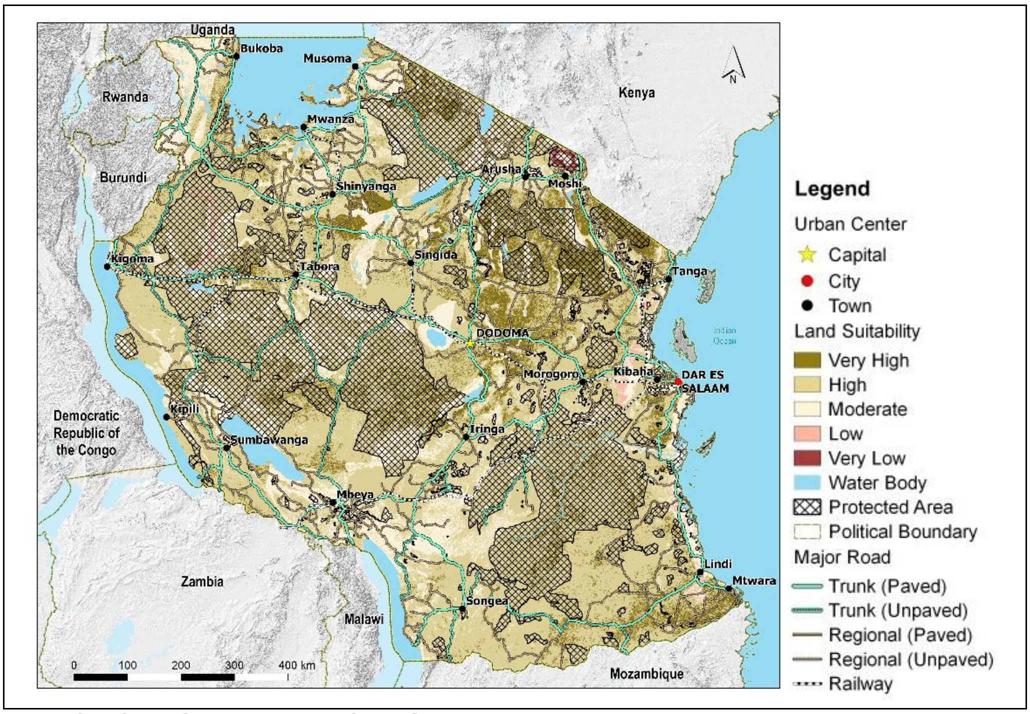
Source: JICA Project Team

Similar to land suitability for paddy field, the land use/cover data are the base for analysis. Out of eight land use/cover classes, four classes were excluded from the land suitability analysis: forest, urban, water, and protected area because the agricultural activities are not allowed in these classes. Thus, the land suitability for upland crops was assessed only on four land use/cover classes: cropland, other natural vegetation, bare area/Sparse vegetation, and Wetland. These four classes were grouped into one class named potential agriculture land. The results, as illustrated in Table 7.3.18 and Figure 7.3.4, show that the total area of very high and high LS classes located within potential agriculture land is 225,105 km^2 (22,510,486 ha) representing 88.3% of the potential agriculture land and 24.0% of the total mainland area which is higher than the percentage of LS of the same class for paddy field. The LS of 24.0% represents almost quarter the area of the country's mainland that is very suitable for upland crops, which indicates plenty of lands suitable for upland crops.

Table 7.3.18 Acreage of Upland Crop Suitability (Land Resource) within the Potential Agriculture Land in Tanzania Mainland

Class	Very Low (ha)	Low (ha)	Moderate (ha)	High (ha)	Very High (ha)	Total (ha)
Other natural vegetation	426	66,353	2,227,292	10,395,236	3,766,376	16,455,683
Cropland	63	27,161	574,618	4,384,596	3,484,270	8,470,708
Wetland	295	2,808	85,599	428,889	6,396	523,987
Bare area/ Sparse vegetation	3	1,391	10,948	30,943	13,780	57,065
Potential Agriculture Area	**787**	**97,713**	**2,898,457**	**15,239,664**	**7,270,822**	**25,507,443**

Source: JICA Project Team



Note: Political Boundary means National Boundary
Source: JICA Project Team

Figure 7.3.4 Land Suitability Map for Upland Crops (Land Resource Scenario)

(2) Land Suitability Rainfed Scenario for Upland Crops

The weighting factors for the rainfed scenario were recalculated since the number of criteria was increased from 10 to 11 when the precipitation criterion was added. Table 7.3.19 and Table 7.3.20 show the weighting calculations and the priority ranking for each criterion, respectively. Precipitation, TWI, temperature, and soil drainage have the highest weightings making up together 69.3% of the total weightings for the rainfed scenario.

Table 7.3.19 Weightings Calculated for Upland Crops Land Suitability (Rainfed and Irrigation Scenarios)

Criteria	ST	S	E	P	T	LU	SD	SOC	S-pH	SDR	TWI	W	CI	RI	CR
ST	1	3	3	1/5	1/3	1	1	1	1	1/3	1/5	0.050	0.080	1.480	0.054
S	1/3	1	1	1/7	1/7	1/3	1/3	1/3	1/3	1/5	1/7	0.021			
E	1/3	1	1	1/5	1/7	1/3	1/3	1/3	1/3	1/5	1/7	0.021			
P	5	7	5	1	1	3	5	5	5	5	3	0.236			
T	3	7	7	1	1	3	3	3	1	1	1/3	0.129			
LU	1	3	3	1/3	1/3	1	3	3	1	1/3	1/5	0.064			
SD	1	3	3	1/5	1/3	1/3	1	1	1/3	1/3	1/5	0.041			
SOC	1	3	3	1/5	1/3	1/3	1	1	1/3	1/3	1/5	0.041			
S-pH	1	3	3	1/5	1	1	3	3	1	1/3	1/5	0.068			
SDR	3	5	5	1/5	1	3	3	3	3	1	1	0.128			
TWI	5	7	7	1/3	3	5	5	5	5	1	1	0.199			

Note: (ST: Soil Type, S: Slope, E: Elevation, P: Precipitation, T: Temperature, LU: Land Use, SD: Soil Depth, SOC: Soil Organic Carbon, S-pH: Soil pH, SDR: Soil Drainage, TWI: Topographic Wetness Index, W: Weighting)
Source: JICA Project Team

Table 7.3.20 Ranking Priority for Upland Crops (Rainfed and Irrigation Scenarios)

Criteria	Weighting	Priority Ranking
Precipitation	0.236	1
TWI	0.199	2
Temperature	0.129	3
Soil Drainage	0.128	4
Soil pH	0.068	5
Land Use	0.064	6
Soil Type	0.050	7
Soil Depth	0.041	8
Soil Organic Carbon	0.041	9
Elevation	0.021	10
Slope	0.021	11

Source: JICA Project Team

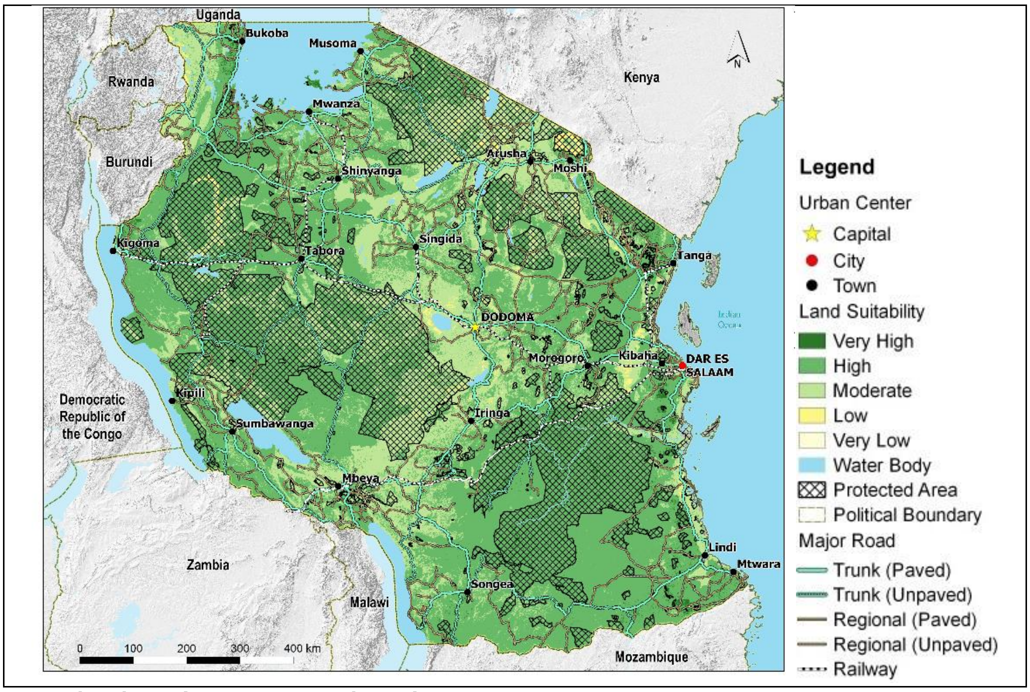
The result of the LS analysis of the rainfed scenario shows that out of 25,507,443 ha of potential agriculture land there are 183,405 km^2 (18,340,483 ha) located within very high and high classes, which represent 71.9% of the total potential agriculture land area, as shown in Table 7.3.21Table 7.3.21, and 19.6% of the total mainland area. Figure 7.3.5 shows the output LS map of the rainfed scenario.

When comparing rainfed scenario with land resource scenario, it is found that the rainfall can limit the potential agriculture land to only areas with high rainfall amounts of more than 1,200 mm/year, which represents 14% of the total mainland area as shown in Table 7.3.13, leaving the majority of the Tanzanian mainland less suitable.

Table 7.3.21 Acreage of Upland Crops Land Suitability (Rainfed Condition) within the Potential Agriculture Land in Tanzania Mainland

Class	Very Low (ha)	Low (ha)	Moderate (ha)	High (ha)	Very High (ha)	Total (ha)
Other natural vegetation	426	66,353	2,227,292	10,395,236	3,766,376	16,455,683
Cropland	63	27,161	574,618	4,384,596	3,484,270	8,470,708
Wetland	295	2,808	85,599	428,889	6,396	523,987
Bare area/ Sparse vegetation	3	1,391	10,948	30,943	13,780	57,065
Potential Agriculture Area	**787**	**97,713**	**2,898,457**	**15,239,664**	**7,270,822**	**25,507,443**

Source: JICA Project Team



Note: Political Boundary means National Boundary
Source: JICA Project Team

Figure 7.3.5 Land Suitability Map for Upland Crops (Rainfed Scenario)

(3) Irrigation Priority Scenario for Upland Crops (Irrigation Requirement)

Similar to the irrigation priority scenario of paddy field, precipitation amount ranging between 800 mm/year and 1,200 mm/year was given the highest ranking of 5 and precipitation amount of less than 600 mm/year received the lowest ranking of 1 as illustrated in Table 7.3.15.

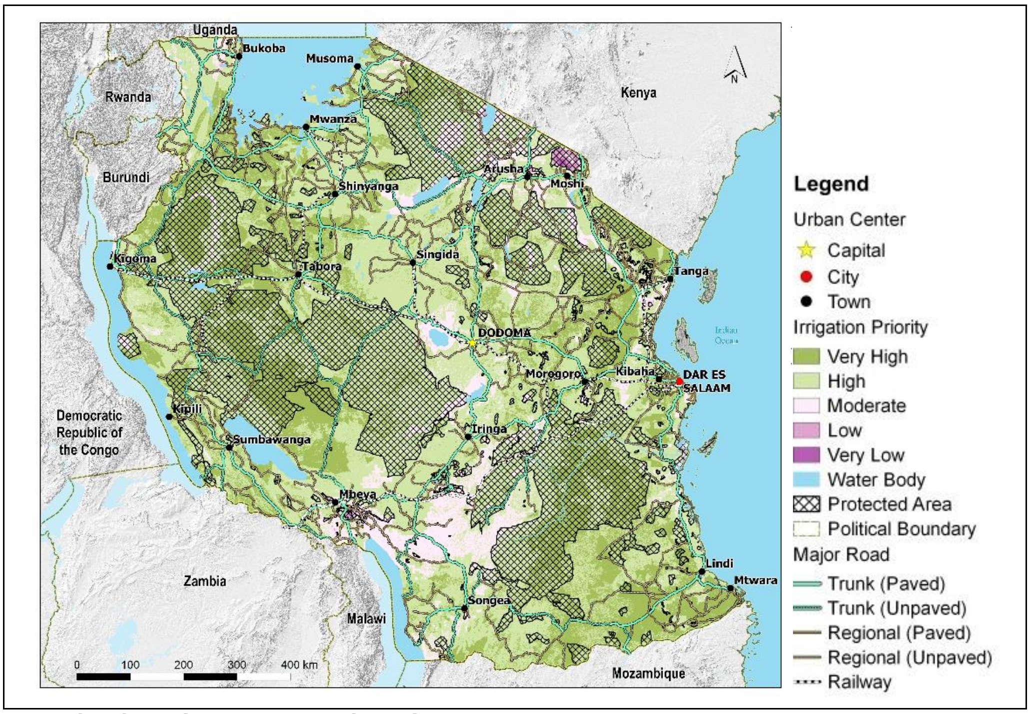
The results show that the total area of very high and high irrigation priority classes is 239,054 km^2 (23,905,362 ha) which represents 93.7% of the potential agriculture land, as shown in Table 7.3.22 and Figure 7.3.6, and 25.5% of the total mainland area.

The increase of 5,564,879 ha of very high and high LS classes in irrigation priority scenario (23,905,362 ha) compared with the rainfed condition scenario (18,340,483 ha) is related to the higher scorings of 4 and 5 to the lands with rainfall amounts between 600 mm/year and 1200 mm/year, as shown in Table 7.3.13, which represent 78.4% of the total mainland of Tanzania. This indicates that the irrigation priority scenario increases the land suitability to agriculture when supporting rainfall distribution with appropriate irrigation system.

Table 7.3.22 The Acreage of Upland Crops Irrigation Priority within Potential Agriculture Land in Tanzania Mainland

Class	Very Low (ha)	Low (ha)	Moderate (ha)	High (ha)	Very High (ha)	Total (ha)
Other natural vegetation	0	8,873	1,176,398	9,775,509	5,494,903	16,455,683
Cropland	0	1,937	338,922	3,681,607	4,448,242	8,470,708
Wetland	0	1,147	50,566	455,456	16,818	523,987
Bare area/ Sparse vegetation	0	1,212	23,026	28,831	3,996	57,065
Potential Agriculture Area	**0**	**13,169**	**1,588,912**	**13,941,403**	**9,963,959**	**25,507,443**

Source: JICA Project Team



Note: Political Boundary means National Boundary
Source: JICA Project Team

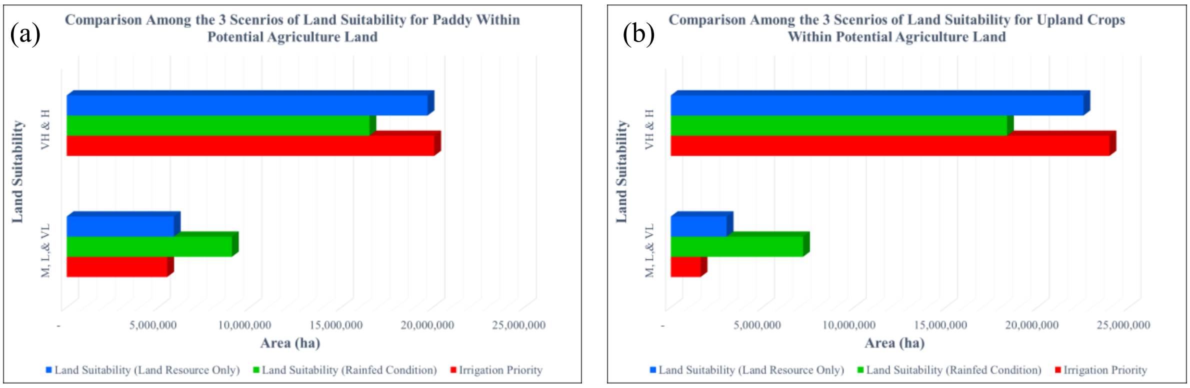
Figure 7.3.6 Irrigation Priority Map for Upland Crops

7.3.4 Summary and Conclusion

The LS analysis using the AHP method is very important to assess the suitability of land for agriculture taking into consideration multiple criteria. Figure 7.3.7 shows a comparison among the three scenarios of land suitability for paddy field and upland crops within the potential agriculture land, respectively. The analysis shows that the Tanzania mainland in general is highly suitable for agriculture. Looking at scenario 1, which is land resource scenario, it illustrates that there are more than 19,000,000 ha highly suitable for paddy field and more than 22,000,000 ha highly suitable for upland crops. However, the suitability decreases for both paddy field (~16,500,000 ha) and upland crops (~18,000,000 ha) when considering only rainfall as a source of water as in scenario 2 (rainfed condition). On the other hand, the land suitability increases for both paddy field (~20,000,000 ha) and upland crops (~24,000,000 ha) when supporting rainfall with irrigation as illustrated in scenario 3 (irrigation priority).

Also, Figure 7.3.7 shows that there are more potential lands when considering upland crops compared with paddy field. This is because the physical characteristics of the land (soil characteristics and topography) are more suitable for upland crops compared with paddy field. As shown above, the suitability increases by 4,000,000 ha in the irrigation priority scenario and 1,500,000 ha in the rainfed scenario when selecting upland crops.

Generally, there are plenty of lands suitable for agriculture in Tanzania whether the chosen crops are paddy fields or upland crops. However, the main controlling factor of land suitability to agriculture is not the availability of lands, but actually the availability of water resources for irrigation. Thus, providing efficient irrigation equipment that improve the agriculture in Tanzania is very important.



Note: VH: Very High, H: High, M: Moderate, L: Low, and VL: Very Low
Source: JICA Project Team

Figure 7.3.7 Comparison among the Three Scenarios of Land Suitability for (a) Paddy Field and (b) Upland Crops Within Potential Agriculture Land

7.4 Irrigation Development Potential Area

7.4.1 Method and Procedure

As explained in Subsection 7.2.2(1), the irrigation sector should follow the water allocation plan which will limit the potential irrigable area for irrigation development, in principle.

(1) Literature Review

In order to evaluate irrigable area estimated in the existing studies, the JICA Project Team reviewed the reports. As a result, the team realised the differences in methodology and values of parameters used among the studies. Especially, differences of irrigation efficiency and unit water requirement affect the irrigable area significantly. In this connection, the team re-estimates the potential irrigable area applying the unified parameters and methodology.

(2) Procedure to Estimate the Potential Irrigable Area

The potential irrigable area is estimated by dividing the allocated water volume by the unit water requirement. The unit water requirements of crops are estimated by the conventional method of Food and Agriculture Organization (FAO) which is introduced in the Irrigation and Drainage Paper No. 24[2]. Necessary data for calculation such as rainfall, potential evapotranspiration and crops concerning data

[2] FAO Irrigation and Drainage Paper No.24can be downloaded from the following website. (http://www.fao.org/publications/card/en/c/6bae3071-5d7b-5206-af5c-c9bfa1d9d1fe/)

are collected. Data on cropping pattern is summarized in the next Section 7.4.3. As for the allocated water volume in each sub-basin on a monthly basis, this review uses the study results made in Section 7.2.2.

7.4.2 Target Crops for Irrigation

For the selection of target crops for irrigation agriculture, the following issues are taken into account:

i) Changes of production and/or supply of the major crops over time: Because the statistical data clearly indicates that the demand by crop are not available, chronological production and/or supply changes of major crops are considered as the responses based on the demand changes.

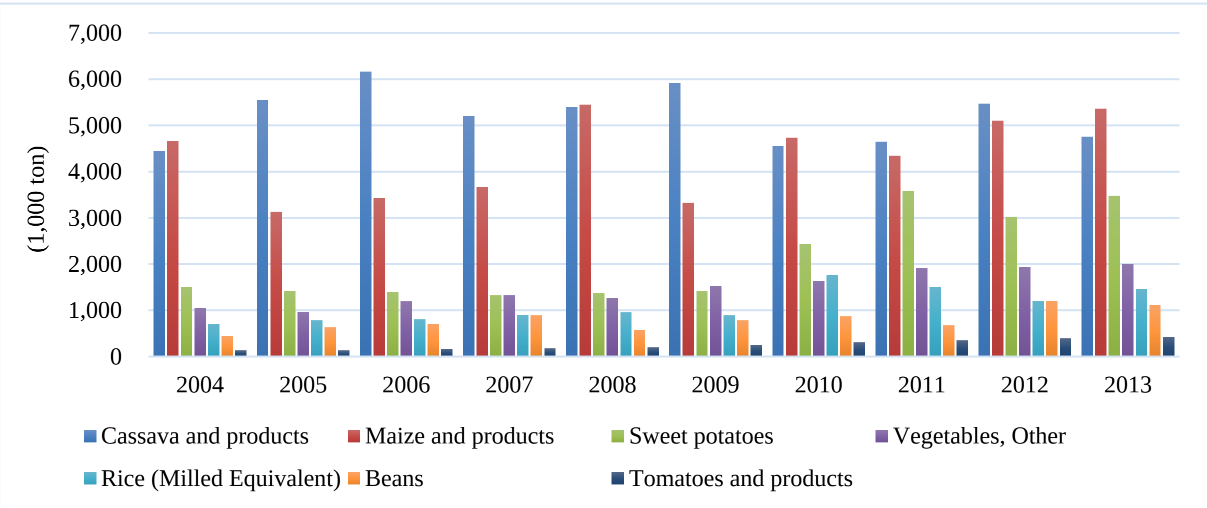
ii) Demand changes of agricultural processing industry: In addition to the food demand, agricultural processing is regarded as one of the major end users of crop production, hence, supply changes of major agricultural materials are analyzed.

iii) Trend of export and import of major crops: Trade surplus and deficit amounts of major agricultural products are analyzed to examine possible import substitute and export-oriented crops for irrigation.

iv) Consistency with other governmental policies/strategies

(1) Change of Production and/or Supply of the Major Crops

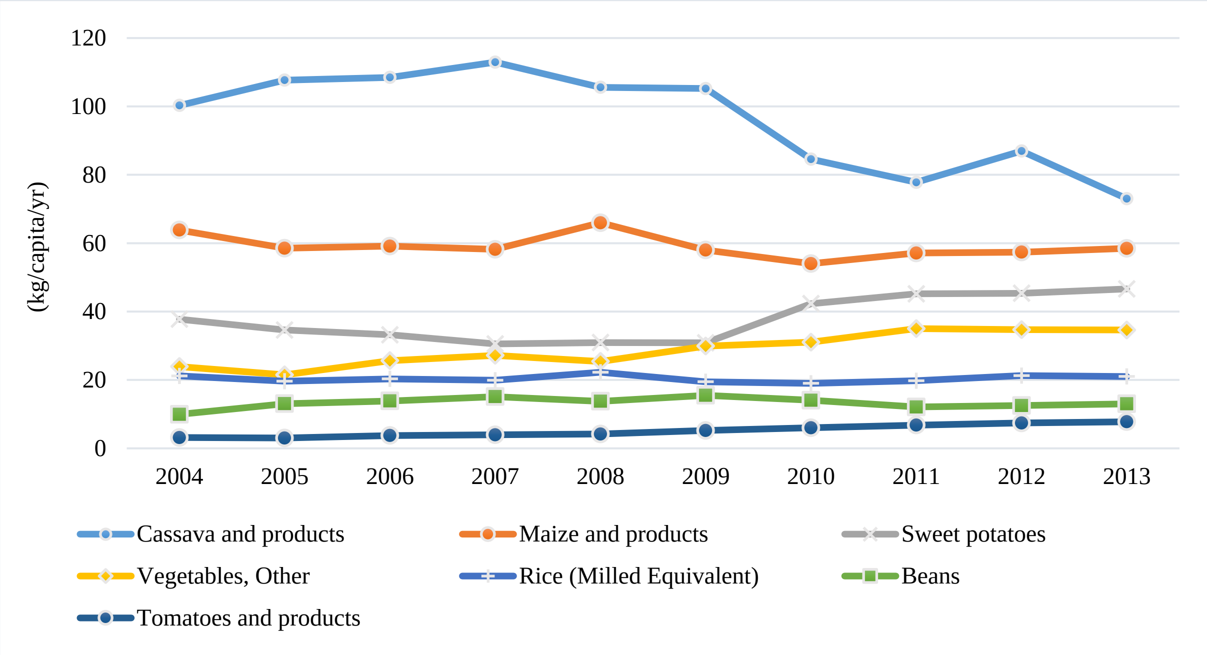
Based on the FAOSTAT statistics, which provide various time series data, production amount changes of the seven major crops are shown below. Cassava and maize are ranked at the first and second places in crop production amount over time. Production amounts of sweet potatoes and vegetables (other) are recently increasing and it is assumed that the demands of these crops are growing.



Source FAOSTAT website, http://www.fao.org/faostat/en/#data

Figure 7.4.1 Production Amount Changes of the Major Crops (2004-2013)

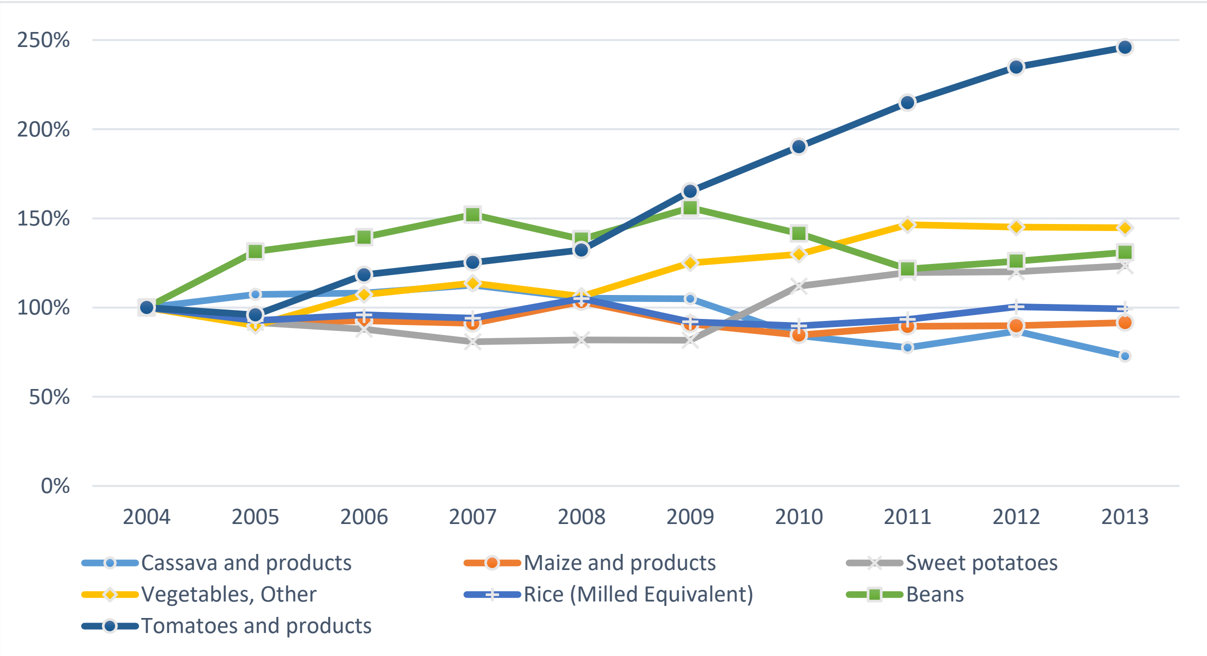
Since the data above does not take into account a factor of population, the per capita food supply quantity data are analysed for seven major crops and is shown in Figure 7.4.2



Source FAOSTAT website, http://www.fao.org/faostat/en/#data

Figure 7.4.2 Per Capita Food Supply Quantity of Major Crops (2004-2013)

While the per capita food supply of cassava gradually decreased, the data of sweet potatoes, vegetables and tomatoes continuously increased. The per capita food supply of rice remained stable as compared with other crops, although its domestic production gradually increased as indicated above. This may imply that annual supply growth of rice is only enough for the volume of the increased population. To see the trends more clearly, the increase rates (2004=100%) are shown in Figure 7.4.3.

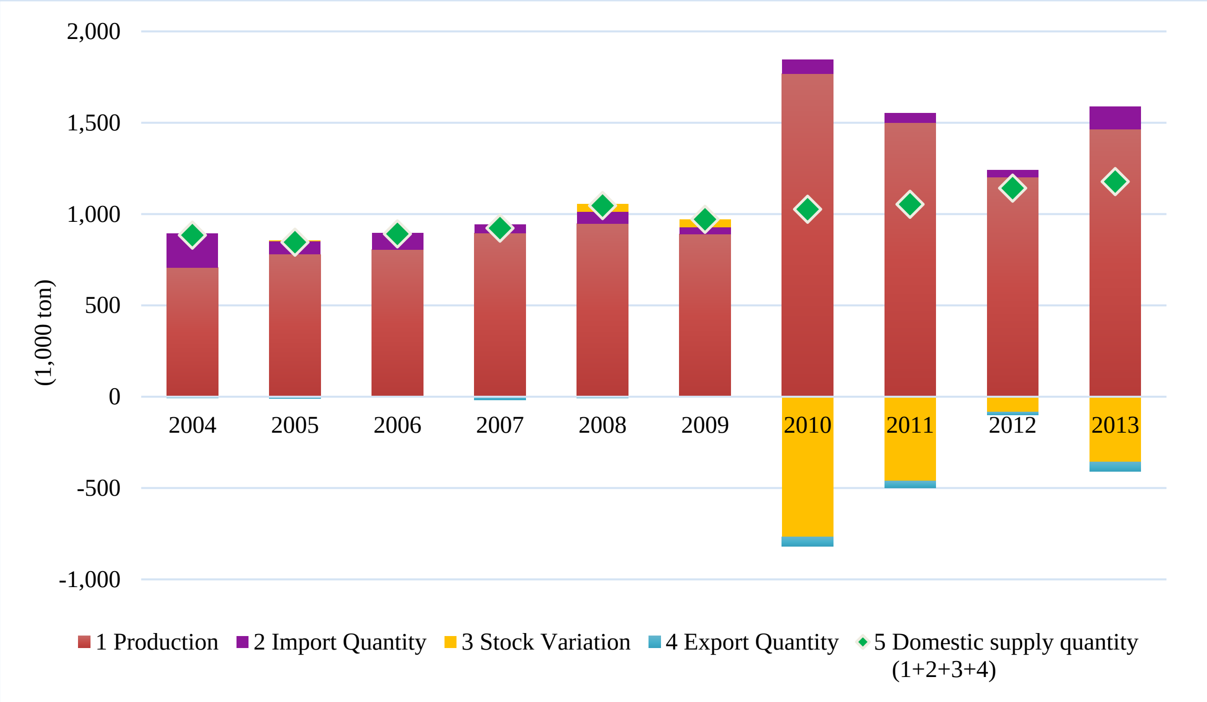


Source FAOSTAT website, http://www.fao.org/faostat/en/#data

Figure 7.4.3 Per Capita Food Supply Quantity of Major Crops (2004=100)

Actual figures are relatively small but the increase rate of tomato is outstanding, nearly 150% increase in the 10-year period. The second highest increase (45% increase during the decade) was observed in vegetables. Sharp increase of per capita food supply quantity for these vegetables may reflect change of dietary habits in Tanzania as well as population concentration in urban areas. Considering the current population growth rate (2.7%) and the ongoing rapid urbanization in Tanzania, it is predictable that the demand for vegetables further expands in the future.

Here, the domestic supply trend for milled equivalent rice, which normally needs a lot of water during its cultivation period except for upland rice, is analysed from 2004 to 2013 as Figure 7.4.4.



Source FAOSTAT website, http://www.fao.org/faostat/en/#data

Figure 7.4.4 Change of Milled Rice Supply (2004-2013)

The domestic supply quantity has been gradually increasing mainly due to the increase of production quantity, particularly since 2010. During the decade, the production doubled. Also, a certain amount of rice has been imported. This may imply that the domestic supply is still not sufficient as a whole.

Stock variation recorded negative figures and its amount was quite large after 2010. It was not clear why they are such large negative figures but one possible cause was informal border trade[3]. Due to the high quality of Tanzanian rice, it is very popular and has high demand at the markets in neighbouring countries (Uganda, Rwanda, Kenya and Burundi) with a 15% price premium.

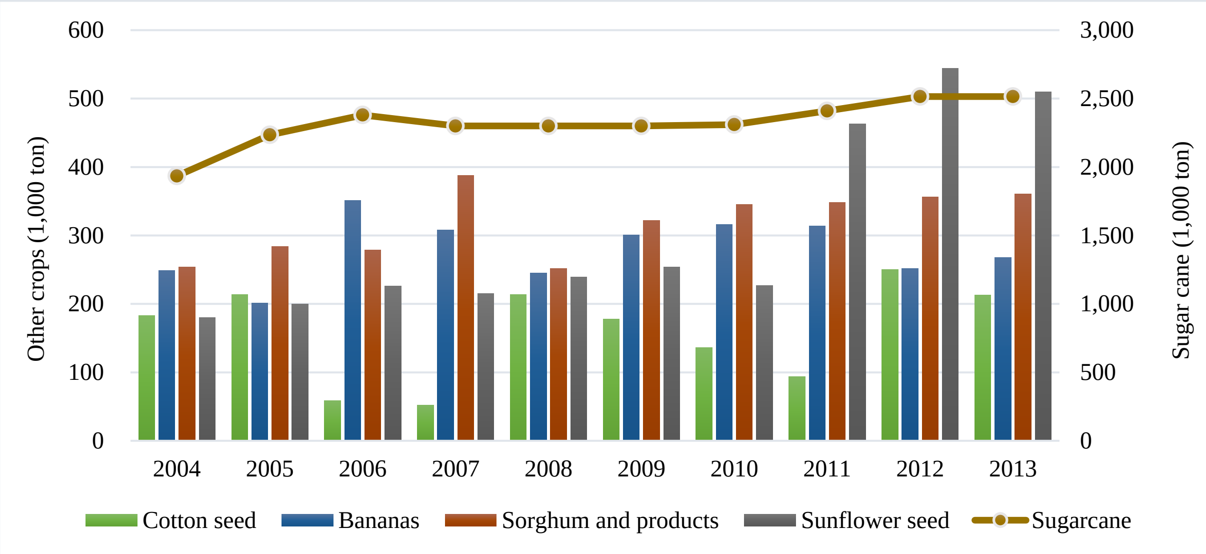
(2) Demand Changes of Agricultural Processing Industry

As mentioned in Chapter 4, agricultural processing is one of the biggest subsectors in manufacturing in terms of contribution to production and employment. However, more than one-third is occupied by sugar, and together with the other top 4 (tobacco products; soft drinks and mineral waters; grain mil products; and cocoa, chocolate and sugar confectionary), those five activities represent nearly two-thirds (62%)

[3] FAO (R. Trevor Wilson and I. Lewis), 2015, The Rice Value Chain in Tanzania - A Report from the Southern Highlands Food Systems Programme (p22)

of the employment in manufacturing.

The recent trend of material supply for five major agricultural processing activities is shown in Figure 7.4.5.



Source FAOSTAT website, http://www.fao.org/faostat/en/#data

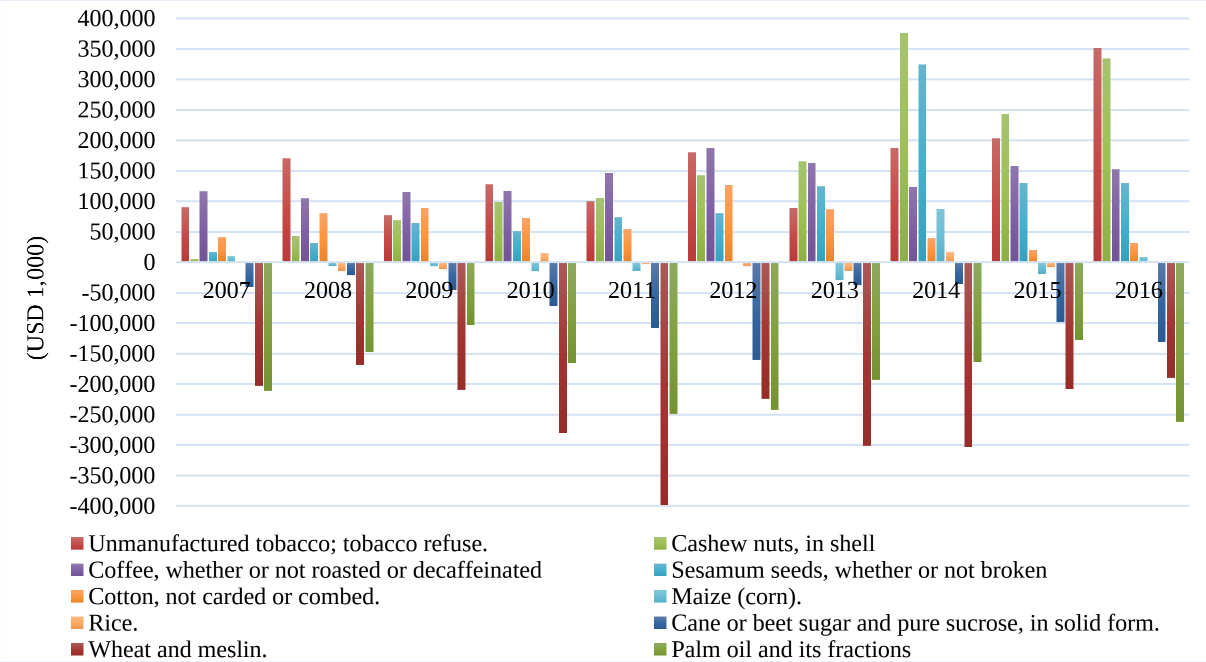
Figure 7.4.5 Material Supply for Agricultural Processing (2004-2013)

The sugarcane supply volume is so large that its axis is indicated on the right hand. Sunflower and sorghum are ranked at the second and third place but their volumes are far fewer than sugarcane. Banana and cotton seeds are ranked at the fourth and fifth. Millet and products, coconuts (including copra), plantains, barley and products and sesame seed are following these top 5 agricultural processing materials.

Except for sugarcane, the material demand for agricultural processing subsector is not so large as compared with the production level. In addition, all these crops for materials are extensively cultivated on rainfed crop land except for commercial sugarcane plantations so it is assumed that there are no material crops that urgently need irrigation water.

(3) Trend of Export and Import of Major Crops

Export and import data of major commodities are compared for the recent ten years, 2007-2016. Because export and import values are considered to be more important than their volumes from the viewpoints of the national economy and import substitution, values are used for comparison. In the UNComtrade trade statistics, both export and import values (USD 1,000) are included by commodity. With these data, trade surplus/deficit figures (export value minus import value) are calculated by commodity and those major surplus and deficit commodities in the last ten years are shown in Figure 7.4.6.



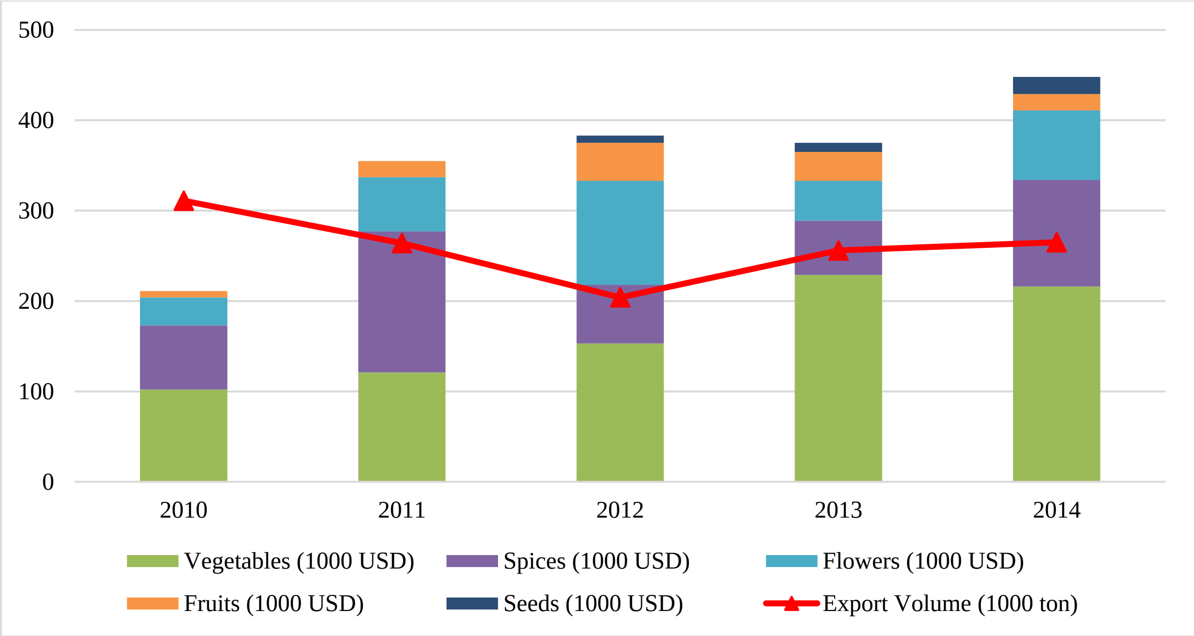
Source UNComtrade website, http //comtrade.un.org/data

Figure 7.4.6 Trade Surplus and Deficit Data of Major Agricultural Commodities (2004-2013)

Major commodities with trade surplus are traditional cash crops such as tobacco, cashew nuts, and coffee. Sesame was once a minor export commodity but its surplus has rapidly increased and its trade surplus ranked second in 2014. In general, these exported cash crops are cultivated on a large scale under rainfed conditions, hence irrigation seems to be less important for production of these crops.

As for the trade deficit, wheat recorded the largest deficit in 2011 with nearly USD 400 million, and still did USD 300 million in 2013 and 2014. Considering the Tanzanian climate conditions, wheat cannot be widely cultivated so it is taken for granted that wheat supply mainly depends on import. Palm oil also has recorded a large amount of trade deficit next to wheat, and its deficit amount exceeded that of wheat in 2016. The trade deficit of sugar ranged from USD 20 million to 160 million for a decade. In 2014 and 2016 a small amount of trade surplus was recorded for maize and rice, but the trade balance was negative in most years and it sometimes reached USD 15-30 million. Among these trade deficit commodities, irrigation is crucial for cultivation of paddy, sugarcane and maize.

Upland crops export value is currently expanding as given below. Between 2010 and 2014, export earnings from upland crops have more than doubled although its amount is still smaller than the traditional cash crops above. The breakdown data indicates that vegetables contribute the most among the five commodities and their export is rapidly boosting and is shown in Figure 7.4.7



Source: Cambridge Economic Policy Associates Ltd., October 2016, Global Agricultural and Food Security Program (GAFSP) Private Sector Window

Figure 7.4.7 Export Data of Upland Crops (2011-2014)

(4) Consistency with Other Governmental Policies/Strategies

For the revision of NIMP, the recent policies and strategies by the central government are also taken into account to select target crops as well as the above information (past trends of production, supply, export, import and processing industry demands). The descriptions in the policies/strategies related to the target crops for irrigation are summarized in Table 7.4.1.

Table 7.4.1 Policies and Strategies Related to the Target Crops for Irrigation

National Agriculture Policy, (NAP, October 2013)
3.6 Irrigation Development 3.6.3 Policy Statements v) Irrigation schemes with special focus on high value crops (vegetable, fruits, and flowers) along with such traditional crops as paddy shall be promoted. (NAP, p15)
Agricultural Sector Development Strategy-II 2015/15-2025/26, (ASDS2, September 2015)
d) Further promote recently increasing export of fish and horticulture. In addition, promote strategically export of maize and rice whose production has been increasing in recent years and the demand from neighbouring countries are continuously high. (ASDS2, p29) Milestone Indicators Showing Progress Towards Objectives: Cropping intensity for irrigated crops (rice, horticulture) (ASDS2, p68)
Agricultural Sector Development Programme 2, (ASDP2, Mar 2017)
61. Sustainability and diversification. ASDS2 emphasizes the need to diversify crop and livestock production to increase farm incomes and to reduce risks in light of both production and price fluctuations. The expansion in irrigated agriculture opens up an opportunity for crop intensification, one of which could be diversification into high value crops, such as horticulture. (ASDP2, p28) Irrigation development towards double cropping, mainly for rice and high value crops (horticulture) (ASDP2, p86) RICE: Tanzania achieves self-sufficiency in rice production (and starts to export these grains) (potential to become a regular exporter) (ASDP2, p86) i. Increased productivity—efficient use of improved technologies iii. Irrigation infrastructure rehabilitation/extension v. Counter-season irrigated vegetables Horticulture (fruits and vegetables): Production for consumption and export in all peri-urban areas and highlands (ASDP2, p87) ii. Irrigation for counter-season production

National Rice Development Strategy, (NRDS, May 2009)
The vision of NRDS is to transform the existing subsistence-dominated rice subsector progressively into commercially and viable production system. (NRDS, p6) General objective is to double rice production by 2018 (from 889,000 ton in 2008 to 1,963,000 ton by 2018) (NRDS, p20) Rainfed lowland: yield will be improved from 1 to 2 tons per ha. (NRDS, p21) Irrigated: yield will be improved from 2.13 to 3.5 tons per ha. (NRDS, p21) Total: yield will be improved from 1.3 to 2.8 tons per ha. (NRDS, p21)

(5) Target Crops

In the National Irrigation Master Plan 2002 (NIMP2002), three crops (paddy, maize, and others such as beans and vegetables) were identified as target crops. In addition to the discussions above, other data such as gross income and necessity of irrigation are added and the result is summarized in Table 7.4.2.

Table 7.4.2 Summary of Crop Comparison

Aspect	Paddy	Maize	Beans	Sugarcane	Tomato	Onion
Gross income *1	3	1	2	3	3	2
Domestic market *2	3	2	2	2	3	3
Export market	3	1	1	1	1	1
Demand of agro-processing	1	1	1	3	2	1
Strategic commodity: NAP	1	-	-	-	1	1
Strategic commodity: ASDS2	1	1	-	-	1	1
Strategic commodity: ASDP2	1	1	1	1	1	1
Necessity of Irrigation *3	3	3	1	3	2	2
Overall priority	16	10	8	13	14	12

*Note: *1: It is estimated by multiplying unit yield in 2014/15 (t/ha, calculated from statistical data collected from Statistics Unit, MALF) and unit wholesale price in 2013 to ensure consistency of data. For sugarcane, 43,000 TZS/t is used for unit price.*
**2: Three grades are applied (1: Low, 2: Medium, 3: High).*
**3: Derived from "Climatic, Soil and Water Requirements for Crops (FAO)"*
Source: JICA Project Team

In terms of irrigation agriculture, paddy always comes first because it generally needs a large amount of water for its growth as compared with other upland crops. Although the NRDS released in 2009 is a bit old, it is still the national strategy for rice development. The NRDS envisages to transform the subsistence-dominated rice sub-sector progressively into commercial production system, but in fact the majority of paddy production systems in Tanzania are still small scale (74% of the planted area by smallholders[4]) and rather subsistent except for some large-scale paddy production schemes in Morogoro and Mbeya regions. Regardless of the production scale, irrigation is indispensable for stable paddy production. With the recent climate changes such as erratic rainfall patterns, it is considered that the role of irrigation becomes increasingly important for paddy cultivation.

Moreover, paddy was regarded not only as a food crop but also as a crop for export in the future in ASDS2. Many neighbouring countries such as Kenya, Mozambique, DR Congo, etc., have imported plenty of rice for years, hence, Tanzania could be a rice supply area for those rice-deficit nations in case tariff barriers are solved among the countries concerned. Considering the overall information above, paddy is selected as one of the target crops for NIMP2018.

Upland crops are regarded as high value crops and one of the diversification and intensification options, particularly in dry season. The demand and export have rapidly grown during the last decade as seen

[4] FAO (R. Trevor Wilson and I. Lewis) , 2015, "The Rice Value Chain in Tanzania - A Report from the Southern Highlands Food Systems Programme"

above. They also enable to improve nutritional conditions at a household level. With these advantages and reasons, it is believed that upland crops are targeted for irrigation agriculture in NAP, ASDS2 and ASDP2, hence they are selected as target crops for NIMP2018, too. Because upland crops include various vegetables as well as fruits, tomato and onion are tentatively chosen as representatives for targeted upland crops because these two crops are ranked in the top three in terms of planted area (another one is okra) and being cultivated across the country according to the 2014/15 AASS[5].

Sugarcane production expansion seems to be important to reduce recent large trade deficit (import substitution) and necessity of irrigation is also high. At present sugarcane is mainly cultivated near sugar factories by private farms/estates (for sugarcane cultivation, existence of nearby sugar factories is indispensable.), but its major production areas are unevenly distributed to several regions such as Morogoro, Kilimanjaro, and Kagera. Considering the limited distribution of beneficiaries and farmland, in principle sugarcane is not selected as a target crop for the NIMP2018. However, there are already large-scale commercial projects targeted for sugarcane as shown in Table 8.6.11. Therefore, sugarcane is set as a target crop only for these five large-scale commercial projects.

Although maize was one of the target crops in NIMP2002, paddy is selected as the representative of high water demanding crops for NIMP2018, and maize and sugarcane are regarded as alternative crops. Likewise, tomato and onion are selected as the representative of low water demanding crops for NIMP2018, which include other upland crops, oil crops, beans and fruit crops as tabulated below.

Table 7.4.3 Summary of Target Crops for NIMP2018

Crops Used for Irrigation Planning	Target Crops	Features
High water demanding crops	Paddy, Maize, Sugarcane	(Low Risk, Low Returns) ・ Less production cost ・ Less labour intensive ・ No large fluctuation in price ・ Long storable (except sugarcane) ・ Need for extension services, etc.
Low water demanding crops	Tomato, Onion, Oil Crops (Sunflower, Sesame, Beans), Cotton, Grapes, Banana, Papaya and other crops	(High Risk, High Returns) ・ Higher production cost ・ Labour intensive ・ Large fluctuation in price ・ Perishable (except oil crops) ・ Need for more extension services, etc.

Source: JICA Project Team

Finally, the selected two crops, paddy and upland crops, are consistent with the Catalysing the Future Agri-food Systems of Tanzania (CFAST) Project, proposed by NIRC in collaboration with the World Bank.

The data relevant to these target crops for irrigation, paddy and upland crops (represented by tomato and onion), are used for the analysis of the water balance later in this chapter.

7.4.3 Model Cropping Pattern for Irrigation by Region

Basic data on model cropping patterns of the target crops by region, which are necessary for the analysis of the water balance, were collected from ZIOs. Among the seven ZIOs, the data were available in the

[5] National Bureau of Statistics,URT, Sep. 2016, 2014/15 Annual Agriculturel Sample Survey Report

six ZIOs. In some regions, the cropping patterns of the target crops were not available even at the ZIOs. For those regions where the cropping pattern data were not given by the ZIOs, other data were referred to make model cropping patterns. Table 7.4.4 and Table 7.4.5 below show the model cropping patterns of the two target crops by region. As for paddy, the cropping patterns of modern and traditional irrigation schemes are separately indicated if possible.

Table 7.4.4 Model Cropping Patterns of Paddy by Region

Region	Sep		Oct		Nov		Dec		Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Remarks	Source
Dodoma										P	P	P	=	=	=	>	H	H	H						Modern Irri. Sch.	ZIO
Arusha	=	=	=	=	=	>	H	H	H	P	P	P	=	=	=	>	H	H	H	H	P	P	=	=	Modern Irri. Sch.	ZIO
		P	P	P	=	>	H	H	H	P	P	P	P	P	P	=	=	=	>	H	H	H			Trad. Irri. Sch.	ZIO
Kilimanjaro	=	=	=	=	=	>	H	H			P	P	=	=	=	=	=	>	H	H	P	P	=	=	Modern Irri. Sch.	ZIO
				P	P	P	=	=	>	H	H	H	P	P	P	=	=	=	>	H	H	H			Trad. Irri. Sch.	ZIO
Tanga	=	=	>	H	H	H	P	P	P	=	=	=	>	H	H	H				P	P	P	=	=	Modern Irri. Sch.	ZIO
	P	P	P	P	=	>	H	H	H	P	P	P	=	=	=	>	H	H	H	H	H	H			Trad. Irri. Sch.	ZIO
Morogoro													P	P	=	=	=	=	=	>	H	H	H		Modern Irri. Sch.	ZIO
Pwani														P	P	=	=	=	=	=	>	H	H	H	Modern Irri. Sch.	ZIO
Dar es salaam														P	P	=	=	=	=	=	>	H	H	H	Apply Pwani	
Lindi					P	P	P	P	P	=	=	=	=	=	>	H	H	H	H	H					Apply Mtwara	
	P	=	=	=	>	H	H	H	H	H											P	P	P	P		
Mtwara					P	P	P	P	P	=	=	=	=	=	>	H	H	H	H	H					Wet season	IWRM[1]
	P	=	=	=	>	H	H	H	H	H											P	P	P	P	Dry season	IWRM[1]
Ruvuma	>	H	H				P	P	=	=	=	=	=	>	H	H		P	P	=	=	=	=	=	Rice-Rice	SESA[2]
							P	P	=	=	=	=	=	>	H	H									Rice-Other crop	SESA[2]
Iringa								P	P	P	=	=	=	>	H	H	H	H	H						Modern Irri. Sch.	ZIO
									P	P	P	P	P	P	=	=	>	H	H	H	H	H			Trad. Irri. Sch.	ZIO
Mbeya	>	H	H			P	P	=	=	=	=	=	>	H	H			P	P	=	=	=	=	=	Rice-Rice	SESA[2]
						P	P	=	=	=	=	=	>	H	H										Rice-Other crop	SESA[2]
Singida										P	P	P	=	=	=	>	H	H	H						Modern Irri. Sch.	ZIO
Tabora								P	P	P	=	=	=	>	H	H	H	H	H	H					Modern Irri. Sch.	ZIO
								P	P	P	P	=	=	=	>	H	H	H	H	H					Trad. Irri. Sch.	ZIO
Rukwa									P	P	P	=	=	=	>	H	H	H	H						Modern Irri. Sch.	ZIO
									P	P	P	=	=	=	>	H	H	H	H						Trad. Irri. Sch.	ZIO
Kigoma							P	P	P	P	>	H	H	H	H	H	H								Modern Irri. Sch.	ZIO
							P	P	P	=	>	H	H	H	H	H	H								Trad. Irri. Sch.	ZIO
Shinyanga						P	P	=	=	=	=	=	=	=	>	H	H								Modern Irri. Sch.	ZIO
											P	=	=	=	=	=	=	>	H	H	H				Trad. Irri. Sch.	ZIO
Kagera						P	P	=	=	=	=	=	=	=	>	H	H								Modern Irri. Sch.	ZIO
											P	=	=	=	=	=	=	>	H	H	H				Trad. Irri. Sch.	ZIO
Mwanza					P	P	=	=	=	=	=	=	=	>	H	H									Modern Irri. Sch.	ZIO
										P	=	=	=	=	=	=	>	H	H	H					Trad. Irri. Sch.	ZIO
Mara						P	P	=	=	=	=	=	=	=	>	H	H								Modern Irri. Sch.	ZIO
											P	=	=	=	=	=	=	>	H	H	H				Trad. Irri. Sch.	ZIO
Manyara	H	H			P	P	=	=	=	=	>	H	H							P	P	P	=	>	Mod. (Pangani riv.)	ZIO
								P	P	P	=	=	=	=	=	>	H	H	H	H					Mod. (Duduera riv.)	ZIO
Njombe									P	P	P	P	=	=	=	>	H	H	H	H					Wet season	IWRM[3]
	P	P	=	>	H	H	H	H															P	P	Dry season	IWRM[3]
Katavi									P	P	P	P	=	=	=	=	=	>	H	H	H	H			Wet season	IWRM[4]
	=	=	=	=	=	>	H	H															P	P	Dry season	IWRM[4]
Simiyu					P	P	=	=	=	=	=	=	=	>	H	H									Apply Mwanza	
										P	=	=	=	=	=	=	>	H	H	H						
Geita					P	P	=	=	=	=	=	=	=	>	H	H									Apply Mwanza	
										P	=	=	=	=	=	=	>	H	H	H						
Songwe								P	P	P	P	=	=	=	=	=	>	H	H	H	H	H			Modern Irri. Sch.	ZIO
									P	P	P	=	=	=	=	=	>	H	H	H	H				Trad. Irri. Sch.	ZIO

Note: Land preparation is not included. P: Transplanting, H: Harvesting

IWRM1: Ministry of Water, 2013, "Preparation of an Integrated Water Resources Management and Development Plan for the Ruvuma River and Southern Coast Basin, Component 1: Review and Inventory of Water Use and Demand and Water Resources Assessment Volume 3: Water Demand Assessment"
SESA2: Ministry of Agriculture Food Security and Cooperatives, 2011, "Agricultural Sector Development Programme, Irrigation Development Sub-Component, The Strategic Environmental and Social Assessment (SESA) for the National Irrigation Master Plan 2002 (NIMP2002) and the National Irrigation Policy (NIP), Final SESA Report Volume III: Appendices"
IWRM3: Ministry of Water, 2015, "Preparation of an Integrated Water Resources Management and Development Plan for the Lake Nyasa Basin, Irrigation Sector Water Plan"
IWRM4: Ministry of Water, 2015, "Preparation of an Integrated Water Resources Management and Development Plan for the Lake Tanganyika Basin, Irrigation and Drainage Sector Water Use Plan"
Source: Data from ZIOs and others are summarized by the JICA Project Team.

Table 7.4.5 Model Cropping Patterns of Upland Crops by Region

Region	Sep		Oct		Nov		Dec		Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Remarks	Source
Dodoma	H	H											S	S	S	S	S	S	>	H	H	H	H	H	Tomato	FAO5
Arusha	H	H	H	H	H								S	S	S	S	=	=	=	=	=	>	H	H	Tomato	ZIO
Kilimanjaro	H	H	H	H	H	H	H	H	H	H	H	H	S	S	S	S	=	=	=	=	=	>	H	H	Tomato	ZIO
Tanga	H	H	H	H	H	H							S	S	=	=	=	=	=	=	=	>	H	H	Tomato	ZIO
Morogoro															S	S	=	=	=	>	H	H	H	H	Tomato	FAO5
Pwani															S	S	=	=	=	>	H	H	H	H	Tomato	FAO5
Dar es salaam															S	S	=	=	=	>	H	H	H	H	Apply Pwani	
Lindi					S	S	S	S	S	=	=	=	>	H	H	H	H	H							Apply Mtwara	
	H	H	H	H													S	S	S	S	S	=	>	H		
Mtwara					S	S	S	S	S	=	=	=	>	H	H	H	H	H							Vegetables (wet)	IWRM1
	H	H	H	H													S	S	S	S	S	=	>	H	Vegetables (dry)	IWRM1
Ruvuma					S	S	S	S	S	=	=	=	>	H	H	H	H	H							Apply Mtwara	
	H	H	H	H													S	S	S	S	S	=	>	H		
Iringa	=	=	=	=	=	>	H	H	H	H												S	S	S	Tomato	ZIO
Mbeya	H	H	H	H	H	H	H	H	H				S	S	S	S	S	S	S	S/H	S/H	S/H	S/H	S/H	Tomato	FAO5
Singida	H	H													S	S	=	=	=	=	=	>	H	H	Onion	ZIO
Tabora			S	S	S	=	=	>	H	H	H	H													Tomato season 1	ZIO
									S	S	S	=	=	>	H	H	H	H							Tomato season 2	ZIO
															S	S	S	=	=	>	H	H	H	H	Tomato season 3	ZIO
	=	>	H	H	H	H															S	S	S	=	Tomato season 4	ZIO
Rukwa	=	>	H	H	H	H												S	S	S	S	=	=	=	Tomato	ZIO
Kigoma			S	S	S	=	=	>	H	H	H	H													Tomato season 1	ZIO
									S	S	S	=	=	>	H	H	H	H							Tomato season 2	ZIO
															S	S	S	=	=	>	H	H	H	H	Tomato season 3	ZIO
	=	>	H	H	H	H															S	S	S	=	Tomato season 4	ZIO
Shinyanga	H	H	H	H	H	H	H	H					S	S	S	S	S	S	S	S/H	S/H	S/H	H	H	Tomato	FAO5
Kagera																	S	S	=	=	=	=	>	H	Apply Mwanza	
Mwanza																	S	S	=	=	=	=	>	H	Tomato	FAO5
Mara																	S	S	=	=	=	=	>	H	Apply Mwanza	
Manyara	H	H											S	S	S	S	S	S	>	H	H	H	H	H	Tomato	FAO5
Njombe	=	>	H	H	H	H	S	S	S	S	=	=	=	=	=	=	=	>	H	H	S	S	=	=	Tomato	ZIO
Katavi													S	S	S	S	=	>	H	H	H	H			Vegetables (wet)	IWRM4
	S	S	H	H	H	H																	S	S	Vegetables (dry)	IWRM4
Simiyu																	S	S	=	=	=	>	H	H	Apply Mwanza	
Geita																	S	S	=	=	=	>	H	H	Apply Mwanza	
Songwe	H	H	H	H													S	S	S	S	S	S	H	H	Vegetables (dry)	IWRM6

Note: S: Seeding, H: Harvesting
FAO5: http://www.fao.org/agriculture/seed/cropcalendar/welcome.do, Accessed on 18 August 2017
IWRM6: Ministry of Water, 2015, "Water Sector Development Program, Lake Rukwa Basin IWRMD Plan: Final Interim Report II, Volume I: Water Demand Projections (2015-2035)"
Source: Data from ZIOs and others are summarized by the JICA Project Team.

7.4.4 Irrigation Water Requirement

The diversion water requirements for paddy and upland crops are estimated by the following equations:

Paddy

NWR = ETo x Kc + SAT + PERC – Re

DWR = NWR / IE

Upland Crop

NWR = ETo x Kc – Re

DWR = NWR / IE

Where, NWR: Net water requirement (mm/month)

DWR: Diversion water requirement (mm/month)

ETo: Reference crop evapotranspiration (mm/month)

Kc: Crop coefficient

SAT: Saturation water requirement (mm/month)

PERC: Percolation and seepage losses (mm/month)

Re: Effective rainfall (mm/month)

IE: Irrigation efficiency (%)

(1) Reference Crop Evapotranspiration (ETo)

FAO recommends to apply the ETo using the most widely used FAO Penman-Montieth (FAO PM) method for water requirement calculation. However, the method requires various reliable meteorological data such as solar radiation, air temperature, relative humidity, and windspeed. Unfortunately, the data can be obtained from very limited number of meteorological stations.

On the website, the “Global Potential Evapo-Transpiration Geospatial Dataset” is available on a global scale for 30 years period. According to the test result conducted by CGIAR-CSI as provider, the error between the dataset and FAO PM is acceptably small. Taking into consideration all the above conditions, the JICA Project Team utilizes this potential data as ETo for the calculation.

(2) Crop Coefficient

Kc is a dimensionless coefficient integrated the effect of both crop transpiration and soil evaporation. In this project, Kc is determined for the four distinct growth stages; i.e., i) initial, ii) development, iii) mid and iv) late stage in reference to the FAO Irrigation and Drainage Paper No. 24. For the sake of irrigation water requirement calculation, rice and tomato as representing upland crops are selected. Kc values and corresponding growing stages of selected crops are summarized in Table 7.4.6.

Table 7.4.6 Kc Values and Corresponding Growing Stages

Crop	Growing Period (days)	Land Preparation	Initial Stage	Crop Development Stage	Mid-season Stage	Late Season Stage
Paddy (Rice)	120	30	20	30	40	30
Kc of Paddy			1.05	1.10	1.20	0.80
Tomato	120		20	30	40	30
Kc of Tomato			0.6	0.8	1.15	0.70

Source: JICA Project Team

(3) Saturation Water Requirement (SAT)

Saturation water requirement (SAT), known as land preparation water requirement in the paddy field, means the amount of water required to saturate soil for puddling of paddy field. The water requirement for SAT varies depending on soil-water condition. In this project, SAT is assumed to be 200 mm.

(4) Percolation and Seepage Loss (PERC)

Percolation and seepage losses (PERC) in paddy field vary highly depending on soil conditions. In this calculation, PERC is assumed to be 3 mm/day on an average.

(5) Effective Rainfall (Re)

Precipitation received by the field is not always fully utilized for crops. Some amount may be wasted after long rainfall. It may be difficult to evaluate the useful amount of precipitation from monthly data. In this situation, the USDA Soil Conservation Service submitted the following method and is widely accepted. Therefore, the project applies this method for calculation.

When the monthly precipitation is excess to 75 mm:

Re = 0.8 x R - 25

When the monthly precipitation is less than 75 mm:

Re = 0.6 x R - 10

Where, Re: Effective rainfall (mm/month)

R: Monthly rainfall (mm)

As for rainfall data, the project collected the dataset of “Climate Hazards Group InfraRed Precipitation with Station data (CHIRPS ver.2)” from the Climate Hazards Group (CHG). The data covers the whole Tanzania for more than 30 years. Effective rainfall is calculated based on the CHIRPS ver.2 dataset.

(6) Net Water Requirement

Net water requirement calculation begins with assigning crop coefficient in each growing stage to a cropping pattern of the crop calendar prepared for each region. Calculation of the net water requirement is carried out for paddy and upland crop and for wet and dry seasons, separately.

In this stage of calculation, adjusted crop coefficients, which are matching the crop calendar, can be obtained for all 26 regions. Sample calculation sheet of this calculation stage is attached in Attachment-7.4.1 (1/2).

And then, the adjusted crop coefficients are proportionally distributed to sub-basins according to the area ratio of regions within the sub-basins because the water is allocated to each sub-basin. In each sub-basin, a combined crop coefficient of distributed coefficients is used for calculation of the net water requirement. Attachment-7.4.1 (2/2) shows a sample calculation of net water requirement.

(7) Irrigation Efficiency

Irrigation efficiency can be obtained multiplying the main canal, branch canal, distribution canal, tertiary canal and field application efficiencies.

IE = Em x Eb x Ed x Et x FA

Where, IE: Irrigation Efficiency

Em: Efficiency of Main Canal

Eb: Efficiency of Branch Canal

Ed: Efficiency of Distribution Canal

Et: Efficiency of Tertiary Canal

FA: Efficiency of Field Application

Table 7.4.7 and Table 7.4.8 show the common values of aforesaid efficiencies.

Table 7.4.7 Estimated Irrigation Efficiency for Lowland Paddy

Lowland Paddy	Traditional Irrigation (Unlined canal)						Improved/New Irrigation (Lined canal)					
	Em	Eb	Ed	Et	FA	IE	Em	Eb	Ed	Et	FA	IE
Large Scheme	0.70	0.70	0.70	0.70	0.85	0.20	0.90	0.90	0.90	0.80	0.85	0.50
Medium Scheme	0.70	0.70	-	0.70	0.85	0.29	0.90	0.90	-	0.80	0.85	0.55
Small Scheme	0.70	-	-	0.70	0.85	0.42	0.90	-	-	0.80	0.85	0.61

Source: JICA Project Team

Table 7.4.8 Estimated Irrigation Efficiency for Upland Crop

Upland Crop	Traditional Irrigation (Unlined canal)						Improved/New Irrigation (Lined canal)					
	Em	Eb	Ed	Et	FA	IE	Em	Eb	Ed	Et	FA	IE
Large Scheme	0.70	0.70	0.70	0.70	0.70	0.17	0.90	0.90	0.90	0.80	0.70	0.41
Medium Scheme	0.70	0.70	-	0.70	0.70	0.24	0.90	0.90	-	0.80	0.70	0.45
Small Scheme	0.70	-	-	0.70	0.70	0.34	0.90	-	-	0.80	0.70	0.50
Dip Scheme	-	-	-	-	-	-	0.95	-	-	-	0.90	0.86
Sprinkler	-	-	-	-	-	-	0.95	-	-	-	0.80	0.76

Source: JICA Project Team

In this project, irrigation efficiencies of the new/improved and traditional schemes are estimated at 50% and 30%, respectively.

7.4.5 Irrigable Area by Allocated Water

Estimate of irrigable area by allocated water in each sub-basin is carried out by the following equation:

IA = AWV / DWR / 1,000 (mm/m) / 10,000 (m^2/ha)

Where, IA: Irrigable Area (ha)

AWV: Allocated Water Volume (MCM/month)

DWR: Diversion Water Requirement (mm/month)

As expressed in Section 7.4.1, DWR varies greatly depending on Kc and IE because ETo is constant. If the paddy cultivation area, where Kc value is large and covers a large portion, DWR will increase and consequently, the irrigation area will decrease. If IE is low, DWR will also increase and the irrigation area will be smaller.

(1) Proportion of Paddy Area

For basins, where a proportion of paddy area is described in the existing reports, the described proportion is applied to the calculation. The basins, where proportion is not shown, the proportion is assumed to be 60%.

(2) Irrigation Efficiency

With regard to irrigation efficiency, various values are applied in the existing reports. Some reports use the low efficiency of unlined canal as an overall efficiency, and in some reports, they consider increase of the efficiency by improvement of irrigation facilities and farmers' trainings.

Judging from the distribution by size of irrigation and the increased number of lining canals expected in the future stage, irrigation efficiencies applied in the existing reports may be very conservative estimates.

Table 7.4.9 summarizes the proportions and irrigation efficiencies presented in the existing reports.

Table 7.4.9 Summary Table for Irrigation Efficiency and Proportion to Crop Area

<table>
<tr><th>River Basin</th><th>Proportion</th><th>Irrigation Efficiency</th></tr>
<tr><td>Pangani</td><td>Paddy: in the range of 2.6% -100% in nine catchment areas
Maize: 0–80%</td><td><table><tr><th>Year</th><th>Rice</th><th>Vegetables</th></tr><tr><td>2015</td><td>25%</td><td>25%</td></tr><tr><td>2025</td><td>30%</td><td>40%</td></tr><tr><td>2035</td><td>30%</td><td>40%</td></tr></table></td></tr>
<tr><td>Wami/Ruvu</td><td>Paddy wet season: 0% -78% in five regions</td><td><table><tr><th>Year</th><th>Overall</th></tr><tr><td>2015</td><td>25%</td></tr><tr><td>2025</td><td>30%</td></tr><tr><td>2035</td><td>30%</td></tr></table></td></tr>
<tr><td>Rufiji</td><td>No description</td><td>No description</td></tr>
<tr><td rowspan="2">Ruvuma</td><td>Ruvuma: Rice wet 55%, Rice dry 50% in 2035</td><td>Overall: 27%</td></tr>
<tr><td>Mtwara, Lindi: Rice wet 65%, Rice dry 57% in 2035</td><td>Overall: 27%</td></tr>
<tr><td>Lake Nyasa</td><td>Rice dry: 30% in 2015, 40% in 2025, 50% in 2035</td><td>Overall: 25%</td></tr>
<tr><td>Lake Rukwa</td><td>No description</td><td>No description</td></tr>
<tr><td>Lake Tanganyika</td><td>Rice: 60–80%</td><td>Overall: 25%</td></tr>
<tr><td>Lake Victoria</td><td>Rice: 67%</td><td>Global: 50%</td></tr>
<tr><td>Internal Drainage</td><td>No description</td><td>Lined canal: 50%
Unlined canal: 36%</td></tr>
</table>

Source: Existing Study reports

7.4.6 Analysis of Irrigable Area and Water Balance

Table 7.4.10 shows the comparison between the estimated result of irrigable area (NIMP2018) calculation by the JICA Project Team based on the allocated water for irrigation determined in Section 7.2.2 and irrigable area projected by the existing studies (IWRMDP).

Table 7.4.10 Comparison Table on Irrigable Area between the Existing Studies and NIMP2018 Estimate (ha)

Basin	2015		2025		2035	
	IWRMDP	NIMP2018	IWRMDP	NIMP2018	IWRMDP	NIMP2018
Pangani	84,473	116,260	89,483	128,430	94,493	111,800
Wami/Ruvu	29,919	32,250	45,039	50,560	57,522	70,460
Rufiji	209,500	225,920	231,400	257,920	319,100	430,470
Ruvuma	12,952	12,520	22,863	29,170	33,338	57,880
Lake Nyasa	5,580	15,910	10,590	32,700	15,590	49,850
Lake Rukwa	28,944	28,970	45,373	64,350	59,637	99,030
Lake Tanganyika	6,501	12,390	14,099	34,510	21,799	77,000
Lake Victoria	40,761	11,010	131,560	27,460	261,288	45,140
Internal Drainage	69,638	21,000	126,647	46,410	183,655	64,070
Total	488,268	476,230	717,054	671,510	1,046,422	1,016,700

Source: JICA Project Team

(1) Analysis of Each River Basin

The JICA Project Team compares the results of the calculation with the estimates of the existing studies and are shown as follows:

Table 7.4.11 Results of Irrigable Area Analysis in Each River Basin

River Basin	Result of Water Balance Calculation
Pangani	Since the project calculation followed the area proportion of the existing study, difference of area is small. Decrease in area in 2035 happens due to decrease in the allocated water amount.
Wami/Ruvu	Difference of total area is small. However, in the sub-basin, there are large gaps which may be attributed to the difference of the crop calendar applied. In the Upper Ruvu sub-basin, irrigable area is about 50% of the existing study estimate. This problem is caused by insufficient water allocation in April. If more water would be allocated in April, it will be possible to expand irrigation area.
Rufiji	The sub-basins will receive sufficient water except the Kilombero. If water allocation in December would be adjusted, the area would be expanded.
Ruvuma	It is considered that sufficient water amount is generally reserved except the Upper Middle Ruvu sub-basin.
Lake Nyasa	This basin is considered to have sufficient water.
Lake Rukwa	In the Songwe River sub-basin, the calculated area is only half of the estimated area by the existing study. Unit diversion water requirement of the sub-basin is calculated to be 0.59 l/sec/ha. Judging from the small amount of unit water, there is a possibility that the planned area was an overestimate. Water allocation for other sub-basins is sufficient.
Lake Tanganyika	This basin is considered to have sufficient water.
Lake Victoria	In this basin, allocated water by the existing study is short significantly. Allocated unit water is estimated at 0.28 l/sec/ha. In the next study stage, it is necessary to request sufficient and necessary water for irrigation.
Internal Drainage	The amount of water allocated to this basin is absolutely short. Unit water allocated is estimated at 0.62 l/sec/ha. Probably, in the existing study, they assumed that most of the area was upland crop with high irrigation efficiency system.

Source: JICA Project team

(2) Results of Analysis

(a) Proportion of Crop and Total Irrigable Area

Irrigable area is highly affected by the proportion of cultivation areas between crops with high water requirement and crops with relatively low water requirement. In this study, paddy is selected as a representative crop with high water requirement, and tomato is chosen as a representative upland crop with a relatively low water requirement.

If the proportion of paddy cultivation area is set large, even if farmers would divert crops from low requirement ones to relatively high requirement ones in the future, the possibility of water shortage will be low. On the contrary, if it is set low, there would be a possibility to create a water shortage problem, which might cause conflicts among farmers.

Taking all of the above into consideration, the JICA Project Team sets the cultivation area of paddy at 60% and that of upland crop at 40% for the river basins where the proportion of crop areas is unclearly set in IWRMDP studies.

As a result of the calculation with the condition of crop area proportion, irrigable area would be 1,017,000 ha in 2035, and irrigable area would be 672,000 ha in 2025, respectively. These irrigable areas are almost corresponding to the estimated irrigable area of IWRMDP. Incidentally, if the proportion of paddy area is set at 70%, the irrigable area would be reduced to 850,000 ha.

(b) Construction of Irrigation Ponds (Small Dams)

Locally occurred flash floods are mostly not used in irrigation schemes along seasonal rivers, and unused water finally flows into the Indian Ocean. In order to utilize the water from flash floods, construction of irrigation ponds (small dams) would be useful. They would contribute a stable irrigation water supply, and it would be expected to expand the irrigation area.

At present, NIRC keeps a list of approximately 420 dams including large-scale dams, and a total of the potential irrigation areas reaches about 300,000 ha to 400,000 ha.

In the promotion of dam construction, however, it would be necessary to pay attention to the serious problem of sedimentation. For sustainable water use, development of management mechanism to remove sedimentation from reservoir area is a big issue.

(c) Irrigation Area in Lake Victoria Basin

Since the IWRMDP study has not yet been completed in the Lake Victoria basin, the allocated water amount is provisionally estimated based on the results of the report published by the Lake Victoria Basin Commission. As mentioned in the previous section, the estimated amount of irrigation demand per unit area in that report is extremely low.

When the scheduled IWRMDP study would be conducted, it can be expected that appropriate water for irrigation sector would be allocated. Regarding lake side districts, where current lake water use is not progressing, irrigation directly using lake water would be expected to expand to 28,000 ha or more as presented in Section 8.5.4 of this report.

(d) Improvement of Irrigation Efficiency

As a result of the irrigation area calculation, irrigable area would increase by 10,000 ha, if the irrigation efficiency would be improved by 1%. Therefore, continuous efforts to improve irrigation efficiency through canal linings and water management trainings would be crucial.

(e) Proportion of Improved Scheme Area

Trial calculation shows that as the proportion of improvement of traditional schemes' area increases by 10%, irrigable area also increases by approximately 25,000 ha because of improved irrigation efficiency. In order to increase irrigation area, it is necessary to continue making efforts to improve irrigation facilities.

7.5 Irrigation Schemes Proposed for Development

7.5.1 Stage of District Priority Analysis

As a first process, after scoring each scheme based on the scheme data and priority given by each district and NIRC/ZIOs, priority order within a district is decided. And then, schemes are selected by allocated water by IWRMDP studies. The following items explain these processes:

Process 1: Scoring of Irrigation schemes

In this step, the JICA Project Team scores the items concerning physical features of schemes and items related to development plan of local governments. The following list itemizes the scored items.

- Priority given by NIRC/Zonal Irrigation Office and District
- Type of water source
- Type of required works for development
- Land suitability for main crops
- Main market
- Maturity of scheme (preparation of scheme documents such as D/D and F/S reports)
- Annual average rainfall amount

Process 2: Selection of Schemes by Limitation of Allocated Water Amount (2025)

Sub-Process 2-1: Convert Allocated Water to Irrigable Area

At first, the water amount in each river basin allocated by IWRMDP study for the year of 2025 is converted to irrigation area in consideration of irrigation water requirement. After this, the irrigation area in each river basin is distributed into the irrigation area of each district depending on the proportion of river basin areas which belong to the district territory.

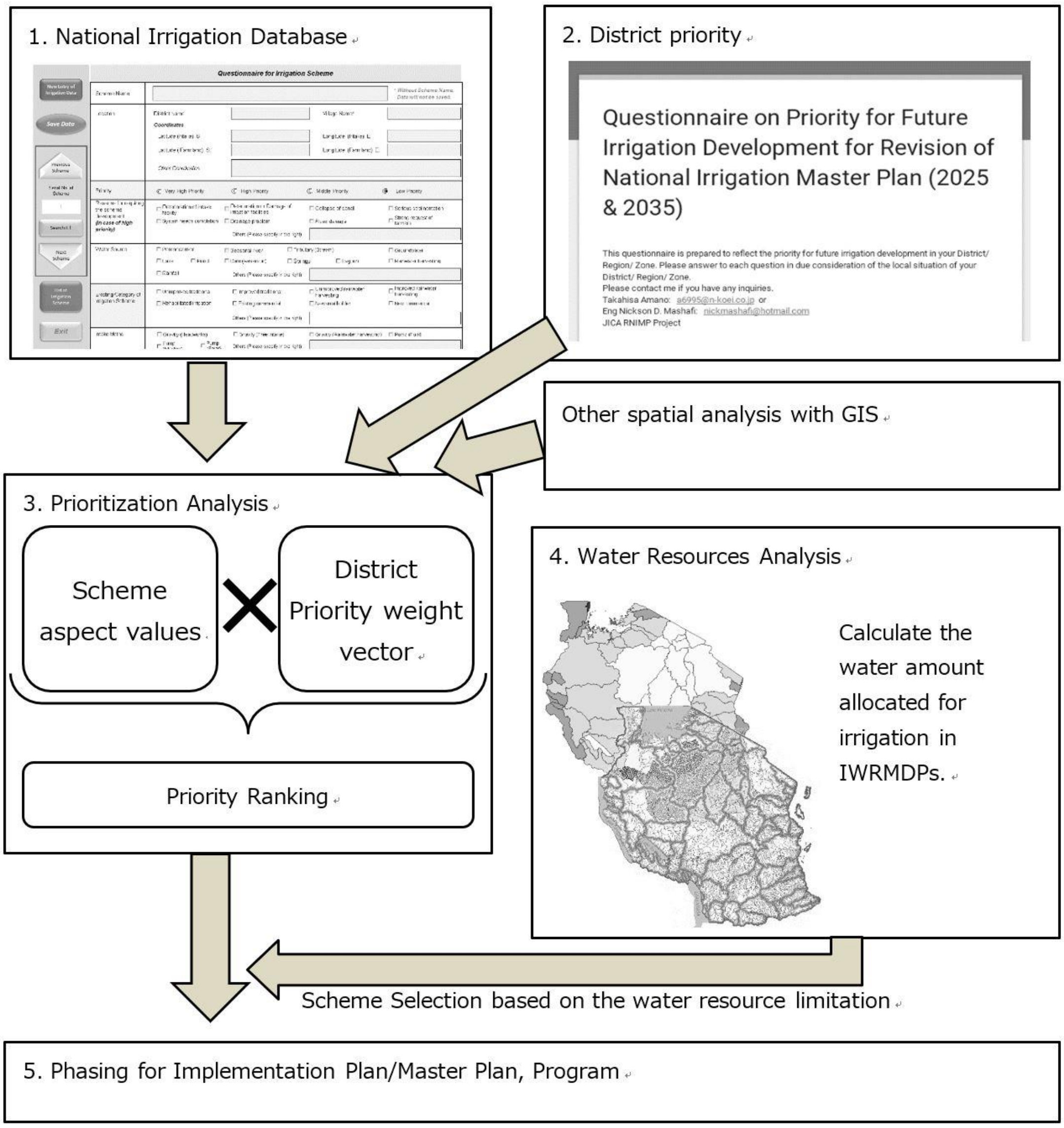
Sub-Process 2-2: Selection of Priority Schemes

In each district, scored irrigation schemes are sorted in descending order of the total scores. The potential irrigation areas of sorted schemes are summed up until reaching the upper limit of the irrigable area distributed to each district. The schemes within the range of upper limit are selected as priority schemes. In this selection process, schemes utilizing ponds (small dams), groundwater, and lake water, which would not depend on allocated water, are selected among the high scored schemes in descending order separately from the aforementioned process.

Process 3: Selection of Schemes by Limitation of Allocated Water Amount (2035)

Phase 2 priority schemes selection uses allocated water for the year of 2035. The selection procedure is the same as Process 2.

Figure 7.5.1 shows the analysis flow of the “District Priority Analysis Stage”.



Source: JICA Project Team

Figure 7.5.1 Analysis Flow Chart for Scheme Selection

7.5.2 Stage of Development Phases

Due to the large number of prioritized irrigation schemes, it is difficult to implement all the irrigation projects at once, therefore, it is better to classify the irrigation schemes development into two phases.

Phase 1 schemes are high priority ones for implementation by 2025. Phase 2 schemes are priority ones to be implemented by 2035. Schemes which require rather long preparation period, are included in Phase 2.

(1) Development Plan of Priority Irrigation Schemes

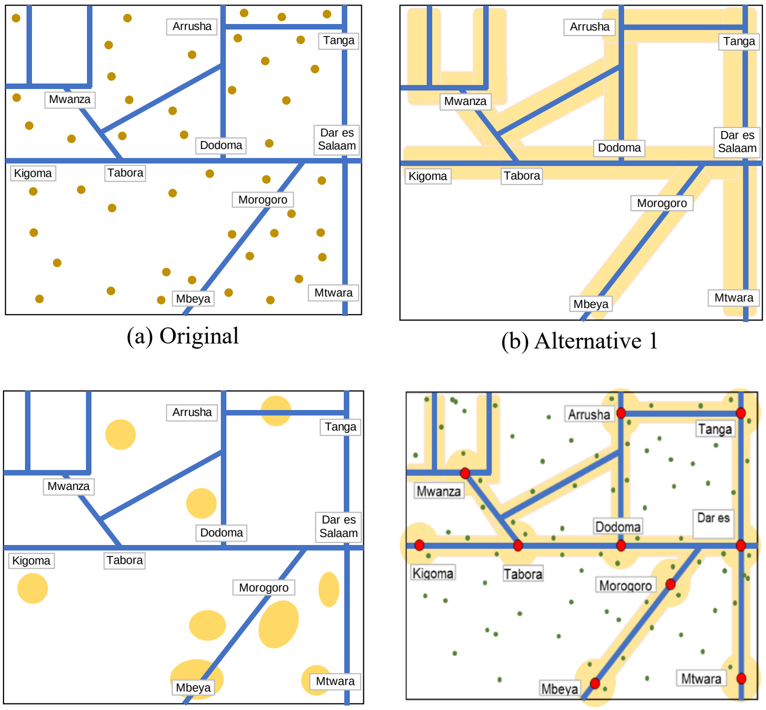
As shown in Table 7.5.1 and Figure 7.5.2, there are four plans to consider which irrigation schemes will be selected in Phase 1 and which of them will be in Phase 2.

Table 7.5.1 Phasing Development Plan of Priority Irrigation Schemes

Plan	Phasing Concept	Merit	Demerit
Original	Focus on irrigation potential:	It is most reasonable from	Low cooperation with

Plan	Phasing Concept	Merit	Demerit
	Irrigation schemes are classified into Phase 1 and Phase 2 according to the development priority order.	the viewpoint of irrigation development potential.	agricultural development.
Alternative 1	Focus on market access: Irrigation schemes along major trunk roads that make up the economic corridor are classified into Phase 1, and others are Phase 2.	High cooperation with the ASDP2, which aims to develop a value chain. It is possible to develop nationwide to some extent.	The priority of the irrigation scheme located at remote places is relatively low.
Alternative 2	Focus on regional cluster: Irrigation scheme is located within the cluster specified in ASDP2, is classified into Phase 1, and others in Phase 2.	High affinity with ASDP2 aiming for cluster agricultural development.	It is regionally concentrated and there is a high possibility that development imbalance between regions will occur.
Alternative 3	Combine distance from major cities and towns, and market access so that irrigation schemes located within specified threshold distance will be conducted in Phase 1 and others in Phase 2	It will focus on irrigation schemes that are close to the major cities and towns as well as major access road for marketing purpose.	It will reduce the potential of selecting irrigation schemes located in villages and within minor roads.

Source: JICA Project Team



(a) Original (b) Alternative 1

(c) Alternative 2 (d) Alternative 3

Source: JICA Project Team

Figure 7.5.2 Conceptual Images of Selecting Irrigation Schemes for Phase 1

(2) Classification of Irrigation Scheme Development

The original plan suggests selecting the top 40% of the highest priority schemes to be implemented in Phase 1 and the remaining priority schemes in Phase 2. The drawback of this plan is that although some of the priority schemes are located within the highest priority, it may be less favourable in terms of agriculture development due to, for example, far access road or due to the lack of support ASDP2 of developing a value chain.

The Alternative 1 Plan suggests selecting within Phase 1 the priority schemes which are located within a specific distance, 30 km distance for example, from the trunk roads, and other irrigation schemes in

Phase 2. Although this plan assists ASDP2, its disadvantage is that it evaluates only one aspect of development by considering transportation as the main influencing factor.

The Alternative 2 Plan proposes to select some specific numbers of priority schemes within the regions as clusters, however, there will be unbalance among the regions for the number of irrigation schemes selected in each region. Big regions will have more irrigation schemes compared with the small regions.

The JICA Project Team suggests implementing Alternative 3 Plan, which is a hybrid plan of alternatives 1 and 2. It considers the distance from major cities and towns and the distance from trunk roads. By identifying a threshold distances from trunk roads as well as cities and towns it will support the idea of the value chain suggested in ASDP2 and helps making an economic corridor that serves not only the domestic markets, but also the international markets.

(3) Selection Procedure of Priority Schemes in Stage of Development Phases

Process 4: Selection of Phase 1 Priority Schemes

In conformity with the ASDP2, schemes are selected applying the Alternative 3 Classification Criteria which is discussed in Section 7.5.2 (2) of this report. In addition to these schemes, high priority schemes in remote areas are also selected from the social aspects.

Process 5: Selection of Phase 2 Priority Schemes

Since the selected schemes in Process 3 includes the Phase 1 priority schemes, Phase 2 priority schemes are further selected by deducting the Phase 1 priority schemes from the selected schemes in Process 3.

7.5.3 Scheme Scoring

In the course of scoring procedure, the JICA Project Team selected items to be evaluated and scored as many as possible as a first step. After verifying whether the result matches the common understanding of the schemes through trial scoring, items were limited to 7.

(1) Scoring of Selected Items

The items finally adopted for scheme scoring are as follows:

Table 7.5.2 Selected Items and Weights for Scheme Scoring

<table>
<tr><th colspan="2">Category</th><th>Weight</th><th colspan="9">Items and Score</th></tr>
<tr><td rowspan="4">Priority</td><td rowspan="2">NIRC/ ZIO</td><td rowspan="2">0.75</td><td>Priority</td><td>Very High</td><td>High</td><td>Medium</td><td>Low</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Score</td><td>10.0</td><td>7.0</td><td>4.0</td><td>1.0</td><td></td><td></td><td></td><td></td></tr>
<tr><td rowspan="2">LGA</td><td rowspan="2">0.25</td><td>Priority</td><td>Very High</td><td>High</td><td>Medium</td><td>Low</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Score</td><td>10.0</td><td>7.0</td><td>4.0</td><td>1.0</td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="2" rowspan="2">Water Source</td><td rowspan="2">1.0</td><td>Source</td><td>Perennial R,</td><td>Seasonal R.</td><td>Stream</td><td>Groundwater</td><td>Lake</td><td>Pond</td><td>Dam</td><td>Spring</td></tr>
<tr><td>Score</td><td>7.75</td><td>5.50</td><td>5.50</td><td>1.00</td><td>1.00</td><td>10.00</td><td>10.00</td><td>3.25</td></tr>
<tr><td colspan="2" rowspan="2">Type of Works</td><td rowspan="2">1.0</td><td>Type</td><td>Upgrading</td><td>Rehabilitation</td><td>Completion</td><td>New Dev.</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Score</td><td colspan="8">(Variable depending on the results of the questionnaire survey. The scores are 10.0, 7.0, 4.0 or 1.0)</td></tr>
<tr><td rowspan="4">Land Suitability</td><td rowspan="2">Paddy</td><td rowspan="2">0.7 or 0.3</td><td>Rating</td><td>Very High</td><td>High</td><td>Medium</td><td>Low</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Score</td><td>10.0</td><td>7.0</td><td>4.0</td><td>1.0</td><td></td><td></td><td></td><td></td></tr>
<tr><td rowspan="2">Upland Crops</td><td rowspan="2">0.7 or 0.3</td><td>Rating</td><td>Very High</td><td>High</td><td>Medium</td><td>Low</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Score</td><td>10.0</td><td>7.0</td><td>4.0</td><td>1.0</td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="2" rowspan="2">Main Market</td><td rowspan="2">1.0</td><td>Location</td><td>Local</td><td>District</td><td>Region</td><td>National</td><td>Export</td><td></td><td></td><td></td></tr>
<tr><td>Score</td><td>10.0</td><td colspan="7">(Variable depending on the result of Questionnaire survey. The scores are 7.75, 5.50, 3.25 or 1.0)</td></tr>
</table>

Category	Weight	Items and Score								
Maturity	1.0	Level	D/D study	F/S study	Pre-F/S	Reconnaissance				
		Score	10.0	7.0	4.0	1.0				
Rainfall (mm)	1.0	Amount	< 600	< 800	< 1,200	< 2,000	> 2,000			
		Score	3.25	7.75	10.00	5.50	1.00			

Source: JICA Project Team

<u>Priority</u>
Since the number of engineers or technicians in many districts is insufficient and the experienced ones are also lacking, it seems that the staffs do not always understand well their assigned schemes. With this reason, this study gives higher weight to the priority given by NIRC/ZIOs.

<u>Type of Water Source</u>
As for the type of water source, this study applies the nationwide unified weighted values.

<u>Type of Works</u>
Regarding the type of works, score is calculated comparing the scheme data and the priorities answered to questionnaires by district, region, and zone. When the data of a scheme matches the priorities, the score of the priority type of works is applied.

<u>Main Market</u>
With conformity to the national policy, highest weight is given to the local market. As for other markets, scoring uses the result of questionnaire survey carried out targeting districts and regions. So, the weights vary from district to district.

<u>Land Suitability</u>
Concerning land suitability, the GIS study evaluated the suitability through various data and classified it into four categories for paddy and upland crops, respectively. Score of the land suitability is a summed-up, one for paddy and one for upland crops. If the main crop of the scheme is paddy, the weight will be 0.7 and weight of upland will be 0.3. On the contrary, in the case that main crop is upland crop, weight for upland will be 0.7 and weight for paddy will be 0.3.

<u>Maturity of Scheme (F/S)</u>
For implementation of schemes in the early stage, existence of documents such as detailed design reports an/or feasibility reports is essential. From this viewpoint, the higher score will be given to schemes with necessary documents.

<u>Rainfall</u>
The higher weight is given to the schemes located in the range from 800 mm/year to 1,200 mm/year, where schemes would be able to utilize irrigation water efficiently. The rainfall range from 600 mm/year to 800 mm/year follows. Since the schemes with more than 2,000 mm/year would not require irrigation water supply, this study gives lowest weight of 1 or 0.

(2) Total Score Calculation

If the scheme scores the full mark with all the seven items, it will be 80 points as shown in the table below.

The bottom row of the table below shows the original score converted into 100 points, which can be obtained multiplying original score by 1.25. This study uses the converted full score of 100.

Table 7.5.3 Weight Table for Total Scoring

	Priority		**Water Source**	**Type of Work**	**Land Suitability**	**Main Market**	**Maturity (Study)**	**Ave. Rainfall**	**Total**
	NIRC/ Zone	**LGA**							
Score	20		10	10	10	10	10	10	80
	15	5							
Final Score	18.75	6.25	12.5	12.5	12.5	12.5	12.5	12.5	100

Source: JICA Project Team

7.5.4 Result of Scheme Selection

(1) Selected Schemes in Each Selection Process

The following explains the selection process of the priority schemes with the number of selected schemes.

District Priority Stage

Process 1: 2947 Schemes lacking the information were scored low.

Process 2: 918 The total number of schemes was 918, which contained 893 schemes selected by allocated water and 25 schemes with high importance.

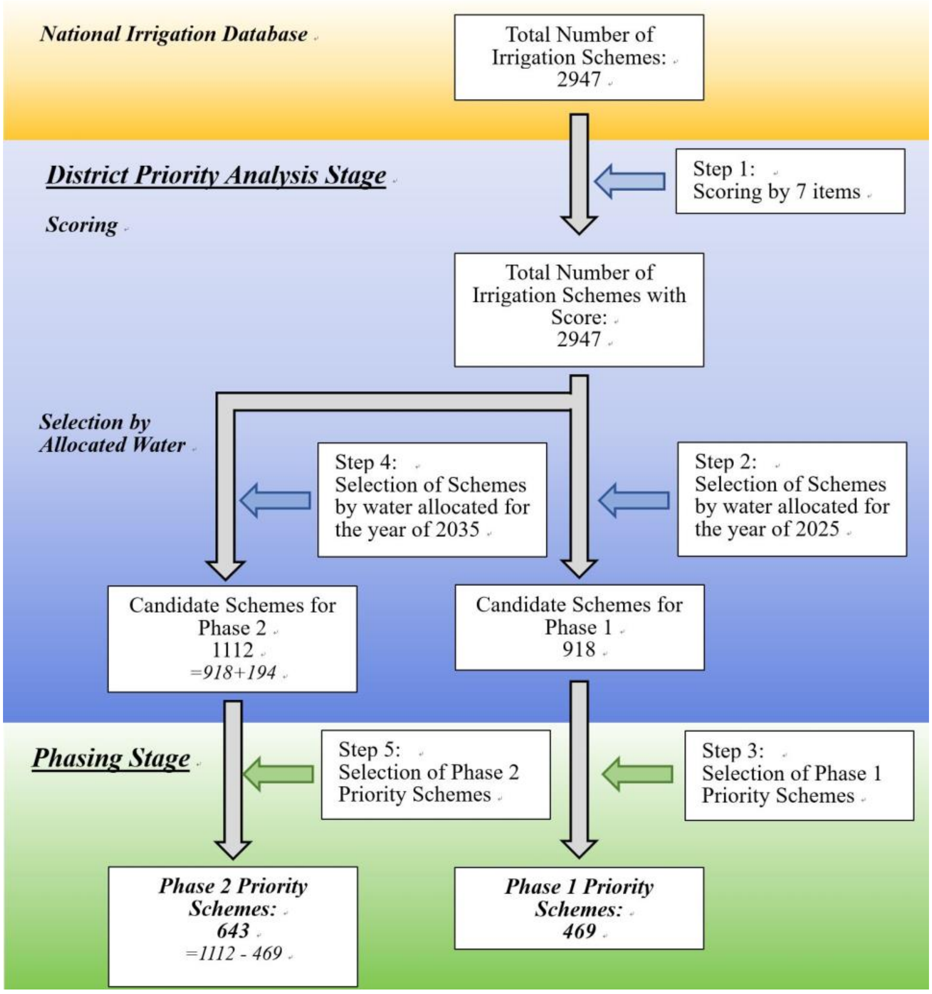
Process 3: 1112 The total number includes Phase 1 priority schemes, schemes which were not selected in Process 2, and new schemes with water allocation for 2035.

Stage of Development Phases

Process 4: 469 As a result of priority scheme selection for Phase 1, 469 schemes with total incremental development area of 248,000 ha were selected.

Process 5: 643 The number is calculated by deducting 469 priority schemes from 1,112 selected schemes in Process 3. Total estimated incremental area of these schemes is 312,000 ha.

The following Figure 7.5.3 visualizes the scheme selection process with selected number of irrigation schemes.



Source: JICA Project Team

Figure 7.5.3 Selection of Priority Irrigation Schemes

The lists of selected Phase 1 priority schemes, Phase 1 related priority dams, and Phase 2 priority schemes are compiled in Attachment-7.5.1.

(2) Selected Irrigation Schemes

New development priority schemes with land reclamation are summarised in Table 7.5.4.

Table 7.5.4 New Development Schemes by Phase and Size

Development Phase	Small Scale		Medium Scale		Large Scale		Total	
	No. of schemes	Irr. Area (ha)	No. of schemes	Irr. Area (ha)	No. of schemes	Irr. Area (ha)	No. of schemes	Irr. Area (ha)
Phase 1	123	15,372	63	43,366	22	78,190	208	136,928
Phase 2	216	34,624	69	49,932	27	85,842	312	170,398
Total	339	49,996	132	93,298	49	164,032	520	307,326

Sources: JICA Project Team

Moreover, priority schemes to improve irrigation efficiency including expansion of irrigation area are tabulated in the following Table 7.5.5.

Table 7.5.5 Priority Improvement Schemes by Phase and Size

Development Phase	Small Scale			Medium Scale			Large Scale			Total		
	No.	Imp area	Exp area	No.	Imp area	Exp area	No.	Imp area	Exp area	No.	Imp area	Exp area
Phase 1	179	27,628	21,114	63	30,127	34,760	19	38,524	55,318	261	96,279	111,192
Phase 2	225	35,680	21,030	87	39,881	44,613	19	17,988	76,069	331	93,549	141,712
Total	404	63,308	42,144	150	70,008	79,373	38	56,512	131,387	592	189,828	252,904

Note: "No." means number of schemes, "Imp area" means improved area (ha), "Exp area" means expansion area (ha)
Sources: JICA Project Team

Table 7.5.6 shows the priority irrigation schemes by water source. In this table, schemes which have several water sources are categorized in one as "multiple water source" because of too many varieties of combinations of water sources.

Table 7.5.6 Priority Irrigation Scheme by Water Source

	Single Water Source							Multiple Water Source	Others	Total
Development Phase	Perennial River	Seasonal River	Dam	Ground water	Lake	Spring	RWH			
Phase 1	253 188,569	41 20,703	31 22,550	9 4,600	14 5,683	15 4,509	10 5,330	83 80,685	13 11,770	469 344,399
Phase 2	311 187,671	88 61,049	42 15,534	10 8,280	4 666	18 11,680	14 13,516	106 64,928	50 42,335	643 405,659
Total	564 376,240	129 81,752	73 38,084	19 12,880	18 6,349	33 16,189	24 18,846	189 145,613	63 54,105	1,112 750,058

Note: the number in the upper row shows the number of schemes and the lower number shows the total irrigation area (ha).
RWH stands for "Rain water harvesting technology".
Sources: JICA Project Team

Chapter 8 Considerations for National Irrigation Master Plan 2018

8.1 General

In this chapter, the Japan International Cooperation Agency (JICA) Project Team conducts a SWOT analysis of current situation, and considers the development scenario and basic framework, needs for irrigation development, major issues and countermeasures, development approach, for the National Irrigation Master Plan 2018 (NIMP2018). The environmental and social considerations are discussed separately in Chapter 10. Table 8.1.1 shows the SWOT analysis for sustainable irrigated agriculture development in Tanzania mainland. In NIMP2018, enhancement of strength and opportunities and mitigation of threats and weaknesses are addressed.

Table 8.1.1 SWOT Analysis for Sustainable Irrigated Agriculture Development in the Mainland of Tanzania

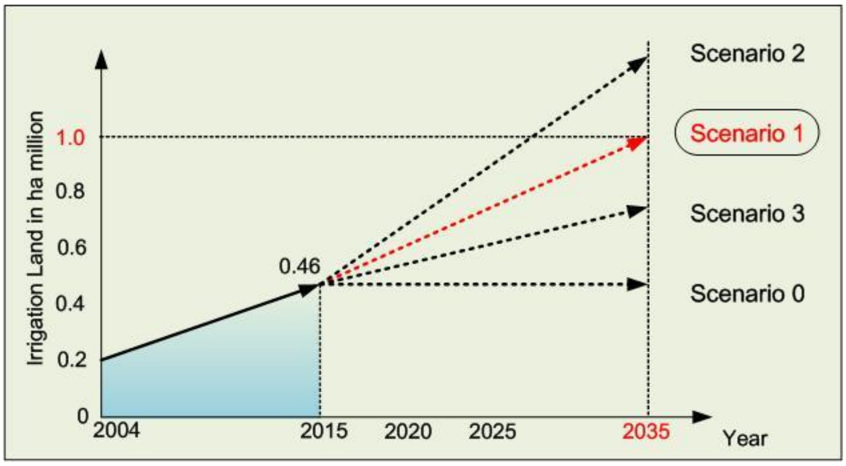
	Helpful **to achieving the objective**	**Harmful** **to achieving the objective**
Internal Origin (attributes of the organisation)	**Strength** ・ As a government agency, NIRC has technology accumulation and experience of irrigation development for many years ・ NIRC has eight zonal offices nationwide. ・ NIRC holds construction machinery and laboratory equipment. ・ NIRC has technical staff not only irrigation engineers but also experts on environmental and social considerations, soil, agriculture and community development. ・ NIRC is a member of the National Water Board and the ASDP Steering Committee. ・ NIRC has achieved almost the initial plan of NIMP2002. ・ With the support of JICA, financial cooperation (SSIDP) and technical cooperation (TANCAID2, TANRICE, ATC) for irrigation fields are in progress. ・ There is a track record of receiving assistance from development partners other than JICA (WB, IFAD, AfDB, etc.).	**Weakness** ・ Experienced senior staff members are retiring, and the number of staff is on a downward trend in NIRC. ・ The government development budget is limited to about 10 to 30% of the approved amount (achievement). ・ In the current budget, for example, the cost of business activities is extremely limited. ・ NIRC headquarters is sometimes borrowed to the MALF, the office space is narrow and the office is dispersed within the premises of the MALF. ・ NIRC has not direct order directive in business with LGAs (irrigation departments) that have jurisdiction over small-scale irrigations. ・ Awareness of Irrigation Policy 2010, Irrigation Act 2013, and NIRC is low. ・ Coordination between different sectors is not well promoted.
External Origin (attributes of the environment)	**Opportunities** ・ FYDP II plans to expand irrigation area to 1 million ha by 2025. ・ In addition, increase in production is expected for raw materials (such as sunflower, grapes and tomato) for nurturing domestic food-processing industry. ・ Reducing poverty in rural areas is an important policy objective. ・ According to World Bank population forecast, the population of Tanzania is expected to exceed 100 million people in 2037. ・ Demand for food will increase due to population increase. Demand for rice, vegetables, and fruit is expected to increase especially in urban areas. ・ Compared with neighbouring countries, Tanzania is blessed with water resources, land resources, climate, and so on. ・ By irrigation it is possible to increase the productivity of agricultural crops two to three times. ・ Tanzania boarders with eight countries and has high export potentials for selected commodities (maize, legumes, and rice). ・ Paving of national/trunk roads is progressing rapidly. Railway and port development plans are underway. ・ Of the four economic corridor developments, improvement of the agricultural value chain is advanced in SAGCOT. ・ Private sector entry and investment in agriculture and irrigation are expected. ・ Water-saving irrigation techniques (drip, sprinkler, etc.) are seen. ・ Irrigation plan using lake water such as Lake Victoria is underway.	**Threats** ・ Rain-fed farming, which is low in productivity and profitability, is common practice in Tanzania. ・ Drought floods occur more frequently due to climate change. ・ Many seasonal rivers and wadis exist, and sedimentation at dams and headworks is a problem. ・ Local water logging and soil salinity occur due to poor drainage. ・ Water disputes related to water (irrigation) use are occurring. ・ Land disputes related to irrigation development are occurring. ・ The activities of IOs are generally inactive. ・ Rural patriarchal system remains strong, and opinions of women and youths are not reflected well in development activities. ・ Underdevelopment of link road from trunk road to the village is an obstacle for harvest transportation. ・ Agricultural value chain development is delayed, such as storing, processing and market information system. ・ Private investment in agriculture/irrigation sector is not active. ・ Contractors and consultants in water resources and irrigation sectors are few, hence low demand for irrigation engineers. ・ Rural finance and microfinance systems are not prevalent. ・ Import/export procedures, fees and taxes of agricultural products are complex and costly. ・ Maize, rice and sugar are susceptible to political interventions (e.g., embargo and import without taxes). ・ Border trade may be closed due to security deterioration in neighbouring countries

Source: JICA Project Team

8.2 Development Scenario and Basic Framework of NIMP2018

(1) Development Scenario

The conceptual diagram for development scenario of the NIMP2018 is depicted in the figure below. It is assumed that Scenario 0 does not implement NIMP2018, Scenario 1 achieves irrigation area of 1 million ha, Scenario 2 achieves irrigation area above 1 million ha, and Scenario 3 achieves irrigation area below 1 million ha. These scenarios are largely influenced by Tanzania's resources (water, land, climate, talent, funds, information, time, etc.). Here, the development goal is supposed to be 1 million ha of Scenario 1 in due consideration of NIMP2018.



Senario 0: NIMP2018 is not implemented.

Scenario 1: New irrigation schemes are developed in addition to improvement and expansion of existing irrigation schemes.

Scenario 2: Large-scale commercial irrigation schemes are developed in addition to Scenario 1.

Scenario 3: Only existing irrigation schemes are improved and expanded.

Source: JICA Project Team

Figure 8.2.1 Conceptual Diagram of Development Scenarios

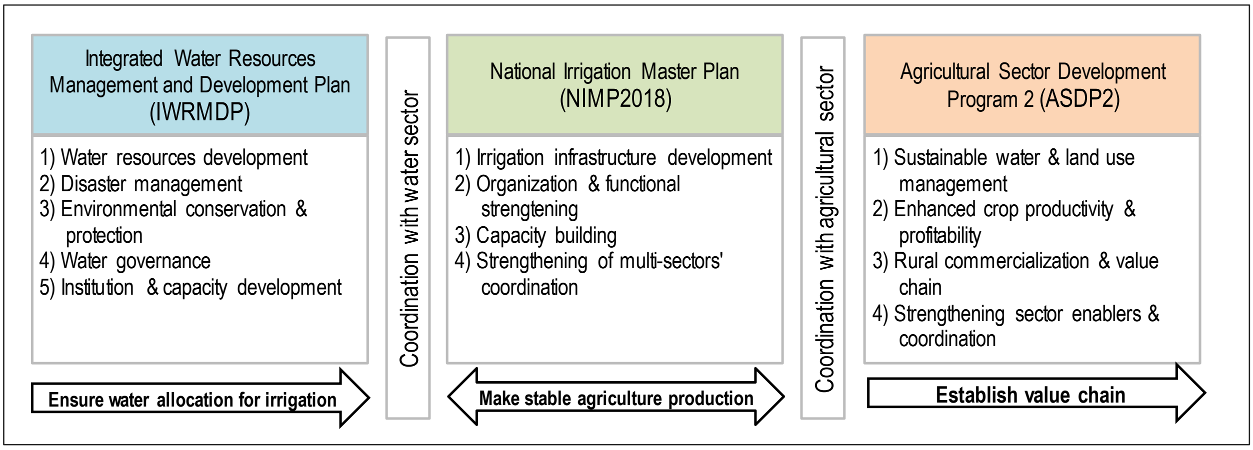
The government approval and implementation of NIMP2018 as planned are prerequisites for realizing Scenario 1. The following shall be considered in implementing NIMP2018.

1) Integrated Water Resources Management and Development Plan (IWRMDP) and Agricultural Sector Development Program Phase 2 (ADP2) are implemented as planned in addition to NIMP2018.
2) Development funds for the item 1 are secured.
3) Organisational set-up for irrigation development and management specified by the National Irrigation Act 2013 is established in addition to increasing in number of irrigation staff.
4) Technical and management capacities of irrigation staff and IOs are strengthened.
5) Coordination among the relevant ministries and agencies is made for cross-cutting issues related to irrigation development.

Incidentally, the development alternatives (scenarios) from the viewpoint of environmental and social considerations will be discussed in Chapter 12.

(2) Coordination among the Relevant Government Ministries and Agencies

As shown in Figure 8.2.2, it is important for the irrigation sector to make good coordination especially with water sector (IWRMDP) to secure water allocation for irrigation through river basin management and soil conservation in the upper catchment areas and agriculture sector (ASDP2) to strengthen the agricultural extension services and agricultural value chain enhancing crop productivity and profitability.



Source: JICA Project Team

Figure 8.2.2 Coordination between Water Sector, Agriculture Sector, and Irrigation Sector

The coordination with relevant ministries and agencies under NIMP2018 is discussed in Section 9.5 of Development Components and in Section 13.2 of Recommendations.

(3) Basic Framework of NIMP2018

The basic framework of NIMP2018 assuming Scenario 1 above is shown in Figure 8.2.3.

		Phase 1 (P1)	Phase 2 (P2)
Overall Goal		Contribution to Agriculture GDP Growth and Rural Poverty Reduction	
Project Purpose		Strengthening of NIRC in a Sustainable Manner	
Development Strategy		･Irrigation Development consistent with National Development Plans ･Irrigation Development based on Water Allocation estimated by IWRMDP ･Irrigation Development in collaboration with ASDP2	
Hard Component	Development Target	**Improvement of Irrigation Efficiency and Expansion of Irrigation Area**	
Hard Component	Development Approach	1) On-going projects with priority 2) More matured projects with priority 3) Development priority of executing agencies 4) Formulation of P2 projects	1) Projects formulated in P1 with priority 2) Projects carried over from previous P1 with priority
Hard Component	Major Activities	･Development of small scale irrigation systems (Improvement, Expansion, New Development) ･Development of medium to large scale irrigation systems (Improvement, Expansion, New Development) ･Promotion of storage-type irrigation development (small dams and ponds) ･Promotion of lake water irrigation development ･Promotion of water saving irrigation development (Drip, Sprinkler), etc.	
Soft Components	Development Target	**Quality Improvement in Irrigation**	
Soft Components	Development Approach	1) Institutional and functional strengthening for smooth implementation of projects 2) Capacity building of government staffs for quality irrigation development 3) Capacity building of irrigators' organization for sustainable O&M in participatory manner 4) Strengthening of coordination with relevant ministries and private sector	
Soft Components	Major Activities	･Organization and function: Unified management of irrigation development, etc. ･Capacity building: Human resource development for sustainable irrigation development ･Coordination: Strengthen efforts towards cross-sectoral issues, and encourage private sector participation	
Scope	NIMP2018	Phase 1 and Phase 2	
Scope	Implementation Plan	Phase 1	To be prepared by NIRC

Source: JICA Project Team

Figure 8.2.3 Basic Framework of NIMP2018

8.3 Justification of Irrigation Development

8.3.1 Enhancement of Agriculture Productivity and Profitability

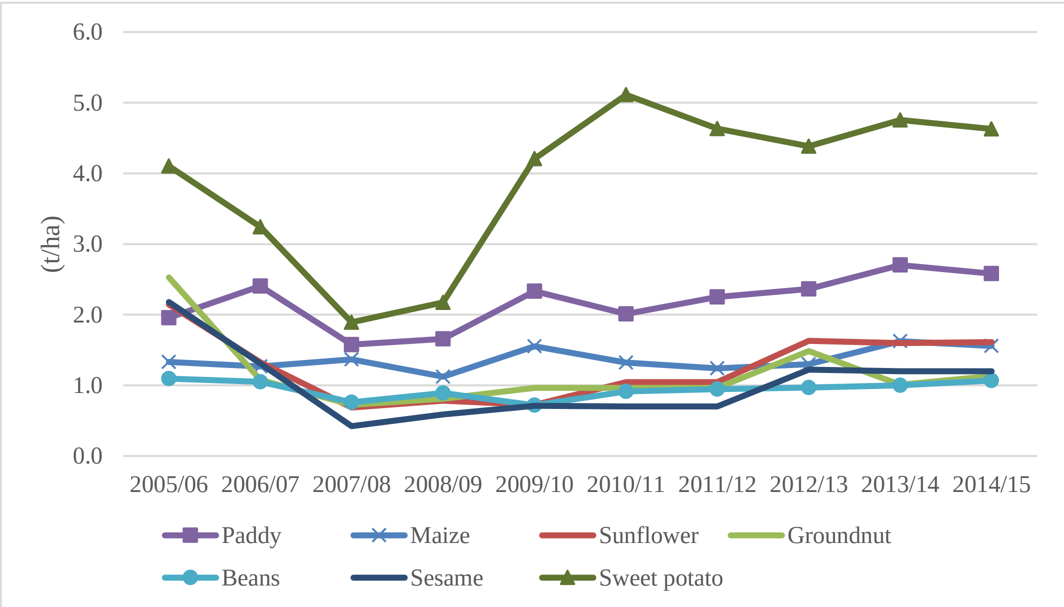
In Tanzania, agriculture productivity and profitability are comparatively low, as traditional agriculture, which depends on rainwater, is widely performed. The NIMP2018 aims to contribute to the improvement of agricultural productivity and profitability through irrigation development. Especially, improvement of unit yield and expansion of irrigation area, accompanied by an increase in production volume.

Firstly, Table 8.3.1 shows the effect of irrigation and the possible yield increase at demonstration farms in Tanzania.

Table 8.3.1 Comparison of Yield of Crops under Rainfed and Irrigation

Crop	Actual Yield*1 (t/ha)		Potential Yield*2 (t/ha)	Theoretical yield *3 (t/ha)
	Rainfed	Irrigation		
Rice (paddy)	1.35	4.49	6.36	11.07
Maize	1.15	-	5.41	13.79

Note: *1= Actual yield averaged in the past five years for irrigated and ten years for rainfed conditions in specific research centres.*
**2= Potential yield like the theoretical yield but under limited water supply.*
**3= Theoretical yield but not dependent on soil characteristics, use as benchmark only.*
Source: *Database of Global Yield Gap and Water Productivity Atlas (GYGA), http://www.yieldgap.org/web/guest/download_data*



Source: Statistical data collected from Statistics Unit, MALF

Figure 8.3.1 Historical Changes in Unit Yield of Major Crops

Next, the historical change in unit yield (t/ha, excluding Zanzibar) is shown in Figure 8.3.1. These data were collected from Statistics Unit, MALF in 2016. It shows that the unit yields of paddy and maize have slightly increased during the last decade, and it is assumed that the unit yield advancement resulted from the expansion of irrigation land and improved farming technologies. It also suggests that there will be a big room to increase unit yields of paddy and maize comparing with potential yields indicated in Table 8.3.1.

To compare unit yield of crops between Tanzania and other countries, Table 8.3.2 was prepared using the 2014 FAOSTAT figures to ensure data consistency.

Table 8.3.2 Comparison of Unit Yields of Crops between Tanzania and Other Countries

Crops	Unit	Tanzania	Kenya	S. Africa	Indonesia	India	Thailand
Rice (paddy)	t/ha	2.74	3.95	2.65	5.13	3.58	3.06
Maize (dry)	t/ha	1.63	1.66	5.30	4.95	2.56	4.25
Beans (dry)	t/ha	0.98	0.59	1.47	1.18	0.41	0.75
Tomato	t/ha	12.35	18.07	78.82	15.52	21.24	21.19
Onion (dry)	t/ha	10.27	15.83	25.55	10.22	16.12	26.78
Sunflower (seed)	t/ha	1.00	1.00	1.39	-	0.75	1.19

Source: FAOSTAT, Data in 2014

The unit yields of Tanzania are still relatively low as indicated in Table 8.3.2. By increasing unit yields of these crops to the level of Asian countries, it is expected that agricultural income for farmers will increase, and that the nation's foreign currency acquisition will be enhanced through export of internationally competitive agricultural commodities to neighbouring countries.

In the National Rice Development Strategy formulated by the MALF in 2009, paddy yield targets by cultivation condition and year were specified as Table 8.3.3.

Table 8.3.3 Yield Targets in Tanzania Rice Development Strategy

Item	Unit	2008	2013	2018
Rainfed Upland	t/ha	0.50	1.00	1.60
Rainfed Lowland	t/ha	1.00	1.50	2.00
Irrigated	t/ha	2.13	3.00	3.50
Total	t/ha	1.30	2.10	2.80

Source: MALF, May 2009, National Rice Development Strategy (NRDS), Draft Final, GOT

In ASDP2, which is regarded as a current national policy of the agricultural sector, the paddy yield in 2020 was targeted as 3.6 t/ha, double the baseline paddy yield in 2015/16, 1.8 t/ha. However, no individual yield targets were set by rainfed and/or irrigated paddy. The National Agriculture Policy (NAP, 2013) also pointed out that low level of land productivity was one of the important issues and it stated that the potential paddy yield was 6.0-7.5 t/ha as compared with the current average paddy yield, 2.0-3.8 t/ha. (No individual yield data were mentioned by rainfed and/or irrigated paddy.)

Subsequently, the paddy yield targets in an ongoing project and at a planning stage are examined. The Expanding Rice Production Project (2015-2020)[1] is a grant scheme funded by the World Bank and it sets the paddy yield target of beneficial farmers in Morogoro in 2019 as 3.5 t/ha as compared with its baseline yield, 1.8 t/ha. In the Catalysing the Future Agri-food Systems of Tanzania (CFAST) Project 2, currently proposed by NIRC in collaboration with the World Bank, 6.0 t/ha of irrigated paddy yield in 2021 is targeted for farmers at high potential districts in SAGCOT areas in comparison with the current irrigation paddy yield in 2017, 3.8 t/ha.

On the other hand, paddy yield data of rainfed and irrigated land in Tanzania were surveyed in 2009 and the yield differences were clearly observed. Some 600 data were collected in major paddy cultivation

[1] World Bank, March 2015, "Project Appraisal Document on A Proposed Grant from the Global Agriculture and Food Security Program in the Amount of USD 22.9 million to the United Republic of Tanzania for an Expanding Rice Production Project "Main components include: (1) Sustainable seed systems with USD 3.38 million, (2) Improving crop productivity through better irrigation and crop management with USD 18.48 million, and (3) Innovative marketing strategies with USD 2.37 million. The beneficiaries are smallholders in Zanzibar and Morogoro.

[2] NIRC, MoWI, July 2017, "Cost Sharing and Recovery Mechanisms for Irrigation Sub-projects, CFAST"

areas, namely: Morogoro, Mbeya, and Shinyanga in 2009 and the results are shown in Table 8.3.4.

Table 8.3.4 Comparison of Paddy Yields in Rainfed and Irrigation Areas

Item	Unit	Morogoro	Mbeya	Shinyanga	Average
Rainfed Areas	t/ha	2.0 (178)	1.6 (103)	1.7 (232)	1.8 (513)
Irrigated Areas	t/ha	3.9 (45)	3.5 (94)	4.6 (8)	3.7 (147)

Note: Numbers in parentheses are sample data numbers.
Source: Tokuda S, Nakano Y., 2014, "Profitability of New Farming Technologies for Paddy Cultivation in Tanzania" (in Japanese), Journal of International Cooperation for Agricultural Development, 13: pages 55-68

The paddy yields in irrigated areas recorded 195-271% (206% on average) as compared with those of rainfed areas in each region. This implies that irrigation can double the paddy yield. The report released in 2015[3] stated that the average yield of irrigated lowland paddy in Mbeya and Morogoro ranged between 3-6 t/ha while that of rainfed lowland paddy ranged between 1-3 t/ha. These figures are consistent with the paddy yield data in Table 8.3.4.

Finally, positive effects of productivity and profitability improvement are briefly mentioned from a socioeconomic viewpoint. Benefits obtained through enhancement of productivity and profitability directly improve farming household livelihoods, which in turn lowers poverty incidence in rural areas. Needless to say, poverty reduction is one of the urgent and crucial issues tackled by the Tanzanian government. The current FYDP II (2016/17-2020/21) sets the target to reduce the rural poverty rate to 19.7% in 2020/21 (to 15.0% in 2025/26) from 33.3% in 2015/16, and the government is now taking various measures to achieve this target. Because the majority of rural population are engaged in agriculture, enhancement of agricultural productivity and profitability is expected to have direct positive effects on poverty reduction and contribute to achievement of the FYDP II.

8.3.2 Efficient Use of Water Resources

The largest water user in Tanzania is irrigation sector. About 80% or more of the water demand comes from irrigation purposes. Water conflict tends to increase, especially in river basins where water supply and demand is tight. The water conflict can be categorised into irrigation sector and other sectors, cultivators and pastoralists, upstream users and downstream users of rivers, or upper end farmers and lower end farmers in the irrigation scheme. Changes in rainfall and rainfall patterns associated with climate change have a great influence on psychological and behavioural aspects of the stakeholders.

The keywords for water conflict resolution on each confrontation axis are efficient water use in irrigation and proper guidance and arbitration by administrative agencies. The challenges and countermeasures are summarised in Table 8.3.5

Table 8.3.5 Water Conflict and its Countermeasures

Confrontation Axis	Challenges	Countermeasures
Between Irrigation Sector and Other Sectors	The water demand is around 82% for irrigation, 10% for domestic use and 8% for others. In addition to inefficient traditional irrigation, there are many uncompleted irrigation systems. Thus, the irrigation efficiency is low, and a large amount of water is consumed in irrigation.	It is necessary to improve the irrigation efficiency by modernizing the traditional Irrigation schemes and completing the incomplete irrigation schemes. Efficient water management by the irrigator's organisation is indispensable for sustainability.

[3] FAO (R. Trevor Wilson and I. Lewis), 2015, "The Rice Value Chain in Tanzania - A Report from the Southern Highlands Food Systems Programme"

Confrontation Axis	Challenges	Countermeasures
Between Cultivators and Pastoralists	In the dry season, in search of water, nomads of Maasai and Sukuma go down south with livestock (mainly cattle) and grazing in paddy fields, reservoirs, etc. As a result, damage to crops and damage to irrigation facilities have occurred.	It is reported that the problem was solved by arbitration of local government (village and ward). As a preventive measure, a watchdog system, enclosure with fence, and installation of drinking facilities can be considered.
Between Upstream Users and Downstream Users of River	Some river basins have issued water use permits, but their monitoring and evaluation have not been well implemented. Also, illegal water use is silent.	Primarily, thorough water management on rivers is important. In addition to this, it is necessary to reduce the irrigation water intake at the upstream part of the river and to make more water flow down to the downstream part of the river by making the irrigation schemes more efficient.
Between Upper End Farmers and Lower End Farmers of Irrigation Scheme	Generally, farmers at the upper end tends to irrigate more than necessary. In addition, the irrigation efficiency is extremely low, so irrigation water is not well distributed to the lower ends.	Improvement of irrigation infrastructure to improve irrigation efficiency and strengthening of water management capacity of irrigator's organisation are indispensable. In some circumstances, the conjunctive use of surface water and groundwater is another way of improvement.

Source: JICA Project Team

As detailed in Section 7.4, irrigation water requirement is determined by crop water requirement, effective rainfall amount and irrigation efficiency. The crop water requirement is specific to crops, while the effective rainfall is specific to the area, whereas the irrigation efficiency is largely dependent on the maintenance level of irrigation facilities and the water management level. Irrigation efficiency in Tanzania is greatly different by designers as shown in Table 8.3.6. In the Rufiji basin, the Lake Rukwa basin, and the Internal Drainage basin, it is assumed that the irrigation efficiency improves due to the synergistic effect of improvement of irrigation infrastructure and water management improvement.

Table 8.3.6 Irrigation Efficiency by River Basin

Basin	PG	WR	RF	RV	LN	LR	LT	LV	ID
Irrigation Efficiency	0.25-0.40	0.25-0.30	NA	0.27	0.25	NA	0.25	0.50	0.36-0.50

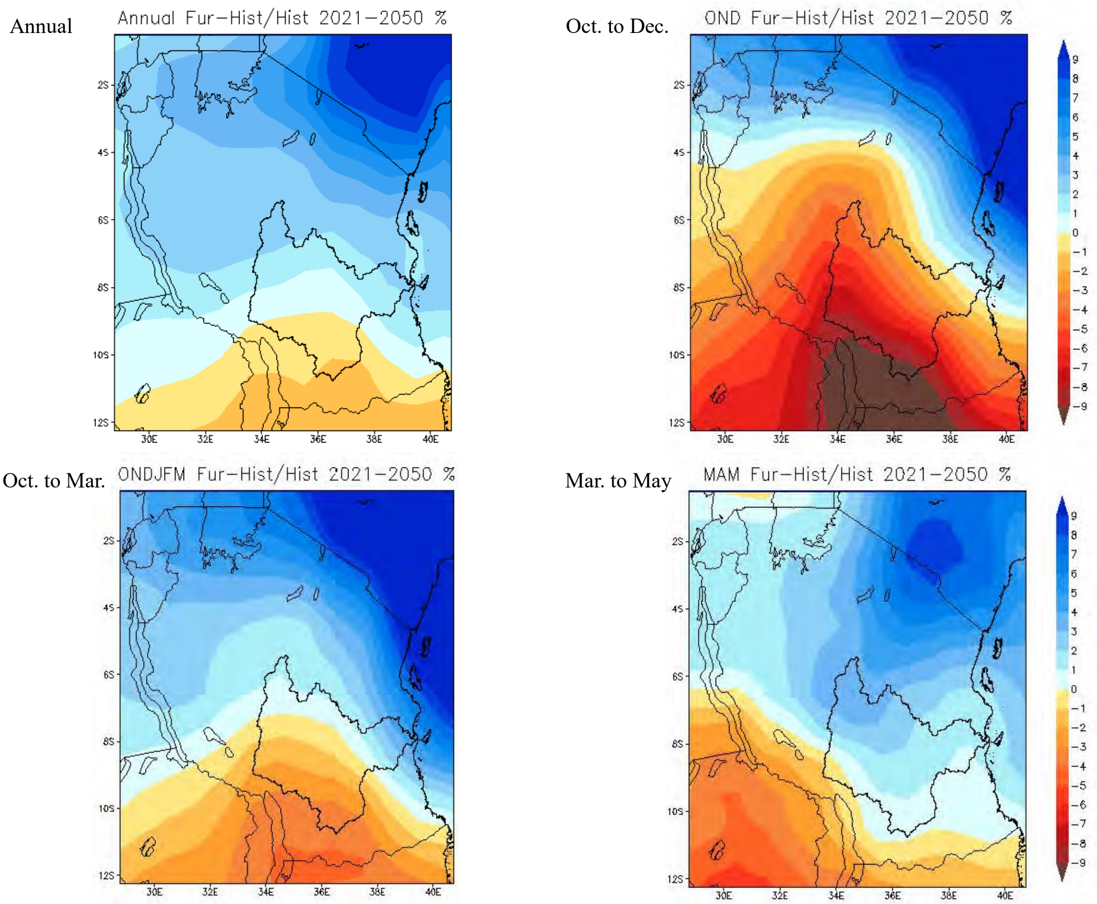
Remarks: PG= Pangani, WR= Wami / Ruvu, RF= Rufiji, RV= Ruvuma, LN= Lake Nyasa, LR= Lake Rukwa, LT= Lake Tanganyika, LV= Lake Victoria, ID= Internal Drainage
Source: MRMDPs, World Bank

The reasons why irrigation efficiency is low in Tanzania are: as already mentioned, that many inefficient traditional irrigation schemes remain, and that there are irrigation schemes left unfinished as a result of constraints such as budget shortage. The irrigator's organisation is not functioning sufficiently. Therefore, as shown in the corresponding measures, modernisation of traditional irrigation scheme is a prerequisite for efficient water use in irrigation, including the early completion of unfinished irrigation schemes, irrigation infrastructure development is an important issue. In order to make this possible and sustainable, it is necessary to design and implement a systematic irrigation plan through strengthening the capacity of the irrigator's organisation and introduce crops that are resistant to drought and varieties with short maturity periods.

8.3.3 Climate Change Adaptation Measures

Most of Tanzania country belongs to the savanna climate, and northern coastal area and central area belonging to tropical monsoon and steppe area.

The Intergovernmental Panel on Climate Change studies different global climate models in 4th Assessment Report, and all different climate change models predicted the future temperature rise in Tanzania. Those different models are compiled as Coupled Model Intercomparison Project (CMIP). Uncertainty reduction in Models for Understanding Development Applications (UMFULA) Project studied the expected climate change in Tanzania with CMIP5 models. Rainfall in Tanzania is expected to have slight increase in north area and decrease in south area. Especially, remarkable rainfall decrease is predicted in October to December as Figure 8.3.2.



Note: Vertical axis shows the change of rainfalls in percentage between actual records (1976-2005) and future prediction (2021-2050) by each color in above figure.
Source: UMFULA

Figure 8.3.2 Mean Rainfall Change (%) for Near-term by Using CMIP5 Models

Despite general trend in large area is expected to increase precipitation, increase of anomaly rain events was observed in last decades. Its dependence on the climate sensitive natural resources, makes the country highly vulnerable to the adverse impact of climate change.

The Tanzania National Adaptation Programme of Action was prepared for overall sector plan integrated plans, policies, and programs for sustainable development at the national level in 2007. In this report, 72 project activities were proposed with a breakdown of 11 in agriculture sector. Around 14 adaptation activities were selected from them as these need to be addressed most urgently.

Agriculture practice relaying on precipitation is extremely vulnerable to climate variability. Irrigation is widely known as major and basic method for adaptation. Despite that, modern irrigation system is implemented in a limited rate. Traditional irrigation area is widely existing which has low irrigation efficiency because of earth canal and need to be modernized to reduce water losses to secure water resources. Water storages such as small-scale dams and water harvesting dikes are seen somewhat in arid lands, but they are still limited. Usage of groundwater for agriculture sector is limited which is relatively stable to climatic anomalies. The major usage of ground water is for domestic purpose.

Table 8.3.7 shows expected effects on agriculture sector and adaptation strategies. Some adaptation methods are effective against multi disasters.

Table 8.3.7 Expected Effects on Agriculture Sector and Adaptation Strategies

Climate Condition	Disaster	Adaptation
Drought	Water shortage	・ Improvement of irrigation system ・ Micro irrigation ・ Research and development on drought tolerant seed varieties ・ Water harvesting ・ Integrated water resource management ・ Exploitation of underground water ・ Inter-basin water transfers ・ Protection of water catchments ・ Rainwater harvesting ・ Water saving agriculture methods (traditional, SRI, etc.) ・ Construction of water reserve facilities ・ Early warning system
Increase of rain	Flood	・ Terracing ・ Contour farming ・ Use of organic manure ・ Construction of water reserve facilities ・ Early warning system
Climate change	Ecological changes	・ Agriculture extension services ・ Crops diversification

Source: JICA Project Team

8.3.4 Revitalization of Regional Economy

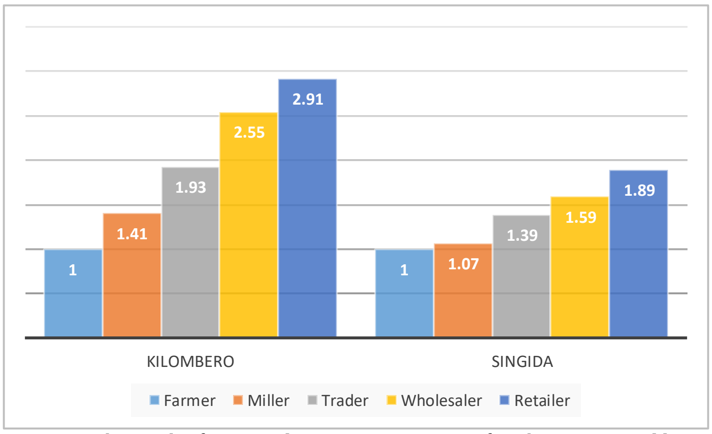
As a result of irrigation development by the NIMP2018, stable agriculture becomes possible, and increased production and increased sales of agricultural crops can be expected. In addition to these direct benefits, it can be expected to stimulate the regional economy by indirect effects such as sales of agricultural input materials, processing and distribution of harvested products, employment of agricultural workers, etc.

(1) Establishment of Production Centre and Expansion of Economic Zone

In recent years, transport infrastructure development in Tanzania has progressed rapidly. In particular, the time distance between major cities is greatly shortened by asphalt pavement and interconnection of main roads. The distribution block can be expanded dynamically by reducing the time distance especially for fresh foods. For instance, vegetables and fruits can be harvested in the evening and delivered to the wholesale markets of major cities next morning.

(2) Revitalization of Regional Economy through Value Chain Development

Figure 8.3.3 shows relative prices when the rice farmer selling price is taken as "1". Rice millers, traders, wholesalers, and retailers are involved in the distribution and sales of rice. Those business persons can gain margins respectively. Distribution and sales of other agricultural crops is generally involved by similar intermediaries (processor instead of rice miller). This mechanism shows the effect of the rice value chain spreading over the regional economy.



Note: It is the result of case study, not representative of each region. In addition, the price difference in both regions is mainly due to the difference in the survey period.
Source: Expanding Rice Market in the East Africa Community, Kilimo Trust

Figure 8.3.3 Profit Structure in Rice Value Chain

To get appropriate profits as a producer farmer, it is necessary to improve the access to market price information, install policy and system to create a competitive environment among intermediaries.

Box 8.3.1 Economic Ripple Effect Induced from Input Output Table in Japan

As an analytical method of economic ripple effect, there is an input-output table showing a chain-like connection of goods/services along "purchase => production => sales." Here, as a reference, the magnitude of the production spread of the agriculture, forestry and fishery industry from the Japanese industry table is shown in Table 8.3.8

Table 8.3.8 Economic Ripple Effect Induced from Input Output Table in Japan

Item	2011	2000	1990	1980
Agriculture	1.84	1.72	1.70	1.83
Average of all sectors	1.92	1.89	1.85	2.06

Source: Ministry of Internal Affairs and Communications, Japan (http://www.soumu.go.jp/toukei_toukatsu/data/io/index.htm)

This table shows that Japan's agriculture, forestry and fisheries industries impact to the magnitude of production spread relative to the final demand per unit is steady at 1.70-1.84. This means that input into goods and services to the agriculture, forestry and fisheries industries had an economic ripple effect of 1.70-1.84 times compared with related industries. The input output tables of Tanzania are not available, but irrigation development in Tanzania where the agriculture sector occupies a large weight in economic activities is considered to have an economic ripple effect beyond Japan.

(3) Job Creation Effect

Based on the data of the Tanzania Investment Centre (TIC), the job creation effect by sector (plan base) in the private investment business was estimated. Job creation effect is indicated by the number of employees per TZS 1 million private investment. As shown in Table 8.3.9, since the annual variation is large, when comparing the average value for three years from 2011 to 2013, sectors with a large job creation effect are in order of agriculture and livestock, commercial buildings, transport, tourism, and manufacturing.

Table 8.3.9 Job Creation Effect through Private Sector Investment Approved by Tanzania Investment Centre

(Unit: Persons/TZS one million)

Sector	2011	2012	2013	Average
Agriculture and Livestock	8.9	69.2	39.0	39.0
Tourism	11.7	14.6	16.2	14.2
Manufacturing	18.4	8.1	11.5	12.7
Commercial Buildings	11.1	68.6	5.3	28.3
Transport	13.9	20.0	19.6	17.8
Communication*1	1215.5	0.3	2.4	1.4
Energy	0.2	3.4	3.2	2.3

*Note: *1= Average of 2012 and 2013 because of extreme figure in 2011 in communication sector.*
Source: Prepared by the JICA Project Team based on the Number of Approved Projects through Tanzania Investment Centre (TIC) by Sector in NBS Statistical Abstract 2015, 2014, 2013, 2012

Since labour-intensive sectors are dominant in Tanzania, it is expected to show a similar tendency in the government public investment projects. For job creation, agriculture is particularly important in Tanzania as the rural population occupies over 70% of the total population (PHC 2012). More effects on job creation can be expected by making investments into the agriculture and livestock sectors.

Box 8.3.2 Employment and Unemployment Rate in Tanzania

The Integrated Labour Force Survey (ILFS) 2014 is the fifth survey conducted by the government to collect labour market information and other socio-economic data in the mainland as required for policy formulation and decision making in the planning processes. The 2014 ILFS revealed that the total population aged 15 years or above was 25,750,116, and 89.7% for employed and 10.3% for unemployed population out of the economically active population of 22,321,924. Table 8.3.10 shows the breakdown of unemployment condition in Tanzania mainland in 2014.

Table 8.3.10 Unemployment Rate of Person 15+ Years by Age Group and Sex, Tanzania Mainland, 2014

Age Group	Male		Female		Total	
	Number	Percent	Number	Percent	Number	Percent
15 - 24	336,609	11.3	495,815	16.1	832,424	13.7
24 – 35	206,501	6.6	424,258	12.9	630,759	9.8
36 – 64	301,300	7.0	401,593	9.2	702,893	8.1
65+	58,631	9.3	67,079	12.5	125,710	10.8
Total	903,041	8.2	1,388,744	12.3	2,291,785	10.3

Source: NBS, 2015, ILFS 2014, accessed to http://www.nbs.go.tz/nbstz/index.php/english/statistics-by-subject/labour-statistics/614-the-2014-integrated-labour-force-survey-ilfs

It revealed that young persons aged 15 to 24 years are more vulnerable to unemployment (13.7%) compared with other age groups, and females have a higher unemployment rate than males in each age group. Other findings indicate that urban unemployment rate is generally higher than the rural. This may be a reason why urban industry sector could not afford yet to absorb persons who migrate from rural in searching of employment opportunities. High unemployment rate for youth and in urban is a result of high incidence of new entrants to the labour force. These call the attention of the government and other stakeholders to address more employment opportunities for youth and females as well as in the rural.

8.4 Synergistic Effect of Irrigation and Value Chain Development

In the agricultural value chain, upstream is the production site such as paddy and upland field. The agricultural commodity and its processed products are transported to customer along the value chain at the end.

1. Production => 2. Transportation and processing => 3. Marketing => 4. Consumption

Irrigation development affects the first production step of the agricultural value chain indicated above very much. Under the current agricultural production environment in Tanzania, which is characterised by long dry season with unstable rainfall patterns even in rainy season, irrigation development enables to secure irrigation water that is indispensable for healthy crop growth. Therefore, appropriate watering in terms of timing and amount can be done on irrigated farmland and drought damages, which were often happened on rainfed farmland will decrease, which in turn will bring about stable and/or increased crop production on irrigated farmland.

It is expected that irrigation development will increase the amount of agricultural produce which will be then handled by the second step, transportation and processing. If the current transportation and processing capacity is not enough to manage the increased amount of produce, strengthening of the second step, transportation and processing, is necessary to be implemented. If the capacity improvement is not achieved by the time when the increased produce is handled, a certain amount of the produce is left over at the farmland and/or may lead to sharp decline of the produce price. (In particular, upland crops are susceptible to price fluctuation due to their perishable nature.) This kind of incident could occur at the further downstream, the third and fourth steps in case the handling capacity of the step is below the produce amount. Consequently, it is fundamentally important to enhance the capacity of each step on the agricultural value chain along the downstream if increase of crop production is expected by irrigation development.

With respect to the NIMP2018, it is predicted that crop production will stabilize and/or increase in the regions where irrigation faculties will be developed in accordance with the plan. So, it needs to improve the capacity of each step on the agricultural value chain (transportation/processing and marketing) along the downstream in coordination with the irrigation development progress. This means that the benefit of irrigation development is not fully achieved unless balanced value chain development between upstream and downstream is materialised.

With respect to crop production, it is natural that both farmland and seeds are necessary but farm inputs such as fertilizer and pesticides are also commonly used to gain a stable and higher level of crop yield. Farmers need to procure these farm inputs, but many farmers in Tanzania practice extensive farming without applying farm inputs or with small amount of farm inputs because rainfall patterns and amounts are really unpredictable and a subsequent drought risk is not low.

Because irrigation development increases the possibilities of stable and higher crop production, it is possible for some farmers to introduce intensive farming by applying farm inputs such as improved seeds and chemical fertilizers. Therefore, to accomplish the maximum effect of irrigation development, it is also crucial to expand the value chain of farm inputs (fertilizer and pesticide companies are in the upstream while farmers are in the downstream) as well as to strengthen agricultural extension services in accordance with the irrigation development progress.

8.5 Major Issues and Countermeasures in Irrigation Development

Based on the results of the field survey, the key issues of irrigation development are organised and categorised in Table 8.5.1.

Table 8.5.1 Major Issues in Irrigation Development and Grouping

Major Issues in Irrigation Development	Grouping
・The imbalance between supply and demand for irrigation human resources has negative impact for further irrigation development.	Irrigation human resources development
・Irrigation staffs are short. ・Payment to the contractor is delayed. ・Non-purpose use of funds is occurring. ・Uncertainty of procurement procedures. ・Research and development related to irrigation such as irrigation method, irrigation water usage, and irrigation efficiency are not being conducted.	Irrigation organisation and function
・CGL which is a manual on irrigation development is not utilised as expected. ・Technical manual for survey, design, specifications and drawings are not standardised. ・The technical capacity of the irrigation engineers is declining. ・Irrigators' organisations are mostly inactive. ・Private service providers lack practical experience.	Capacity development
・The entry of the private sector into the irrigation sector hardly progresses. ・Responding to cross-sectoral issues such as water, land, climate change, poverty reduction, gender consideration, youth involvement, value chain development, etc. are delayed.	Coordination and collaboration

Source: JICA Project Team

8.5.1 Irrigation Human Resources Development

Current status and issues of irrigation human resources development have been described in detail in Section 5.8. Domestic training and educational institutions can produce over 500 graduate engineers (GEs) and 250 technicians annually, while current labour market does not provide GEs with sufficient level of employment opportunities. On the other hand, increased level of investment in irrigation development is expected under the NIMP2018, and irrigation human resources are vital in promoting the process particularly at the Local Government Authorities (LGA) level. This point will be discussed further in the next section.

8.5.2 Irrigation Organisation and Functions

(1) Government Organisations for Irrigation Development

(a) NIRC and Zonal Irrigation Offices

The NIRC is currently composed of 10 units, 5 technical divisions, 8 zonal irrigation offices as shown in Chapter 5. Many posts of director and assistant director for both technical and administrative departments/units have continued to be vacant or represented by acting officers[4]. While a change of organisational structure is expected to take place, it is crucial to fill the vacancies to set up a sound management system at the central level. Besides, there is a deficiency of technical staff, especially

[4] Source: Data on job list and job descriptions from DAHRM, NIRC, dated on 29 October 2015 (obtained on 17 August 2017).

irrigation engineers and technicians, both at central and zonal levels[5]. Since the number of irrigation schemes will increase in the course of NIMP2018 implementation, it is necessary to increase the size of technical staff for NIRC headquarters' technical divisions and Zonal Irrigation Offices (ZIOs), too.

In particular, strengthening coordination function with the development partners including the private sector, review function (survey/design), information management function (such as irrigation database update, project monitoring) and monitoring and auditing function (technical/accounting) is an important issue for the organisation. Therefore, it is recommended that the NIRC headquarters equip itself with sufficient staff to undertake these functions. The staff recruitment can be arranged with the following principles:

- To fill the vacancies in the units and divisions according to current job descriptions and recruitment plan of the NIRC (short-term: -2025).
- To add technical officers based on the organisational structure and increased level of irrigation investments suggested in the NIMP2018 (long-term: -2035).

In addition, the NIRC has opened a Katavi zonal irrigation office and has decided to shift from the conventional 7-zone system to the new 8-zone system. Table 8.5.2 shows the changes in the regions under the jurisdiction of the zone irrigation offices.

Table 8.5.2 Regions under Management of ZIO

ZIO	Regions under Management of ZIO (New 8-Zone System)	Regions under Management of ZIO (Old 7-Zone System)
Dodoma	Dodoma, Singida, Manyara	Dodoma, Singida, Manyara
Kilimanjaro	Arusha, Kilimanjaro, Tanga	Arusha, Kilimanjaro, Tanga
Mbeya	Iringa, Mbeya, Songwe, Njombe	Iringa, Mbeya, Songwe, Katavi, Rukwa, Njombe
Morogoro	Morogoro, Pwani, Dar es Salaam	Morogoro, Pwani, Dar es Salaam
Mtwara	Lindi, Mtwara, Ruvuma	Lindi, Mtwara, Ruvuma
Mwanza	Kagera, Geita, Mwanza, Mara	Kagera, Geita, Mwanza, Mara, Shinyanga, Simiyu
Tabora	Tabora, Shinyanga, Simiyu	Tabora, Kigoma
Katavi*	Katavi, Kigoma, Rukwa	-

*Note: *= Katavi Zone Irrigation Office has started operation from fiscal 2017.*
Source: JICA Project Team

Even in the 8-zone system after the change, each ZIO will have jurisdiction over three regions and twenty districts on average, so it is difficult to keep good communication and detailed support. To cope with this situation, NIA 2013 is supposed to newly establish a regional irrigation office (RIO) under the direct control of NIRC in each region. First of all, in Phase 1, six RIOs will be established experimentally based on the number of projects and geographical locations. In Phase 2, the remaining 12 RIOs will be established based on the experience. The region where the ZIO is located concurrently holds the ZIO as RIO. As a result of these measures, it is necessary to add additional 18 irrigation engineers as shown in Table 8.5.3

[5] Ditto.

Table 8.5.3 Tentative Plan for Establishing RIOs

Irrigation Zone	Phase 1	Phase 2
Dodoma	-	Singida, Manyara
Kilimanjaro	Arusha, Tanga	-
Mbeya	Iringa	Njombe, Songwe
Morogoro	-	Pwani, Dar es Salaam
Mtwara	Ruvuma	Lindi
Mwanza	Kagera	Mara, Geita
Tabora	-	Shinyanga, Simiyu
Katavi	Kigoma	Rukwa

Source: NIRC (2016)

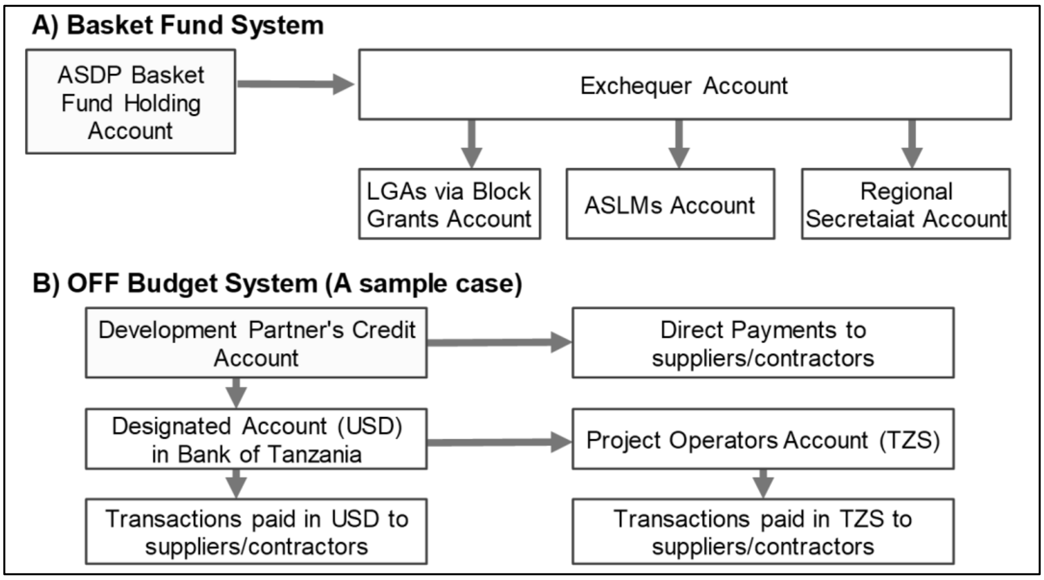
(b) Irrigation Staff of LGAs

LGA-level irrigation development is undertaken primarily based on the Comprehensive Guideline (CGL). Accordingly, each LGA is expected to staff the District Irrigation Development Team (DIDT)/ District Irrigation Development (DID) for formulating, implementing, and supervising all irrigation projects in its jurisdiction. The following shows an idea of how to calculate and secure sufficient number of technical officers.

- To allocate an irrigation engineer for every 2,500 ha of irrigation area, which is presumably the maximum that one engineer can manage and supervise.
- To assign two technicians per engineer for supporting work.
- To assign one LGA officer for each irrigation scheme in the O&M and further stages. The officer links the IO and the district council in case of further support.

(2) Fund Flow and Management

In ASDP1, there were two fund flows of the basket fund system and the off-budget system as shown in Figure 8.5.1



Source: JICA Project Team

Figure 8.5.1 Fund Flow Chart of ASDP1

In the basket fund system, the Tanzanian government and development partners who support it pool the funds into the basket fund account of the Central Bank of Tanzania and remit it from the exchequer account to the bank account of each implementing entity (LGAs, ASLMs, RSs) (see Figure 8.5.1, A).

Irrigation development has two major funds, mainly, district irrigation development fund (DIDF) for small-scale irrigation projects and national irrigation development fund (NIDF) for medium- and large-scale irrigation projects. The former was governed by the district government and the latter was supposed to be managed by the NIRC. The settlement approval of DIDF was the district executive director (DED). Payment to the contractor was remitted to the bank account of the contractor via the bank account of the irrigators' organisation's project committee (PC) after the DED approved the statement from the contractor. This was aimed at fostering ownership of the irrigator's organisation by involving a PC in the payment process. On the other hand, NIDF's settlement approval was the Zone Irrigation Engineer (ZIE) of ZIO. In this case, after approval of the progress payment statement from the contractor, it was remitted directly from the bank account of ZIO to the bank account of the contractor. In both cases, the fund flow was systemised, but in the case of DIDF, due to the fact that the DED is busy and the payment to be settled is diverse, the settlement approval procedure tends to be delayed. Also, at the discretion of the DED, DIDF was diverted to payment other than irrigation projects occurred. In addition, the fact that the timely progress report has not been issued from the LGAs to the NIRC was also pointed out as a problem. As a result of this, there was a case where there was a difference between the physical work progress and the financial progress.

On the other hand, the World Bank and USAID adopt the transfer method (also called on-budget for basket fund system). This is a system for identifying projects and remitting them directly or indirectly to their suppliers and contractors to their respective bank accounts (see Figure 8.5.1, B).

(3) Procurement System

Public procurement in Tanzania is managed centrally by the Public Procurement Supervision Agency (PPRA). PPRA was established based on the Public Procurement Law No. 7 (2011) and is conducting fairness, competition, dissemination of transparent procurement, systemization of public procurement, monitoring of compliance with laws and ordinances. On the PPRA website, eight types of standard tender documents and six types of guidelines such as prequalification examination, procurement of goods, works (small and medium and large scale), consulting services and so on are up. An electronic bidding system (TANePS) has already been introduced by PPRA.

Although this public procurement system was originally developed to support the procurement of LGAs in accordance with decentralization, there are also inexperienced and violating acts of district officials, so that the system utilization is not necessarily carried out as expected.

(4) Irrigation Information Management System

The irrigation department in Tanzania has frequently changed the affiliated ministries along with the changes of the administration. Since 2015, when it became an independent government agency as NIRC, the regulatory ministry has changed from the Ministry of Agriculture to the Ministry of Water until now. Currently, the NIRC office is dispersed within the premises of the Ministry of Agriculture. During this time, valuable assets such as study reports, design report and drawings, various manuals and guidelines are lost. Some of them remain in the ZIO. Under these circumstances, it is essential to conduct inventory survey of available technical references and digitize them first (image of electronic library). It is expected to open the NIRC website for the purpose of disclosing activities of the NIRC, irrigation scheme maps, and irrigation database.

In addition, it is an urgent issue to update, in a systematic manner at regular interval, the irrigation information such as the outline of the project, planning and operation, basic information on the outcome. It is considered useful to open the NIRC website for the purpose of disclosing activities of the NIRC, including irrigation maps and irrigation database. The information technology (IT) unit will be in-charge of these tasks. It is highly expected for the irrigation information management system of the NIRC to be developed sustainably mainly by irrigation engineers of the IT unit currently participating in the JICA Project Team.

(5) Research and Development

There are several areas of irrigation development where further research and development are necessary, such as irrigation efficiency, water and land conflict management, gender mainstreaming, climate change, water budgeting and auditing, and O&M costing. The NIRC as the overseer of irrigation development, is in the position to promote such research. Yet the areas of interest are diverse and multidisciplinary, and the resource of NIRC cannot cover all subjects. One possible mode of operation for the irrigation research is to rely on outer resources if the NIRC is not well-equipped for a particular topic. For instance, if an academic and research institute has a comparative advantage in the paricular area of focus, then the NIRC can commission the research to that institute. In the country, there are sizable number of institutes which are specialising in various areas of irrigation development, such as Sokoine University of Agriculture (SUA), Arusha Technical College (ATC), Nelson Mandela African Institution of Science and Technology (NM-AIST), Water Institute (WI), Mbeya University of Science and Technology (MUST), agricultural research institutes, and Ministry of Agriculture Training Institutes (MATIs). As such, the NIRC can focus on its area of advantage and function as a coordinator of various irrigation researches.

To achieve this goal, it is advisable for the NIRC to have a research and training centre with minimum facilities and equipment, which can also serve as a place for disseminating applicable irrigation techniques.

8.5.3 Strengthening of Capacity Building

(1) Capacity Building of Irrigation Engineers and Technicians

The problem of hunger in Africa due to the drought that continued since the 1970s triggered an interest in global food security; and a large-scale irrigation project aimed at food self-sufficiency was implemented throughout the world in the 1980s. Even in Tanzania, irrigation projects representing the country, including the Lower Moshi Irrigation Project (1982-87) and Ndungu Irrigation Project (1987-88), were carried out under the support of foreign assistance at that time. Young irrigation engineers engaged in these irrigation developments and experienced have been leading the subsequent irrigation development, but many of them are now retiring. Meanwhile, in Tanzania, as the national policy has been decentralized since the latter half of the 1990s, the division of irrigation administration had occurred. For example, in ASDP1 that started in 2006, the medium and large-scale irrigation projects were under NIRC implementation and the small-scale irrigation projects were implemented under LGAs. There are still experienced irrigation engineers at the NIRC, but LGAs has little experienced irrigation engineers and the number is not insufficient in many cases. TANCAID2 is underway mainly for improving capacity of irrigation engineers of these local governments. In light of these circumstances, capacity building measures shall be taken at each stage of project development; investigation, design, construction and maintenance of irrigation projects.

The CGL was revised in 2016 was prepared as a guide to irrigation development and it is divided into three parts; project formulation (12 steps), implementation (9 steps), and operation and maintenance (6 steps). The contents are described in Table 8.5.4.

Table 8.5.4 Implementers and Participants in Work Steps of CGL at Each Stage

Stage	Work Step		Implementer	Participants
Formulation	1	Confirmation of irrigation development priority of the district	LGAs with/without support from NIRC/ZIO	IO members / Ward & Village Officers
	2	Quick site inspection for all irrigation schemes		
	3	Screening of all irrigation schemes		
	4	Assessment and endorsement by ZIO/RIO		
	5	Field survey for selected irrigation schemes		
	6	Preliminary planning for selected irrigation schemes		
	7	Identification of district supporting program		
	8	Design of district supporting program		
	9	Preparation of irrigation scheme formulation plan report		
	10	Validation and agreement by ZIO/RIO		
	11	Feedback workshop for selected irrigation scheme		
	12	Finalize irrigation scheme formulation plan for ISD		
Implementation	1	Scheme awareness campaign	LGAs with/without support from NIRC/ZIO	IO members
	2	Participatory action planning		
	3	Participatory diagnostic study		
	4	Commitment letter		
	5	Participatory design and F/S	NIRC or LGAs with/without Consultants	
	6	Project implementation agreement	NIRC/ LGAs	
	7	Detailed design/ tender documentation	NIRC or LGAS with/without Consultants	
	8	Tendering/ contract award	NIRC/ LGAs	
	9	Construction	Contractor	IO members
	9	Construction (Supervision)	NIRC or LGAs with/without Consultants	
O&M	1	Establishment of O&M system	NIRC or LGAs with/without Consultants	IO members
	2	Water distribution and operation planning		
	3	Maintenance planning and O&M budgeting		
	4	Practice of operation	LGAs with support from NIRC/ZIO	
	5	Practice of maintenance		
	6	Monitoring of operation and maintenance		

Source: TANCAID2

(a) Project Formulation Stage

Regardless of the size of the irrigation schemes, project formulation follows the CGL procedures. The implementing body is the LGA. For that purpose, continuous training for capacity building of LGA irrigation staff is indispensable. The training is conducted along the actual implementation of formulation stage of an irrigation project with NIRC personnel as trainer and DIDT as trainee. In turn, DIDT will formulate the project under the participation of IOs.

(b) Implementation Stage

The implementation stage is carried out according to the procedure of CGL. Participatory design and feasibility study (F/S) in step 5, detailed design of step 7 and preparation of bid documents, construction supervision of step 9 will be outsourced to private consultants in principle, but it is also possible to the ZIO or LGA offices. Also, construction work in principle will be carried out by responsible contractors on contract basis. As for construction management, the capabilities of supervisory staff shall be improved through thorough utilization of a site handbook on construction management currently being developed by Capacity Development for the Promotion of Irrigation of Scheme Development under the District Agricultural Development Plan 2 (TANCAID2).

In any case, it is important to provide capacity development trainings on selection of private consultants and contractors, contract management, and project management for irrigation staff of the ZIO and LGAs.

(c) Operation and Maintenance Stage

The operation and maintenance (O&M) of irrigation facilities are carried out by the irrigator's organisations in accordance with CGL procedures. DIDT and liaison officer attached to each scheme monitor and provides technical guidance to the IO.

(2) Capacity Building of IO

While IO is actively involved in the formulation and implementation stages, the focus of capacity building of IOs are water management and O&M. Besides, it is important to include capacity building on production, processing and marketing as well as organisational management, so that irrigators realize economic benefits of engaging in IO activities. While water management and O&M training is conducted along the CGL process, the training for these subjects need to rely on external sources, such as MATI, TCDC, and other agriculture-related training institutes.

(3) Capacity Building of Local Engineers and Contractors

At present, consulting work and construction for medium to large-scale irrigation projects, financed by development partners or investors, are mostly commissioned to foreign companies. To promote capacity development of local engineering firms and contractors, it is advisable that the government promote participation in those projects.

One of possible measures is to include a clause in the project contract to encourage joint venture or any other forms of partnership between foreign and local firms. If the procuring entity is the government, such preference can be included in the tender document in accordance with the Public Procurement Act and its regulations. Another measure is to include technical transfer component in an irrigation project - most probably the one supported by development partners - in which private sector engineers as well as NIRC officers are well involved and trained in the project process so that they can obtain knowledge and skills on the job. It is expected that those local firms learn from foreign companies and accumulate the capacity of independently managing irrigation projects in the long run. This arrangement will widen the market entry for local companies and lead to larger job opportunities in the private sector for irrigation engineers and technicians. As the agency which oversees all irrigation development plans and related programs and projects, the NIRC is in a good position to ensure the addition of such conditions in the agreements and project designs.

8.5.4 Strengthening of Coordination

(1) Coordination with Relevant Government Ministries for Cross-cutting Issues

Irrigation can be compared with the role of a bridge connecting water resources and agriculture. In the upstream part of the irrigation, water and soil conservation measures and dam construction in the catchment area, are planned to secure irrigation water. On the other hand, in the downstream part, agricultural crops produced in irrigation schemes which are selected considering the agricultural value chain to revitalize local economy. For that purpose, coordination and cooperation with the Ministry of Water and Irrigation (MoWI) and the MALF is indispensable.

Also, with regard to issues to be addressed across sectors, for instances, land and water conflicts, climate change measures, poverty reduction, gender consideration and youth utilization, cooperation among the President's Office Regional Administration and Local Government (PO-RALG), Ministry of Lands, Housing and Human Settlement Development, Vice President's Office - Department of Environment (DOE), Ministry of Natural Resources and Tourism (MNRT), LGA is important. As shown in the implementation structure of Figure 9.8.1, since these related ministries and agencies are the main members of the ASDP2 lead ministries, the ASDP2 Steering Committee will arrange coordination among relevant ministries and agencies.

(2) Coordination with Private Sector for Irrigation Investment

Primary role of NIRC in promoting private sector investment for irrigation development is to design the models of public-private partnership (PPP) arrangements and apply them in its contracts for trial and improvement. There are various types of PPP arrangements applicable to irrigation projects, e.g., Build-Own-Transfer (BOT), Build-Own-Operate (BOO), service contract and management contract[7]. The division or unit responsible for private sector coordination in the NIRC will first conduct a study on what types of PPP arrangements are economically viable and suitable for the conditions in Tanzania. Subsequently, the NIRC preliminarily introduce these PPP options in its projects on a trial basis for further improvement.

8.6 Approach to Irrigation Infrastructure Development

The JICA Project Team has developed a technical approach to irrigation infrastructure development in Tanzania as follows through interviews and discussions with NIRC/ZIOs officials, other government officials, development partners, and national/international experts in irrigation, water and agriculture sectors, in addition to site visits and interviews to IOs.

[7] The World Bank, 2016, How to Develop Sustainable Irrigation Projects with Private Sector Participation, page 35, accessed to http://documents.worldbank.org/curated/en/906661468329686580/How-to-develop-sustainable-irrigation-projects-with-private-sector-participation (on 22 August 2017).

Table 8.6.1 Major Issues in Irrigation Infrastructure Development and Grouping

Major Issues in Irrigation Infrastructure Development	Grouping
・ Many farmers have been waiting for irrigation development to cope with frequent drought and flood events. ・ There are a great number of irrigation schemes uncompleted due to insufficient fund allocation under ASDP1, resulting in a limited impact to improvement of irrigation efficiency and agriculture production. ・ Due to slow progress of ASDP1 and other projects/programs in the past, a significant number of planned irrigation schemes has been left behind the development.	Completion of uncompleted irrigation schemes including carry over irrigation schemes from ASDP1 and other projects/ programs.
・ Irrigation efficiency is reportedly quite low between 0.1 to 0.2 in traditional irrigation schemes, resulting in more water but less yield. ・ Rivers in semi-arid lands are usually seasonal, which often bring a huge sediment deposit and flash floods in rainy seasons. ・ Dams and ponds are effective measures for irrigation in semi-arid lands. ・ Demands of lake water use for irrigation are increasing around Lake Victoria. ・ Groundwater irrigation is not popular in Tanzania because it takes a high electricity bill.	Irrigation infrastructure development to meet local conditions (Effective use of water for irrigation)
・ BRN planned to develop 25 large commercial farms in 2013 but the progress was slow mainly due to land issues.	Promotion of commercial irrigation farms

Source: JICA Project Team

8.6.1 Completion of Uncompleted Irrigation Schemes

(1) ASDP1 Carry-Over Projects

According to draft ASDP2 document, it is expected that there will be deliberate efforts to build on ASDP1 and BRN targeted priorities. This will include financing (a) the expansion of irrigation development by building 87 new small and medium-scale irrigation schemes (43 picked by JICA); or (b) completion of 198 unfinished schemes (120 earmarked by JICA) and the expansion of existing ones, targeting priority commodities in high potential areas as proposed in the next sections. The investments supported by JICA, USAID, and World Bank will include three main investment areas as summarised in Table 8.6.2.

Table 8.6.2 Irrigation Forecast Given by ASDP2

Irrigation Schemes		No. of Schemes	Area (ha)
(1) Ongoing implementation by JICA, USAID, and GFSP			
	Earmarked by JICA	120	51,964
	(JICA, but overlapping with BRN)	*(13)*	
	Earmarked by Global Accelerated Food Security Program (GAFSP)	4	10,000
	(GAFSP, but overlapping with BRN)	*(4)*	
	Earmarked by USAID (under review)	5	18,600
	(USAID, but overlapping with BRN)	*(2)*	
(2) BRN by WB (not overlapping with schemes of (1))		59	25,879
	(Original total BRN schemes: 59+13+4+2=78)	*(78)*	
(3) ASDP1 priorities (not overlapping with (1) and (2)		179	52,243
Total (120+4+5+59+179=367)		**367**	**158,686**

Source: Prepared by the JICA Project Team based on MALF, May 2016. Draft ASDP2 document shared with BMGF, page 43

The delay in irrigation infrastructure development under ASDP1 was mainly caused by the poor processes of implementation mechanism such as:

- Limited focus results in thinly spread resources resulted in fragmented results or impacts;
- Delayed disbursement of funding for projects and carry over of funds from year to year;
- Limited mechanisms to facilitate private sector participation, development partners and other stakeholders; and
- Inadequate data and data systems to support ongoing monitoring and evaluation.

These lessons need to be utilized in the implementation of NIMP2018.

(2) Completion of Uncompleted Projects

There are a lot of irrigation projects left incomplete in the past in Tanzania. The most dominant reason for the incompletion is the inability of the government to budget and disburse funds for building irrigation infrastructure. This has affected the pace of expansion of irrigated land in two ways: failure to open new lands for irrigation, and delayed implementation of already identified sites. As such, special interventions are required for the completion of uncompleted projects under NIMP2018 include:

- Incompletely constructed or under construction: such as Msoga in Bagamoyo, Kwala in Kibaha, Kiroka in Morogoro, Changanyikeni and Kisere in Mkuranga, Nyameke and Ngorongo in Rufiji and Itete and Euga in Ulanga. Other schemes, have been under construction for a long time, such as Sukuma (since 2011) and Katunguru (since 2009) in Sengerema District. Nyangwi scheme (180 ha) is among the newest schemes that must be completed under NIMP2018.
- Require some major repairs to the structures: Nsalala (due to poor design), Mbarika (leakages), and Igongwa (canal destruction).
- Major O&M interventions to raise production levels from poor or average to good: such as Tosamaganga in Iringa, Manda in Ludewa, Chomachankola in Igunga, and Lakuyi in Nzega. In fact, this type of intervention will be required for most of the schemes in the country.

Irrigation schemes discussed in items (1) and (2) could be prioritised for the development under NIMP2018 but it should be ensured that irrigators organisations and their member farmers are willing to maintain the irrigation facilities in a sustainable manner and improve the productivity and profitability of irrigated agriculture.

Box 8.6.1 Completion of uncompleted irrigation systems

During implementation of ASDP1, irrigation development was done towards improving and/or rehabilitating existing irrigation schemes and developing new irrigation schemes in various districts within the seven existed irrigation zones. In most cases, there were no full feasibility studies made on the irrigation schemes prior to development. Decisions on investment were made based on partial feasibility studies, mostly limited to topographic surveys and hydrological studies to assist in the engineering designs. This emanated from the available funds for the particular schemes/projects allocated to the districts through the DIDF.

The limit for the amount of funds financed for one irrigation scheme for irrigation interventions from the DIDF was set to be TZS 800,000,000 (USD 357,000 equivalent). An intervention requiring funding above the mentioned amount was considered for funding from the NIDF. About 70% of ASDP1 investment was implemented through DIDF. General observation is that limited funds were spread thinly across many schemes. The result was a backlog of unfinished schemes that take years to complete before they can produce benefits for the target populations and therefore, not optimizing the investments made.

An irrigation scheme to function well it requires that its irrigation facilities should be well planned and constructed, this includes proper scheme layout, headworks, canal system with appurtenant structures and drainage systems. Due to the reasons mentioned above, many of the schemes implemented in the districts are reported to be partially completed, it is therefore being recommended to set aside funds for completion of such irrigation systems.

8.6.2 Weir and Pump Irrigation

In Tanzania, a weir diverting irrigation water directly from a river is the most common modern irrigation system. Besides it, there is a pump irrigation that pumps water from a river. Many of the rivers are seasonal rivers and are strongly affected by rain. In the semi-arid lands, there are many wadis where water flows just after the rain. On the other hand, there are relatively few perennial rivers flowing throughout the year. Most of existing irrigation schemes have been developed along the perennial rivers, and as a result, it is reported that excessive water intake is a serious problem in the Pangani basin, the Wami / Ruvu basin, and the Rufuji basin. The weir irrigation and pump irrigation explore the possibility of development based on the calculation of the balance of water resources and water demand of surface water allocated for irrigation. If the water balance is tight, the development priority shall be placed first on the improvement of the existing irrigation schemes in order to enhance the water use efficiency, and secondly on new irrigation development with surplus water (see Table 8.6.3).

Generally, irrigation gives priority to the use of surface water, but consider the use of groundwater in areas where surface water resources are small and tight, especially in semi-arid areas. Figure 7.2.3 in Chapter 7 shows the water resources potential distribution for each sub-basin. In 2035, six sub-basins (Pangani River, Coast, Lower Ruvuma, Muchuchuma, Magogo-Moame, Nyashishi) where surface water shortage is expected will be excluded from the target areas of new weir and pump irrigation development in principle. Moreover, special attentions shall be placed on design of diversion weirs for minimizing sedimentation and flash flood damages in case that annual rainfalls in upper catchment is less than 800 mm or seasonal river. There are several project proposal documents including pre-feasibility studies prepared by NIRC for implementation of those projects. Among others, the projects shown in Table 8.6.3 are considered as promising.

Table 8.6.3 Weir Irrigation Projects Planned by NIRC

Region	District	Irrigation Scheme	Irrigation Area (ha)
Morogoro	Ulanga	Euga	400
Katavi	Mpanda	Karema	1,000
Kagera	Karagwe	Kitengule	50
Lindi	Lindi	Lukuledi	4,680
Mbeya	Mbarali	Madibira Phase-II*1	3,600
Mbeya	Kyela	Songwe*1	3,005
Rukwa	Sumbawamga	Maleza	7,500
Kagera	Ngara	Muhongo	1,500
Mbeya	Chunya	Nanjembo	1,750
Iringa	Iringa	Pawaga	3,170
Mtwara	Newala	Makondeko	2,000
Morogoro	Kilombero	Kisegese*2	16,131 (2,766)
Morogoro	Kilombero	Udagaji*2	5,371 (280)
Morogoro	Kilombero	Mgugwe*2	3,701
Morogoro	Kilombero	Mpanga-Ngalamila*2*3	28,141
Morogoro	Morogoro	Mgongola	620
		Total	55,964

*Note: *1= Madibira Phase-II depends on water from Lugoda Dam and Songwe also depends on water from Songwe Dam planned for hydropower (TANESCO), which are listed in Table 8.4.7.*
**2= One was studied by USAID2016. Figures in parenthesis indicate the feasible area. The rest, two projects have been finally cancelled as a result of EIA.*
**3= This will be implemented by a private sector (see Table 8.4.11).*
Source: NIRC, USAID F/S, Project Proposal Documents, etc.

Thus, the weir and pump irrigation development was assumed to be 55,964 ha in NIMP2018. NIRC shall carry out a feasibility study to confirm the technical soundness, financial feasibility as well as farmers' willingness for the development prior to implementation of the projects.

8.6.3 Dam and Pond Irrigation

According to the agriculture ecological zone map of Tanzania, the semi-arid lands occupy almost one-third of Tanzania. In the semi-arid lands, the amount of surface water is relatively small, and many rivers become dry up during dry seasons. Therefore, a storage facility to reserve flood water during the rainy season is prerequisite in semi-arid land. As detailed in the water resources assessment in Section 3.7, over 80% of the available surface water flows out to the sea and/or the lakes unused as flood. In big rivers, large dams are built (or planned) to save lives and property from floods during rainy seasons and use them for power generation, domestic water and/or irrigation water. Small dams and reservoirs (such as Charco Dam) which store flood water during rainy seasons, are also built in various places in tributaries, streams and/or depressions in semi-arid lands.

(1) Dam and Pond Irrigation Planned by NIRC

NIRC has prepared the concept paper titled the "Participatory Dams Development Programme in Semi-Arid Areas of Tanzania" in September 2016 as a strategic action towards sustainable irrigated agriculture and flood control. This program has been updated covering 96 dams including 23 existing dams identified in 2007/08 through the Opportunities and Obstacles to Development (O&OD) for future development. As summarised in Table 8.6.4, 124 new dams and 30 existing dams have been identified in nine administrative regions in semi-arid lands.

Table 8.6.4 Summary of Dam and Pond Irrigation Schemes Planned by NIRC

Region	Improvement of Existing Dam and Pond Irrigation Schemes			Newly Proposed Dam and Pond Irrigation Schemes		
	Nos.	Potential Area (ha)	Developed Area (ha)	Nos.	Potential Area (ha)	Developed Area (ha)
Dodoma	12	4,104	451	34	41,570	571
Singida	6	4,540	616	20	17,960	1,340
Manyara	3	1,180	409	22	10,838	1,995
Mwanza	-	-	-	5	1,670	-
Mara	2	180	-	9	43,720	-
Kagera	-	-	-	2	1,300	-
Shinyanga	-	-	-	10	5,300	-
Kigoma	-	-	-	1	50	-
Tabora	7	1,930	600-	21	7,900	-
Total	30	11,934	2,076	124	130,308	3,906

Source: NIRC, September 2016, Participatory Dams Development Programme in Semi-Arid Areas of Tanzania.

In addition to the above, there is a preliminary investigation of the Irrigation Potential Lake Victoria conducted by the Nile Equatorial Lakes Subsidiary Action Program (NELSAP) in 2008 as shown in Table 8.6.5.

Table 8.6.5 Planned Dam Irrigation Schemes in Lake Victoria Basin by NELSAP Study

Region	District	Irrigation Scheme	Irrigation Area (ha)	Priority	Remarks
Mara	Musoma	Mara Valley*1	3,000	1	Detailed design is under way.
Mwanza	Kwimba	Isanga*1	2,000	2	
Kagera	Bukoba	Ngono*1	8,000	2	Detailed design is under way.

Region	District	Irrigation Scheme	Irrigation Area (ha)	Priority	Remarks
Mara	Musoma	Bugwema*1	1,600	4	
Shinyanga	Kahama	Manonga*1	7,000	4	
		Sub-total	21,600		
Kagera	Karangwe	Karazi*2	493	-	F/S completed in 2012.
		Total	22,093		

*Source: *1= NBI, October 2008, Irrigation Potential Lake Victoria, Tanzania*
**2= NBI, November 2012, Draft Feasibility Study Report for Karazi Dam*

Table 8.6.6 Other Planned Dam Irrigation Schemes in Tanzania

Region	District	Irrigation Scheme	Irrigation Area (ha)	Remarks
Mbeya	Mbarali	Luhanga*1	4,000	Proposed by Luhanga Farmers SACCOS for commercial agriculture, F/S completed in 2013
Katavi	Mlele	Mwamapuli	10,900	
Kigoma	Kigoma-Ujiji	Luiche*2	3,000	Pre-F/S completed.
Kilimanjaro	Same	Ndungu*3	680	Yongoma Dam was identified in JICA F/S to provide supplemental water to Ndungu Project
		Total	18,580	

*Source: *1. Luhanga AMCOS, June 2013, Luhanga Consolidated Rice Project, F/S on Agri-business for Rice Growing and Processing*
**2. NIRC, July 2015, Pre-Feasibility Studies for an Irrigation Development Project in Luiche Valley in Kigoma Region Tanzania*
**3. NIRC, February 2014, Project Proposal for Carrying Out Detailed Feasibility Study for Construction of Yongoma Dam*

Thus, the dam and pond irrigation development was assumed to be 182,915 ha in NIMP2018. NIRC needs to execute a feasibility study to confirm the technical soundness, financial feasibility as well as farmers' willingness for the development prior to implementation of the projects.

(2) Large Dam Planned by TANESCO and MoWI

There are 70 new dams planned in IWRMDPs. Among them, the outline of five new large dams that could obtain data and information from TANESCO and the MoWI is shown in Table 8.6.7.

Table 8.6.7 List of Planned Large Dams

Dam Name	Location	Purpose	Dam				Irrigation Scheme in D/S
			Type	H (m)	L (m)	Q eff (MCM)	
Kikonge Dam (TANESCO)*1	Mbinga DC, Ruvuma Region (Lat696700, Lon884500)	Hydropower Irrigation	CFRD	120	NA	6,200	New scheme: Ruhuhu (3,200 ha)
Songwe Dam (TANESCO)*2	Ileje DC, Mbeya Region Manodo (Lower), Sofre (Middle)	Hydropower Irrigation	Concrete Gravity	115 115	460 457	237 228	New scheme (3,005 ha)
Farkwa Dam (MoWI)*3	Chemba DC, Dodoma Region	Water supply Irrigation	Comb. of RCC and Earthfill	32 (15)	1,185 (1,500)	370	7 existing schemes (3,658 ha in total)
Kidunda Dam (MoWI)*4	Morogoro DC, Morogoro Region (E413545, N9196445)	Water supply Hydropower Irrigation	BFRD	21	860	190	Mkulazi Agriculture City (75,000 ha)
Lugoda Dam (MoWI)*5	Mufindi DC, Iringa Region (E737770, N9084901)	Hydropower Irrigation	CFRD	60	721	347	Madibira Phase-II (3,600 ha)

Source:
**1. TANESCO, 2014, Kikonge HPP Reconnaissance and Preliminary Economic Assessment*
**2. TANESCO, April 2014, Feasibility Study*
**3. MoWI,Feb. 2015, Environmental and Social Impact Assessment (ESIA) Report for the Proposed Construction of Farkwa Dam and Water Conveyance System*
**4. MoWI, Feb. 2015, Kidunda Dam Main Report Vol. 1 of 3. (Civil Works). The downstream irrigation scheme namely: Mkulazi Agriculture City will be implemented by a private sector.*
**5. MoWI, Dec. 2015, Final Design Report, Lugoda Dam*

In connection with the above dams, NIRC needs to examine the possibility of downstream irrigation development and conducts necessary investigation and study during NIMP2018 in close coordination and collaboration with MoWI and TANESCO. It is considered that the irrigation schemes in the downstream of these dams would be implemented in Phase 2.

8.6.4 Lake Water Irrigation

In Tanzania, there are five transboundary lakes, namely: Lake Victoria, Lake Tanganyika, Lake Nyasa, Lake Jipe, and Lake Chala, and more than 25 lakes in the country. NIRC has great expectations, especially on the use of water in Lake Victoria. The JICA Project Team examined the use of water in the Lake Victoria herein below.

According to a survey conducted by the Nile Basin Initiative (NBI) [8], water use in ten countries in Nile River basin, as of 2001 was 80.4% in Egypt and 16.9% in Sudan, these two countries exclusively occupied 97.3% of total water resources in the Nile River, and the balance 2.7% was shared by other eight countries. Incidentally, Tanzania's share was only 0.1%. Article 4 of the Cooperation Framework Agreement (CFA) stipulates the allocation of the Nile River water resources. Since Article 4 (d) suggests water allocation by population, simply applying this, Tanzania will be able to develop irrigation between 300,000 ha to 900,000 ha in the whole Lake Victoria basin. According to the irrigation database 2015, the irrigation area of the whole Mwanza irrigation zone (inclusive of the Lake Victoria catchment) is the sum of 51,021 ha for the existing schemes.

Besides it, a small-scale irrigation scheme that utilises water directly from Lake Victoria is proposed by NIRC in Busega District of Simiyu Region (see Table 8.6.8).

Table 8.6.8 Proposed Lake Water Irrigation Schemes in Busega District of Simiyu Region

No.	Village	Distance from the Lake (m)	Nos. of Pumps	Irrigation Area (ha)	Nos. of Farmers
1	Lukungu	1,934	1	44	22
2	Kisesa	2,000	1	64	23
3	Lamadi	190	1	32	5
4	Kalago	765	5	105	95
5	Chamagasa	1,013	4	701	544
6	Nyamikoma	800	3	179	191
7	Shimanilwe	891	2	232	86
8	Milambi	1,886	1	135	110
9	Mwamanyali	3,000	4	893	195
10	Humya	2,218	2	233	75
11	Yitwimila B	2,600	1	61	50
12	Ihale	700	1	27	58
	Total		26	2,706	1,454

Source: Besega DC, June 2016, Report on Area which are suitable for Irrigation in the Villages around Lake Victoria

It has been confirmed by NIRC that the same scale of lake water irrigation scheme development is quite possible even in the following 13 districts facing the Lake Victoria. In this case, to prevent random

[8] The Nile Basin Initiative (NBI) was established in 1991 with ten-member countries from the Nile River basin; Burundi, Congo, Egypt, Ethiopia, Kenya, Rwanda, South Sudan, Sudan, Tanzania, and Uganda. Under the NBI, in 2008 the "Cooperation Framework Agreement (CFA)" was drafted with the aim of equitable distribution of the Nile River water and other resources, and by the year 2011, the six countries of Tanzania, Kenya, Uganda, Rwanda, Burundi, and Ethiopia signed it. The ratification of more than six countries is necessary for the entry into force of the CFA, but it is currently only ratified by the three countries including Tanzania.

development, the target irrigation schemes shall be selected within 5 km from the lake's shore and about 100 ha in size. In addition, irrigation facilities will be a combination of pipeline and drip or sprinkler, and target crops will be highly marketable upland crops suitable for local conditions, in order to promote water-saving irrigation.

Table 8.6.9 Districts Adjoining Lake Victoria

Region	District	Region	District	Region	District
Mara	Rorya	Mwanza	Magu	Geita	Geita
	Butiama		Ilemela+Nyamangana		Nyang'wale
	Musoma		Misungwi		Chato
	Bunda		Sengerema	Kagera	Muleba
Simiyu	Busega				Bukoba

Note: It is regarded as one development unit for Ilemela District and Nyamangana District in Mwanza Region because of small land size.
Source: JICA Project Team

Thus, the lake water irrigation development was assumed to be 28,000 ha in total (= 2,000 ha x 14 districts) in NIMP2018 on condition that the proposed schemes were confirmed to be feasible and final decision for implementation would be made after consultation with the NBI based on the results of the feasibility study.

8.6.5 Groundwater Irrigation

As a general rule, irrigation gives priority to the use of surface water, but consider the use of groundwater in areas where surface water resources are small and tight, especially in semi-arid areas. Figure 7.2.3 in Chapter 7 shows the groundwater potential distribution for each sub-basin. In 2035, nine sub-basins (Ngerengere, Coast, Mbaka, Nyashishi, Lake Eyasi, Monduli-A, Monduli-B, Bahi Swamp, Namanga) where groundwater shortage is expected will be excluded from the target areas of new groundwater development in principle. Thereafter, the semi-arid areas having relatively high groundwater potential will be identified as alternative water resources to surface water resources with reference to the hydraulic geological map in Figure 3.4.1. According to (URT, 2002; Baumann et al., 2005), regions most prospective for groundwater irrigation include:

- Mtwara, Coast, Morogoro, Ruvuma, Shinyanga, Kilimanjaro, Kagera, Lindi, Mwanza and Mbeya due to the dominance of unconsolidated sand and gravels water bearing formations that permits good yields and the existence of suitable soil for agricultural crop cultivation.
- Singida, Mara, Iringa, Kigoma, Dodoma, Rukwa and Manyara due to predominance of the weathered and/or fractured granites/gneisses water bearing formations, including Arusha which is dominated by igneous rocks and the water bearing zones which are mostly in weathered and fractured lava flows with suitable land for crop cultivation.

At the same time, the existing groundwater use situation will be verified with the water point assessment data[9] (especially shallow wells and boreholes) of the Ministry of Water and Irrigation.

NIRC has prepared the project proposal document on the Promotion of Micro Irrigation Systems for Improved Crop Production for Smallholder Farmers in Tanzania prepared by NIRC in June 2016, in which NIRC has proposed 14 large-scale irrigation schemes (14,310 ha), 14 small-scale irrigation

[9] Water Point Mapping Tanzania, http://wpm.maji.go.tz/?x=aEV2F0-uEYYym3Be*ThQWdBVnn0b4y1Xcb0O9nHe8qNepp5p99e-sAPZI9q-jT37V0W-spscB3I

schemes with surface water (1,400 ha) and 10 small-scale irrigation schemes with groundwater (1,000 ha) in combination with micro irrigation systems (drip or sprinkler). In NIMP2018, the groundwater irrigation with drip will be proposed to start with the following small-scale schemes shown in Table 8.6.10.

Table 8.6.10 Proposed Small-scale Groundwater Irrigation Schemes with Drip

Region	District	Scheme	Irrigation Area (ha)	Type of Crop
Dodoma	Dodoma MC.	Mpunguzi	100	Grape
	Dodoma MC.	Mkoyo	100	Banana
	Chamwino	Mvumi Mission	100	Grape
Singida	Singida	Isuna	100	Grape
	Singida	Kituntu	100	Banana
	Iramba	Mwanga	100	Grape
Kilimanjaro	Moshi	Kisangesangeni	100	Banana
Morogoro	Kilosa	Msimba	100	Banana
Shinyanga	Kishapu	Kabila	100	Cotton
Simiyu	Bariadi	Matongo	100	Cotton
Total			1,000	

Source: NIRC, June 2016, Project proposal document on the Promotion of Micro Irrigation Systems for Improved Crop Production for Smallholder Farmers in Tanzania

In addition to the above, the Kibaoni Groundwater Irrigation Scheme (50 ha) in Mpanda District of Katavi Region, Ngongwa Groundwater Irrigation Schemes (130 ha) in Maswa District of Simiyu Region and Bukirilo-Gwanumpu Groundwater Irrigation Schemes (50 ha) in Kibondo District of Kigoma Region have been identified, as potential, by NIRC in May 2010, November 2013, and May 2010, respectively. Under the NIMP2018, a feasibility study shall be conducted for the above 12 groundwater schemes (1,230 ha) to confirm the technical soundness, financial feasibility as well as farmers' willingness for the project. In parallel with the above, other potential groundwater development schemes for 2,000 ha in total shall be identified in a participatory manner involving local people from the relatively high groundwater potential regions. Thus, the groundwater irrigation development was assumed to be 3,230 ha in total (= 1,230 ha + 2,000 ha) in NIMP2018.

8.6.6 Large-scale Commercial Irrigation Project by Private Investment

In order to achieve the targets of Tanzania Development Vision 2025, the Big Results Now (BRN) had started in 2013 with two major goals; to become a food basket in the East Africa region by the year 2015 in the agricultural sector, and to achieve national food security and food self-sufficiency rate by 2025 in addition to enhancement of national income through national and international trade. Among them, 25 large-scale commercial irrigation projects were taken up on the assumption of private sector investment (9 rice and 16 sugarcane). Based on the results of interviews with BRN officials, the JICA Project Team confirmed the current status of the above 25 projects and examined the feasibility of the future development. It revealed that eight projects out of 25 projects had some progress, of which four projects obtained the land title are categorized as priority A and the rest is priority B. However, Mkulazi has been changed to priority B because it would require large-scale dam construction. The present status of these eight projects are summarised as shown in Table 8.6.11.

Table 8.6.11 Present Status of Large-scale Commercial Irrigation Project

Region	District	Site	Crop	Land Size (ha)			Present Status (with Priority*1)	
				Nucleus Farm	Out-growers	Total		
Pwani	Bagamoyo	Bagamoyo	Sugarcane	20,374	4,000	24,374	**A**	Land title given to **Azam**, but only 10,000 ha
Pwani	Rufiji	Lukulilo	Paddy	8,000	4,000	12,000	**A**	Land title given to **Lukililo** Holding Co. Ltd.
Kagera	Karagwe	Kitengule	Sugarcane	16,000	2,000	18,000	**A**	Land title given to **Kagera Sugar** Ltd.
Kigoma	Kasulu	Kasulu	Sugarcane	20,000	2,000	22,000	**B**	Dam completed, Cadastral mapping done.
Kigoma	Kibondo	Kumusenga/ Kibwie	Sugarcane	20,000	5,000	25,000	**B**	Dam completed, Cadastral mapping done.
Morogoro	Morogoro	Mkulazi*2	Sugarcane	50,000	25,000	75,000	**B**	Land title given to **National Social Security Fund (NSSF) and PPF Pensions Fund**.
Morogoro	Kilombero	Mpanga-Ngalamila	Paddy	5,128	16,203	21,331	**B**	Cadastral mapping done. Minor issue remains.
Morogoro	Kilombero	Kisegase	Paddy	10,000	15,188	25,188	**B**	Kisenga Dam completed
Total				149,502	73,391	222,893		

*Note: *1= Priority "A" means comparatively advanced status than "B".*
**2= This has been taken up for priority project in FYDP-II as the Mkulazi Agriculture City, but it depends on the development of Kidunda Dam.*
Source: JICA Project Team based on interview with BRN.

Thus, the large-scale commercial irrigation development is assumed to be 222,000 ha (54,000 ha of priority A in Phase 1 and 143,000 ha of priority B in Phase 2) in NIMP2018. However, this 222,000 ha is not included in the target 100 million ha. NIRC shall fully support the private firms to promote the large-scale commercial irrigation projects to achieve the development scenario 2 in collaboration with other ministries and institutions concerned.

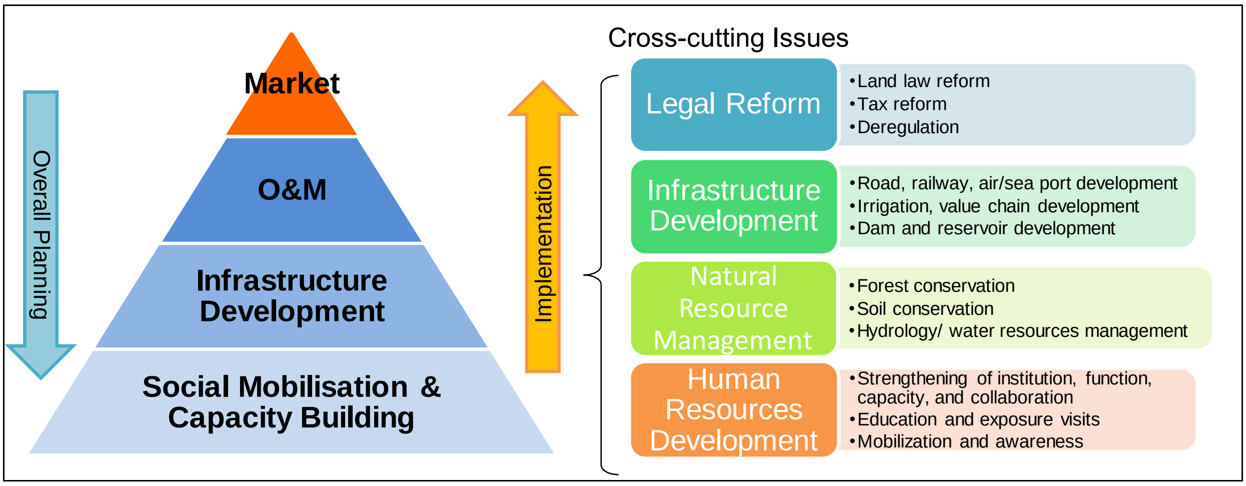
Chapter 9 Formulation of the National Irrigation Master Plan 2018

9.1 Introduction

In this chapter, the Japan International Cooperation Agency (JICA) Project Team has made the formulation of the National Irrigation Master Plan 2018 (NIMP2018) based on the discussion in Chapter 8. First, basic concept of overall irrigation development is presented, on which NIMP2018 is formulated. Second, NIMP2018's basic approaches are introduced. These approaches are the basis for formulating individual development components, which are presented in the following section. The subsequent items such as implementation schedule, cost estimate, organisational arrangement, benefits and economic evaluation, monitoring and evaluation (M&E), possible financial arrangement, and risk assessment and mitigation measures of NIMP2018 are discussed hereunder.

9.2 Basic Concept of Irrigation Development

Figure 9.2.1 (left) shows the basic concept of irrigation development. The promotion of irrigation agriculture begins with the mobilisation of beneficiary farmers (establishment and strengthening of irrigator's organisation), improvement of irrigation infrastructure, operation and maintenance (O&M) of irrigation systems, and production to distribution (sales), which will be carried out step-by-step. On the contrary, in the NIMP2018, the JICA Project Team has planned the irrigation development from the viewpoint of value chain with distribution at the top. That is, based on the irrigation potential (irrigable area) determined by water resources and land resources, the target irrigation projects are selected considering the superiority of market access (domestic distribution and export).



Source: JICA Project Team

Figure 9.2.1 Basic Development Concept

Figure 9.2.1 (right) shows the environment surrounding the irrigated agriculture based on the development policy of Tanzania. As can be seen from this figure, irrigation development constitutes only a part of infrastructure development. Regarding cross-sectoral issues, it is not easy for the National Irrigation Commission (NIRC) alone to deal with it, and cross-sectoral measures are indispensable. In the NIMP2018, the scope of activities to be undertaken by NIRC will be limited, and correspondence to other common issues will be compiled as recommendations to competent ministries.

9.3 Basic Approaches

The NIMP2018 is formulated based on the approaches shown in Table 9.3.1. It should be noted that NIMP2018 is designed in due consideration of the alignment with IWRMDP and ASDP2 but also other development plan relevant to irrigation sector.

Table 9.3.1 Basic Approach to NIMP2018

Approach	Methodology
Irrigation scheme prioritization in a scientific manner (Ref. Chapter 7)	· Water allocation to irrigation on a monthly basis in 71 sub-basins · Land resources potential analysis by AHP method · Irrigation development potential area by monthly water balance calculation · Updating irrigation database · GIS spatial analysis · Prioritization of irrigation schemes with priority weight vectors
Consideration of export-oriented agriculture development (Ref. Section 7.4)	· Crop selection for irrigation
Phasing development plan enabling a linkage with value chain development by ASDP2 (Ref. Section 7.5)	· Comparison of an original plan with various alternative plans
Strengthening of supporting system for irrigation infrastructure development (Ref. Section 8.5)	· Irrigation organisation and functions · Capacity building of irrigation staff and IOs · Coordination with other sectors
Irrigation infrastructure development to meet local conditions (Effective use of water for irrigation) (Ref. Section 8.6)	· Completion of uncompleted irrigation systems · Irrigation development by source of water · Promotion of commercial irrigation farms
Focus on full development of irrigation schemes (Ref. Section 8.6)	· Costs for water intake structures, main and secondary canals, O&M roads, drainage canals

Source: JICA Project Team

9.4 Basic Plan

The development policy of Tanzania is based on the Tanzania Development Vision 2025. While keeping in mind the consistency with the National Irrigation Policy (2010) and the National Irrigation Act (2013) in addition to the second National Development Five-Year Plan, water sector and agriculture sector policies and plans, accordingly, the basic plan of the NIMP2018 will be formulated as shown in Table 9.4.1.

Table 9.4.1 Basic Plan of the Revised National Irrigation Master Plan 2018

Overall Goal of NIMP2018	Agriculture GDP annual growth rate (6%), Rural poverty rate (≤ 24%), Food poverty rate (≤ 5%)
Objectives of NIMP2018	Contribution to the national economy and food security by improving agriculture productivity and profitability through irrigation development, consequently reduce rural poverty, and strengthen climate change resilience.
Development Target of NIMP2018	Irrigation developed area (One million ha), Number of beneficiary farmers (more than 358,000 FHHs), Crop yield (5 ton/ha for paddy, 40 ton/ha for tomato and 10 ton/ha for onion), Incremental net annual farm income (more than TZS 3 - 4 million/ha on average)
Target Year of NIMP2018	2035 Phase 1: 2018 to 2025 and Phase 2: 2026 to 2035

Source: JICA Project Team

(1) Overall Goal

The second agricultural sector development strategy (ASDS2), which is positioned at the top of the irrigation sector, addressed that, "the agricultural sector (crops, livestock, and fisheries) for higher livelihoods, food security, and nutrition needs higher productivity, we will convert to smallholder farmer's income." As an important key performance indicator (KPI), agricultural gross domestic product (GDP) growth rate (6% per year), rural poverty rate reduction (24% or below), and food poverty rate reduction (5% or below) are set. In its development plan ASDP2, irrigation infrastructure development is positioned as an important development component for the purpose of increase production. The NIRC contributes to agricultural development through irrigation development and set the KPI of ASDS2 as the overall development goal.

(2) Objectives of NIMP2018

The objective of NIMP2002 was the "implementation of sustainable irrigation development through effective use of national resources" to contribute to the improvement of agricultural productivity. In order to respond to changes in the conditions surrounding irrigation over the past fifteen years, NIMP2018 will continue to pursue its objective and improve the national economy, food security and nutrition through improving agricultural productivity and profitability by irrigation development. Thus, NIMP2018 will contribute to poverty reduction and climate change resilience.

(3) Target of NIMP2018

In NIMP2018, achievable and specific targets for the irrigation development are set as shown in Table 9.4.2.

Table 9.4.2 Development Target of NIMP2018

Target Item	Target Value	Basis of Estimation
Irrigation Area	1 million ha	National Development Policy and Plans, IWRMDP, and NIMP2018 (Ref. Table 7.4.10)
Beneficiary Farmers	358,0000 households	Estimated number of beneficiary farmers (Ref. Table 9.9.15)
Unit Yield	Paddy: 5 ton/ha	Achievable Yield (Ref. Table 9.9.6)
	Tomatoes: 40 ton/ha	Achievable Yield (Ref. Table 9.9.6)
	Onions: 10 ton/ha	Achievable Yield (Ref. Table 9.9.6)
Net Increment of Annual Farm Income	TZS 3 - 4 million/ha/year	Achievable Net Annual Incremental Benefit (Ref. Table 9.9.9)

Source: JICA Project Team

(4) Target Year of NIMP2018

The development plan of Tanzania follows the Tanzania Development Vision 2025, many of which set the fiscal year 2025 as the target. In the Integrated Water Resources Management Development Plan (IWRMDP) also so-called the Water Resources Master Plan undertaken by the Ministry of Water and Irrigation, water resources, water demand and environmental flow in nine major river basins nationwide, for the target sector for 2015, 2025, and 2035 are calculated. Since the sectoral water demand forecast also includes irrigation water demands, the target year of NIMP2018 was set at 2035, Phase 1 at 2025, and Phase 2 at 2035 according to IWRMDP.

9.5 Development Components

As shown in Table 9.5.1, the development component of the NIMP2018 consists of hard components(HC) such as the development of various irrigation infrastructure and their associated agricultural infrastructure; and organisational and functional strengthening, capacity building, and strengthening of coordination to facilitate the development and management of irrigation and agricultural infrastructure as a soft component (SC). In order to maximize the synergistic effect of hardware and software, careful consideration of the contents and timings of implementation of both components discussed hereinbelow.

Table 9.5.1 Strategies and Plans of Irrigation Development in NIMP2018

	SN.	Development Strategy	Development Plan
HC	1	Increase Irrigation through Sustainable Water Use	(1) Dodoma Zone Irrigation Development Plan (2) Kilimanjaro Zone Irrigation Development Plan (3) Mbeya Zone Irrigation Development Plan (4) Morogoro Zone Irrigation Development Plan (5) Mtwara Zone Irrigation Development Plan (6) Mwanza Zone Irrigation Development Plan (7) Tabora Zone Irrigation Development Plan (8) Katavi Zone Irrigation Development Plan (9) Large-scale Commercial Irrigation Development Plan
SC	1	Organisation and Functional Strengthening	(1) Establishment of RIOs and strengthening of DIDTs/DIDs (2) Improvement of NIRC function (human resources, equipment, facilities) (3) IO registration (4) Establishment of project performance monitoring and evaluation system (5) Establishment of public relations system (6) Research and development for irrigation
	2	Capacity Building	(1) Capacity development training for irrigation staff in ZIOs/RIOs (2) Capacity development training for irrigation staff in LGAs (DIDTs/DIDs) (3) Capacity development training for IOs (4) Establishment of design standards for irrigation in Tanzania (5) Establishment of training modules for irrigation development (6) Promotion of private contractors and enhancement of their engineering capacities
	3	Strengthening of Coordination	(1) Coordination with private sector for irrigation investment (2) Coordination with relevant institutions for cross-cutting issues (water, land conflict, etc.)

Sources: JICA Project Team

9.5.1 Irrigation Infrastructure Development Projects

Based on the discussion so far, the irrigation infrastructure development project will be classified into one development strategy in the large division, nine development plans in the middle division, and 36 (= 3 work types x 3 scales x 4 intake structures) development project groups in the small division, as shown in Table 9.5.2. Details of the irrigation infrastructure development project was discussed in Section 8.6.

Table 9.5.2 Plans and Projects in the Irrigation Infrastructure Development Projects

SN.	Plan	Project (Common for All Zones)		
HC1(1)	Dodoma Zone Irrigation Development Plan	By Work Type	By Scale	By Intake Structure
HC1(2)	Kilimanjaro Zone Irrigation Development Plan	Improvement Expansion New Development	Small Medium Large	Weir and Pump Irrigation; Dam and Pond Irrigation; Lake Water Irrigation; and
HC1(3)	Mbeya Zone Irrigation Development Plan			
HC1(4)	Morogoro Zone Irrigation Development Plan			
HC1(5)	Mtwara Zone Irrigation Development Plan			
HC1(6)	Mwanza Zone Irrigation Development Plan			
HC1(7)	Tabora Zone Irrigation Development Plan			

SN.	Plan	Project (Common for All Zones)		
HC1(8)	Katavi Zone Irrigation Development Plan			Groundwater Irrigation
HC1(9)	Large-scale Commercial Irrigation Development Plan			

Sources: JICA Project Team

The Government of Tanzania shall recognise the importance of study and design, and allocate more budget necessary for conducting those of priority irrigation schemes in advance. To improve the quality and to shorten the time for the study and design, it is an option to accept the support of development partners. By working with foreign consultants, their skills, knowledge, and management know-how can be absorbed by Tanzanian's irrigation staff. It may be the ultimate on-the-job training for them.

Upon implementation of irrigation infrastructure development project, packaging tender (combining several projects) will be introduced aiming at promoting the entry of private companies. As a rule, the packaging tender will be executed collectively in the district unit except for new development.

As the results of prioritization process were deliberated in the previous chapters, the breakdown of priority irrigation schemes by phase and size is summarised as follows:

Table 9.5.3 Breakdown of Priority Irrigation Schemes by Phase and Size

Phase	Small Scale		Medium Scale		Large Scale		Total	
	No. of Schemes	Area (ha)	No. of Schemes	Area (ha)	No. of Schemes	Area (ha)	No. of Schemes	Area (ha)
Phase 1	302	36,486	126	78,126	41	133,508	469	248,120
Phase 2	441	55,654	156	94,545	46	161,911	643	312,110
Total	743	92,140	282	172,671	87	295,419	1,112	560,230

Source: JICA Project Team

9.5.2 Activities of Soft Component

The SCs are shown in Table 9.5.4, followed by the explanations of backgrounds and rationales. There are thee improvement strategies in the large division, 14 improvement plans in the middle division, and 45 improvement programs in small division based on the discussion in Section 8.5.

Table 9.5.4 Outline of Soft Components

SN.	Plan	Project/Program
SC 1: Organisation and Functional Strengthening	(1) Establishment of RIOs and strengthening of DIDTs/DIDs	(a) Setting up RIOs to supplement ZIOs and strengthening DIDT/DIDs functions. (b) Recruitment of professional and supporting staff (c) Provision for operation funds
	(2) Improvement of NIRC function (human resources, equipment, facilities)	(a) Addition of staff members to fill vacancies. (b) Procurement of necessary equipment and facilities. (c) Improvement of NIRC's operational capacity
	(3) Registration of IOs	(a) Registration of IOs for providing continuous support
	(4) Establishment of project performance monitoring and evaluation system	(a) Routine update of irrigation database (b) Performance monitoring · Daily intake discharge · Irrigated area (planted and harvested) · Crop yield and production (c) Monitoring and evaluation of annual work performance (d) Institutionalization of data collection and reporting unit (e) Mid-term evaluation, and evaluation at completion of NIMP2018 (f) Formulation of irrigation development plan beyond 2035
	(5) Establishment of public relations system	(a) NIRC website (b) Periodic update of contents
	(6) Research and development for irrigation	(a) Improvement of irrigation efficiency by water saving technologies (b) Water and land conflict management in and around irrigation schemes

SN.	Plan	Project/Program
		(c) Gender mainstreaming in irrigation sector (d) Water budgeting and auditing of irrigation schemes (e) O&M cost for irrigation systems (f) Climate change resilience 1: Sediment and erosion control measures (g) Climate change resilience 2: Flood control and mitigation measures (h) Climate change resilience 3: Early warning system (i) Groundwater monitoring and evaluation (j) Value chain for irrigation crops
SC 2: Capacity Building	(1) Capacity development training for irrigation staff in ZIOs/RIOs (Level 1) (2) Capacity development training for irrigation staff in LGAs (DIDTs/DIDs) (Level 2) (3) Capacity development training for IOs (Level 3) ** If the capacity of LGA personnel as trainer is low, ZIO officers can be the trainers.*	(a) Trainings for irrigation staff (NIRC to Level 1) (b) Trainings for irrigation staff (Level 1 to Level 2) Overall project management ・ Fund management (budgeting and payment) ・ Project formulation (identification) ・ Detailed design and cost estimate ・ Tender documents and tender evaluation ・ Construction S/V ・ O&M of irrigation systems (c) Trainings for IOs/PC members (Level 2 to Level 3) ・ Dissemination of NIP2010 and NIA2013 ・ Fund management (Fees collection, bookkeeping, etc.) ・ Business planning ・ Seasonal cultivation meeting ・ Preparation of crop calendar and irrigation schedule ・ Water distribution ・ Farm management (incl. water saving practices) ・ Maintenance and repair of irrigation system, farm-to-market roads, and warehouse ・ Conflict management ・ Gender mainstreaming ・ Initial processing and marketing of farm produces ・ Group management
	(4) Establishment of irrigation technical manuals and checklists	(a) Standard design manual (b) Standard technical specifications (c) Drawing standard (d) Standard construction management manual (e) Checklists for study, design and construction S/V
	(5) Establishment of training modules for irrigation development	(a) Training modules for SC2 (1) and (2) (b) Training modules for SC2 (3)
	(6) Promotion of private contractors and enhancement of their engineering capacities	(a) To share the technical manuals and checklists with private contractors along with CGL. (b) To organise irrigation workshops to exchange experiences and opinions (c) To promote the use of local engineering firms and contractors.
SC 3: Strengthening of Coordination	(1) Coordination with private sector for irrigation investment	(a) Irrigation human resources development (b) Outsourcing the works to private consulting firms and contractors (c) Private investment for irrigation development (d) Performance evaluation of private consulting firms and contractors
	(2) Coordination with relevant institutions for cross-cutting issues (water, land conflicts, etc.)	(a) Coordination with MoA (b) Coordination with MoWI (c) Coordination with other institutions

Sources: JICA Project Team

(1) SC1: Organisation and Functional Strengthening

This component will prepare the implementation arrangement of effective NIMP2018 implementation and a system of monitoring and feedback and technological development.

(a) Establishment of RIOs and Strengthening of DIDTs/DIDs

As described in Section 5.8, the support of Zonal Irrigation Offices (ZIOs) to Local Government Authorities (LGAs) is rather extensive and overloaded. Establishment of region-level irrigation offices (RIOs) will ease the burden of ZIOs, and the support from irrigation office will be more available especially for remote LGAs. The RIOs will be strategically set-up in phases as described in Section 8.5.

In terms of implementation arrangement in LGAs, the most serious problem is the lack of technical staff in the irrigation sector (see Section 5.8). While the NIA recommends an introduction of DID, NIMP2018 proposes to prioritize the increase of irrigation staff over DID set-up as an imminent issue.

Under this activity, therefore, the NIRC will (a) set up RIOs and encourage staff increase in LGAs, (b) recruit required staff, and (c) secure sufficient fund for RIO operation.

(b) Improvement of NIRC Function

As described in Section 5.8, the number of NIRC technical personnel is decreasing while the commission is supposed to play the primary role of implementing NIMP2018. The NIRC also plans to set up a headquarters in Dodoma for improving its function. Thus, this activity is intended to (a) secure minimum level of technical staff and (b) procure necessary equipment and facilities, so that the NIRC is capable of leading NIMP2018.

(c) Registration of IOs

The Irrigators' Organisation (IO) registration to NIRC is behind schedule as articulated in Section 5.6. Without the registration, the NIRC, with the help of LGAs, cannot extend support to the IOs. Thus, the NIRC promotes the registration at least of the IOs of irrigation schemes improved or developed in NIMP2018.

(d) Establishment of Project Performance Monitoring and Evaluation System

NIMP2018 needs to be regularly updated with the review of field data, and the NIRC will set up a monitoring system with the help of LGAs. First, the irrigation database (see Chapter 6) requires periodical update, and the indicators of individual irrigation schemes need to be collected as the basis of performance review. The collected data will be reviewed annually and at the time of mid-term and final evaluation for further improvement. The evaluation results will be the basis for setting the plan beyond NIMP2018 period (from 2035 onwards).

(e) Establishment of Public Relations System

As described in Section 6.5, the irrigation database and irrigation scheme maps have been uploaded on the NIRC website. The contents should be updated on a regular basis not only for public relations purpose but for decision making of the government in the irrigation sector.

(f) Research and Development for Irrigation

The areas of research and development in irrigation development revolves around i) effective use of limited water, ii) impact of climate change, iii) irrigation-related social conflicts, and iv) increase of economic impact.

- Water-saving technologies and monitoring of water use
  In NIMP2018, water availability is the basis of setting potential irrigation areas as described in Chapter 3 and Chapter 7. As such, research on water-saving technologies and monitoring system of water use are of high importance.

- Mitigation measures for negative impacts of climate change
  Impacts of climate change to water resources have been well articulated in Chapter 3, and several of mitigation measures are introduced in Section 8.3. There should be a research on adaptation measures of climate change in the irrigation sector.
- Land and water conflicts and gender mainstreaming
  Social issues can be a major obstacle of irrigation development as articulated in Section 8.5.
- Increase of economic impact of irrigation
  As Sections 4.8 and 8.4 describe, there is a room for value chain development of irrigation crops and will be a major topic of research. Also, the research on irrigation costs, such as operation and maintenance, should be conducted for improving the economic benefit of irrigation.

As explained in Section 5.9, there are various research institutes that have comparative advantage in particular themes. While NIRC plans to establish a research centre and engage in research and development, the commission can outsource some of research topics to those institutes and coordinate the overall research activities in the irrigation sector.

(2) SC2: Capacity Building

This component aims at developing the capacities of individual stakeholders engaged in irrigation development.

(a)-(c) Capacity Development Training

Different stakeholders need different skills and knowledge as follows:

- NIRC technical staff requires overall management skills of NIMP2018 as well as large-scale irrigation projects. (See Section 5.4 for the mandates.)
- LGA technical staff is supposed to have management skills of irrigation projects and support IOs in operation and maintenance and group management. (See Section 5.4 for the mandates.)
- IOs need to have skills and knowledge on operation and maintenance (O&M), group management as well as production and marketing. (See Section 5.6 for their activities.)

Based on their different needs, on-the-job training will be designed and conducted along the project cycles of NIMP2018.

(d) Establishment of Technical Manuals and Standards

One of the challenges of irrigation development in the past is the lack of standard designs, manuals, and specifications as described in Sections 5.10 and 5.11. Thus, the NIRC, with possible support of outer sources, will develop or compile standard manuals on design, drawing, technical specifications, and construction management for the sake of quality control.

(e) Establishment of Training Modules

To standardise the training mentioned above ((a)-(c)), the NIRC will prepare a set of training modules.

(f) Promotion of Private Contractors and Enhancement of Their Engineering Ability

As mentioned in Section 5.8, there is a little room for local private contractors to engage in public irrigation projects. To improve the situation, the NIRC will (a) share the technical information with private contractors, (b) organise a series of workshops for discussion, and (c) promote the participation of local firms with possible adoption of affirmative measures.

(3) SC3: Strengthening Coordination

This component is designed to improve the coordination for irrigation development.

(a) Coordination with Private Sector for Irrigation Investment

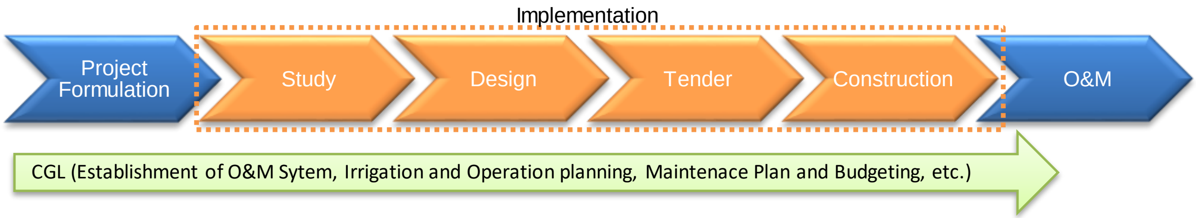
As indicated in Section 9.11 below, NIMP2018 implementation also relies on private funding. Thus, the NIRC will promote and attract private investors through providing information of prioritised irrigation projects and introducing private-public partnership (PPP) model on a preliminary basis (see also Section 8.5).

(b) Coordination with Relevant Institutions for Cross-cutting Issues

As stated in Section 9.8, the implementation arrangement of NIMP2018 is well ingrained into that of ASDP2. Thus, the coordination will be primarily made in ASDP 2 arrangements while NIRC will lead the discussions especially on cross-cutting issues of irrigation development with relevant ministries and other stakeholders, where necessary (see Section 8.5).

9.6 Implementation Schedule

The irrigation infrastructure development will be implemented with a timeframe of the NIMP2018; which is defined as **Phase 1** for eight years from 2018 to 2025 and **Phase 2** for ten years from 2026 to 2035 in the same target year as IWRMDP. The SCs of NIMP2018 will be designed so as to support the infrastructure development smoothly and efficiently in the implementation and beyond. This section will deal with the activities from the study to construction in the general project cycle shown in Figure 9.6.1.



Source: JICA Project Team

Figure 9.6.1 Project Cycle

9.6.1 Hard Component

As a rule, NIMP2018 will implement the projects formulated by Comprehensive Guideline (CGL). Based on the past experiences and actual performance, the implementation schedule is prepared assuming each time requirement according to the scale of the irrigation scheme as shown in Table 9.6.1 and Table 9.6.2.

Table 9.6.1 Time Requirement assumed for Study, Design, and Bidding in Month

Irrigation Project	Study		Design		Tender	
	Improve.	New	Improve.	New	Improve.	New
Small-scale Irrigation Scheme	3	6	4	6	8	8
Medium-scale Irrigation Scheme	4	8	6	10	8	10
Large-scale Irrigation Scheme	6	10	8	12	8	10

Note: 1) Geodetic survey and simple geological/soil investigation is included in the study and design.
2) ICB method will be employed for bidding of new medium and large irrigation schemes and LCB for the rest.
Source: JICA Project Team

Table 9.6.2 Time Requirement Assumed for Construction in Year

Irrigation Project	Intake Structure		Canal System		Construction Period	
	Improve.	New	Improve.	New	Improve.	New
Small-scale Irrigation Scheme	1.0	1.5	1.0	1.5	1.0	1.5
Medium-scale Irrigation Scheme	1.5	2.0	1.5	2.0	1.5	2.0
Large-scale Irrigation Scheme	2.0	3.0	2.0	3.0	2.0	3.0

Note: Defect liability period for civil work contract will be set for one year.
Source: JICA Project Team

In addition to the above, it is expected the same period of tender by project scale to procure engineering consultants for study, design, and construction supervision.

9.6.2 Soft Components

The SCs will be implemented in accordance with the project cycles of the HC. The following describes the basic principles of scheduling SC activities in NIMP2018:

(1) Organisation and Functional Strengthening

- RIO establishment is to be implemented in a phased manner so as to review the effectiveness of RIOs in Phase 1 and modify the approach in Phase 2.
- Vacancies of NIRC headquarters and ZIO staff need to be filled in early stages of NIMP2018 to maintain the minimum function.
- Promotion of IO registration, establishment of monitoring system and public relations system are less cost-intensive and can initiate major activities in Phase 1.
- As for research and development, the studies of identifying research areas are to be conducted in the first years of Phase 1, and research and development (R&D) continues for the entire period.

(2) Capacity Building

- The training is conducted in the project cycle of CGL, the capacity building of each stakeholder follows the irrigation scheme development schedule based on the CGL.
- The major activities of establishment of design standards for irrigation and training manual, and promotion of private contractors and their ability are implemented in the early years of NIMP2018.

(3) Coordination Strengthening

- Principles and approaches of coordinating private investments and relevant institutions will be set in the initial stage of Phase 1. The continuous discussion and adjustments need to be undertaken on a regular basis.

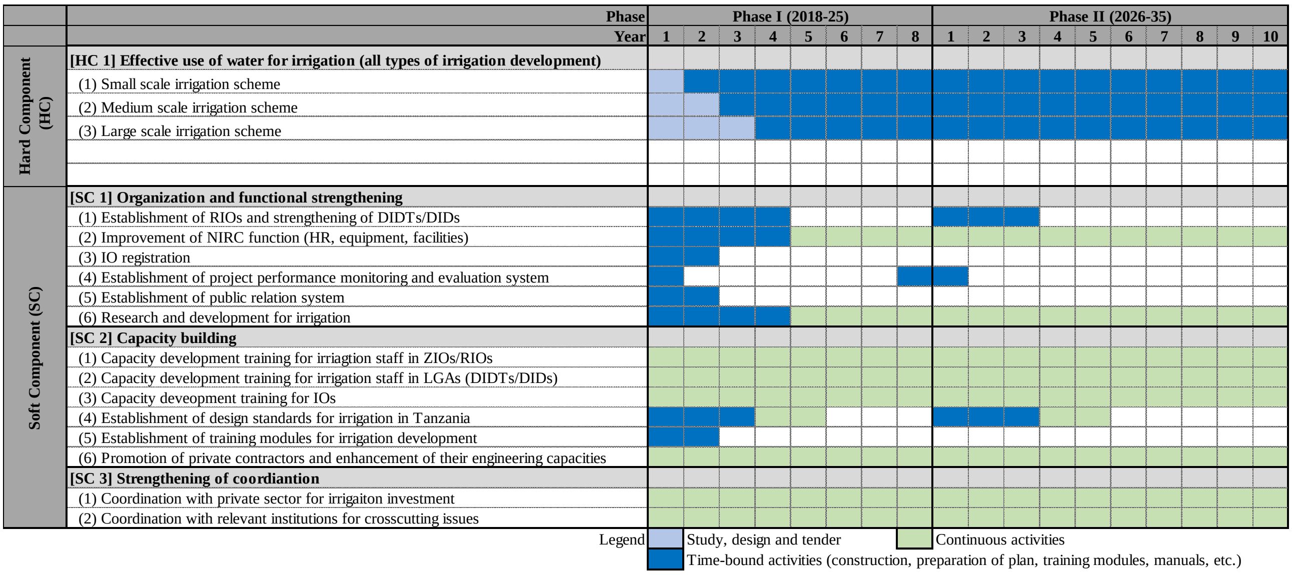
The table below summarises the detailed accounts of respective activities.

Table 9.6.3 Details of Soft Component Activities

	Development Plan	Activity
SC 1	(1) Establishment of RIOs and strengthening of DIDTs/DIDs	[RIO establishment] ・ RIOs will be established in phases (Phase 1 and 2). ・ 8 ZIOs will continue to be zonal centres and also function as RIOs. Hence, 18 RIOs will be newly established. ・ Prioritization criteria are: 1) number of planned/existing schemes; and 2) accessibility from the zonal office. ・ At least 1 engineer and 2 technicians are assigned to each RIO. ・ Only if deemed appropriate, district-level irrigation office can be set up in the LGAs with many schemes. [DIDT/DID strengthening] ・ Assignments of irrigation engineers are phased based on the scheme prioritisation and project cycles of small-scale scheme development. ・ In principle, 1 engineer and 2 technicians are assigned for every 2,500 ha in the LGA. ・ 1 field officer is assigned for each scheme for monitoring and IO support. ・ Set-up of DIDs will be discussed between interested LGAs, PO-RALG, and NIRC.
	(2) Improvement of NIRC function (human resources, equipment, facilities)	・ Vacant posts will be filled in the early stage of Phase 1. ・ New headquarters will be constructed in Phase 1.
	(3) IO registration	・ Effective support system for IOs will be discussed with stakeholders in the early stage of Phase 1. ・ Awareness raising for stakeholders continues throughout Phase 1 and Phase 2.
	(4) Establishment of project performance monitoring and evaluation system	・ Performance indicators will be set in the preparation period of Phase 1. ・ Introduction of monitoring system is planned in Phase 1. ・ Performance evaluation will be conducted in the mid and end of each phase.
	(5) Establishment of public relations system	・ NIRC website will be developed in the preparation period of Phase 1. ・ The contents are updated for the entire period of NIMP2018.
	(6) Research and development for irrigation	・ Where appropriate, researches are commissioned to academic/research institutes in Phase 1 and Phase 2. ・ A research centre will be developed in Phase 1.
SC 2	(1) Capacity development training for NIRC irrigation staff in ZIOs/RIOs	・ ZIO/RIO staff will receive training in project management in the early stage of the Phase 1. ・ Practical training will be conducted on the job along the project cycles of the HC (Phases 1 and 2).
	(2) Capacity development training for irrigation staff in LGAs (DIDTs/DIDs)	・ LGA staff will receive training in project management in the early stage of Phase 1. ・ Practical training will be conducted on the job along the project cycle (Phases 1 and 2).
	(3) Capacity development training for IOs	・ IO members receive practical training along the CGL project cycle. ・ Additional training will be provided (e.g., group management, production and marketing) (Phases 1 and 2).
	(4) Establishment of design standards for irrigation in Tanzania	・ Technical standard manuals and checklists will be prepared in the preparatory period of Phase 1. ・ The manuals are periodically updated for the entire period.
	(5) Establishment of training modules for irrigation development	・ Training modules will be developed in the preparatory period of Phase 1. ・ The modules are periodically updated for the entire period.
	(6) Promotion of private contractors and enhancement of their engineering capacities	・ Seminar for technical manuals and project management will be periodically conducted for the entire period. ・ Commission to local firms will be promoted for the entire period.
SC 3	(1) Coordination with private sector for irrigation investment	・ Seminars for private investors will be held periodically for the entire period.
	(2) Coordination with relevant institutions for cross-cutting issues	・ Discussions will be made on crosscutting issues such as water right and land-use right with relevant ministries and agencies (including MOWI, MALF and PO-RALG.

Sources: JICA Project Team

Taking the above all into account, an overall implementation schedule is tentatively proposed as presented in Figure 9.6.2.



Source: JICA Project Team

Figure 9.6.2 Overall Implementation Schedule of NIMP2018

9.7 Project Costs

9.7.1 Preconditions for Cost Estimate

The basic conditions and assumptions employed for the cost estimate of the NIMP2018 are the following:

- Prices are referred to as of July 2017;
- Exchange rate of USD 1.0 = TZS 2,240 = JPY 112 at the time of July 2017 was applied;
- The cost covers only for the development components specified in NIMP2018;
- O&M cost is excluded in the Project cost.
- The recurrent cost of NIRC/ZIOs/LGAs such as personnel costs, office administration and management, and field operation, will not be included in NIMP2018;
- Land acquisition and resettlement in principle will not take place in the irrigation infrastructure development under NIMP2018. However, the government shall be responsible for settlement of those if happen; and
- The cost of projects and programs for cross-cutting issues will not be covered by NIMP2018 unless otherwise specified in NIMP2018.

9.7.2 Cost Estimate

Taking the preconditions abovementioned into account, the total project cost by component is estimated, and summarised as shown in Table 9.7.1 below.

Table 9.7.1 Summary of the Total Project Cost

No.	Item	Phase 1 Cost (USD in Mil.)	Phase 2 Cost (USD in Mil.)	Total Cost (USD in Mil.)	Total Cost Equivalent (TZS in Bil.)
1	Irrigation Infrastructure Development	2,025.7	2,422.9	4,448.6	9,965.0
2	Organisation and Functional Strengthening	23.9	9.2	33.1	74.2
3	Capacity Building	3.3	5.2	8.5	19.1
4	Strengthening of Coordination	0.05	0.06	0.11	0.2
	Total	2,052.9	2,437.4	4,490.3	10,058.5

Note: Engineering costs and training fees are inclusive in each component cost. All figures include VAT (18%).
Source: JICA Project Team

The breakdown of each component is discussed herein below.

(1) Costs for Irrigation Infrastructure Development

The cost for irrigation infrastructure development will consist of (a) feasibility study, detailed design, construction supervision, and (b) construction works.

(a) Costs for Engineering Services (HC1)

It is assumed in NIMP2018 that feasibility study and detailed design will be outsourced to the private firms in accordance with PPRA's guideline. Based on the above assumption, the estimation of unit cost was made as shown in Table 9.7.2 for budgeting purpose.

Table 9.7.2 Unit Cost for Engineering Services

Item	Unit	New Development	Improvement
Feasibility Study (F/S)	USD/ha	4% TCC	3% of TCC
Detailed Design (D/D)	USD/ha	6% TCC	4% TCC
Construction Supervision (S/V)	USD/ha	12% TCC	8% TCC
Total	USD/ha	22% TCC	15% TCC

Note: TCC= Total construction cost shown in Table 9.7.3.
Provisions of topo- survey, geological investigation, and preparation of tender documents are included.
Source: JICA Project Team

(b) Costs for Construction Works

The unit cost per ha for construction in NIMP2018 was estimated for budget planning purpose in USD taking into consideration the three different cases; the average unit development cost in Asia, Sub Saharan and ASDP1, and NIRC's project proposals in Tanzania as shown in Table 9.7.3.

Table 9.7.3 Unit Cost for Construction Works

Work	Unit	Sub Saharan*1		ASDP1*1		NIMP2018*2	
		New	Improve	New	Improve	New	Improve
Gravity-type Irrigation System	USD/ha	5,600	2,000	2,170	1,670	5,600	3,000
Pressure-type Irrigation System	USD/ha					15,000	-
Canal Extension only	USD/ha	-	-	-	-	3,000	-

Note: The above costs are VAT exclusive.
*Source: Prepared by the JICA Project Team based on *1= JICA and DPs, July 2013, Assessment of Achievements of the ASDP, Returns to Irrigation Development, *2= NIRC's Project proposals, F/S and Pre-F/S and sample BOQ of NIRC.*

The gravity-type and pressure-type irrigation schemes shall be a full development covering the scope of works; i) water source structure (such as diversion weir, dam, pond, pump station), ii) main and secondary canal systems with concrete lining or pipe, iii) main and secondary drainage systems, and iv) O&M roads. The tertiary canal system will be improved or constructed by IO's members under technical guidance and support by respective LGA. The construction cost of the tertiary canal system is supposed to be 13% of the total construction cost.

Based on the unit costs in the (a) and (b) above, the cost of irrigation infrastructure development by phase is estimated in Attachment-9.7.1 and summarised in Table 9.7.4 below.

Table 9.7.4 Summary for Costs of Irrigation Infrastructure Development

No.	Item	Phase 1 Cost (USD in Mil.)	Phase 2 Cost (USD in Mil.)	Total Cost (USD in Mil.)	Total Cost equivalent (TZS in Bil.)
1	Engineering Services	345.7	417.9	763.6	4,537.6
2	Construction of Irrigation Infrastructure	1,680.0	2,005.0	3,685.0	5,427.4
	Total	2,025.7	2,422.9	4,448.6	9,965.0

Note: The above costs include a construction cost of tertiary canal. VAT inclusive.
Source: JICA Project Team

(c) O&M Costs for Irrigation Systems

In addition to the above item (a) and (b) for irrigation infrastructure development costs, cost for the operation and maintenance (O&M) will be considered in the project evaluation. The O&M cost was estimated on the following conditions.

- Annual O&M cost: 1% of the irrigation infrastructure development cost
- Replacement cost: 10% of the irrigation infrastructure development cost at every 10 years
- Period of O&M: 30 years for individual projects from the completion and 50 years for NIMP2018

(2) Costs for Organisational and Functional Strengthening (SC1)

The cost consists of: i) construction of RIO offices, NIRC headquarters and the research centre and procurement of equipment and facilities; ii) commission for research and other services; and iii) field trips, workshops and seminars. RIOs will be established in phases (Phase 1 and 2), and the NIRC headquarters will be constructed in Phase 1. The establishment of NIRTC is scheduled in the latter half of Phase 1. As for research and development, part of planned activities will be commissioned to other research institutes although the extent of outsourcing will depend on the timing of NIRTC establishment. (Refer to Attachment-9.7.2.)

Table 9.7.5 Costs for Organisational and Functional Strengthening (SC1)

Activity	Phase 1 (USD)	Phase 2 (USD)	Total (USD)
(1) Establishment of RIO and Strengthening of DID/DIDT	3,548,022	7,028,188	10,576,210
(2) Improvement of NIRC Function	5,032,188	0	5,032,188
(3) IO Registration	101,784	135,712	237,496
(4) Establishment of Project Performance Monitoring and Evaluation System	305,624	706,600	1,012,224
(5) Establishment of Public Relation System	4,686	2,230	6,916
(6) Research and Development for Irrigation	14,950,765	1,307,265	16,258,030
Total	23,943,069	9,179,995	33,123,064

Note: Costs in the table include the VAT (18%)
Source: JICA Project Team

(3) Costs for Capacity Building (SC2)

The cost consists of: i) training to the technical staff of the NIRC and LGAs, and to the IOs; and ii) commission for developing training modules and technical manuals; and iii) workshops and seminars.

The training is conducted in a cascade system, and the stakeholders of NIRC, LGAs and IOs will be trained on the job along project cycles of irrigation development. The NIRC leads the preparation of training modules and technical manuals while it may commission part of the works for technical support. (Refer to Attachment-9.7.2.)

Table 9.7.6 Costs for Capacity Building (SC2)

Activity	Phase 1 (USD)	Phase 2 (USD)	Total (USD)
(1)-(3) Capacity Development Training (Level 1-3)	3,041,683	4,872,785	7,914,468
(4) Establishment of Irrigation Technical Manual and Checklist	201,396	201,396	402,792
(5) Establishment of Training Modules for Irrigation Development	65,167	65,167	130,334
(6) Promotion of Private Contractors and Enhancement of their Engineering Ability	28,568	35,710	64,278
Total	3,336,814	5,175,058	8,511,872

Note: Costs in the table include the VAT (18%)
Source: JICA Project Team

(4) Costs for Strengthening of Coordination (SC3)

The cost consists of seminars and workshops. The coordination and discussion with government agencies and DPs are expected to take place in ASDP 2 system while NIRC may organise a series of meetings when further coordination is necessary. Furthermore, seminars and workshops for private investment in irrigation development are scheduled and included in the cost calculation. (Refer to Attachment-9.7.2.)

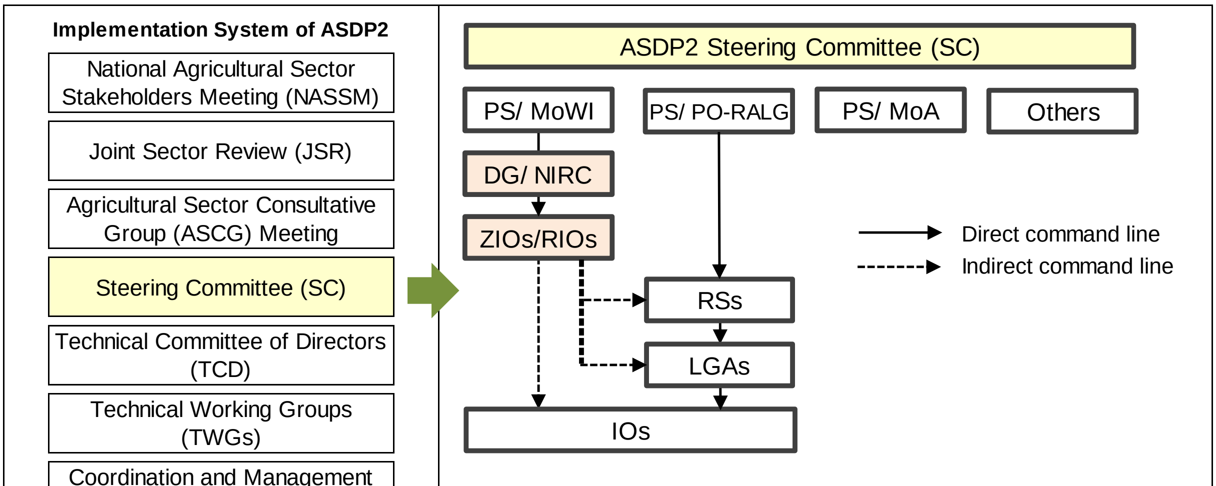
Table 9.7.7 Costs of Strengthening of Coordination (SC3)

Activity	Phase 1 (USD)	Phase 2 (USD)	Total (USD)
(1) Coordination with Private Sector for Irrigation Investment	28,568	35,710	64,278
(2) Coordination with Relevant Institutions for Cross-cutting Issues	21,428	26,785	48,213
Total	49,996	62,495	112,491

Note: Costs in the table include the VAT (18%)
Source: JICA Project Team

9.8 Organisational Arrangement for Implementation

The executing agency of the NIMP2018 will be the NIRC. As mentioned above, since irrigation development is a major component of ASDP2, in principle, the implementation system of NIMP2018 will be in accordance with the implementation system of ASDP2. Since the implementation of ASDP2 is mainly managed by the steering committee, the implementation system of NIMP2018 will be proposed as shown in Figure 9.8.1. NIRC qualifies as a member of ASDP2 and seeks to share policies and information by participating in various conferences and committees. To ensure the implementation of NIMP2018, it is preferable to employ a project management consultant to support NIRC/ZIOs.



Source: Prepared by JICA Project Team based on ASDP2 report

Figure 9.8.1 Organisation Structure of NIMP2018

NIRC and LGAs are not in a directive system of administration. Also, in the case of a small-scale irrigation project to be implemented with District Irrigation Development Fund (DIDF), the fund flow is remitted from the Ministry of Finance (national treasury) directly to the bank account of the LGAs without going through the NIRC. For this reason, there were several cases in which information and data on small-scale irrigation projects were not shared timely with NIRC in ASDP1. As a countermeasure to this, (i) the survey report and the design report should be approved by NIRC, (ii) the status of progress on construction and the status of payment to contractors are sent to NIRC/ZIO every month. It will be stipulated by detailed rules etc., so as to ensure thoroughness.

To strengthen the capacity of IOs, the training of trainer (TOT) system will be employed under NIMP2018. Using training modules, transfer of technology from NIRC to ZIO, from ZIO to LGA, from LGA to IOs will be made. However, due to low capacity of irrigation human resources at the LGA level, the possibility of direct training from ZIO to IOs will also be considered. Meanwhile, NIRC will jointly work with LGAs in dissemination and publicity such as the Irrigation Act and Regulations.

Table 9.8.1 Role Matrix of Development Component

Development Component	NIRC	ZIO	LGA	IO	Consultant	University/ Institute	Contractor	NGO
HC: Irrigation Infrastructure Development								
Irrigation Infrastructure Development (Small Scale)	○	○	●	○	●		●	
Irrigation Infrastructure Development (Medium/Large Scale)	●	●	○	○	●		●	
SC-1: Organisation and Functional Strengthening								
Establishment of RIOs and strengthening of DIDTs/DIDs	●	●	●					
Improvement of NIRC function (HR, equipment, facilities)	●	●						
Registration of IOs	●	○	○	●				
Establishment of project performance monitoring and evaluation system	●	○	●	○				
Establishment of public relations system	●	○						
Research and development for irrigation	●	○				●		
SC-2: Capacity Building								
Capacity development training for irrigation staff (Level 1)	●	●						

Development Component	NIRC	ZIO	LGA	IO	Consultant	University/ Institute	Contractor	NGO
Capacity development training for irrigation staff (Level 2)	○	●	●					
Capacity development training for IOs (Level 3)	○	○	●	●		●		○
Establishment of irrigation technical manuals and checklists	●	○			●			
Establishment of training modules for irrigation development	●	○				●		○
Promotion of private contractors/ consultants	●	○			●		●	
SC-3: Strengthening of Coordination								
Coordination with private sector	●	○						
Coordination with relevant institutions	●	○						

Note: ●= Main player, ○= Sub Player
Source: JICA Project Team

Regional Secretariat (RS) will play a role of coordination between vertical axis and horizontal axis of Table 9.8.1. RS will organise a coordination committee to discuss various issues for the implementation of NIMP2018, inviting the LGA officers in charge of irrigation. To realise it, the Government of Tanzania shall arrange the necessary resources such as budget, technical support, and staff.

9.9 Project Evaluation

The NIMP2018 is assessed in terms of its economic viability on the basis of the economic internal rate of return (EIRR). The financial soundness is studied by looking at the improvements of farmers' income, together with its positive contribution to poverty reduction. Also considered are indirect benefits such as the impact to the possible expansion of rice export to neighbouring countries which would bring in foreign currency to the country.

9.9.1 Basic Approach and Assumptions

In performing the assessment, the following basic assumptions are adopted:

- The evaluation is made for the duration of 30 years from 2035 to 2065. Consequently, the evaluation period assumed to be 30 years to 48 years for individual projects.
- The exchange rate is USD 1 = TZS 2,240, as of July 2017.
- The direct costs considered in the assessment are of those for the HC (costs for facility construction and engineering services), the SC (costs for capacity development, institutional strengthening, and coordination), and O&M cost for completed irrigation systems.
- The direct benefits are those materialised by increased production and resulting net income. The financial prices of the target crops are assumed to be a domestic market price. As for the economic prices, it is considered as international market price (at CIF of Pakistan milled rice with 25% broken rate) for rice and domestic market prices for tomato and onion.
- Shadow wage (SW) of 0.65 and standard conversion factor (SCF) of 0.96, which were used in ASDP2 document, are adapted for the assessment.
- In the case of economic assessment, transfer payments such as tax, duty, subsidy are excluded in the assessment calculation.
- The past investment for existing irrigation infrastructures are regarded as a sunk cost in this

assessment.

- IWRMPD is implemented as planned.
- ASDP2 is implemented as planned.

9.9.2 Costs and Benefits

(1) Costs

The cost side of the analysis has two components: HC and SC in addition to O&M for irrigation infrastructures. Table 9.9.1 shows the contents of each cost item.

Table 9.9.1 Contents of Cost Items

Cost Item	Contents	Remarks
HC	Construction cost of irrigation infrastructure and associated engineering costs	Refer to the Sub-section 9.5.1 and Table 9.7.1
SC	Costs for organisation and functional strengthening, capacity building, and stakeholders' coordination	Refer to the Sub-section 9.5.2 and Table 9.7.1
O&M	Operation and maintenance cost of completed irrigation systems.	Refer to the Sub-section 9.7.2 (c)

Source: JICA Project Team

Here, the financial cost is composed by the Project costs of Section 9.7.1 and the O&M costs both measured by nominal value. In contrast to the financial cost, costs for HC and SC have been subject to the economic cost adjustment. For the HC costs, following composition was assumed to calculate the economic cost.

Table 9.9.2 Components of HC Cost Items

Irrigation type	Cost Item	Labour Cost		Material Cost	
		Skilled	Unskilled	Tradable	Non-tradable
New full development (Surface irrigation)	Engineering	100%	0%	-	-
	Construction	3%	12%	65%	20%
New full development (Pressure irrigation)	Engineering	100%	0%	-	-
	Construction	3%	12%	75%	10%
New canal extension (Surface irrigation)	Engineering	100%	0%	-	-
	Construction	3%	12%	65%	20%
Improvement of exiting (Surface irrigation)	Engineering	100%	0%	-	-
	Construction	3%	12%	65%	20%

Source: JICA Project Team

In the SC costs, those items in the category of studies and research activities are regarded as done by skilled labour. Similarly, items such as vehicle, computer, and other international goods have been adjusted as tradable goods. The following are economic costs after adjustment.

The financial costs and economic costs each for the HC and SC are summarized in Table 9.9.3 and the details are given in Attachment-9.9.1.

Table 9.9.3 Summary of Financial and Economic Costs

Item	Financial Cost (TZS in Million)			Economic Cost (TZS in Million)		
	HC	SC	Total	HC	SC	Total
Phase 1	4,537,595	61,219	4,598,814	3,594,281	44,983	3,639,264
Phase 2	5,427,361	32,295	5,459,656	4,315,203	21,975	4,337,178
Total	9,964,956	93,514	10,058,470	7,909,484	66,959	7,976,442

Source: JICA Project Team

The annual disbursement schedule of financial costs and economic costs is calculated on the following conditions.

- HC costs: It is calculated multiplying the total HC costs in each development phase and the annual progress to be obtained from S-curve passing 45.5% progress (= 4,537,595 / 9,964,956 (TZS in billion)) at the mid-term of each phase, in due consideration of the past experiences and implementation schedule of NIMP2018 in Figure 9.6.2.
- SC costs: It is calculated multiplying the total HC costs in each development phase and the annual progress to be obtained from S-curve passing 65.5% progress (= 61,219 / 93,514 (TZS in million)) at the mid-term of each phase, in due consideration of the past experiences and implementation schedule of NIMP2018 in Figure 9.6.2.

Taking the above into account, the annual disbursement schedule of financial costs and economic costs are summarised as shown in Table 9.9.4.

Table 9.9.4 Annual Disbursement Schedule

	Year	The Number of Year	Financial Cost (TZS in Million)	Economic Cost (TZS in Million)
Phase 1	2018	1	145,382	114,631
	2019	2	373,515	295,348
	2020	3	633,231	501,034
	2021	4	952,576	753,849
	2022	5	1,083,201	857,611
	2023	6	739,656	628,442
	2024	7	376,626	298,021
	2025	8	240,627	190,328
Phase 2	2026	9	59,093	46,652
	2027	10	363,036	288,049
	2028	11	430,631	342,009
	2029	12	712,366	565,863
	2030	13	957,000	760,340
	2031	14	1,020,617	811,077
	2032	15	864,866	687,424
	2033	16	555,207	441,247
	2034	17	259,151	205,736
	2035	18	237,690	188,781

Source: JICA Project Team

Incidentally, the O&M costs were calculated based on the conditions given in Clause 9.7.2 (c).

(2) Benefits

For the benefits, they are derived from the improvement of yield and crop intensity due to irrigation. The benefits were estimated as follows.

For the sake of project evaluation, as elaborated in Section 7.4.2 (5), the JICA Project Team has selected the following as target crops for analysis. Considering a typical farming practices and risk of price fluctuation, land area share was assumed to be 60% for paddy, 5% for tomato and 35% for onion as shown in Table 9.9.5.

Table 9.9.5 Target Crops

Selected Target Crop	Characteristics	Land Area Share
Rice/ Paddy	High water demanding and low risk low return crop	60%
Tomato	Low water demanding and high risk high return crop	5%
Onion	Medium water demanding and medium risk high return crop	35%

Source: JICA Project Team

As to the yield, again for the analysis purposes, the JICA Project Team assumed the following levels for each of the target crops for three cases. These levels are relatively conservative estimation if compared them with the current level of the country and actually materialised level in agriculturally advanced areas[1]. It goes without saying that the positive impacts of irrigation development are to be materialised not only with irrigation itself but also with adequate support and improvements in agricultural practices such as proper supply of seeds, fertilizer, and extension services, which are brought about by implementing ASDP2 as envisaged.

Table 9.9.6 Estimated Yields of Target Crops

Crop	Rainfed/ Irrigation	Present (ton/ ha)	Future (without Project) (ton/ ha)	Future (without Project) (ton/ ha)
Rice/ Paddy	Rainfed	1.85	1.85	5.00
	Irrigation	2.50	2.50	5.00
Tomato	Rainfed	5.00	5.00	40.00
	Irrigation	20.00	20.00	40.00
Onion	Rainfed	2.00	2.00	10.00
	Irrigation	7.00	7.00	10.00

Note: - The estimated crop yields are assumed to be achieved from the third year after the completion of irrigation systems.
- Crop yields under present and future without project conditions are assumed same in the project evaluation.
Source: JICA Project Team

The crop intensity of the target crops is adopted based on projected available irrigation land. NIMP2018 has estimated irrigable land areas for both wet and dry seasons based on water availability. Therefore, instead of assuming nationally constant crop intensity, the analysis has directly made use of the wet/dry irrigable land area for the estimates of crop production. As a national average, the crop intensity was estimated as shown in Table 9.9.7:

Table 9.9.7 Cropping Intensity

Season	Irrigable Land (%)
Wet season	100 %
Dry season	30.3%
Total	130.3%

Source: JICA Project Team

[1] The yields of the target crops were adopted with reference to the following observations:
- Paddy (Rice): (1) MALF "Crop Production Guideline" (2017) Potential yield = 5.00 ton/ha, (2) "ASDP2" (2017) Target value by 2021/22 = 3.6 ton/ha (rainfed and irrigation combined), (3) National Rice Development Strategy (2009) Irrigation yield target by 2018 = 3.5 ton/ha, (4) Field data of smallholder irrigation farmers at Dakawa Irrigation Scheme (2014) (Average of 6 samples) = 5.12 ton/ha, (5) Data of JICA field study (Average of 4 locations in Tanga, Iringa, and Mbeya) Yield of irrigation farming = 5.88 ton/ha
- Tomato : (1) MALF "Crop Production Guideline" (2017) Potential yield = 60 ton/ha, (2) Data from TAHA (Morogoro area) (2017) Irrigation farming = 49.42 ton/ha, (3) Data of JICA field study (Average of 3 locations in Tanga and Iringa) Irrigation farming = 49.67 ton/ha
- Onion : (1) MALF "Crop Production Guideline" (2017) Potential yield = 10 ton/ha, (2) Data from TAHA (Morogoro area) (2017) Irrigation farming = 32.12 ton/ha, (3) Data of the JICA field study (Average of 3 locations in Tanga and Iringa) Irrigation farming = 17.75 ton/ha

9.9.3 Financial Analysis of NIMP2018

In carrying out the financial analysis, small scale field surveys and reference to past studies have been made to substantiate data of crop budget and farm budget, including crop prices and production costs, as well as transportation costs and other mark-ups along with value chain.

The crop budget per ha (financial prices) was calculated for each target crop under the different conditions as shown in Table 9.9.8. The crop budget calculation sheets (financial prices) are given in Attachment-9.9.2.

Table 9.9.8 Net Farm Income of Target Crops under Different Conditions (Financial Prices)

Crop	Season	Rainfed Condition (TZS/ha)			Irrigation Condition (TZS/ha)		
		Present	Future (w/o Project)	Future (with Project)	Present	Future (w/o Project)	Future (with Project)
Paddy	Wet	▲198,853	▲198,853	1,646,050	▲68,950	▲68,950	1,646,050
	Dry	▲10,153	▲10,153	2,156,050	186,050	186,050	2,156,050
Tomato	Wet	395,250	395,520	18,655,359	6,175,359	6,175,359	18,655,359
	Dry	1,570,250	1,570,250	28,055,359	10,875,359	10,875,359	28,055,359
Onion	Wet	▲604,150	▲604,150	2,113,750	400,750	400,750	2,113,750
	Dry	▲176,150	▲176,150	4,253,750	1,898,750	1,898,750	4,253,750

Note: w/o= without
Source: JICA Project Team

Table 9.9.9 shows the farm budget (financial prices) by unit area (1 ha) and by farmer (1.6 ha), with combination of the target crops in land share proportion, under different conditions. The details are given in Attachment-9.9.3.

Table 9.9.9 Incremental Net Farm Income under NIMP2018 (Financial Prices)

Financial Benefits	Shifting from Rainfed to Irrigation by NIMP2018			Shifting from Existing Irrigation to Irrigation by NIMP2018		
	w/o Project	with Project	Net Increment	w/o Project	with Project	Net Increment
Farm Income per ha (TZS / ha/year)	▲307,754	3,922,448	4,230,202	805,754	3,922,448	3,116,695
Farm Income per farmer (TZS/ farmer/year)	▲492,406	6,257,917	6,768,323	1,289,206	6,257,917	4,986,711

Note: Farm size is 1.6 ha per farmer on national average (2014/15 AASS),
w/o= without
Source: JICA Project Team

With Project condition, it can be expected that the net incremental benefit of typical farmers (1.6 ha) would increase to about TZS 5.0 million for shifting from rainfed to irrigation and about TZS 6.8 million for shifting existing irrigation to irrigation with NIMP2018.

As a reference, the financial cash flows of the project benefits and costs are summarized in Attachment-9.9.4.

9.9.4 Economic Analysis of NIMP2018

Like the financial analysis, the crop budget per ha (economic prices) was calculated for each target crop under the different conditions as shown in Table 9.9.10. The crop budget calculation sheets (economic prices) are given in Attachment-9.9.5.

Table 9.9.10 Net Farm Income of Target Crops under Different Conditions (Economic Prices)

Crop	Season	Rainfed Condition (TZS / ha)			Irrigation Condition (TZS / ha)		
		Present	Future (w/o Project)	Future (with Project)	Present	Future (w/o Project)	Future (with Project)
Paddy	Wet	▲299,582	▲299,582	722,130	▲332,832	▲332,832	722,130
	Dry	▲299,582	▲299,582	722,130	▲332,832	▲332,832	722,130
Tomato	Wet	735,379	735,379	21,079,011	8,599,011	8,599,011	21,079,011
	Dry	1,910,379	1,910,379	30,479,011	13,299,011	13,299,011	30,479,011
Onion	Wet	▲389,843	▲389,843	2,660,466	947,466	947,466	2,660,466
	Dry	38,157	38,157	4,800,466	2,455,466	2,455,466	4,800,466

Note: w/o= without
Source: JICA Project Team

The farm budget (economic prices) by unit area (1 ha) and by farmer (1.6 ha), with combination of the target crops in land share proportion, under different conditions. is summarised as shown in Table 9.9.11, and the details are given in Attachment-9.9.6.

Table 9.9.11 Incremental Net Farm Income under NIMP2018 (Economic Prices)

Financial Benefits	Shifting Cultivation under Rainfed to Irrigation by NIMP2018			Shifting Cultivation under Existing Irrigation to Irrigation by NIMP2018		
	w/o Project	with Project	Net Increment	w/o Project	with Project	Net Increment
Farm Income per ha (TZS / ha/year)	▲300,801	3,515,410	3,816,212	960,321	3,515,410	2,555,089
Farm Income per farmer (TZS/ farmer/year)	▲481,282	5,624,656	6,105,938	1,536,514	5,624,656	4,088,142

Note: Farm size is 1.6 ha per farmer on national average (2014/15 Annual Agricultural Sample Survey),
w/o= without
Source: JICA Project Team

The economic analysis was made based on the above economic benefits and economic costs. The result is summarised as shown in Table 9.9.12, and the details are shown in Attachment-9.9.7.

Table 9.9.12 Results of the Economic Analysis of NIMP2018

Indicator	Value	Sensitivity Analysis		Cost		
				Base	+5%	+10%
EIRR	16.4%	**Benefit**	Base	16.4%	15.7%	15.1%
B/C	1.40		-5%	15.7%	15.0%	14.4%
NPV (TZS in Million)	1,468,323		-10%	14.9%	14.3%	13.7%

Notes: EIRR= Economic Internal Rate of Return, B/C= Benefit / Cost Ratio, NPV= Net Present Value
Source: JICA Project Team

Taking the above into account, it can be concluded that NIMP2018 is economically feasible with EIRR of 16.4%.

9.9.5 Indirect Benefits

Apart from the economic benefits above, there are various indirect benefits and impacts expected from implementing the NIMP2018. Major indirect benefits and impacts are described below.

(1) Income Increase and Poverty Alleviation

Based on the above financial analysis, this NIMP2018 is expected to generate on the national average net benefits as per ha or per farmer household as shown in Table 9.9.9.

This incremental financial benefit is substantial if one compares this with the annual average household expenditure of TZS 3,796,560[2]. With respect to the impact poverty reduction, more cautious approach is necessary because the population under the poverty line is typically not well endowed even in the rural agricultural setting. They owned less area of land and probably not privileged to have access to irrigated land. Therefore, these irrigation benefits may have limited impact to the reduction of poverty. However, the development of irrigation schemes brings about more production in the rural areas and invigorate the rural economy. Such stimulus should have trickle-down effect to the general population of rural areas, providing better opportunity of work, increase employment and wage levels.

(2) Export Expansion and Foreign Currency Earnings (Tanzania being Breadbasket in EAC)

In recent years, the East Africa Region is undergoing rapid expansion both in economy and population[3]. Consequently, the issue of food security of the region is being recognized as one of major concerns. Also, the per-capita income is growing so that the food preference is expected to shift to meat, vegetables, rice, and dairy products. In this general trend, Tanzania has considerable advantages against other countries due to its diverse natural endowments and ample lands still available for further cultivation. Especially with respect to rice/paddy production, Tanzania is the most potential country in the region. Table 9.9.13 below shows a forecast of rice production and demand of relevant countries by extrapolating the past trend to the year 2035. As seen there, Tanzania is practically the only country in the region that can supply substantial amount of rice.

Table 9.9.13 Rice Demand-Supply Forecast of the East Africa Region

Data Item	Supply (ton)			Domestic Demand (ton)			Domestic Surplus (ton)		
Year	2013	2025	2035	2013	2025	2035	2013	2025	2035
Burundi	26,945	93,353	106,485	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
D.R. Congo	199,651	215,213	233,202	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Kenya	81,416	84,985	94,082	580,000	1,220,486	1,803,858	▲498,584	▲1,135,501	▲1,709,776
Malawi	81,351	46,301	37,214	83,000	98,432	111,291	▲1,649	▲52,130	▲74,078
Mozambique	74,108	119,811	142,162	651,000	778,878	885,443	▲576,892	▲659,067	▲743,281
Rwanda	60,935	101,658	134,787	111,000	205,292	279,151	▲50,065	▲103,634	▲144,363
Uganda	139,100	190,299	225,737	188,000	259,315	315,187	▲48,900	▲69,016	▲89,449
Tanzania	1,426,588	2,426,422	3,527,949	1,178,000	2,140,574	3,236,585	248,588	285,848	291,364
Zambia	29,086	26,153	30,546	47,000	56,988	65,588	▲17,914	▲30,835	▲35,042
Entire East Africa							▲ 834,416	▲ 1,559,129	▲ 2,225,567

Note: All values in the above table are of "milled rice equivalent" with conversion rate of 0.65 from paddy to milled rice.
Source: Produced by the JICA Project Team based on FAO data

Tanzania's ability is beneficial not only for Tanzania itself but also to the region as a whole. Having a surplus country in the region allows the region to be protected from volatile price fluctuation of the international rice market which is caused by its unique production and supply characteristics[4].

[2] 2011/12 Household Budget Survey.
[3] The average 10-year real GDP annual growth rates of major East African countries are as follows: Kenya 5.2%, Mozambique 6.7%, Tanzania 6.7%, Uganda 6.1%, and Zambia 6.5%. Regional average population growth rate for the same period is 3.1%. Similarly, per capita GDP growth rates are Kenya 2.4%, Mozambique 3.6%, Tanzania 3.4%, Uganda 3.4%, and Zambia 3.4%. (GDP data: World Bank, Population data: FAO)
[4] In the world, rice production is concentrated in only a handful Asian countries: China, India, Indonesia and Bangladesh. The production of

In order to capture this advantage, Tanzania should make full use of irrigation development. With irrigation facilities, the productivity, cropping intensity, production stability, and crop quality are all improved. And the steady export to the neighbouring countries allows Tanzania to earn foreign currency while contributing stable food supply to the region.

The implementation of NIMP2018 enables Tanzania to add more than 500,000 ha of irrigated area by 2035. With the JICA Project Team's assumption of the improvement of rice/paddy yield from current 1.85 ton/ha of rainfed or 2.00 ton/ha of current irrigation to 5.0 ton/ha, Tanzania can expect another 1.46 million ton of rice/paddy to be produced. Part of this increase may be overlapping with the projection shown in the table above as the figures of the table are extrapolation of the past trend. If the JICA Project Team takes a conservative estimate that just a half of the amount, 200,000 ton (equivalent to approx. 308,000 ton on paddy basis) of rice could be sold to neighbouring countries like Kenya, and assumes the current international price of middle quality rice without freight charge, the possible earning of foreign currency in USD will be approximately USD 70 million. This earning would be supplemented by the savings of about 70 million ton[5] of imported rice which could be replaced by domestic production.

This potential combined earning is reasonably significant to exploit given the prospect of food situation of the east African countries. Just for the sake of comparison, the recent (2015) Tanzania the value of export and import are approximately USD 5,800 million and 14,700 million, respectively.

(3) Other Indirect Benefits

(a) Contributions to Tax Revenue

In Tanzania's tax system, major taxes are: the value added tax (VAT), which is on any market transactions, income tax, and corporate tax, which is charged on business entities. The corporate tax is less applicable in the irrigation development because production activities in agriculture are still mostly carried out by individual smallholders. As to VAT, the Tanzania government maintains a long-standing policy of VAT exemption for agricultural items with clear intention of the promotion of agricultural sector. The exemptions are quite extensive covering almost all capital goods, inputs and agricultural commodities including rice/paddy and vegetables. Therefore, improvement in tax revenue due to irrigation development is not expected in VAT either.

On the other hand, revenue from income tax is expected to increase as farmers' income should increase as they adopt irrigation farming which enables them to produce more and sell more. The current income tax rates are summarised below.

Table 9.9.14 Income Tax Rates (Presumptive Tax System)

Annual Turnover	Tax Payable when Records are Incomplete	Tax Payable when Records are Complete
Where turnover does not exceed TZS 4,000,000	NIL	NIL

these four countries amount to 67% of world production. Moreover, majority of the outputs are for domestic consumption leaving only 8 to 9% of the outputs exported to the world market. Furthermore, majority of exports is limited only to a few countries: India, Thailand, and Viet Name, exports of these countries amount to 63% of world export. Because of high concentration of countries, world rice market prices are easily affected by natural conditions and policy changes of these few countries.

[5] USD 70 million is the average of the rice import for four years from 2010 to 2013 (Source: FAO Stat)

Annual Turnover	Tax Payable when Records are Incomplete	Tax Payable when Records are Complete
Where turnover exceeds TZS 4,000,000 but does not exceed TZS 7,500,000	TZS 150,000	3% of the turnover in excess of TZS 4,000,000
Where turnover exceeds TZS 7,500,000 but does not exceeds TZS 11,500,000	TZS 318,000	TZS 135,000+3.8% of the turnover in excess of TZS 7,500,000
Where turnover exceeds TZS. 11,500,000 but does not exceed TZS 16,000,000	TZS 546,000	TZS 285,000+4.5% of the turnover in excess of TZS11,500,000
Where turnover exceeds TZS 16,000,000 but does not exceed TZS 20,000,000	TZS 862,500	TZS 487,000+5.3% of the turnover in excess of TZS 16,000,000

Source：TRA、https://www.tra.go.tz/index.php/income-tax-for-individual

As written in Section 9.9.3, farmers expect an increase in their income as they adopt irrigation farming from current rainfed or irrigation practices. The increase in income is estimated with the following assumptions:

- At present, many farmers are on the subsistent farming, generating limited level of annual income which is much below the taxable level. Therefore, it is assumed that, after the implementation of the master plan, the farmers’ income will increase by the amount of the net benefit shown in Table 9.9.9. Namely, it is TZS 6,868,323 and TZS 4,986,711 for farmers changing from present-rainfed to future-irrigation and from present-irrigation to future-improved-irrigation, respectively. In either case, the resulting annual income is in the category of the lowest taxable income: between TZS 4,000,000 and TZS 7,500,000.
- The number of affected farmers is computed by dividing the target irrigation area of wet season by the average farming area of a farm household 1.6 ha. (It is considered that the irrigation area in dry season is the reuse of part of the wet season area.)
- It is also assumed that farmers follow the “presumptive tax system” and the case of “incomplete record”. In that case, farmers will be taxed at a constant amount of TZS 150,000 per household.

Based on these assumptions, the increase in income tax revenue is estimated. The results are as shown below. It is expected that, towards the end of NIMP2018, approximately TZS 100 billion will additionally be collected from benefitting farmers.

Table 9.9.15 Estimates of Revenue Increase in Income Tax

Improvement by NIMP2018		Phase 1 (2018-2025)	Phase 2 (2026-2035)	Total (2018-2035)
From Rainfed to Irrigation	Number of Farm Household	119,143	148,714	267,857
	Expected Revenue Increase (TZS in Million)	17,871	22,307	40,179
Continuation of Irrigation	Number of Farm Household	46,231	44,574	90,805
	Expected Revenue Increase (TZS in Million)	6,935	6,686	13,621
Expected Number of Farm Household (Total)		165,374	193,288	358,662
Expected Revenue Increase (Total) (TZS in Million)		24,806	28,993	53,799

Source：JICA Project Team

Apart from the above tax revenue for the national government, there is another opportunity of tax revenue increase for the local government. It is Produce Cess, which is a major revenue source for LGAs. It should be noted, however, there has been continuing discussion in the government if the Cess is to be abolished or maintained but with reduced rates, suggesting its uncertain status in the future. Therefore, it is simply assumed that the system will remain with a low rate. In the present practice, the way the system is applied varies across localities and commodities, sometimes with a set of rates depending upon commodities, while at other times with fixed sum values per unit of measure (like 3% per market price or TZS 2,000 per bag, etc.). In this estimation, the following are assumed for simplicity:

- Given the future uncertainty, a rate of 2% of market value is assumed.
- The farmgate prices of the target crops (paddy, tomato, and onion) are assumed to be the prices to which the Cess is charged.
- The rate of 2% is assumed to be applied to the three target crops.

Table 9.9.16 Estimates of Revenue Increase of Produce Cess

Improvement by NIMP2018		Phase 1 (2018-2025)	Phase 2 (2026-2035)	Total (2018-2035)
From Rainfed to Irrigation	Increase in Sales (TZS in Million)	1,058,520	1,333,724	2,392,243
	Expected Revenue Increase (TZS in Million)	21,170	26,674	47,845
Continuation of Irrigation	Increase in Sales (TZS in million)	230,540	224,344	454,884
	Expected Revenue Increase (TZS in Million)	4,611	4,487	9,098
Expected Revenue Increase (Total) (TZS in Million)		25,781	31,161	56,943

Source : JICA Project Team

As shown in the table, an increase of TZS 57 billion is expected towards the end of NIMP2018.

In addition to the above, there will be other tax revenues such as from VAT on irrigation construction works, corporate tax on construction companies, income tax and corporate tax on milling companies, transporters and input suppliers all of which will be activated due to expanding value chain activities accompanying the production increase from irrigation farming. Especially the VAT revenue from irrigation construction works is expected significant: in Phase 1 period, TZS 692 billion, in Phase 2 period, TZS 828 billion, and for a whole master plan period, TZS 1,520 billion.

(b) Contribution to Employment Enhancement and Empowerment of Women and Youth

The progress of the irrigation development contributes to the expansion of employment in rural areas. As the production of rice and vegetables increases, local market activities are further stimulated and jobs in transport, sales and processing (like rice milling) will expand. However, it should be noted that the empowerment of women and youth does not automatically follow the market and job expansion. It is because handicaps of women and youth are often results of their limited access to production resources, uneven distribution of decision making powers, and restricted participation to discussions and meetings, all of which are typically founded on traditions and customary practices. Therefore, it is indispensable to have training and sensitization workshops to be held along with the physical development and technological capacity building. In these occasions, relevant issues on gender and youth participation should be picked up and discussed explicitly so that mind sets of rural population will effectively be adjusted.

While the mind sets and views of rural people change, the increase of farm income and resulting greater use of agricultural inputs and modern technologies will provide better incentives for young generations to stay at farming business. Also, irrigation should bring opportunities for broader range of crops to be produced enabling farmers to try different approaches in doing farm businesses. In that context, a variety of cash crops such as vegetables and fruits will be considered, which often makes women more active and participating in farming. Moreover, as farm income rises, it has been observed that farmer household will engage more in non-farm activities, diversifying their income generating sources. Such trend should also be encouraging for women and youth to find jobs and other opportunities.

9.10 Monitoring and Evaluation

In the NIMP2018, process management and the status of project effect are monitored and evaluated. Specifically, at the implementation stage of NIMP2018, monitoring and evaluation (M&E) cover implementation status of individual projects/program from all inputs to outputs, and the O&M stage mainly deals with ripple effects of projects. It is important that these M&E results are compiled as reports in a prescribed form, and improvement measures are taken as necessary.

(1) Monitoring and Evaluation of Process Management

NIMP2018 continuously and efficiently improves process management by applying the PDCA cycle method as shown in Table 9.10.1. Under NIMP2018, prepare an annual work/activity plan, execute and evaluate it, and reflect it in the plan of the next fiscal year as necessary. By repeating this process, implementation of NIMP2018 will continuously be improved. Also, in 2025, review the implementation status of NIMP2018 Phase 1 and review Phase 2 plans for 2035.

Table 9.10.1 Process Management of Annual Plan

Stage	Content of Activities
Plan	Preparation of annual activity report
Do	Implementation of projects and programs
Check	Confirmation of implementation status (physical and financial progress, etc.)
Action	Feedback the implication and lessons to the next annual activity report

Source: JICA Project Team

Also, the items to be managed in the process management are presented in Table 9.10.2.

Table 9.10.2 Summary from Inputs to Outputs of NIMP2018

Item	HC	SC
Inputs	Funds, NIRC/ZIO Staff, LGA Irrigation Staff, Contractors, Consultants, Private Investment	Funds, NIRC/ZIO Staff, LGA Irrigation Staff, Consultants, NGO
Activities	Survey, Design, and Construction	Strengthening of Organisation and Function, Capacity and Coordination
Target	Irrigation Schemes (including Agriculture Infrastructures)	NIRC/ZIO Staff, LGA Irrigation Staff, IO and member farmers
Outputs	Development of Irrigation Schemes (including Agriculture Infrastructure)	Training Participants, Technical Manuals, Training Modules, Project Activity Reports, NIRC Website

Source: JICA Project Team

To make continuous improvements by applying the PDCA cycle, it is necessary to set the targets and monitor actual results accordingly. The implementing body of process management is NIRC. NIRC confirms the implementation status of each process directly or indirectly and compiles those into annual activity report (achievement). Especially, the small-scale irrigation projects and capacity development of the irrigator's organisations, in which the LGA is responsible for implementation, NIRC as irrigation supervisory authority shall monitor and evaluate the implementation status in timely manner. And NIRC gives the appropriate improvement instruction when a large deviation (delay) from the plan is found. If improvement is still not seen, measures such as reduction and suspension of the irrigation infrastructure development projects and subject-wise improvement program shall be taken. As a result, it will be considered to allocating the remaining budget to other LGAs with good implementation status (budget allocation based on results). Based on the above, NIRC shall formulate the annual activity report (plan) for the next fiscal year.

(2) Monitoring and Evaluation of Outcomes

Indicators of monitoring and evaluation (M&E) for quantitatively confirming the achievement status of NIMP2018 are shown in Table 9.10.3. As a responsible unit, NIRC's "Planning and Monitoring Evaluation Unit" will centrally manage M&E with support from other units and division of NIRC.

Table 9.10.3 Performance Monitoring of NIMP2018

Item	Indicator	Target		Supporting Units and Divisions
		Phase 1	Phase 2	
Impact to National Level	1) Agriculture sector GDP growth rate (Annual %) 2) Reduction in rural poverty (%) 3) Reduction in food poverty (%)	6 ≤ 24 ≤ 5	- - -	Environmental Social Management Unit
Impact to Irrigation Sector (Irrigation Schemes only)	1) Irrigated area accumulated (ha) 2) Number of benefited farm households, accumulated 3) Unit yield (ton/ha) - Paddy - Tomato - Onion 4) Incremental net annual farm incomes (TZS/ha) – mixed average	700,000 400,000 5.0 40.0 10 3~4 mil.	1,000,000 600,000 5.0 40.0 10 3~4 mil.	Operation and Support Services Division
Output 1 (HC)	1) Dodoma Zone Irrigation Development Plan (ha) 2) Kilimanjaro Zone Irrigation Development Plan (ha) 3) Mbeya Zone Irrigation Development Plan (ha) 4) Morogoro Zone Irrigation Development Plan (ha) 5) Mtwara Zone Irrigation Development Plan (ha) 6) Mwanza Zone Irrigation Development Plan (ha) 7) Tabora Zone Irrigation Development Plan (ha) 8) Katavi Zone Irrigation Development Plan (ha) 9) Private Sector Commercial Irrigation Development Plan	19,812 22,274 43,329 53,605 14,450 38,189 20,241 36,221 54,000	37,549 14,102 45,766 67,069 40,232 30,131 32,149 45,112 168,000	Planning, Design and Private Sector Coordination Division
Output 2 (SC-1)	1) New establishment of RIO (nos.) 2) Workshop for district implementation system (nos.) 3) Increase in number of irrigation staff (persons) 4) Registered IOs (nos.) 5) Preparation of annual activity report (times) 6) Updates of NIRC's website (times) 7) Research on irrigation related subjects (times)	6 3 163 469 8 7 5	12 4 55 643 10 10 5	Information Communication Technology Unit
Output 3 (SC-2)	1) Development of irrigation design manuals (kinds) 2) Development of irrigation checklist (kinds) 3) Development of training modules (kinds) 4) Trainings to ZIOs/RIOs staff (times) 5) Trainings to LGAs staff (times) 6) Trainings to IOs (times) 7) Training to private firms (times)	1 1 1 4 78 78 4	1 1 1 5 104 104 5	Research and Technology Promotion Division
Output 4 (SC-3)	1) Investment by private sector (TZS) 2) Cooperation and collaboration for cross-sectoral issues (nos.)	4 4	5 5	Planning, Design and Private Sector Coordination Division

Source: JICA Project Team

Regarding the evaluation of the irrigation operational aspect, utilise research, and development study, confirm the intake planned volume, actual results and irrigation efficiency of selected irrigation schemes, and reflect it for the phase 2 plan revision. Specifically, the following study is scheduled:

Item No. SC1 (6) (d)	Water budgeting and auditing of irrigation schemes (Refer to Table 9.5.4) (comparison between irrigation plan and actual water allocation)

Also, the activities and results performed so far will be evaluated in 2025 at the end of Phase 1, for the purpose of updating activities of Phase 2 targeting 2035, considering the progress of NIMP2018 and the changes in the environment surrounding irrigation sector. In response to the above, the following study is scheduled:

Item No. SC1 (4) (e)	Mid-term evaluation and evaluation at completion of NIMP2018 (Refer to Table 9.5.4)

The tentative project design matrix (PDM) of NIMP2018 created based on the above discussion results is shown in Attachment-9.10.1.

(3) Irrigation Development Plan beyond the Year 2035

NIMP2018 sets the final target year to 2035. For further growth of the agricultural sector, continuous efforts would be placed on developing irrigation schemes after the year 2035. Here, points to pay attention in considering irrigation development beyond the year 2035 have been summarised below.

(a) The basic data and information such as comparison of plan and actual performance, problems and solutions encountered, changes of the environment surrounding irrigation through the survey on the evaluation at completion of NIMP2018 (2018-2035) will be very useful in preparation of the revision of the next national irrigation master plan.

(b) The irrigation database developed by NIMP2018 has to be regularly updated. It can be expected for the existing irrigation schemes to utilise the database for monitoring O&M status. Also, being properly maintained, the database of newly identified irrigation schemes by NIRC/ZIOs and LGA properly will be very useful for revising the next national irrigation master plan.

(c) Water demands in Tanzania will increase with population increase and economic growth after the year 2035. On the other hand, the water supply is expected to slightly increase nationwide due to the influence of climate change. The Ministry of Water and Irrigation needs to implement the next National Water Resource Master Plan targeting the year 2055 at an appropriate timing. A fundamental review of environmental flows and protected areas would be discussed by that time.

Based on the above points, the survey to formulate a basic plan of the next national irrigation master plan is scheduled to be carried out under NIMP2018.

Item SC1 (4) (f)	Formulation of basic irrigation development plan beyond 2035 (Refer to Table 9.5.4)

9.11 Possible Financial Arrangements

The NIMP2018 has identified financial requirements as follows to achieve the expected goals.

Table 9.11.1 Financial Requirements of NIMP2018

Target Cost Component	Phase 1 (2018 – 2025: 8 years) (USD in Mil.)	Phase 2 (2026 – 2035: 10 years) (USD in Mil.)	Total (2018 – 2035: 18 years) (USD in Mil.)	Total (2018 – 2035: 18 years) (TZS in Bil.)
Targets	700,000 ha	1,000,000 ha	--	--
HC	1,717	2,053	3,770	8,445
SC	23	12	35	93
Total	1,740	2,065	3,805	8,538
Converted to annual layout (/yr)	217	206	211	474

Note: These figures are without VAT
Source: JICA Project Team

As observed here, the financial requirements are rather significant. Just to place them in perspective, the few financial benchmarks are referred below.

- ASDP2 Component 1 budget (Water and Land Use Management): USD 941 million (for 5-year period until 2025) (approx. TZS 2,024 billion)
- The Government of Tanzania’s agricultural sector annual budget (ASLMs combined budget for 2015/16): TZS 401 billion (approx. USD 201 million (TZS 1,991/ USD))

In the following, an examination is attempted on possible financial arrangement, focusing first on the past financial trend and deliberating possible fund mobilisation. However, as NIMP2018 has a long-time horizon of 18 years (2018–2035), and as irrigation development is highly capital intensive and requiring substantial amount of resources upfront, such examination is inherently subject to various uncertainties.

9.11.1 Possible Future Financial Resources Available for Irrigation Development

As described in Section 2.4.4, the average public (government and DPs) expenditure in the irrigation development was estimated at about TZS 23 million for the last ten years. During ASDP1, because of the basket fund, fund flow was relatively steady, facilitating continuing expansion of irrigated land. Still this past amount of funds is just about one-tenth of TZS 217 million expected to be needed annually for the Phase 1 of NIMP2018. Therefore, it is utmost importance for the government to engage all possible fund sources to attract as much financial resources possible for the implementation of NIMP2018.

In general, possible financial resources are divided into public and private. As shown above, past development was mostly carried out by public funds.

In the second ASDP (ASDP2), which has recently been authorised by the government, irrigation development is included as one of major components receiving about 15% of expected budget. The annual average expenditure is budgeted to be USD 188 million[6] for five years. Availability of this financial resource is uncertain, if compared with the past records. One concern of ASDP2 is the possible lack of the basket fund arrangement. In ASDP1 it was a valuable arrangement for the government as it ensured a stable fund flow to various subsectors including irrigation development. However, in ASDP2, DPs are more likely to implement their stand-alone projects rather than placing their resources in a common pool. There is also a shift of focus among DPs towards agro-processing and marketing aspects

[6] Exch. rate of TZS 2,200/ USD, Total budget for Component 1 is USD 941 million for five years.

from production. Consequently, it is anticipated that the number of DPs, which continue to engage in irrigation development might be limited at least for a few years to come.

An overview of DPs' major project is given in Section 5.10. Currently, the World Bank is planning to implement REGROW project (for the period of seven years, 2018 – 2024, with USD 150 million (annual average USD 21.4 million), in which USD 27 million (annual average USD 4 million) of Component 3 is allocated to irrigation activities)[7], and if it is assumed that JICA might implement a project similar to the current SSIDP with similar level of funding of approximately USD 8 million per year, the total annual funds available for irrigation would be about USD 12 million. Still it is not sure if such level of funds is actually available. Other potential sources are African Development Bank (AfDB) and International Fund for Agricultural Development (IFAD), both of which were supporting a large-scale Bagamoyo sugarcane development during the BRN time. However, due to the delay in its implementation, they may be willing to provide financial support elsewhere. AfDB is in fact in the process of supporting irrigation development in Songwe Region as part of overall water resources development. It also plans to engage in value chain development of rice and edible oil across the country. Another possible funder is the Kuwait Fund which has been active in Tanzania in recent years. It plans to support an irrigation project in Kigoma Region (Luiche Delta) from 2018. There is also a possibility to tap financial resources in the climate change context. The government should explore the availability of funds from Green Climate Fund[8] or Global Environment Facility[9] both of which include water/ irrigation development in their portfolio of support. As such, there will be multiple donors interested in supporting irrigation development. Therefore, if at least a part of the donors are solicited into NIMP2018 implementation, it is reasonable to expect to obtain the level of resources similar to the past trend. In either case, in order to fulfil the financial requirements of NIMP2018, the government needs to persuade and convince as many DPs as possible to come together to engage in this long-term endeavour.

As to the government side of the available funds, as shown in Section 2.4.4 its share is already included in the estimated USD 23 million above. The fund is mostly included in the NIDF as a local portion. The proportion is on an average of 27% (TZS 1,488 million (approx. USD 1.0 million)[10]) for five years of 2013/14 to 2016/17, although actual percentage varies widely from one year to another. Currently, NIRC has a plan of establishing the Irrigation Development Fund which is stipulated in the Irrigation Act (2013)[11]. A draft plan was already submitted to the Ministry of Finance in 2016. Its financial projection is summarised in Table 9.11.2.

7 IDA, Project Appraisal Document on a Proposed Credit to the United Republic of Tanzania for a Resilient Natural Resource Management for Tourism and Growth Project (September 7, 2017)

8 · A fund for supporting reduction of greenhouse gases (mitigation) and addressing impacts of climate change (adaptation) in developing countries, (MoFA HP: http://www.mofa.go.jp/ic/ch/page1we_000106.html)

9 An international multilateral funding mechanism set up in 1991, previous to the UNCED (1992), with a view to contributing to the solutions to global-scale environmental problems, (MoFA HP: http://www.mofa.go.jp/policy/un/pamph96/global.html)

10 Exch. rate of TZS 1,541/USD (avrg 2006-2016)

11 Irrigation Development Fund (TDF) is a fund proposed together with the establishment of NIRC. It is considered that such a fund is necessary instead of NIDF and DIDF, which were dependent upon a basket fund, for steady and committed irrigation development.

Table 9.11.2 Irrigation Development Fund Financial Projection

No.	Fund Source	Financial Projections (TZS in Million)									
		2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26
1	Irrigation Service Fees	21,791	28,928	40,240	50,415	66,268	72,273	85,208	89,040	112,259	117,279
2	Fees on Irrigators Organisation Registration	79	113	153	194	235	275	316	356	397	438
3	Government Budget	35,370	42,444	50,933	61,119	73,343	88,012	105,614	126,737	152,085	182,501
4	Others (NIRC's revenue)	1,161	3,755	4,147	4,592	4,652	5,608	6,204	6,853	7,531	8,283
	Total	**58,401**	**75,240**	**95,473**	**116,320**	**144,498**	**166,167**	**197,342**	**222,986**	**272,271**	**308,501**

Source: NIRC, 2016 January, Operation Manual of Irrigation Development Fund

About 50% to 60% of the projection is supposed to come from the government (Item 3 in Table 9.11.2) which in turn means either from government general budget or DPs funds. Note also that this government fund is set to grow 20% every year starting from TZS 35,370 million (approx. USD 15 million), reaching at TZS 308,501 million in 2025/26 (approx. USD 130 million). This projection might be too optimistic in comparison with the past records. The projection of the Irrigation Service Fees seems also slightly overestimated despite of the practical assumptions such as the yield, market prices and the rate of collection to be set as 5%, because it assumes rather immediate start of collection. As such the plan of IDF has a few less realistic aspects, it clearly shows the importance of aggressive financial mobilization, like the rapid expansion of resources is essential for achieving the targets of NIMP2018.

The present Tanzanian government sets high priority in the "industrialisation" of the country, which has been long aspired by the Tanzania Development Vision (TDV) 2025. In order to achieve the goals, the government has chosen to focus on a few major investment projects. This focus would continue at least until 2025, during which no notable changes will take place in the policies of irrigation development. Based on the above analyses, it is considered that the government would be able to mobilise USD 150 million annually for the implementation of NIMP2018.

Apart from the above fund sources, it is also valid to include contribution of irrigation beneficiaries. Conventionally, farmers who will benefit from planned irrigation schemes are supposed to contribute 20% of the construction costs either in cash or kind. NIMP2018 maintains this convention. On the other hand, the Irrigation Act (2013) recommends individual beneficiaries to pay 5% of their harvested value to the irrigators' organisation as a fee for O&M. Moreover, the Irrigation Regulation (2015) stipulates that of the 5% of the harvested value to be collected, 75% should be used for O&M while the rest of 25% for funds for future irrigation development. However, it is proposed in NIMP2018 that this fee should be increased to 10%, out of which 5% goes to O&M while the other 5% is to be collected and used for future irrigation development. Such an arrangement can reduce the burden of the government financial support to irrigation development. Based on the identified net benefits per hectare of irrigation crop production, the 10% fee could generate TZS 420,000/ha for the improvement of rainfed to irrigation farming (TZS 312,000/ ha for current irrigation to improved irrigation). Multiplying this inflow of funds to the expected development area of Phase 1 (248,121 ha (only those improved from rainfed to irrigation)) can generate TZS 104,210 million (USD 46 million) at the end of Phase 1. Although this inflow does not match to the needed annual investment, even half of the inflow surely eases financial stress of the government and other stakeholders interested in irrigation development.

On the side of private sector, several notable initiatives have been attempted in the past: Kilimo Kwanza, Southern Agriculture Growth Corridor of Tanzania (SAGCOT), and Big Results Now (BRN). The importance of Public and Private Partnership (PPP) is described in the next section. In order to attract a greater number of private players, it is fundamental to apply the PPP arrangement with flexibility. PPP should be modified to find out an optimum combination of public and private contributions on case-by-case bases. The combination should be deliberated to allow private sector to join with less risk and more returns so that they are willing to consider the possibilities. In reality, however, despite the high expectation of private investments for irrigation development, as shown in Section 4.13, the outcomes so far are not impressive. Major constraints are land titles, agreement with local stakeholders and prolonged administrative procedure. Because these are challenges beyond irrigation and even agriculture, it is hoped that the government will as a whole accelerate mitigating the constraints. Given the prospect that such mitigations would take a long time, it is reasonable to assume the safety side in the forecast of available resources from the private sector.

There are some movements for improving financial access in agriculture and water sectors. One such activity is the Financial Sector Deepening Trust (FSDT) sponsored by some DPs[12]. This has started as project facilitating financial sector reform. But now, it has extended its scope to include easing financial access for irrigation and rural finance with plans of setting up special funds or financial facilities. Agricultural financial conditions are improving as the Tanzania Agricultural Development Bank (TADB) was created. TADB is recently considering to engaging in a few irrigation development projects along the support to agribusinesses in value chain[13]. Such improving trend seems to continue in the future, still it is not yet certain when more concrete outcome such as the plan of FSDT will be materialised or any other mechanisms become available for sizable investment such as irrigation development. Therefore, conservative side needs to be taken for estimation of private sector financial contribution to irrigation development.

9.11.2 Prospect of Probable Financial Mobilization

Based on the deliberation above, there will be considerable effort needed for the government to persuade DPs, attract more private actors and ensure IO's positive engagement for the irrigation development. Although it may be too ambitious, one possible financial layout of NIMP2018 implementation is suggested below. The table shows the prospect of financial demand and supply for NIMP2018.

Table 9.11.3 Annual Financial Mobilization during NIMP2018 Period (USD in Million)

Financial Demand and Supply (Annual Amount)		Phase 1: 8 years (2018 – 2025)	Phase 2: 10 years (2026 – 2035)		
			26 - 28 3 years	29 - 31 3 years	32 - 35 4 years
Financial Demand (Annual)		**217.0**	**206.0**	**206.0**	**206.0**
Public	Government	52.0	41.0	41.0	41.0
	DPs	100.0	85.0	70.0	55.0

12 SIDA、DANIDA、CIDA、BMGF、UKAID, etc.
13 https://www.tadb.co.tz/products-services/infrastructure-loans/

Financial Demand and Supply (Annual Amount)		Phase 1: 8 years (2018 – 2025)	Phase 2: 10 years (2026 – 2035)		
			26 - 28 3 years	29 - 31 3 years	32 - 35 4 years
Private	IO contribution	10.0	10.0	20.0	20.0
	Plantation Investment	40.0	40.0	50.0	50.0
	Large scale PPP	10.0	20.0	25.0	25.0
	Small scale PPP	5.0	10.0	10.0	15.0

Source: JICA Project Team

In the table above, NIMP2018 period is divided into two parts. During the first eight years of the Phase 1, major parts of the funds come from DPs. This estimate is derived from reflection that (1) financial drive of ASDP2 will enable to bring about some parts of the proposed USD 188 million, but (2) private sector funds, either large-scale plantation investments or some types of PPP arrangement are not readily available in the near future. In the latter half, ten years is divided into 3- to 4-year periods during which the involvement of private sector is assumed to improve gradually. Namely, from 2026 the large and small PPP arrangements will start to be used more often. Obviously, this scenario is optimistic. Still it is necessary if the irrigation development is seriously taken as one of major investment goals of the country.

9.11.3 Possibility of PPP in Irrigation Development

At this moment, it is less likely that private sector involvement in irrigation development is soon expanding to a remarkable level. However, if so, the government should double the efforts to reduce the constraints hampering the private sector involvement. One possible measure is to contrive flexible application of PPP arrangement to irrigation development.

(1) Flexible application of PPP arrangement to irrigation development[14]

In general, it is hard for private companies to undertake an irrigation development project by itself. This is because a project typically requires large initial costs and in order to secure the returns for a short period of time which is usual practice of a private firm, it needs to set a high user fee to cover both O&M costs and the return to investment. Therefore, one approach to reduce such a constraint is to adjust the scope of the firm and lower the hurdle of the involvement. This approach has already been recognized and put into a law and other policy instruments by the government[15]. Now it is only a matter of application to irrigation development. There are a few possible patterns of the PPP arrangement for irrigation development[16]. The patterns and actual project of such a pattern are given below.

- Build, Operate and Transfer (BOT): Private companies construct facilities and operate them for a certain period of time until they recover the investment and transfer the ownership to either the government or irrigators' organisations. (Example: Chiansi Project, Zambia, 2,500 ha)
- Management contract: Private companies lease an irrigation scheme, enter contractual

[14] This subsection is mostly drawn from a document: World Bank and PPIAF, 2016, How to Develop Sustainable Irrigation Projects with Private Sector Participation.
[15] PPP Policy (2009), PPP Act (2010), PPP Regulation (2011), and PPP Procurement Act (2011)
[16] How to develop sustainable irrigation projects with private sector participation (Public-Private Partnership Toolkits), World Bank 2016

relationship with farmers and keep operating the scheme until the lease is over (or renew the lease). (Example: Muhuri Irrigation Project, Bangladesh, 17,000 ha)

- O&M contract: Private companies are employed to carry out O&M of a scheme. (Example: Megech-Seraba Irrigation Scheme, Ethiopia, 4,000 ha)

In any of the arrangements above, there should be certain kind of government support like subsidies, guarantees, guidance, or supervisions. The following are some examples of such support:

- Part of the construction costs is financed by the government.
- Part of the production inputs is exempted from taxes.
- Part of user fees is subsidized by the government.

(2) PPP application to small-scale irrigation development

Because Tanzania has many small irrigation schemes with projected irrigation area of less than 500 ha, the application of the above PPP approach should be extended to such schemes. In the past, these small schemes are left to LGA's responsibility for their development. However, what often happened was LGAs whose financial resources are heavily dependent upon the national government (DIDF, DADG or LGDG) could not secure sufficient funds, hence, unable to achieve steady and speedy completion of development. In order to overcome such restrictions, LGAs (or NIRC) need to promote PPP arrangements between farmers groups and private companies. Applying some types of arrangement and with certain risk-taking by LGA/NIRC, farmers and the companies should jointly be able to get loans from banks, implement proper facility management and ensure benefits from the scheme. However, some preconditions such as capacity building of farmers and proper supervision by the government need to be met for this approach.

9.11.4 Necessary Measures to Accelerate Financial Resource Mobilisation for Irrigation

Financial resource is the most crucial issue of irrigation development. The government should make every effort and take all necessary actions to overcome this issue. The following are recommended for the actions.

- NIRC/MoA should make maximum effort to convince the Ministry of Finance and top decision makers of the government to at least maintain the level of budget similar to the past records, and whenever possible to increase the level.
- Acceleration and simplification of land title transfer: The government should accelerate the currently ongoing land planning and registration operation, upgrade Tanzania Investment Centre (TIC)'s land bank, implement fast-track handling for major investment projects as done in the Big Results Now (BRN).
- To make effective and transparent consultation with local stakeholders: The government should formalize the process of close consultation with stakeholders and set-up of conflict resolution committee.
- To carry out flexible and effective PPP arrangement for irrigation development, conduct necessary studies and implement pilot projects.
- To create a special purpose fund for irrigation development based on farm land tax and others:

Land tax should be amended to transfer those imposed to farm land to a special purpose fund for irrigation and other agricultural infrastructure.

- To make LGAs more active in enhancing linkages between farmers groups and private sector.
- To strengthen and build the capacity of irrigators' organisations.
- To facilitate farmers groups in obtaining the Certificate of Customary Right of Occupancy (CCRO), or acess to financial institutions such as the Tanzania Agricultural Development Bank (TADB).

9.12 Risk Assessment and Mitigation Measures

(1) Possible Risks

Possible risks in relation to the implementation of the NIMP2018 are summarised in Table 9.12.1.

Table 9.12.1 Possible Risks Associated with NIMP2018

S/N	Risk	Contents
(a)	Government priority of irrigation development drops.	Among government policies, irrigation development receives less priority and hence suffers stagnation of budgets.
(b)	NIRC and other irrigation- related government organisations undergo significant or frequent re-structuring.	Irrigation-related organisations or institutions (e.g., mandates or scope of responsibility of NIRC) are changed so dramatically or so frequently that steady implementation of NIMP2018 will be disrupted.
(c)	Significant alterations of irrigation-related laws and regulations.	Irrigation-related laws such as laws on water resources management or on land use are so amended that irrigation development is adversely affected.
(d)	Shortage of financial resources for irrigation development.	Irrigation development will be delayed due to shortage of financial resources.
(e)	Shortage of human resources for irrigation development.	Irrigation development will be delayed due to shortage of manpower and human resources (both in public and private sectors).
(f)	Inadequacy of monitoring and evaluation of the irrigation master plan.	Monitoring and evaluation of NIMP2018, which is the foundation for proper implementation of the plan suffers from inadequate operation, management or financial and/or human resources. Hence, it becomes difficult to keep proper management of NIMP2018.
(g)	Lower than expected involvement of private sector.	Progress of irrigation development is hampered by limited participation and investment contribution of private sector.
(h)	Capacity development of irrigators' organisations goes so slow that irrigation facilities are left unattended without proper O&M.	Due to lack of proper O&M, many irrigation facilities are left and not-functioning. Therefore, irrigation development stagnates.
(i)	Social and environmental conditions surrounding irrigation development deteriorate.	Socio-environmental conditions around irrigation development deteriorate. For example, conflicts surge between livestock keepers and crop farmers, or resistance of neighbouring residents intensifies against irrigation water use.
(j)	Adverse effects of global warming.	Effects of global warming signify the changes of natural conditions at a pace greater than expected. For example, the patterns and amount of rainfall become different so that originally projected irrigation potential becomes invalid.

Source: JICA Project Team

(2) Mitigation Measures

(a) Government Priority of Irrigation Development Drops

Because the Tanzanian government upholds the poverty reduction as one of the key policy priorities, it is less likely that irrigation development which is a major component of agricultural and rural development will receive reduced priority in the future. On the other hand, however, as the present administration strongly advocates industrialisation of the country, consideration, and budget allocation to agricultural sector might be lessened. In that case, NIRC and MALF should intensify their efforts to increase the budget. The Ministry of Finance should be able to persuade by such reasons as irrigation development can facilitate rice and horticulture production, hence raise farmers' income (improvement of purchasing power of domestic market) and also contribute to enhancement of agro-processing and foreign earnings by expanding exports.

(b) Significant or Frequent Re-structuring of NIRC and Other Irrigation-related Government Organisations

In the past, NIRC had been subject to the change of affiliation between the ministries of Agriculture and Water. Similar change may take place in the future. Also, the current zone-based administrative network may be re-arranged to the formally accepted region-based network. In any event, NIRC should immediately take actions to mitigate the adverse impacts and to return to steady administrative process as soon as possible. One effective countermeasure may be to expand the level of delegation of irrigation development to LGAs.

(c) Significant Alterations of Irrigation-related Laws and Regulations

To begin with, NIRC should keep close and routine relationship and communications with other ministries and organisations, which have authorities on relevant laws and regulations. Through such communications, NIRC should be able to negotiate with the concerned organisations to minimise negative effects caused by amendments of the laws. Should such amendments happened, NIRC should take immediate actions to assess the possible effects and provide necessary countermeasures to alleviate them.

(d) Shortage of Financial Resources for Irrigation Development

Shortage of financial resources directly and negatively affect the pace and scale of irrigation development. Therefore, NIRC should make every possible effort to secure necessary resources, including defending government budget, expanding DPs contributions, and attracting private sector, etc. Also, it should work hard to find new found sources such as the establishment of the Irrigation Development Fund, new PPP arrangements, and enhancement of IOs' access to financial sector. However, if financial shortage becomes eminent, NIRC should revise evaluate the significance and NIMP2018 accordingly.

(e) Shortage of Human Resources for Irrigation Development

Likewise, the NIMP2018 implementation could be delayed due to 1) underemployment of technical staff, and 2) lack of practical experience among irrigation engineers and technicians. This situation may cause a delay in implementing studies, designing, supervision, and capacity development of farmers (IOs). NIRC should promote 1) increase of technical staff in the public sector in accordance with NIMP2018 progress, 2) further involvement of local engineering firms and contractors in irrigation projects, and 3) practical training (OJT) along the project cycle guided by the CGL.

(f) Inadequacy of Monitoring and Evaluation of NIMP2018

Stable and continuous M&E is indispensable for effective implementation of NIMP2018. NIRC should assign appropriate number and qualified staff at due offices. It should also maintain necessary budget for data collection, assembling, and reporting. Monitoring results should be circulated to management of NIRC, Ministry of Agriculture, Ministry of Water and other relevant organisations. In order to lower the costs, coordination with other agricultural data systems such as the annual sample survey and ARDS should actively be explored. If work needs to be reduced by shortage of budget, adjustments should be made immediately to narrow down the scope and focus of data so that the system can maintain the continuity of monitoring.

(g) Less Involvement of Private Sector

NIMP2018 assumes considerable level of private sector involvement. However, such involvement may take some time to come by because it will be affected by general business and investment environment of the country. Still NIRC should make effort to accelerate the process by actively engaging in improving the environment together with other ministries. For its own part, NIRC should widely share information relevant to irrigation. Furthermore, NIRC, without delay, should carry out necessary study on the effective PPP arrangement for irrigation development, and legalize the approach with close consultation with private sector.

(h) Slow Progress in Capacity Development of Irrigators' Organisations

Capacity development of irrigators' organisations is crucial. While ASDPs aims at strengthening capacity of farmers' group under one of the major components, NIRC should carry out training to and monitoring of irrigators' organisations with close collaboration of LGA's cooperative officers. On the other hand, the zonal irrigation offices should distribute the CGL to all LGAs and irrigators' organisations, and make sure they are referred to in daily operation. It may also be helpful to consider contracting the O&M services to private entity as a type of PPP arrangement.

(i) Deterioration of Social and Environmental Conditions around Irrigation Development

In order to cope with this challenge, NIRC should properly conduct the environmental and social assessment study with which stakeholders identify likely problems and agree with possible countermeasures. Prior to any development activities, sufficient consultation with full information should be conducted to all concerned parties including farmers and livestock keepers. When any serious issue emerges after operation begins, there should immediately be meetings for discussion and conflict solving among relevant parties. Especially, if the issue is related to water use, the water basin board should be involved to ensure proper dealing of the issue.

(j) Adverse Effects of Global Warming

If negative influence of global warming appeared sooner than expected, NIRC should return to NIMP2018 and examine the effects such as changes in irrigation potential (area, development timing and scale) and revise the plan appropriately.

Chapter 10 Environmental and Social Considerations

10.1 Environmental Framework and Environmental Impact Assessment

10.1.1 Legal Framework Associated with Environmental and Social Considerations

(1) Legal Framework

The policy and legal framework for environmental management in Tanzania intends at providing the opportunity for legislative enforcement in the processes for compliance and adherence by government authorities mandated in promoting and enhancing the sustainable management of the environmental resources for the benefit of human life in Tanzania. The policies and legislations relevant to the National Irrigation Master Plan 2018 (NIMP2018) implementation and environmental and social considerations are summarised in Table 10.1.1.

Table 10.1.1 Legal Framework and Associated Legislations

Sector	Policy	Legislation	Administering Authority
Environment	National Environmental Policy (1997)	Environmental Management Act No. 20 of 2004 Environmental Impact Assessment and Audit Regulations, GN 349 of 2005 and Strategic Environmental Assessment Regulations, GN 348 of 2008	Vice President's Office, Division of Environment (VPO-DOE), National Environment Management Council (NEMC)
Land and Land Use	National Land Policy (1995)	Land Act (1999) Land Regulations (2001) Village Land Act (1999) Land Acquisition Act (1967) Land Use Planning Act (2007) Rural Farmlands Act Chapter 22 Local Government District Authorities Act (1982) Protected Places and Areas Act (1969) Public Lands (Preserved Areas) Act (Ordinance 12 of 1954)	Ministry of Lands, Housing, and Human Settlements, President Office- Regional Administration and Local Government (PO-RALG)
Agriculture	Agricultural and Livestock Policy (1997) National Irrigation Policy (NIP) (2010)	Pesticides Control Regulations (1984) Industrial and Consumer Chemicals (Management and Control) Act (2003) National Irrigation Act (2013)	Ministry of Agriculture, Ministry of Livestock and Fisheries
Livestock	Livestock Policy (2006)	Fisheries Act (2003) Fisheries Regulations (2005) Grazing Land and Animal Feed Resources Act No. 13 (2010)	Ministry of Livestock and Fisheries
Natural Resources and Tourism	National Forests Policy (1988) Wildlife Policy (1998)	Plant Protection Act (2002) Ngorongoro Conservation Areas Act, Chapter 284 Forest Act No. 14 (2002), National Parks Act (1992) Wildlife Conservation Act No. 5 (2009)	Ministry of Natural Resources and Tourism
Water	National Water Policy (2002)	Water Resources Management Act (2009) Water Miscellaneous Laws Amendments (1999)	Ministry of Water and Irrigation (MoWI)

Source: The SESA for the NIMP2002 and the NIP, 25 April 2011 supplemented by the JICA Project Team

To provide legal support to the institutional framework in furnishing their environmental management roles, the below three key national legislations are in place:

i) Environmental Management Act (EMA), No. 20 of 2004;
ii) Environmental Impact Assessment and Audit Regulations, 2005; and
iii) Strategic Environmental Assessment (SEA) Regulations, 2008.

(a) Environmental Management Act 20, 2004

According to the Part VII of EMA, any proposed laws, national policies, strategies, plans, or undertakings, be accompanied by a SEA to assess the likely effects of the proposal on the sustainable management of the environment. Furthermore, Section 105, Subsection (1) emphasizes on undertaking SEA for the identified mineral or petroleum resource before specific details are planned or a hydro-electric power station is planned or a major water project is planned (such as irrigation project with a dam construction), the ministry responsible for mining, energy, or water shall carry out a SEA.

(b) Relevance to Irrigation Policy and Act

One of the objectives of the National Irrigation Policy, 2010 and Act 5, 2013 is: to mainstream cross-cutting and cross-sectoral issues such as gender, human immunodeficiency virus/acquired immune deficiency syndrome (HIV/AIDS), environment, health, land, and water in irrigation development. In response to the policy requirement under this objective, the following environmental and social considerations are discussed under cross-cutting issues in Table 10.1.2 and Table 10.1.3, respectively.

Table 10.1.2 Irrigation Policy and Environmental and Social Concerns

Issues	Policy Objectives	Policy Statements
Environmental and Social Considerations		
・Irrigation can lead to negative environmental impacts. These may result right from the initial stage of construction, rehabilitation activities, or from crop cultivation and irrigation practices. ・They can affect water quality, sanitation, and erosion and create water use conflicts through reduction in downstream water flows, which sometimes neglect consideration of environmental flows. ・Inappropriate water use practices and the resulting degradation threaten the sustainability of ecosystem, human health, food security, and productivity; and constraint investment in various social and economic sectors. ・Inappropriate land use practices can result into accelerated run-off, reduced groundwater recharge, soil erosion, and increased sediment transported by rivers and silt accumulation in reservoirs and irrigation systems.	To have irrigation systems which are environmentally sound.	・To ensure that environmental issues are addressed in all irrigation interventions in accordance with the EMA 2004; ・In collaboration with non-state actors, promote irrigation development in a way that protects and conserves water and land sources; ・Establish mechanism for pollution control in irrigated agriculture; and ・In collaboration with the ministry responsible for agriculture, promote and ensure proper land use practices.
Gender Considerations		
・Women play major roles in rural economic development especially in developing and practising irrigated agriculture but are hampered by low level of social status in the community, illiteracy, low entrepreneur	To have active and effective participation of both women and men in irrigation development.	・Encourage a fair representation of both women and men in irrigators organisations; ・Promote effective participation of both women and men in initiation, planning,

Issues	Policy Objectives	Policy Statements
skills, inadequate access to productive resources and services. ・ The concept of equity access to water or irrigated lands and decision making is a challenge which has to be addressed. Participation of both women and men in irrigation development will be encouraged to include the most vulnerable groups.		implementation, and operation and maintenance of irrigation schemes; ・ Facilitate awareness raising, training, and empowerment of women to actively participate at all stages of irrigation development; and ・ Ensure that women and vulnerable groups have equal access to water, land, productive resources, and support services for irrigation development.

Source: NIP 2010

Table 10.1.3 Irrigation Act and Environmental and Social Considerations

Description Relevance to Environmental and Public Health (Section 51)
(1) The act requires the commissioner to ensure that all irrigation developments are integrated with other natural resources development and management activities such as catchment management in order to protect the environment.
(2) Any person who washes articles in or otherwise pollutes or causes to be polluted any irrigation works shall be guilty of an offence and upon conviction, shall be liable to a fine not less than one million or to imprisonment for a term of not less than one year or to both such imprisonment and fine.
(3) Without prejudice to the generality of the foregoing, the commission, in collaboration with other competent authorities in environment and health, shall: a. Carry out such other activities and take such other measures with regard to irrigation as may be necessary or expedient for the better protection of the environment and human health; b. Ensure compliance to the environmental protection requirement during planning, implementation, and operation stages of irrigation schemes; c. Ensure that unacceptable environmental impacts are avoided and that features such as high water tables, salinity, and erosion are monitored; d. Ensure that designs of irrigation schemes take into consideration safety measures for flood control and other natural disasters; e. Prohibit the use of such chemicals, pesticides, and other substances as may be specified on any land under irrigation farming; f. Control the grazing of livestock in irrigation and drainage areas and river banks of rivers supplying water to an irrigation scheme; g. Provide for the environmental standards to be adhered by the irrigators in the schemes development; and h. Ensure that all irrigators comply with other written laws governing the environmental protection and good agricultural practices.
(1) For purposes of environmental protection, local government authorities, and other stakeholders shall: a. Ensure that all irrigators comply with the directions requiring them to protect the environment within and in the vicinity of the irrigation areas; and b. Ensure that all irrigators and other stakeholders do not undertake interventions detrimental to the environment in the irrigation areas.

Source: National Irrigation Act 5, 2013

(2) Administrative Framework

(a) Administrative Framework for Environmental and Social Considerations

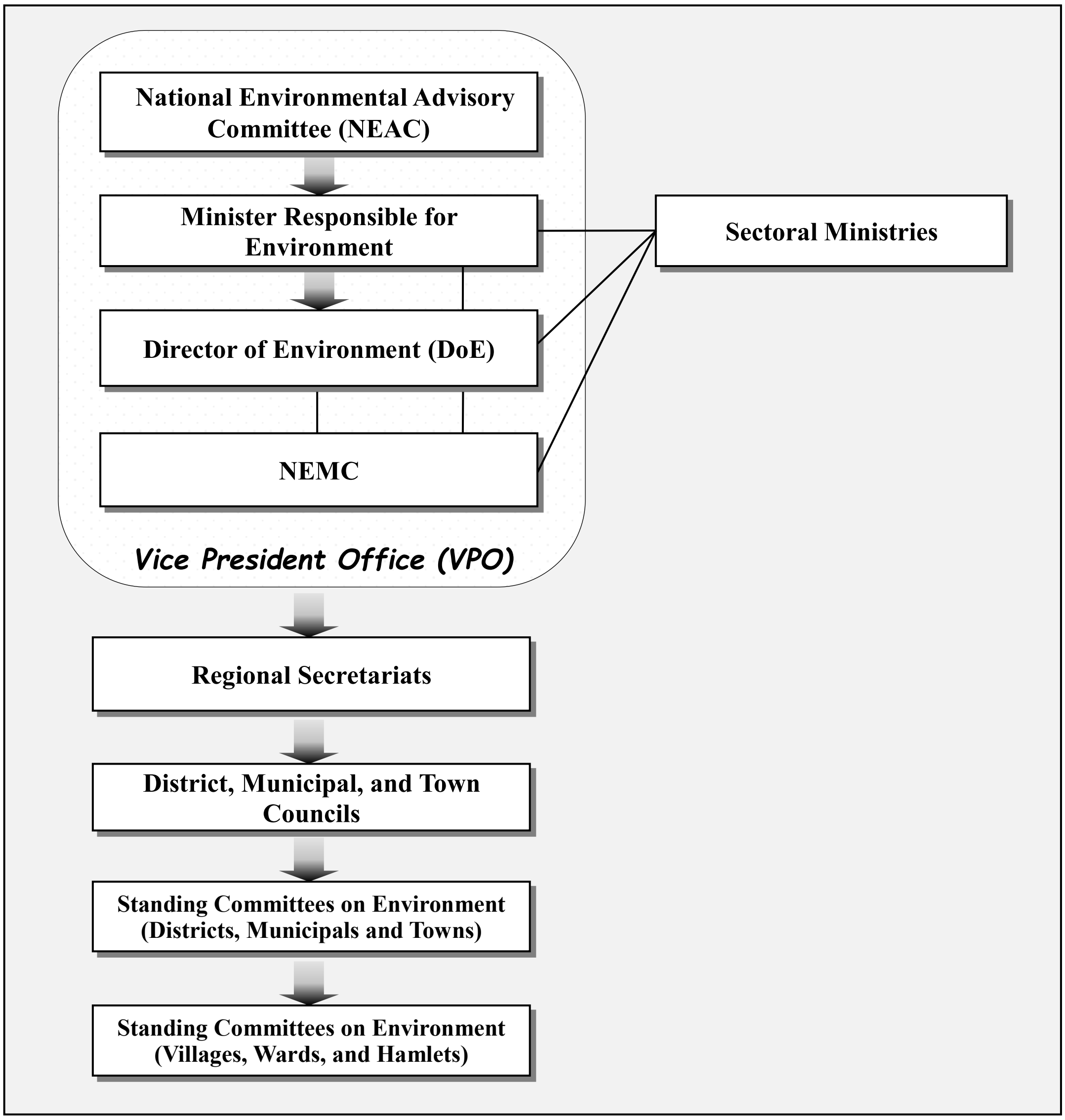
The Minister of State, Vice President's Office - Environment is responsible for the environmental issues such as monitoring of environmental planning, environmental monitoring and management as well as legal aspects on environmental and social considerations throughout the country. The summary of administrative and institutional framework for the environmental management in Tanzania is described below and shown in Figure 10.1.1.

1) National Environmental Advisory Committee

This is the national advisory body to the minister for environmental issues related to the environmental management. The body is composed of experienced environmental experts drawn from the public and private sectors as well as the civil society.

2) Minister Responsible for Environment

The minister bears the overall responsibility for matters relating to the environment including articulation of the policy guidelines necessary for promotion, protection, and sustainable management of the environment.



Source: JICA Project Team

Figure 10.1.1 Administrative Framework for Environmental Management in Tanzania

3) Director of Environment (VPO-DOE)

The director is responsible for coordination of various environmental management activities being undertaken by other agencies and promotes integration of environmental management in developing policies, plans, strategies, programs, projects, and undertakes strategic environmental assessment with a view to ensure proper management and rational utilization of the environmental resources on a sustainable basis for improvement of human life quality. The director is also responsible for providing technical advice on matters related to environmental management in the country and international agreements and conventions and monitor and assess activities carried out by relevant agencies to ensure that there is no environmental degradation.

4) NEMC

The council was established with the objective of undertaking enforcement, compliance, review, and monitoring of the environmental impact assessment, facilitate participation in environmental decision making, supervision and coordination of issues related to environmental impact assessment.

5) Sector Ministries

To facilitate the cross-sectoral coordination of the environmental matters, each sectoral ministry is required to establish the sectoral environmental section. The sections at the ministry level have to ensure compliance with the Act, implementation of the sectoral environmental matters and submission of report and liaise with the Director for Environment on all corporate matters related to the environment.

6) Regional Secretariat

At the regional level, the regional secretariat is responsible for coordination and provision of advice and liaise with the Director of Environment on enforcement and implementation of environmental matters. To furnish this role, the act requires every region to employ and have in place the Regional Environmental Management Expert who is appointed by the minister responsible for regional administration.

7) Local Government Authorities

At the district, municipal, and town councils there are Environmental Management Officers with the role of: ensure the enforcement of the act, advise the environmental management committee on the related matters at the geographic reach, promote environmental awareness, gather and manage information on the environment, and utilization of the natural resources, prepare reports on the status of the local environment, monitor preparation, review, and approval of the local environmental impact assessment, report to the Director of Environment and the Director General on the implementation of the Act.

8) Standing Committees on Local Government Authorities

For enhancement of the horizontal coordination across the environmental related sectors, the Environmental Management Act recognizes the Standing Committees on Urban Planning and Environment established under the Local Government (Urban Authorities and District Council) Act.

9) Standing Committees in Townships, Wards, Villages, and Hamlets

At the lowest level of the government, to ensure the completeness of the environmental management architecture from the national to the local level, the Environmental Management Act recognizes the Standing Committees Economic Affairs, Works, and Environment of a township established under the Local Government (District Councils and District Authorities) Act.

(b) Regional and International Agreements and Conventions

In order to protect the environment and ensure sustainable development, Tanzania is affiliated with many international agreements, conventions, and protocols. Some of them seek to avoid and reduce potential transboundary environmental impacts. Table 10.1.4 gives a summary of the Agreement and Convention related to SEA of NIMP2018.

Table 10.1.4 Agreements and Convention Related to SEA of NIMP2018

S/N	Regional Agreements and Conventions	Priority
1	East African Community Treaty	
2	Lake Victoria Basin Commission's Protocol	High
3	Southern African Development Community, 2003	
4	Nile Basin Initiative, 1990	High
S/N	**International Commitments/ Agreements (signed and ratified)**	**Priority**
1	UN Framework Convention on Climate Change (New York, 1992)	High
2	World Meteorological Organisation's Convention (Washington, 11 October 1947)	
3	Convention for the Protection of the World Cultural and Natural Heritage (Paris, 1972)	
4	Kyoto Protocol aimed at fighting global warming was entered into force in 2005	
5	Ramsar Convention for the Internationally Important Wetlands Especially as Waterfowl Habitats (1971)	High
6	Basel Convention on the Control of Transboundary Movements of Hazardous Waste and Their Disposal (Basel, 22 March 1989)	
7	Convention on the Environmental Impact Assessment in a Transboundary Context (EPS, Finland, 1991)	High
8	Stockholm Convention on Persistent Organic Pollutants (22 May 2001; has not come into force yet)	
9	Convention on Biological Diversity (Rio de Janeiro, 1992)	High
10	Convention on the Protection and Use of Transboundary Watercourses and International Lakes (Helsinki, 1992)	
11	Convention on International Trade in Endangered Species of Wild Flora and Fauna (Washington, 1973)	
12	Aarhus Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters (1998)	
13	Rio Declaration on Environment and Development (UN Conference, 1992)	
14	UN Convention to Combat Desertification, 1997	High

Source: BICO (2006), MTB/VPO/2004/2005/09 modified by the JICA Project Team

10.1.2 Environmental Impact Assessment and Environmental Audit

According to the Environmental Management Act 20, 2004, the Environmental Impact Assessment (EIA) and Environmental Audit (EA) are defined as the systematic examination of the environment to determine whether or not the program or project will have any adverse impacts on the environment. As described in the First Schedule of EIA (the list of projects requiring EIA (mandatory list) and Audit Regulations in 2005, most of irrigation scheme project requires EIA in the preparation phase. However, as shown in Figure 10.1.2, EIA is not always required in some cases of Small-scale Irrigation Development Project (SSIDP), but depending on the type of project and evaluation resulted by the screening process. On the other hand, according to the report on Environmental and Social Management Framework (ESMF) for Agricultural Sector Development Program Phase 2 – Agricultural Sector Development Program Phase 2 (ASDP2-ESMF), Agricultural Sector Development Program Phase 2 – Big Results Now (ASDP2-BRN) project is assigned to Environmental Risk Assessment Category B and triggers the World Bank (WB) Safeguard Policies that subsequently will apply to the sub-project activities funded under the ASDP2-BRN project. However, the mandatory procedure of Environmental and Social Impact Assessments (ESIAs) and Resettlement Action Plans (RAPs) for most of the sub-projects funded by the first phase ASDP were not adequately done nor submitted to the NEMC for approval. The reason[1] is that district officers were assessed to have limited technical capacity to address the issues of environmental and social safeguards requirements. Lack of or little budgetary resources to support the staff in their work is cited as the main cause of lack of or low knowledge and experience relevant to carrying out environmental analyses and designing mitigation measures for ASDP subprojects.

<table>
<tr><th colspan="2" rowspan="3">List of Projects and Type* Concerned with Irrigation Scheme Project

* First Schedule of EIA and Audit Regulations, 2005</th><th colspan="3">Preparation Phase</th><th>Project Implementation Phase</th></tr>
<tr><th colspan="2">Screening Process</th><th rowspan="2">Full EIA</th><th rowspan="2">Audit</th></tr>
<tr><th>Screening</th><th>Preliminary Environmental Assessment</th></tr>
<tr><td colspan="2">Type A
Water Management Project for Agriculture
(Drainage, Irrigation)</td><td>Mandatory</td><td>-</td><td>Mandatory</td><td>Mandatory</td></tr>
<tr><td colspan="2">Type A
Agricultural Program necessitating the Resettlement of Communities (e.g., dam construction)</td><td>Mandatory</td><td>-</td><td>Mandatory</td><td>Mandatory</td></tr>
<tr><td colspan="2">Type A
Water Supply Project
(Canalization of water course, diversion of normal flow of water, and abstraction and utilization of ground and surface water)</td><td>Mandatory</td><td>-</td><td>Mandatory</td><td>Mandatory</td></tr>
<tr><td colspan="2">Type A
Multi-sectorial Projects
(River basin development and watershed management projects)</td><td>Mandatory</td><td>-</td><td>Mandatory</td><td>Mandatory</td></tr>
<tr><td rowspan="2">Small-scale Irrigation Development Project (SSIDP)
(Such as gravity irrigation schemes, pump irrigation schemes for which the water source is a river, pond/lake, or water harvesting scheme.)</td><td>Type A : Project requiring a mandatory EIA</td><td>Mandatory</td><td>-</td><td>Mandatory</td><td>Mandatory</td></tr>
<tr><td>Type B : Project requiring preliminary EA</td><td>Mandatory</td><td>Mandatory
(if required)</td><td>-</td><td>Mandatory</td></tr>
</table>

Most Cases of SSIDP

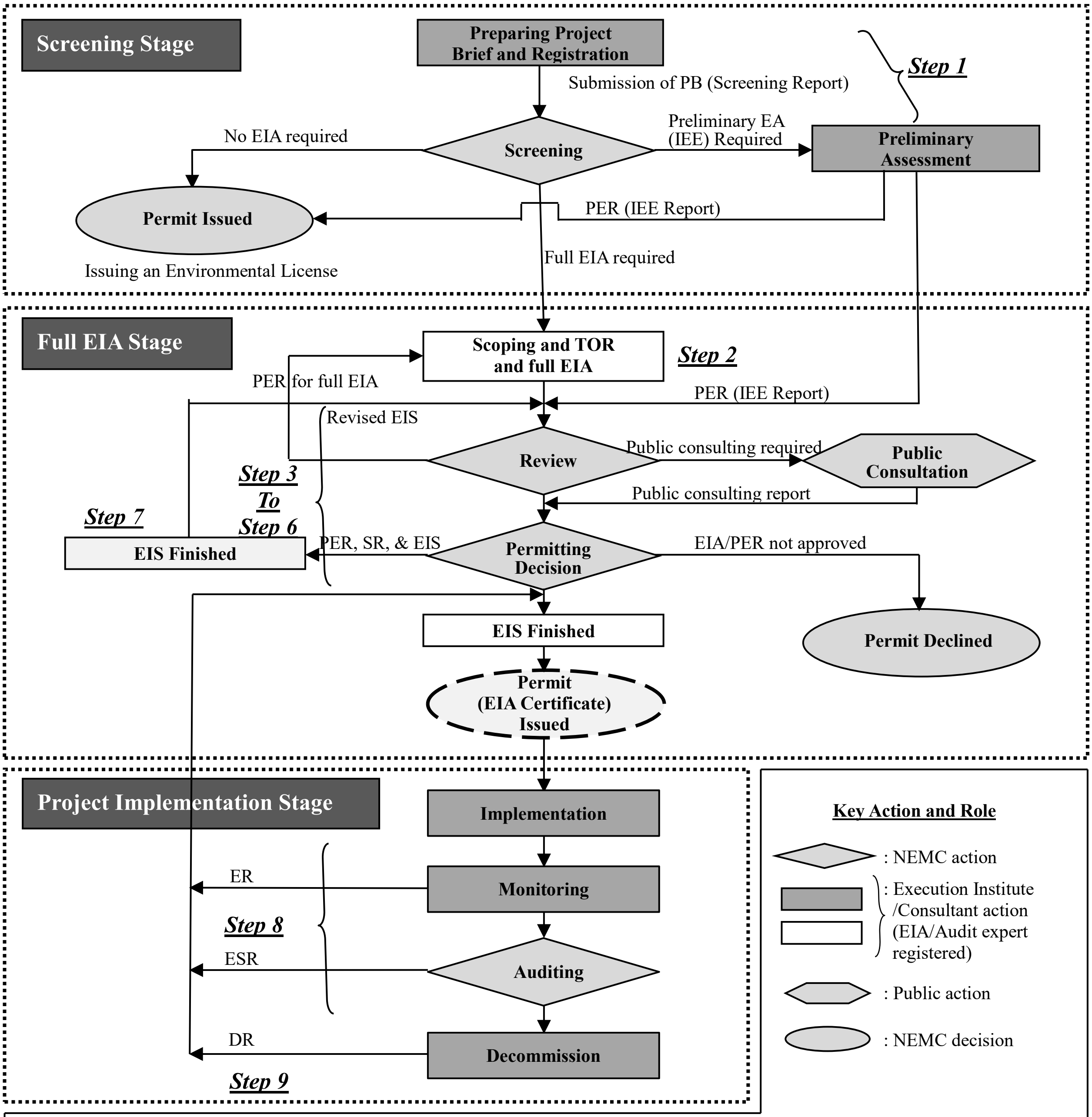
Based on the Screening Criteria (Second Schedule of EIA and Audit Regulations, 2005), above process shall lead to one of the following decisions/results: ・ Full EIA is required where the project is known to have significant adverse environmental impacts ・ Preliminary environmental assessment is required where the project may have environmental impacts

Source: Environmental Impact Assessment and Audit Regulations in 2005 created by the JICA Project Team

Figure 10.1.2 EIA Categorization for Irrigation Scheme Development

EIA/audit implementation procedures are composed of three stages as screening, full EIA, and project implementation as indicated in Figure 10.1.3. A series of workflow (steps) for conducting EIA/audit are described as follows:

[1] ASDP Implementation Completion Report (MAFC, July 2014) and Environmental and Social Audit of Selected ASDP Subprojects (MAFC, December 2014)



DR: decommissioning report	PB: project brief (screening report)
EAR: environmental audit report	PER: preliminary environmental report
EIA: environmental impact assessment	***preliminary assessment: initial environmental examination (IEE)**
EIS: environmental impact statement	
ER: environmental report	SR: scoping report

Source: Environmental Impact Assessment and Audit Regulations in 2005, created by the JICA Project Team

Figure 10.1.3 Flow Chart of EIA/EA for Irrigation Scheme Development

(1) EIA

(a) Step 1: Registration

Register the proposed project with NEMC by submitting an application for the EIA certificate where one is required to fill in a 'Preliminary Environmental Assessment Registration Form' for the project. The application fee is TZS 70,000/=. Environmental experts will be available to use when filling in registration form and during preparation of the project brief.

(b) Step 2: Screening

Return to NEMC three copies of a duly filled Application Form attached with ten copies of the project brief for screening by NEMC. The contents of the project brief must comply with the EIA and Audit Regulations of 2005. Screening report is approved by the council within 45 days from the date of submission of the brief.

(c) Step 3: Scoping

Contract an Environmental Expert/EIA Consultant to prepare a Scoping Report and Terms of References (TORs) for conducting the EIA and submit them to NEMC for review and approval before the commencement of the EIA study. NEMC will provide a list of registered experts whom you can negotiate with. TORs are approved by the council within 14 days.

(d) Step 4: Environmental Assessment

Conduct EIA study (by the Consultant) according to the approved TOR. Time taken to carry out EIS depends on the type and complexity of the individual project.

(e) Step 5: Review

Submit an Environmental Impact Statement (EIS) also called EIA Report to NEMC for review by a Cross-sectoral Technical Advisory Committee (TAC); the EIS shall be submitted along with duly filled EIS submission form, i.e., Form No. 2. Prior to the review by TAC, NEMC and key stakeholders from other sectors (depending on the type of project) may visit the proposed site for verification of issues that have been raised on the EIS and confirmation of stakeholder consultation at the proponent's costs (transport arrangements to be done by the developer). The council shall, within 60 days following submission of EIS, carry out its review.

(f) Step 6: Recommendations of the TAC

The Consultant will make improvements in the EIS by incorporating all comments and recommendations raised by the TAC.

(g) Step 7: Submission to the Minister for Environment

The Consultant will submit the improved (final) version of the EIS to NEMC for final scrutiny. NEMC will forward recommendations to the Minister for Environment for final approval.

(h) Step 8: Approval of the EIS

Upon signing of the certificate by the minister, it will be brought back to NEMC for collection by the developer. The minister may approve or disapprove the EIS within 30 days.

(i) Step 9: Issuance of Certificate

The signed EIS Certificate will be attached to the General and Specific Conditions that must be adhered to by the developer. Regular monitoring will be carried out to ensure that the specified conditions are followed.

(2) EA

(a) Step 1: Registration

Register the proposed project with NEMC by submitting an application for the EA certificate, where one will be required to fill in a ‘Preliminary Environmental Assessment Registration Form’ for the project. The application fee is TZS 70,000. Environmental Experts will be available to use when filling in the registration form and during preparation of the project brief.

(b) Step 2: Approval of Terms of Reference

Return to NEMC three copies of a duly filled EA Application Form attached with ten copies of the project brief and TORs for review by NEMC. The contents of the project brief must comply with the EIA and Audit Regulations of 2005. The TORs are approved by the council within 14 days from the date of submission of the brief and TOR.

(c) Step 3: Environmental Assessment

Conduct EA study (by the Consultant) according to the approved TOR. Time taken to carry out EA depends on the type and complexity of the individual project.

(d) Step 4: Review

Submit an Environmental Audit report to NEMC for review by a Cross-sectoral TAC; Prior to the review by TAC, NEMC and key stakeholders from other sectors (depending on the type of project) will visit the location of the ongoing project for verification of issues that have been raised on the EA, and confirmation of stakeholder consultation (transport arrangements to be done by the developer). The council shall, within 60 days following submission of EA report carry out its review.

(e) Step 5: Recommendations of the TAC

The Consultant will make improvements of the EA report by incorporating all comments and recommendations raised by the TAC. The developer will improve the situation on the ground following recommendations by the TAC.

(f) Step 6: Submission to the Minister for Environment

The Consultant will submit the improved (final) version of the EA to NEMC for final scrutiny. NEMC will forward recommendations to the Minister for Environment for final approval.

(g) Step 7: Approval of the EA Report

Upon signing of the Certificate by the Minister, it will be brought back to NEMC for collection by the developer. The minister may approve or disapprove the EIS within 30 days.

(h) Step 8: Issuance of Certificate

The signed EA Certificate will be attached with the General and Specific Conditions that must be adhered to by the developer. Regular monitoring will be carried out to ensure that the specified conditions are followed.

10.1.3 SEA

(1) Objectives of SEA

According to SEA Regulations, objectives of SEA are to:

- Ensure that environmental concerns are taken in the policies, bills, regulations, plans, strategies or programs;
- Enable the public to contribute to the consideration of environmental concerns in the preparations of policies, bills, regulations, plans, strategies or programs;
- Establish clear, transparent and effective procedures for formulation of policies, bills, regulations, plans, strategies or programs; and
- Integrate environmental concerns into measures and instruments designed to further sustainable development.

(2) Legal and Regulatory Requirements of SEA

The legal and regulatory requirements of SEA are provided in Sections 104 and 105 of EMA. Section 104 requires that when preparing a bill that is likely to have an effect on the management, conservation, and enhancement of the environment; or sustainable management of natural resources, SEA should be undertaken and submitted to the minister responsible for environment. Moreover, the act requires that when promulgating regulations, public policies, programs, and development plans that may have effects on the environment, SEA shall be conducted.

Furthermore, Section 105 of the Act requires that where a mineral or petroleum resource is identified and before specific details are planned or a hydro-electric power station is planned or a major water project is planned, the Ministry responsible for mining, energy, or water should carry out a SEA.

(3) Principles of SEA

The principles upon which SEA is based include:

- Early proactive consideration of the environmental and social effects of strategic actions;
- Broad institutional and public engagement;
- Analysis and integration of qualitative and quantitative information within a dynamic, interactive framework;
- Flexible to allow adaptability to the planning and sectoral development cycle;
- Early warning of potential cumulative effects and large-scale changes; and
- Identification of best practicable options that can be articulated from the policy level to the individual project level.

SEA complements and strengthens the EIA at the project level by: identifying prior information needs and potential impacts; addressing strategic issues and concerns that may relate to project justification; and streamlining the project review process. In this way, the SEA “sets the scene”: ideally through an Outcome-based Strategic Environmental Management Plan (SEMP).

(4) Authority Responsible to Undertake SEA

Regulation 8(1) of the SEA Regulations requires sector ministry, government agency or department, hereinafter referred to as Responsible Authorities, where it is found necessary at the commencement of preparation of a policy, bill, regulations, strategy, program or plan to carry out SEA. In doing so, the Responsible Authority shall form a team to undertake the assessment, comprising experts in SEA or environmental and natural resource management from a sector ministry, government agency, department, and public higher learning and research institutions or registered environmental experts.

(5) SEA Steps

In establishing the SEA context, a step-by-step approach on the regulatory requirements, the decisions to be taken, and the documentation to be provided in conducting SEA are required. These steps are intended to be valid for all policies, bills, regulations, strategies, plans and programs to which the SEA Regulations apply in the respective sector or geographical scope. A step-by-step framework for SEA implementation is presented in Table 12.2.1 of Chapter 12.

(6) Safeguard Policies for SEA Implementation

The SEA study of NIMP2018 will be designed to comply with all environmental laws of the United Republic of Tanzania and the Environmental and Social Safeguard Policies of the Japan International Cooperation Agency (JICA) as well as the WB. In this sense, the WB's Safeguard Policy and its applicability are referred to in SESA 2011, as shown in Table 10.1.5.

Table 10.1.5 WB's Safeguard Policy

S/N	WB Safeguard Policy	Policy Applicability	Reason/Notes
1	Environmental Assessment (OP 4.01, BP 4.01, GP 4.01)	Yes	Category A project direct impacts perceived, external impacts perceived.
2	Natural Habitats (OP 4.04, BP)	Yes	Wherever irrigation expansion will affect officially recognized natural habitats.
3	Forestry (OP 4.36, GP 4.36)	Yes	To see to it that irrigation areas are not situated in forests; irrigation development should not involve unsustainable deforestation practices.
4	Pest Management (OP 4.09)	Yes	Increase in cultivated area, hence, an increase in the application of pesticides, insecticides, and herbicides in absolute terms.
5	Physical Cultural Resources (OP 4.11)	Yes	No significant cultural resources were identified during the field reconnaissance survey in the project area yet, triggered for precautionary reasons. Provisions for chance-find procedures are obligatory.
6	Indigenous Peoples (OD 4.20)	Yes	Irrigation expansion and intensification should not affect distinctive indigenous ethnicity with distinct cultural characteristics.
7	Involuntary Resettlement (OP/BP 4.12)	Yes	There may be small-scale involuntary resettlement required for the construction of the irrigation infrastructure and large-scale dams.
8	Safety of Dams (OP 4.37, BP 4.37)	Yes	There are intentions to create large-scale dams in the NIP and the NIMP.
9	Projects in International Waters (OP 7.50, BP 7.50, GP 7.50)	Yes	There are shared water resources in Tanzania borders.
10	Projects in Disputed Areas (OP 7.60, BP 7.60, GP7.60)	No	Project area is within the sovereign territory of the United Republic of Tanzania.

Source: The SESA for the NIMP2002 and the NIP, 25th April 2011

10.2 Land and Assets Compensation and Resettlement

The impacts due to involuntary resettlement from development projects such as irrigation scheme project may give rise to economic, social, and environmental risks resulting in production systems being removed, people facing an exhausting condition when their productive assets or income sources are lost, people being relocated to environments where their productive skills may be less applicable, and the competition for resources increases; community institutions and social networks being weakened; kin groups being dispersed; and cultural identity, traditional authority, and the potential for mutual help being diminished or lost.

10.2.1 Legal Framework for Resettlement and Asset Compensation in Tanzania

Currently, in the case that resettlement of the land owners, who are mostly community members, sometimes is inevitable when it comes to project development by the private or the public sector, when the need for resettlement arises although there is no specific resettlement policy in Tanzania, it should be done. However, there are good policies, legal, and institutional frameworks for management of social issues related to land and property acquisition and compensation enshrined in the National Constitution, the Land Policy, and Land Acts as well as supporting local laws and by-laws.

The following policy and legal instruments provide guidance for acquisition of land and associated properties and compensation and resettlement procedures in Tanzania:

- Constitution of the United Republic of Tanzania (1977 - as amended)
- National Land Policy (1996)
- Land Acquisition Act, 1967 (Act No. 47/1967)
- Land Act, 1999 (Act No. 4/1999)
- Land (Assessment of the Value of Compensation) Regulations, 2001
- Village Land (Part III, practical guidelines on assessment of compensation) Regulations, 2002
- Land (Compensation Claims) Regulations, 2001
- Land (Schemes of Regularization) Regulation, 2001
- Land Disputes Court Act, 2002 (Act No. 2/2002)
- Land Use Planning Act, 2007 (Act No. 6/2007)
- Sector Policies and Laws on Access, Use, and Management of Natural Resources

In the above instruments, the Land Act No. 4 and Village Land Act No. 5 of 1999 have set clear procedures for full, fair, and prompt compensation while acquiring land from citizens. These procedures should be adhered to, especially Land Regulations (assessment of the value of compensation which was made under S.179 of Land Act No. 4 of 1999) GN 78 published on 4/5/2001.

10.2.2 JICA and WB’s Safeguard Policy for Involuntary Resettlement

According to the JICA Guidelines for Environmental and Social Considerations (April 2010), it is described that involuntary resettlement and loss of means of livelihood are to be avoided when feasible by exploring all viable alternatives, and furthermore, it is desirable that the resettlement action plan include elements laid out in the WB’s Safeguard Policy OP 4.12.

The objectives of WB's Safeguard Policies OP 4.12 that cover direct economic and social impacts caused by the involuntary taking of land and other assets applicable for the resettlement are summarised below.

- Involuntary resettlement and land acquisition should be avoided where feasible, or minimised, exploring all viable alternative subproject designs;
- Where involuntary resettlement and land acquisition are unavoidable, resettlement and compensation activities should be conceived and executed as sustainable development;
- Programs providing sufficient investment resources to give the persons displaced by the project the opportunity to share in project benefits. Displaced and compensated persons should be meaningfully consulted and should have opportunities to participate in planning and implementing resettlement programs;
- Displaced and compensated persons should be assisted in their efforts to improve their livelihoods and standards of living or at least to restore them, in real terms, to pre-displacement levels or to levels prevailing prior to the beginning of project implementation, whichever is higher.

10.2.3 Environmental and Social Management Framework 2015 in Tanzania

According to the Environmental and Social Management Framework (ESMF) 2015 related to ASDP2-BRN project, the useful and the latest information can be referred to the land and assets compensation and resettlement for irrigation scheme development as follows:

(1) Present State of Land

(a) Land Tenure:

The land tenure system is fully aligned to the national regulations: Customary Rights of Occupancy with unlimited tenure period. Because of land availability, the practice of renting land is rare in the village. For investment projects, crop compensation is done in agreement and negotiation between the land holder / user and the investor. The district is usually involved in crop evaluation and compensation payments as required by a regulation. In most cases, the transaction is based on a direct negotiation between investors and the affected people resulting in a single or multiple instalment cash payment.

(b) Land Use / Land Registration:

Only 2% of rural land and 20% of urban land is registered. The land use planning process has been completed in some villages and the village land management committees have been established in some. However, land use plans do not necessarily bring significant changes to the land uses that were previously in place and instead formalize existing practice while planning for future development.

(c) Conflicts Over Land:

Most villages in the Southern Agriculture Growth Corridor of Tanzania (SAGCOT) area do not have any land-related conflict with neighbouring villages. The geographical limits were clearly defined from the earliest days of the village's creation and only occasionally contested. Within the village, land-related conflicts are not an important source of disputes within the community. Even land inheritances are rarely contested.

(2) Legal Requirement and Institutional Framework on OP/BP 4.12 (Involuntary Resettlement)

(a) Trigger of WB Safeguard Policy OP 4.12

The individual farmers, farmer groups, and farmers organisations as implementers or operators of the subprojects will make every possible effort to avoid impacts on people, land, and property, including people's access to natural and other economic resources, as far as possible. Notwithstanding, land acquisition, compensation, and resettlement of people seems inevitable for certain type of ASDP2-BRN project investments. The project will support rural investments related to improvements of agricultural productivity and commodity value chains that may require land for the physical construction of infrastructures. This social issue is of crucial concern to the Government of Tanzania and the bank, as its impact on poverty, if left unmitigated, is negative, immediate, and widespread. Thus, the WB's Safeguard Policy OP 4.12 will be triggered in those cases

(b) Involuntary Resettlement in the Irrigation Project

In this case a farmer group's irrigation sub project causes the involuntary taking of land and other assets resulting in: (a) relocation or loss of shelter, (b) loss of assets or access to assets, (c) loss of income sources or means of livelihood, whether or not the affected persons must move to another location.

(c) Most Cases of Land Acquisition and Compensation

The OP 4.12, in most cases, is not triggered because people are being affected by physical displacement. It is triggered because the project activity causes land acquisition, whereby a physical piece of land is needed and people may be affected. In most cases, people are compensated for their loss (of land, property, or access) either in kind or in cash of which the former is preferred. The resettlement policy applies to all displaced persons regardless of the total number affected, the severity of the impact, and whether or not they have legal title to the land. Particular attention should be paid to the needs of vulnerable groups among those displaced.

(d) RAP for affected persons

The WB's Involuntary Resettlement Policy OP 4.12 requires that all subprojects that may involve involuntary resettlement for which a RAP cannot yet be prepared at the time of project appraisal by the WB be screened as guided by the Resettlement Policy Framework (RPF) that has been prepared for the ASDP2-BRN. Furthermore, for those subprojects that may involve involuntary resettlement, the RPF requires the preparation and implementation of a resettlement assistance program (i.e., a RAP) for affected persons.

(e) RPF and RAP in Tanzania

In Tanzania, there are no explicit requirements for a RPF or RAP. With regard to compensation, the Tanzanian laws require that only the rightful land or property owner (statutory or customary rights of occupancy) should be compensated, while the WB OP 4.12 requires that any person (whether the rightful owner or not) who loses or is denied or has restricted access to economic resources - including tenants, encroachers, squatters - should be compensated. Although there are no significant discrepancies between the WB requirements and the Tanzanian government's requirements regarding compensation and resettlement of Project Affected People (PAP), as far as this ESMF (and RPF) for ASDP2-BRN subprojects are concerned, the WB's safeguard policies will prevail. The RPF provides the framework for determining the need for and content of a RAP for subprojects, including institutional responsibilities, and a mechanism for the redress of grievances.

(3) Resettlement Management

In case a project is likely to cause severe economic, social, and environmental risks, the WB Safeguard Policy on Involuntary Resettlement (OP 4.12) requires a RPF and a RAP are disclosed as a pre-requisite before the project is appraised. The Government of Tanzania (GoT) has prepared a RPF to address the needs of those who might be affected when an operation causes the involuntary taking of land and other assets resulting in: (a) relocation or loss of shelter, (b) loss of assets or access to assets (c) loss of income sources or means of livelihoods, whether or not the affected person must move to another location. The RPF has been prepared as a stand-alone and separate document but whose processes are also included in this ESMF. The RAP will be prepared following guidelines provided in the RPF for all investments that may cause relocation or loss of access to assets and resources.

10.3 Impacts on Environment

10.3.1 Impacts on Environment Relevance to Irrigation Scheme

According to the SESA 2011 for the NIMP2002 and the NIP, the details on key environmental issues and concerns (biological and physical impacts due to irrigation development) are summarised in Table 10.3.1. Issues and concerns are regarded as High-Medium-Low Priority when raised by many stakeholders as observed in many locations consulted.

Table 10.3.1 Issues and Concern on Environment Raised by Stakeholders

S/N	Issues and Concerns	Significances	Potential Negative Impact	Priority
	Physical Environment			
1	Some of the irrigation schemes lack cross bridges for livestock and human in canals, hence, causing destructions in canals. Most of irrigation canals are not lined and lack of on-farm road.	Investments in most irrigation schemes are arranged without ensuring local accesses to the rivers and other important sites including stock routes and wildlife corridors.	• Loss of crops, human life, and destruction of irrigation infrastructure may occur • Loss of irrigation water • Destruction of farms when undertaking irrigation activities	MEDIUM
2	Dam construction creating water bodies.	Construction of dams may lead into increase in water-borne and water related diseases.	• Inundation of facilities • Outbreak of water associated diseases	MEDIUM
3	Poor compaction of earth canal and mismanagement of water within irrigation schemes resulting to localized soil erosion.	Mismanagement of water within irrigation schemes and poor compaction of earth canal exacerbate the localized soil erosion.	• Increased sedimentation in canals and rivers. • Loss of arable land and low crop productivity	HIGH
4	Irrigating using saline water and over-watering in some schemes result into increased salinity.	As water dries saline environment is formed. Land becomes useless and may end up with desertification.	• Loss of arable land and low crop productivity rendering desertification	LOW

S/N	Issues and Concerns	Significances	Potential Negative Impact	Priority
5	Loss of farms, habitat for flora and fauna as a result of clearing and inundation for damming.	Bush clearing during construction of irrigation infrastructure and inundation due to damming may result into loss of farms, habitat for fauna and flora, and land degradation.	• Soil erosion/ land degradation • Habitat loss • Biodiversity decline	MEDIUM
6	Cultivation, tree cutting on the river banks, and illegal abstractions of water from river accelerate degradation of land near the river banks.	Cultivation, tree cutting on the river banks, and illegal water abstractions from rivers in unimproved irrigation schemes accelerate degradation of land near the river banks. This is normally done using temporary intakes made of tree logs, grass, and mud. The tree logs and mud are cut near the riverbanks causing instability in riverbanks and in some cases subjecting the river to change its course.	• Change in river courses and creation of meanders • Soil erosion • Loss of biodiversity resulting from degradation of riparian ecosystems	MEDIUM
7	Inadequate drainage systems which complies with recognized safety measures in irrigation systems leading into flooding damages.	Although irrigation schemes are planned to control water inflow, flooding still occurs. Most irrigation schemes lack adequate drainage and do not comply with safety measures. Flooding damages irrigation systems and can cause injuries and drowning.	• Destruction of irrigation schemes • Increase in maintenance costs • Water logging and reduced crop productivity	MEDIUM
8	High levels of sedimentation in the irrigation schemes resulting from other land uses activities within the catchment.	Sediments are the main problem in some of the irrigation schemes in Tanzania. The source of sediments in irrigation schemes is the soil erosion taking place in the catchment area and river banks upstream. The medium and large floods always carry heavy bed and suspended loads, which are deposited when the velocity decrease at the intake sites until the sediments accumulate up to the weir crest level and then is deposited in front and behind the intake gates of the head works.	• Destruction of irrigation infrastructures and peoples' property • Reduction in farm size • Reduced soil and crop productivity • Reduced storage of reservoirs	MEDIUM
9	Inadequate on-farm water management (flooding of schemes) without considering downstream water users.	If irrigators draw the amount of water that is not in conformity with crop optimal water requirement and this constitutes water wastage and gross water mismanagement that could be wisely used by other users in the downstream including hydropower generation, domestic water supply, livestock, fishing, and maintaining the ecological functioning of wetlands.	• Water flow reduction downstream of the irrigation schemes leads to adverse effects on the ecosystem thereby creating water use conflicts among the users.	LOW
	Biological Environment			
10	Pollution of land and water bodies due to fertilizers and agrochemical utilization.	Utilization of chemical fertilizers is needed for maintaining the agricultural production at high level; however, inappropriate application and the use of toxic chemical elements bring a risk to both plants, human health as well as the natural eco-system especially for aquatic species.	• Human and natural ecosystem health impairment • Mortality or morbidity of flora and fauna • Bioaccumulation of toxic substances	HIGH
11	Degradation of irrigation water quality due to industrial and domestic effluents, as well as pollution from animal excreta.	Industrial and domestic effluents, as well as pollution from animal production, can lead to the degradation of irrigation water quality. This is largely attributable to absence of integrated water resources management that among others, accounts for the location of potential contamination sources while planning the irrigation project.	• Degradation of irrigation water quality can lead to poor crop production and quality of the products	LOW
12	Implications on aquatic and water sensitive biodiversity and wildlife habitats due to possible reduction in environmental flows.	Majority of the schemes are in seasonal rivers, which are already water stressed. Furthermore, flows in permanent rivers are decreasing over time with potential to further decrease due to abstraction for irrigation.	• Reduced environmental flows with negative consequences on aquatic and water sensitive species • Loss of wildlife habitats and biodiversity	HIGH
13	Degradation of river catchments and riparian ecosystems	Some of the river catchments in irrigation schemes are highly degraded by both downstream and upstream users.	• Loss of water sensitive species dependent on the riparian ecosystems	HIGH
14	Degradation of ecologically sensitive areas.	Some of the irrigation schemes are established in ecologically sensitive areas such as wildlife corridors, protected areas and water catchment areas/forests.	• Habitats fragmentation • Loss of gene flow among populations • Decline of wildlife populations to	MEDIUM

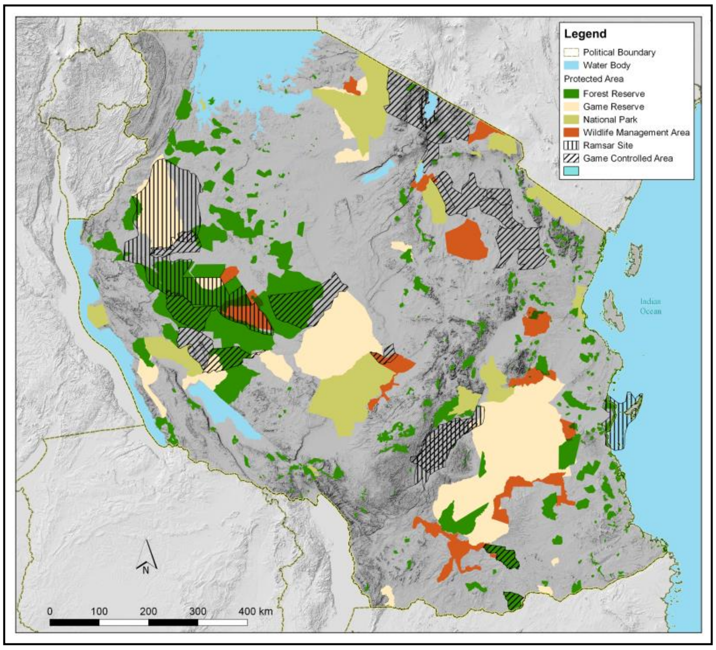
S/N	Issues and Concerns	Significances	Potential Negative Impact	Priority
			below minimum viable levels • Local extinction of sensitive flora and fauna	
15	Blockage of fish movement and consequent Interference with fish migration and breeding	There is no scheme that has created fish bridges at their water intakes or dam sites.	• Creation of physical barriers to fish and other aquatic organisms' movement • Interference with flow regimes and reduction in flood periods in some cases which will affect fish migratory behaviour	LOW
16	Single resource management approach on irrigation scheme planning	Without integrated water resources management and land use management plan, implementation of the NIMP2002 and NIP may become disastrous with respect to environmental flows and biodiversity conservation. Most important, all the irrigation schemes have neither Integrated Water Resource Management Plan nor Integrated Land Use Plans and thus, no one would expect their management to follow an integrated approach to resources management.	• Conflicts in resource uses • Unbalanced resources utilization/ exploitation	HIGH

Source: The SESA for the NIMP and the NIP, 25th April 2011

10.3.2 Remarkable Potential Impact on Environment

In the previous SESA report, it was concluded that the key issues are the potential impacts on Environmental Flows, Aquatic and Water Sensitive Biodiversity, and Wildlife Habitats. This is because majority of the irrigation schemes abstract water from seasonal rivers, which are already water stressed.

With respect to the degradation of river catchments and riparian ecosystems, some of the river catchments in irrigation schemes are highly degraded by both downstream and upstream users. Expansion of irrigation schemes, if not controlled, will likely lead into more degradation and resultant water pollution and sedimentation with negative effects on the aquatic life. As for degradation of ecologically sensitive areas, some of the irrigation schemes are established in ecologically sensitive areas such as wildlife corridors, protected areas, and catchment forests. Irrigation activities in such areas will affect negatively the ecological integrity of these habitats including habitat fragmentation with a resultant loss of gene flow among populations and possibly driving some wildlife populations to below minimum viable levels and local extinction and may as well result into conflicts among stakeholders.



Source: created by the JICA Project Team

Figure 10.3.1 National Parks and Major Protected Areas in Tanzania

In general, lack of legal land use plans by some of the schemes and the fact that some of them have not done EIAs adequately will likely lead into haphazard land uses, encroachment of sensitive areas, and consequent soil erosion and water pollution. High erosion rates caused by poor agronomic practices in different schemes will result into siltation and water pollution with consequent lowering of the water quality and subsequent effect on resident and aquatic biodiversity of these ecosystems. Lack of proper land use plans, hence, leading to high illegal encroachment to the catchment forests and riparian ecosystems. However, other causes may come from natural calamities such as floods.

Tanzania has over 16 national parks, which comprised an area of more than 42,000 km^2 as shown in Figure 10.3.1. In addition, as listed in Table 10.3.2, four Ramsar sites totalling 4,868,424 hectares were designated as being of significant value to Tanzania and to the international country. These ecological sensitive areas and neighbouring areas will be more-or-less needed a special attention to the environment when irrigation development is newly planned.

Table 10.3.2 Ramsar Sites in Tanzania

S/N	Site	Date of Designation	Region/Province/State	Area (ha)	Coordinates
1	Kilombero Valley Floodplain	25th April 2002	Morogoro Region	796,735	08°40'S 036°10'E
2	Lake Natron Basin	04th April 2001	Arusha Region	224,781	02°21'S 036°00'E
3	Malagarasi- Muyovozi Wetlands	13th April 2000	Kigoma, Shinyanga, and Tabora	3,250,000	05º00'S 031º00'E
4	Rufiji-Mafia- Kilwa Marine Ramsar Site	29th October 2004	Coast, Lindi Regions	596,908	08°08'S 039°38'E

Source: The SESA for the NIMP and the NIP, 25th April 2011

10.4 Specific Issues

10.4.1 Water Conflict

(1) Background of Water Conflict Related to Irrigation Development in Tanzania

Water use conflicts in Tanzania have been identified as serious problems especially in highly populated and land scarce areas. Water use conflicts among farmers, between farmers, and pastoralists are the most serious conflicts in most of the areas in Tanzania. Most of these conflicts result from the population increase, water scarcity, and inadequate participation by local community in the management of water resources, irregularity in scheduling water for irrigation, and lack of land use plans. There are socioeconomic factors that significantly influence water use conflicts such as age, farm size, and gender[2]. Most of the conflicts concerning irrigation water depend on a number of reasons such as water scarcity, unfair water allocation and distribution, population growth, and livestock. One common problem is the tension between upstream and downstream stakeholders because of their different strategic positions. Water allocation is primarily first come, first served. Thus, farmers at the head tend to get all the water they need, while farmers at the tail-end often receive inadequate and unreliable amounts of water. This situation has often led to conflicts between head and tail farmers.

[2] Water Resources Management Issues and conflict resolutions at a catchment level. A Case Study of Pangani River Basin, Tanzania, Felix Mtalo 2005, Water Sector Development Strategy 2006

(2) Type of Water Conflict and Example in Irrigation Scheme

The conflicts on water use in Tanzania may have been caused by any or a combination of some situations. According to the studies carried out in the Pangani River Basin[1] in Tanzania, the following categories were identified as water conflicts:

- Small-scale versus large scale irrigators
- Upstream - downstream irrigators
- Domestic water use versus other uses (agriculture, livestock, industrial, and municipal)
- Industrial versus environmental water use (environmental protection and ecosystem management)
- Agricultural versus industrial use (power generation)
- International organisations (donors) that support different projects in the basin

In order to identify the state of water conflict and measures to be taken into considerations in the irrigation scheme, the JICA Project Team distributed the questionnaires to the Zone Office through NIRC. The answers were summarised in Table 10.4.1.

Table 10.4.1 Summary of Water Conflict Related to the Irrigation Scheme

Scheme Name / District	Description Regarding Issues and Concerns Raised			What kind of implication or lessons learned from the case? (Proposed Mitigation Measures)
	What kind of conflict happened? (Details of Issues/Problems)	Why it happened? (Reasons)	How it was settled or not settled? (Actions taken)	
Worst Case Mawala/Moshi DC	・Increase of area for cultivation which lead to shortage of water as per earlier water use permit. ・There were conflicts between farmers, i.e., ONGAMA, which is in the form of cooperative instead of Irrigator's Organisation	・Water shortage due to the increase of area for cultivation than the water permit given ・The cooperative does not impose somebody to obey its rules as in the Irrigators Organisation	・Tanganyika Planting Company (TPC) which has greater water use permit allowed farmers to use water in case the company is closed for maintenance. ・Because they were using the same intake, i.e., TPC and farmers from Mawala they proposed to divide the intake to solve this problem.	・Training on water management practices in order to reduce water conflict. ・To survey the availability of water before the start of farming activities. ・Possibility of utilizing groundwater should be investigated.
Worst Case Ndungu/Same DC	・Conflict between farmers due to shortage of water, which lead to some blocks not to be under cultivation	・Water shortage due unreliable rainfall which lead to river drying	・Conserve the environment surrounding rivers	・Environment training should be conducted so as to conserve the water and land
Worst Case Itete Scheme Malinyi District	・Farmers prepared their water distribution plan ・District prepared their water distribution plan	・Every side insisted to stick on its plan	・The district eliminated the IO leaders and select interim leaders ・The district was advised by ZIO to follow the steps outlined in the CGL to prepare participatory water distribution plan	・Formation and training of DIDT ・Conduct election to get scheme leaders ・DIDT to follow CGL and water distribution manual in training the IO leaders ・The IO leaders to prepare water distribution plan with assistance of DIDT and approve the plan in the IO General Meeting

Scheme Name / District	Description Regarding Issues and Concerns Raised			What kind of implication or lessons learned from the case? (Proposed Mitigation Measures)
	What kind of conflict happened? (Details of Issues/Problems)	Why it happened? (Reasons)	How it was settled or not settled? (Actions taken)	
Worst Case Itete Scheme Lumuma Scheme Kilosa District	・ Water users' associations interfering IO responsibilities to collect water fees and implement bylaws	・ IO leaders look weak in implementing their bylaws ・ poor organisation structure of IO leading to inability to conserve environment as started in regulations	・ District explained roles of each organisation	・ Strengthening the IO ・ Restructure the organisation structure of the IO ・ Consultation meetings with WUA to establish working regulations
Worst Case Irienyi /Rorya DC	・ Conflict between farmers and livestock keepers over water use	・ No water point for livestock at the reservoir	・ The LGA in collaboration with IO to construct livestock water trough	・ Engineering design stage was not participatory
Successful Case Minepa scheme Ulanga District	・ Some farmers scrambling to get water for their fields by closing the gates on other plots	・ Insufficient water to some plots during dry season	・ Establishment of cropping calendar and pattern ・ Minor rehabilitation on the main canal ・ Repairs on some critical areas to increase water efficient ・ Participatory water distribution plan and supporting bylaws	・ Existing project for construction of new weir and main canal will solve the problem

Source: NIRC (2017) edited by the JICA Project Team

(3) Case Study of Measures for Resolution of Water Related Conflicts[3]

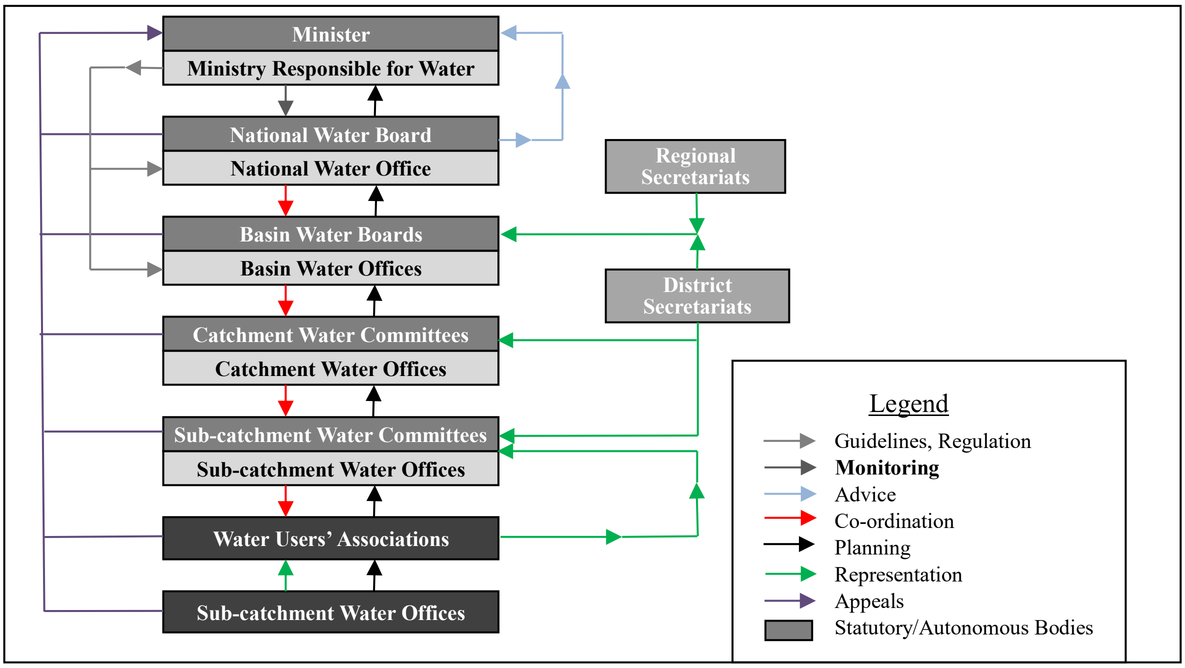
Various measures are known to have been used to resolve some of the conflicts. The indigenous people on the Kilimanjaro and Pare Mountain slopes have had traditional water allocation (sharing) and conservation methods that worked efficiently. They also managed to resolve any conflicts that might have arisen in the course of water sharing practices through the institutions. The system was abandoned by the government in favour of a centralized system controlled through government institutions. The latter has not been able to resolve (as for now) the conflicts within the water users' community. Equitable management of water resources is needed, e.g., rehabilitation of the old irrigation furrows to make them more efficient. Currently, the furrows' efficiencies range between 15-20%. Overall efficiency could be raised to 40–50% by lining, thus, reducing water losses. Dialogue has been considered as one method, which can be used to reduce the upstream and downstream conflicts and non-governmental organisations (NGOs) are better placed to bring the conflicting parties together and be able to bear some fruits. Communication with the primary water managers is important. To contain the situation, population growth control and provision of alternative activities that could draw off people from absolute dependency on cultivating the land are necessary. The promotion of the use of groundwater for irrigation, adopting more water-efficient cropping patterns and the construction of micro dams at the end of conveyance canals for storage of water during the rainy season are some of the ways of reducing

[3] Water Resources Management Issues and Conflict Resolutions at a Catchment Level. A Case Study of Pangani River Basin, Tanzania, Felix Mtalo 2005, Water Sector Development Strategy 2006

the strain in the competition for water between irrigation and hydropower generation as well as other uses.

(4) Institutional and Legal Framework for Resolution of Water-related Conflicts

The National Water Policy (2002) divides the country into nine river basins which do not follow administrative boundaries such as regions and districts. Considering this fact, the management of water resources will have five main levels: national level, basin level, catchment level, district level, and community or water user association level, which will be the lowest level and will bring integrate users of the same source. A part from the legal and institutional frameworks indicated under the National Water Policy and the Water Resources Management Act, Section 35 (1) of the National Irrigation Policy stipulates that "In order to minimise water conflicts on irrigation schemes, the Commission will collaborate with the local government authorities, basin water boards, and respective irrigators using water from the same source and establish a mechanism of amicable settlement of disputes within the schemes through involvement of relevant government institutions or systems.



Source: Water Sector Development Strategy 2006

Figure 10.4.1 Institutional Framework of Water Resources Management

(5) Ideas of Mitigation Measures to the Water Related Conflicts

According to the SESA 2011 for NIP 2010 and NIMP 2002, proposed mitigation measures in terms of water conflict were identified as shown in Table 10.4.2.

Table 10.4.2 Proposed Mitigation Measures for Potential Impact in SESA for NIMP2002 and NIP Implementation in terms of Water Conflict

Issues and Concerns	Potential Negative Impact	Potential Mitigation Measures	Priority
Issuance of water use permits, which does not conform to available water	· Reduced environmental flows · Degradation of aquatic biodiversity · Conflict over water use	· Conduct water demand assessment and inventory of water users and permits · Assess the response of aquatic biodiversity to flow regimes	HIGH

Poor on-farm water management	・ Water flow reduction downstream ・ Adverse effects on the ecosystem ・ Water use conflicts among the users	・ Promote and ensure use of irrigation water management guidelines by farmers and extension workers	MEDIUM

Source: The SESA for the NIMP2002 and the NIP, 25th April 2011

Water conflict is a major concern expected among different irrigation schemes and different sectors of farmers such as agriculture and livestock. Ideas of mitigation measures as a social consideration will be examined through SEA study that subsequently will apply to the NIMP2018. Tentative ideas of mitigation measures are summarised as follows:

- Clarification of water potential and water requirement by different users
- Management of water rights
- Installation of watering facilities for livestock

10.4.2 Land Conflict

According to the description of land issues in the report of SAGCOT Investment Project (2013), "*Tanzania is an agricultural country and land is the fundamental resource - not only for cultivation: other key uses are grazing and fuel wood collection. Land governance in Tanzania is exhaustively analysed in numerous documents (see e.g., Deininger et al., 2012), with key features being a strong movement for reform hampered by limited implementation and many ambiguities, resulting in a complex, slow process of formalisation, little certainty of tenure for marginalised groups, and limited transferability of land. There is significant public concern over what is perceived to be "land grabbing" by investors and an increasingly vocal civil society willing to speak out on land issues.*" Thus, land conflicts in rural areas always tied to increasing population pressure and the diversification of rural land use patterns resulting from irrigation development.

(1) Historical Background of Land Conflict in Tanzania

(a) Colonial Land Tenure

The history of Tanzania land laws dates back to the 1890s when the German colonial rule promulgated imperial decrees to govern land matters in 1895. The decree vested all powers on land onto the colonial master leaving the natives without a say on land. The British colonial rule reinforced this order by enacting the Land Ordinance No. 3 of 1923. The 1923 law declared that land is public but vested the radical title to the governor. Sporadic land conflicts emerged between the colonialists and local communities where land was alienated but the climax was the MAJIMAJI uprising of 1905-1907 in which several tribes came together to fight for their land and other resources including labour.

(b) Land Tenure after the Independence

Between 1961 and 1998 land was still governed under the 1923 ordinance with minor amendments. Land declared public but vested in the president as custodian on behalf of all citizens, the 1967 Land Acquisition Act reinforced presidential powers on land.

(c) 1960s -1990s Land Conflicts

These were mainly between the state and its agencies on one side and people on the other the main reasons being, villagilization, alienation of land to public enterprises, new cities engulfing village lands, land resources use conflicts between different groups mainly farmers and pastoralists. Land conflicts were resolved in courts, party machineries, and administratively by government organs from the village level.

(d) Land Laws since 1999

The Land Act No. 4 and the Village Land Act, No. 5 were enacted in 1999. The Village Land Act No. 5 provides for conflict settlement from sections 60 to 65. The Land Courts Act No. 2 was enacted in 2002, and other land related laws include: the Land Use Plan Act of 2007, the Town and County Planning Act of 2007, the Unit Titles Act of 2008, and the Mortgage Financing Act of 2008.

(2) Various Aspects of Land Conflict

According to the existing document[4] on land conflict in Tanzania, various aspects in terms of land conflicts are summarised below:

(a) Nature of Land Conflicts

Most land conflicts are resource-based conflicts, i.e., parties compete over resources like land, water, grazing pastures, etc. Most land conflicts are in rural and peri urban, where resource endowment and the quality of resources governance is poor. Most land and related conflicts involve power relations between those who have access and control means to resources and those who are struggling to snatch the opportunities.

(b) Context of Land Conflicts

Land conflicts are taking place within a neo liberal context where the question of balancing context where there is too much dramatization of commercial value of the land and related resources over its traditional use or subsistence value. The policies and laws fail to balance between the business motives on land and livelihoods interests.

(c) Types of Land Conflicts

Land is a common pool resource like water and pastures. Types of conflicts are small farmers versus large-scale farmers, boundary conflicts between villages, villages against reserve land authorities, where the authorities expand their land to villages and vice-versa, artisan miners against large-scale investors on mining where investors invade on artisan miners land communities versus large-scale investors for not paying full, prompt, and fair compensation.

(d) Cause of Land Conflicts

- The legal system vests too much power on the presidency and admin instruments which are often misused.
- Lack of participation of people in decision-making regarding land and other resources they

[4] Investigating Just systems over land and sources of conflicts, Getrude Sackey, 2010

depend for their livelihood

- Lack of legal knowledge/public awareness on land matters
- Unscrupulous dealings on land by land administrators
- Failure of land owners to abide by the conditions of their titles, e.g., failure to develop the land
- Expansion of cities and towns engulfing villages and peri-urban
- Both scarcity and abundance of resources cause conflicts
- Perceptions, stereo types, and mind sets
- Appreciation of the land value is appreciating

(3) Land Conflict Related to the Irrigation Scheme

In order to identify the state of land conflict and measures to be taken into consideration in the irrigation scheme, the JICA Study Team distributed the questionnaires to the Zone Office through NIRC. The answer was summarised in Table 10.4.3.

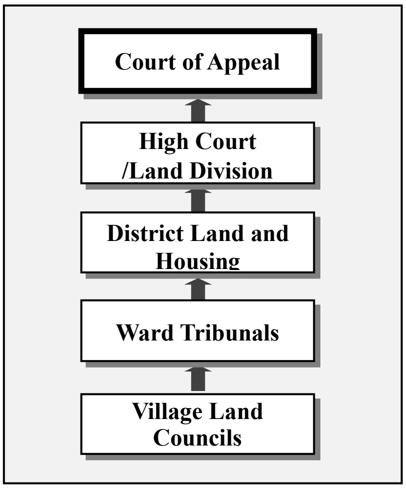
Table 10.4.3 Summary of Land Conflict Related to the Irrigation Scheme

Scheme Name / District	Description Regarding Issues and Concerns Raised			What kind of implication or lessons learned from the case? (Proposed Mitigation Measures)
	What kind of conflict happened? (Details of Issues/Problems)	Why it happened? (Reasons)	How it was settled or not settled? (Actions taken)	
Worst Case Most of the schemes in our zone	・ Most farmers do not own land, this leads to land problems in many areas of our zone especially in areas with livestock keepers	・ The same area needed by livestock keepers for keeping cattle while farmers need to do cultivation	・ Still there are problems in most of schemes especially where there are livestock keepers.	・ Farmer's farm ownership is needed ・ Land use planning should be highly addressed and highly emphasized
Worst Case Mvumi Scheme Kilosa District	・ IO complaining for more land from the prison-occupied land	・ The prison was allocated 80 ha of land in the scheme area but no demarcation set during that time	・ Survey of the prison-occupied land to get exact amount of land being 120 ha	・ The prison should surrender the excess land to the farmers ・ The district and village should assist the farmers to get the land back
Worst Case Tulo-Kongwa Scheme Morogoro District	・ Livestock keepers against farmers	・ Groups of livestock invading farms and destroy crops during dry season	・ Complaints taken to village government ・ Fines to the livestock keepers	・ Strengthen the IO ・ Incorporate the NIRC regulations on IO bylaws ・ Preparation of village land use plan ・ Construct cattle trough for livestock keeper
Worst Case Ibanda/Geita TC and Sengerema DC	・ Fear of losing agricultural land among the farmers after construction of irrigation structures ・ Reluctance of farmers to render their farm plots for construction of irrigation infrastructures ・ Lack of farm boundaries within scheme areas	・ Low knowledge on carrying out irrigation activities ・ Fear of unknown ・ No land survey and proper right of occupancy established system at the village level and national at large	・ Awareness creation through consultation meetings with farmers ・ Study tour to successful schemes ・ Advising the LGAs Land and Settlement Department to set aside the budget for surveying farm plots and put boundaries	・ Farmers need demand driven projects ・ Irrigation projects should consider compensation component at the formulation stage ・ Land conflicts sometimes are the result of poor planning at GOT level
Successful Case Nyamweke Scheme Rufiji District	・ Livestock keepers against farmers	・ Groups of livestock invading farms and destroy crops during the dry season	・ Preparation of village land use plan	・ Farmers and livestock keeper obey the plan

Source: NIRC (2017) edited by the JICA Study Team

(4) Legal and Institutional Framework for Land Conflicts Resolution

The overview of institutional framework associated with the legal and judicial system for land conflict resolution in Tanzania is indicated in Figure 10.4.2. Of these, the Land Division of the High Court and the District Land and Housing Tribunal are new bodies. Section 167 is the only one in the Land Act dealing with dispute settlement and it does no more than define which courts have jurisdiction of land cases. Therefore, in addition to the measures after the occurrence of land conflict, a precautionary approach will be needed to prevent the land conflict.



Source: NIRC (2017) edited by the JICA Study Team

Figure 10.4.2 Institutional Framework of Land Conflict Management

(5) Challenges and Improvement of Land Conflicts Management

According to the existing document[5] on land conflict in Tanzania, implication and negative factors of land conflicts and their effective improvement are summarised below:

(a) Implication of land conflicts

- Loss of properties (houses, crops, infrastructure)
- Loss of human life and livestock
- Social disharmony and/or instability
- Conflicts affect the production patterns
- Loss of social values (customs, traditions, belief systems, etc.)

(b) Negative factors in conflicts management

- Village councils not established and where established not functional.
- Resources constraints – when the councils lack facilities to run their offices, corruption prevails
- Interference of the councils by village governments
- Multiple jurisdictions
- Low public awareness on the conflict management machineries

[5] Investigating just systems over land and sources of conflicts, Getrude Sackey, 2010

(c) Proposed effective improvement in conflicts management

- Establishment of the conflict management machineries in all the villages, wards, and districts and adequate financing of the same;
- Public awareness raising on the role and powers of those machineries, strengthening enforcement bodies, insist on the rule of law;
- Give the communities and investors what is due to them without bending rules and procedures;
- At the centre of land conflicts, there is a human being interested in livelihood or money. These need to be balanced or else conflicts shall never be avoidable;
- Institutions can help reduce the magnitude of conflicts and sometimes bring lasting peace.

(6) Ideas of Mitigation Measures to the Land Related Conflicts

According to the SESA 2011 for NIP 2010 and NIMP2002, proposed mitigation measures in terms of land conflict were identified as shown in Table 10.4.4.

Table 10.4.4 Proposed Mitigation Measures for Potential Impact in SESA for NIMP2002 and NIP Implementation in terms of Land Conflict

Issues and concerns	Potential Negative Impact	Potential Mitigation Measures	Priority
Limited understanding of land governing policies, laws, and regulations	· Conflict among users · Land degradation	Provide training to land committees	HIGH
Inadequate land use planning	· Degradation, misuse, and waste of productive land resources · Loss of opportunities for economic and social development	Undertake land use planning and enforce the plans accordingly	MEDIUM
Imbalance in allocation of irrigation land between different scales of irrigation categories	Conflict of access and usage	Reallocate irrigation land equitably between the different scales of irrigation categories	MEDIUM
Default and land grabbing	Poor land compensation	Discourage direct purchase of land by investors from customary or statutory landowners; instead, encourage them to go into joint ventures using their land as their contribution to the investment	MEDIUM

Source: The SESA for the NIMP2002 and the NIP, 25th April 2011

Land conflict is one of the major concerns expected by land tenure system and domestic animals coming to farm land in the NIMP2018. Ideas of mitigation measures as a social consideration will be examined through SEA study that subsequently will apply to the NIMP2018. Tentative ideas of mitigation measures are summarised as follows:

- Precautionary approach to prevent the conflict and inadequate procedures associated with acquisition of land

As mentioned previously, the court of justice is in-charge of conflict resolution associated with the land acquisition. On the other hand, the legal and judicial system to prevent the occurrence of land conflict has not been established yet. In order to solve this problem, a new land conflict management system for irrigation development should be formulated based on the coordination between central government (Ministry of Land, President Office, Ministry of Agriculture, Ministry of Water and Irrigation) and the local government.

10.4.3 Climate Change Resilience

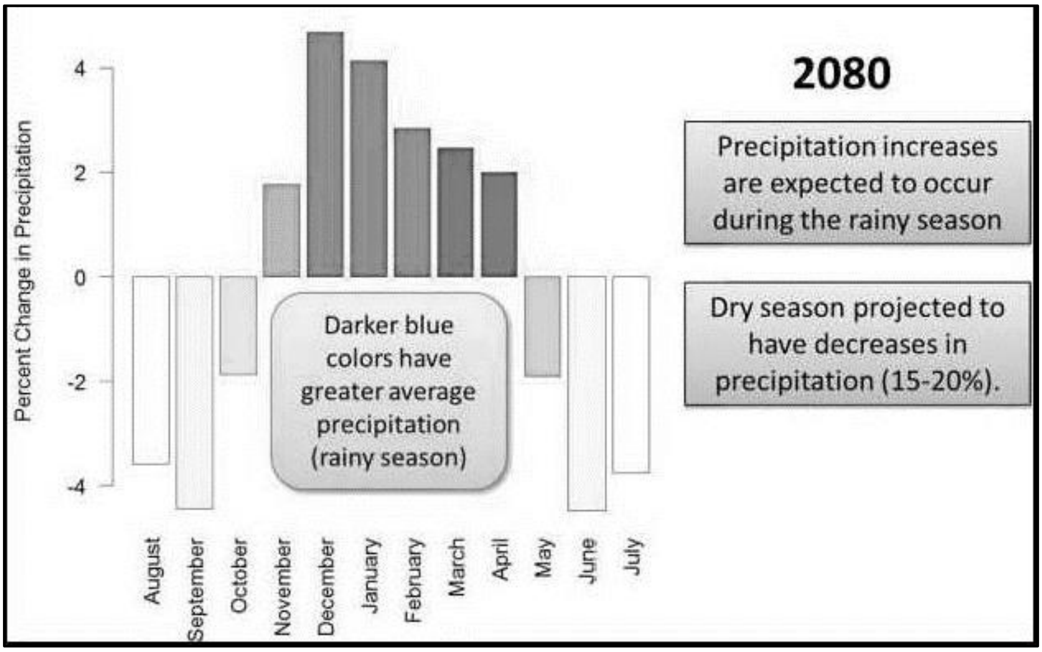
(1) Constraints of Irrigation Development due to the Climate Change

According to the Global Circulation Model (GCM) and emission scenarios projections, future change in rainfall, and increases in average annual temperatures from 1ºC to 3ºC above the baseline period (1961-1999) by the 2050s, with the latest projections indicating a high certainty of a 1 ºC rise across the country.

Even though climate change is projected to bring more rain to Tanzania in some areas, as shown in Figure 10.4.3, models show that this increase in rainfall is only during the middle of the rainy season (November – April rain season) with all other months projected to decrease in precipitation. This would result in the rainy season becoming shorter but more intense, and the dry season becoming drier. Increased intensity in frequency of storms, drought, flooding, may alter the hydrological cycles while variable precipitation may have implications for food, pasture, and water availability related to irrigation development.

(2) Challenges to build climate change resilience for agricultural farming system including irrigation development

According to the CSA Program[6] in Tanzania, in order to increase productivity of the agricultural sector through climate smart agriculture practices, programmatic result areas are presented. Table 10.4.5 shows extracted component and outputs related to irrigation development from these programmatic result areas of CSA Program.



Source: Tanzania Climate Smart Agriculture Program 2015-2025

Figure 10.4.3 Percent Change in Precipitation in 2080[7] in Tanzania

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[6] Tanzania Climate Smart Agriculture Program 2015-2025

[7] Condition under the higher RCP 8.5 greenhouse gas emissions scenario based on an ensemble of 19 climate models from the IPCC Fifth Assessment Report.

Table 10.4.5 Summary of CSA Program Related to the Irrigation Scheme

Component 2: Irrigation and Agricultural Water Management
Development issues: ・ Overdependence of agriculture on inadequate and erratic rainfall (rainfed agriculture). ・ Inadequate infrastructure development for irrigation, drainage, and water storage. ・ Inefficient water use of existing irrigation systems. ・ Low productivity on existing irrigation schemes. ・ Inadequate and un-coordinated information in irrigation research, science and technology. ・ Inadequate operation and maintenance practices of existing irrigation schemes. ・ Limited knowledge on the role of in-situ rainwater harvesting technologies through tillage and conservation agriculture.
Output 1: Irrigation schemes productivity increased by 25% and integrated farming systems increased by 50% by 2025
Actions: ・ Promote development and diffusion of appropriate efficient small-scale irrigation technological packages. ・ Train extension workers on irrigation and water management technologies and skills. ・ Build the capacity of Irrigators Organisations in agricultural water management and their obligations. ・ Undertake comprehensive management needs assessment of existing large scale irrigation schemes.
Output 2: 1.5 million ha of irrigation developed by 2025 to benefit 2.3 million households
Actions: ・ Review of the NIMP2002 and update irrigation potential areas for small-scale irrigation systems. ・ Train farmers in the installation, operation and maintenance of recommended irrigation technologies.
Output 3: 500,000 ha of integrated farming systems with sustainable water harvesting and management systems developed by 2025 to benefit 700,000 households
Actions: ・ Identify suitable areas for rainwater harvesting and agricultural water management systems. ・ Train farmers/household members in water harvesting and agricultural water management technologies. ・ Facilitate the construction of water harvesting structures at household and community levels. ・ Introduce and promote in-situ rainwater harvesting technologies (e.g., conservation agriculture)

Source: Tanzania CSA Program 2015-2025, edited by the JICA Project Team.

(3) Ideas of Mitigation Measures relevance to Climate Change Resilience

Climatic issue corresponding to climate change (such as change in rainfall pattern, increased rainfall intensity, frequent drought, temperature rise) is a major concern expected in the NIMP2018. Ideas of mitigation measures are summarised as follows:

- Alteration of cropping system
- Development of water storage facility and drainage channels
- Application of water saving cultivation method and drought tolerant crops

10.4.4 Gender and Youth Mainstreaming

(1) Gender Issues Associated with Irrigation Development

It is evident that women farmers play a fundamental role in agriculture and in particular, in irrigated agriculture. However, a number of serious problems are associated with it in Tanzania:

- Rural women in general have less access to and control over such economic and productive resources than men.
- Women's participation in decision-making processes that affect them is often low at all levels.
- Many laws, and especially customary practices, are discriminatory against women.

- Men have more access to and control over agricultural income (a consideration in relation to compensation for lost property such as farmland). On the contrary, women tend to be dependent on their own non-farm activities for income.
- Women often are dependent on their husband for permission to access medical care and continue to be more likely than men to be poor and illiterate and to be subject to gender-based violence. Some cultural groups, especially pastoralists, maintain extreme forms of gender inequality.
- Women are generally not able to irrigate at night owing to security concerns and during the day may face other time limitations. Water distribution systems rarely provide the flexibility necessary to satisfy such needs.

(2) Legal and Institutional Framework for Gender Issue

As for land tenures and gender issues, according to the report of Strategic Regional Environmental and Social Assessment (SRESA) 2013 for SAGCOT, customary practices that restrict a woman's property rights are still widespread, but steps are being taken to improve the relevant legislation. The 1999 Land Act gives Tanzanian women the right to obtain access to land, including the right to own, use, and sell it, and mandates joint titling of land. The Village Land Act requires women to be represented on land allocation committees and land administration councils[8]. Nevertheless, the National Land Policy (1995) stipulates that inheritance of clan (tribal) land will continue to be governed by custom and tradition provided it is not contrary to the Constitution. Village land councils, which settle land disputes, comprise seven members, of whom three must be female (Ikdahl, 2008)[9].

To address gender issues, the Government of Tanzania has the following Policy Statements as stipulated in the NIP, 2009 that if put in practise the gender involvement in irrigation schemes development will be enhanced and strengthened. The government will:

- Encourage a fair representation of both women and men in irrigators organisations;
- Promote effective participation of both women and men in initiation, planning, implementation, and operation and maintenance of irrigation schemes;
- Facilitate awareness raising, training and empowerment of women to actively participate at all stages in irrigation development; and
- Ensure that women and vulnerable groups have equal access to water, land, productive resources, and support services for irrigation development.

(3) Gender and Youth Issues Related to the Irrigation Scheme

In order to identify the state of gender and youth issues and their measures to be taken into considerations in the irrigation scheme, the JICA Project Team distributed the questionnaires to the Zone Office through NIRC. The answer was summarised in Table 10.4.6.

[8] Food and Agriculture Organization (FAO): Women, agriculture and rural development
[9] FAO. 2011. The State of Food and Agriculture 2010-2011. Rome

Table 10.4.6 Summary of Specific Gender and Youth Issues in the Irrigation Scheme

Scheme Name / District	Description Regarding Issues and Concerns Raised			What kind of implication or lessons learned from the case? (Proposed Mitigation Measures)
	What kind of conflict happened? (Details of Issues/Problems)	Why it happened? (Reasons)	How it was settled or not settled? (Actions taken)	
Worst Case Lekitatu/Meru DC and most of the schemes in our zone.	· Youth are not mostly involved · Male do not participate fully in irrigation and agriculture.	· Negative altitude to youth concerning agriculture in general, i.e., they do not believe that agriculture may help to solve life problems.	· Not yet settled	· Youth Training which will help Youth to participate fully in Agriculture and irrigation · Gender Training which will allow male and female to participate fully in irrigation
Worst Case Nyida/Shinyanga DC	· Unequal sharing of agricultural produce in between men and women in irrigated agriculture · Women face workload on agricultural activities · Land ownership is mainly men	· Lack of awareness on gender · Cultural perceptions	· Creating gender awareness	· Lack of gender awareness on access to, ownership, or distribution of resources may result to domestic antagonism · Constructed cultural behaviour may result to unequal sharing of gender roles and responsibilities among communities
Worst Case Nyida/Shinyanga DC	· Sharing of leadership positions in IOs Management Committee between men and women · Women participation in irrigation activities as well as community activities	· Gender awareness is growing among communities	· Introducing gender quota-system in IO management leadership	· If women, youths and disabled are involved in irrigation projects are likely to reduce poverty at household level and regional at large
Worst Case Chanjale scheme Gairo District	· All farm holders are male	· All IO leaders are men · Women are labourers		· Raise awareness on family CCROs · Allow women whose husband are members to participate in elections · Raise awareness on gender mainstreaming
Worst Case Msufini scheme Mvomero District	· Majority of scheme members are adult women	· Youths do not have land ownership · Men are too shy to participate on scheme activities perceiving them as women duties		· Awareness campaign on gender mainstreaming
Successful Case Segeni Scheme Rudiji District	· Women are on front line in all scheme activities	· Men and women share scheme land ownership and leadership positions	· Gender awareness by district	· Encourage both men and women to share benefits of the scheme and create sense of ownership of the scheme

Source: NIRC (2017) edited by JICA Project Team

(4) Gender Mainstreaming in the Irrigation Scheme

Based on "the Gender in Agriculture Sourcebook (WB, FAO, and International Fund for Agricultural Development (IFAD), 2009)", the following are discussed as lessons learned at both the project and the policy levels in gender mainstreaming in agricultural water management including irrigation scheme.

(a) Project Level

The following four main issues should be considered in project planning and implementation of gender-sensitive approaches to agricultural water management:

- Genuine gender-sensitive participatory project planning and implementation will prevent elites from capturing most project benefits. The benefits will therefore extend to a much larger population base.
- Water projects should be designed to address women and men's domestic and productive water needs. To date, many single-sector projects have been planned for either irrigation or domestic water supply and multiple-use needs had requirements that have been overlooked causing particular difficulties in rural areas.
- Planners should include among project objectives specific reference to increasing women's capacity to participate in irrigation projects and plan for ways to increase their access to productive resources.
- Project planners need to have a better understanding of the social, economic, and institutional reality of the project area. In practical terms, this means that some modest incremental resources should be allocated for assessment of such realities, particularly during the planning stage.

(b) Policy Level

The effectiveness of Agriculture Water Management (AWM) programs is heavily affected by government policies for the sector and related sectors. Gender issues that require active policy support include the following:

- Ensure that women enjoy de jure and de facto equality in access to land and other property, including inheritance and purchase.
- Support pro-poor development actions. Investment Note 10.3 (WB forthcoming) provides more detailed orientations in the interrelation between poverty-gender issues and AWM policies.
- Promote the participation of women in Water User Associations (WUAs) and other organisations by supporting appropriate institutional measures such as minimum quotas, or allowing that other forms of tenure besides ownership be eligible for being a member in the association.
- Provide an equal opportunity legal framework for agricultural labourers (and others) and ensure its application, including support for gender-equitable wages.
- Provide improved coordination among concerned WUAs to facilitate the implementation of multiple-use water projects.
- Support equal employment opportunities in WUAs.
- Provide and support capacity building around gender issues in WUAs with particular attention to extension staff. The establishment of dedicated government offices to monitor gender progress and provide specialized training, technical assistance, and sometimes modest

financial incentives can be most effective in providing more opportunities for women.

(5) Youth Issues in Tanzania

In Africa, the number of youths (aged 14 to 25 years) has grown significantly over the past decades, contributing to the bulk of the labour force. Tanzania's youth are no exception as demonstrated below[10]:

Youth in Tanzania represents roughly 18% of the total population and this share remained stable between 1990 and 2010. These figures are comparable for Uganda and Senegal but far above those registered in emerging and developed countries where the share of youth declined from 15% in 1990 to 12% in 2010.

In absolute numbers, the size of Tanzania's youth almost doubled from 4.4 million in 1990 to 8.1 million in 2010. It is expected to swell to 11 million by 2020 and 15 million by 2030.

Although youth unemployment in Tanzania is low on average, employed youth usually hold precarious jobs in the agricultural sector without any formal contracts or benefits. They are also more prone to unemployment in urban areas, and paradoxically, when they are more educated.

About 75% of employed youths are active in the agriculture sector and only 6.7% hold public sector wage jobs.

A youth in Dar es Salaam is more than 6 times (13%) more likely to be unemployed than a rural youth (2%).

More than 20% of youths with secondary education in Dar es Salaam are unemployed and a staggering 56% of secondary educated youths in Zanzibar are unemployed

The poor quality of jobs held by Tanzanian youth is to a large extent determined by their low level of education attainments. Of the approximately 900,000 youths (15 – 24 years) that entered the labour market in 2010/11: 14% did not complete primary school, 44% finished their primary but did not transit to secondary, an additional 38% went to secondary but did not reach or finish Form IV, and a mere 4% went beyond O-level. Many of them are unlikely to find good paying jobs as the majority did not acquire the necessary skills to create and grow a successful enterprise.

All the above facts raise a number of questions:

- Does the high unemployment rate of the urban and educated youth constitute a risk to Tanzania's social cohesion?
- Is the lack of educated youth a time bomb for a country like Tanzania?
- Should firms hire more youth?
- Should apprenticeships be encouraged?
- Should the government invest more in secondary and higher education?
- Do schools provide the skills needed by the labour force?
- Should more emphasis be given to technical and vocational training schools?

[10] http://blogs.worldbank.org/africacan/youth-in-tanzania-a-growing-uneducated-labor-force

(6) Ideas of Mitigation Measures to the Gender and Youth Issues

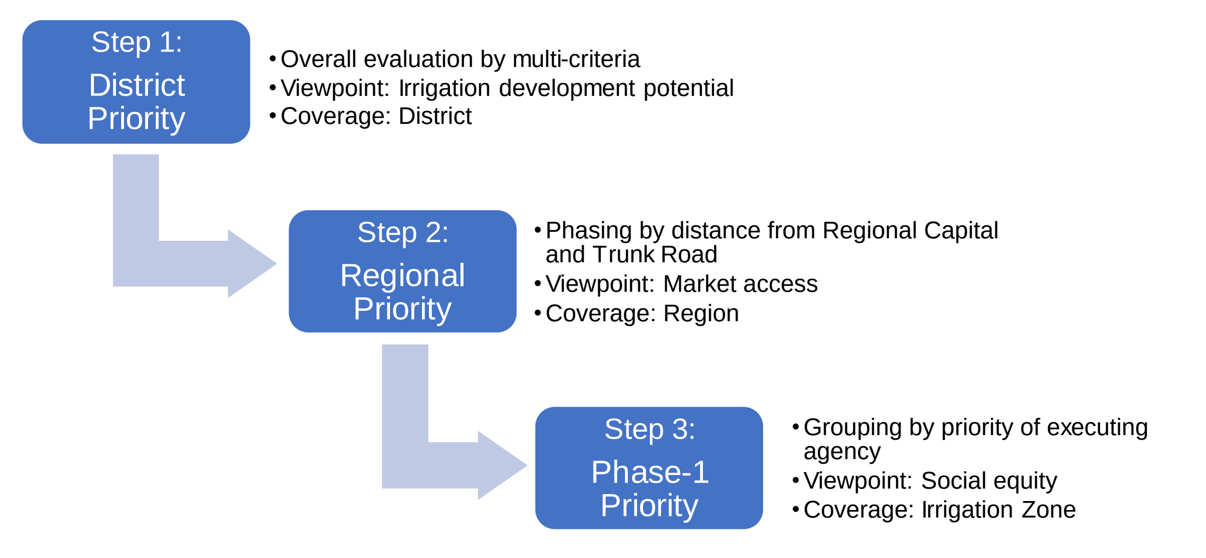
Gender and youth issues such as discrimination, different agricultural work load, etc., are major concerns expected in the NIMP2018. Ideas of mitigation measures as a social consideration will be examined through the SEA study that subsequently will apply to the NIMP2018. Tentative ideas of mitigation measures are summarised as follows:

- Identification of gender and youth roles, issues, and needs
- Consideration of gender and youth equality and empowerment (e.g., work sharing by female and male)

Chapter 11 Implementation Plans for Phase 1

11.1 Introduction

In this chapter, the JICA Project Team has formulated implementation plans for priority irrigation schemes selected for Phase 1 through Step-1 (District Priority) and Step-2 (Regional Priority). This process will be called as Step 3 (Phase 1 Priority). In Step 3, the implementation plan, which is combined with action plans will be finally prepared to achieve the target cumulative development area of 700,000 ha by the year 2025 proposed in Chapter 9 of this report.



Source: JICA Project Team

Figure 11.1.1 Proposed Data Sharing and Website Utilization Method

Incidentally, the National Irrigation Commission (NIRC) will formulate the Phase 2 development program according to the progress status, issues encountered, and changes in the environment surrounding irrigation sector during implementation of Phase 1.

11.2 Action Plan for Hard Components in Phase 1

It is equally important for the National Irrigation Master Plan 2018 (NIMP2018) to improve the irrigation efficiency by improvement work and enlarge the irrigation area by new development and expansion work in order to attain the development target. The 469 priority irrigation schemes selected for Phase 1 will be grouped in a most reasonable way for a smooth implementation and timely completion of those schemes within a timeframe of Phase 1.

(1) Objective:

The achievement of the target irrigation development area (accumulated to a total 700,000 ha) by the year 2025.

(2) Contents:

As shown in Figure 11.1.1, the JICA Project Team has adopted a zonal irrigation development approach from social equity aspect. Also, in order to reflect the intention of the executing agency, the projects will be implemented in descending order of priority given by the executing agency.

At first, priority irrigation schemes proposed for Phase-1 implementation is summarised in Table 11.2.1 below by irrigation zone and size (new development). The new development will increase the irrigation areas.

Table 11.2.1 New Development of Irrigation Schemes by Zone and Size in Phase 1

Irrigation Zone	Small Scale		Medium Scale		Large Scale		Total	
	No. of Schemes	New Area (ha)	No. of Schemes	New Area (ha)	No. of Schemes	New Area (ha)	No. of Schemes	New Area (ha)
Dodoma	13	2,617	4	2,820	1	500	18	5,937
Kilimanjaro	44	3,491	12	7,001	3	5,650	59	16,142
Mbeya	18	2,111	5	3,610	2	7,660	25	13,381
Morogoro	7	1,281	15	9,493	6	25,600	28	36,374
Mtwara	12	1,297	4	2,793	1	2,710	17	6,800
Mwanza	12	1,755	10	8,412	4	18,500	26	28,667
Tabora	8	1,470	8	4,737	2	4,280	18	10,487
Katavi	9	1,350	5	4,500	3	13,290	17	19,140
Sub-Total	**123**	**15,372**	**63**	**43,366**	**22**	**78,190**	**208**	**136,928**
Private Sector	-	-	-	-	3	54,000	3	54,000
Total	**123**	**15,372**	**63**	**43,366**	**25**	**132,190**	**211**	**190,928**

Source: JICA Project Team

Next, the distribution status of the Phase 1 priority irrigation scheme selected in Step 2 by irrigation zone/size (existing improvement) is shown in Table 11.2.2 below. The existing improvement has two types: one for improvement of irrigation efficiency by renovating existing facilities and another for increasing irrigation area by expansion of irrigation facilities.

Table 11.2.2 Improvement and Expansion of Irrigation Schemes by Zone and Size in Phase 1

Development Phase	Small Scale			Medium Scale			Large Scale			Total		
	No.	Imp. Area	Exp. Area	No.	Imp. Area	Exp. Area	No.	Imp. Area	Exp. Area	No.	Imp. Area	Exp. Area
Dodoma	29	5,473	2,177	13	5,045	5,263	3	7,065	6,435	45	17,583	13,875
Kilimanjaro	28	7,557	2,361	4	6,357	1,870	1	3,380	1,900	33	17,294	6,131
Mbeya	37	3,881	4,492	14	5,454	5,198	6	10,155	20,258	57	19,450	29,948
Morogoro	26	2,150	4,009	9	4,453	6,658	2	1,901	6,564	37	8,504	17,231
Mtwara	25	2,546	3,104	7	1,821	4,546	1*	290	-	32	4,567	7,650
Mwanza	15	3,016	1,568	4	1,899	2,954	1	1,040	5,000	20	5,955	9,522
Tabora	12	1,420	2,238	7	2,725	5,146	1	1,850	2,370	20	5,955	9,754
Katavi	7	1,585	1,165	5	2,373	3,125	5	12,883	12,791	17	16,841	17,081
Total	**179**	**27,628**	**21,114**	**63**	**30,127**	**34,760**	**19**	**38,524**	**55,318**	**261**	**96,279**	**111,192**

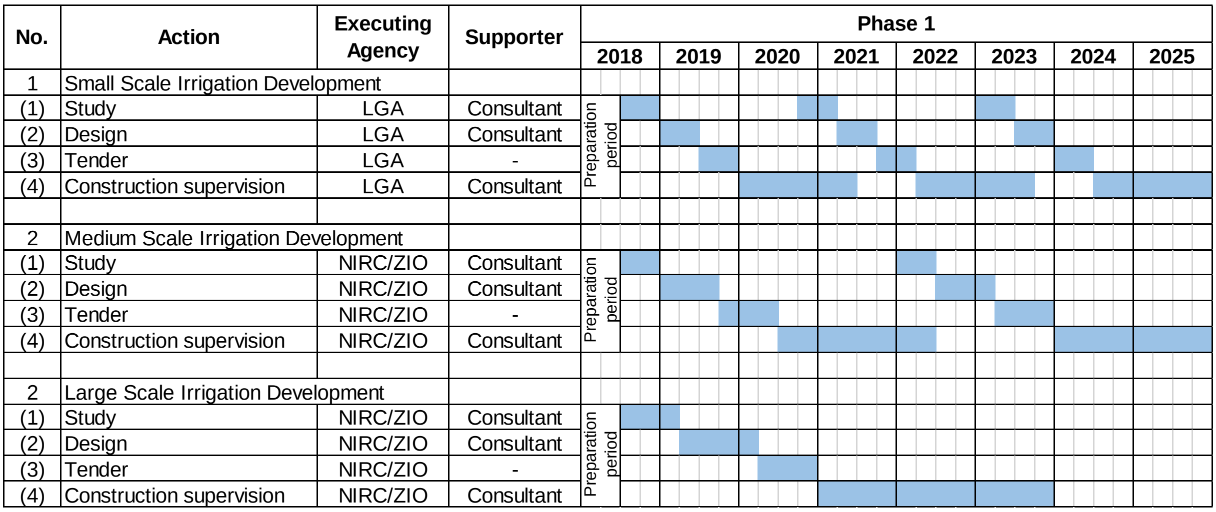
Note: "No." means number of schemes, "Imp. Area" means improved area (ha), "Exp. Area" means expansion area (ha).
Scheme number with as asterisk (*) is counted as a new development scheme.
Sources: JICA Project Team

Based on the above, the irrigation infrastructure developments in Phase 1 are planned to expand to 248,120 ha and existing improvement of 96,278 ha. Adding 54,000 ha of the large-scale commercial irrigation developments planned by private sector during the period of Phase 1, the irrigation areas would be 763,120 ha (= 461,000+ 248,120+54,000) at the end of Phase 1.

In order to implement such a great number of irrigation schemes within eight years, it is necessary to work for irrigation infrastructure development speedily and smoothly. According to the breakdown table above, there are 302 small-scale irrigation schemes where the Local Government Authorities (LGAs) will be the executing agency, and similarly 167 medium- and large-scale irrigation schemes to be executed by NIRC/Zonal Irrigation Offices (ZIOs). Moreover, there are three large-scale commercial irrigation farms will be added.

From the perspective of the project implementation, it is suggested to classify small-scale irrigation into three groups (S1, S2 and S3), medium-sized irrigation in two groups (M1 and M2) and large-scale irrigation in 1 group (L1), considering the construction period including study, design, and tendering. In principle, the study, design, and construction supervision would outsource to external consultants and all construction works would be given to contractors.

Based on the above conditions, an action plan 1 has been developed as shown in Figure 11.2.1 below.



Source: JICA Project Team

Figure 11.2.1 Action Plan 1: Irrigation Infrastructure Development

(3) Selection Results

Utilising a filtering function of the irrigation database developed under the NIMP2018, a list of target irrigation schemes and database information of respective irrigation schemes for each irrigation zone will be made up by following parameters in Table 11.2.3.

Table 11.2.3 Breakdown of Irrigation Schemes

Sector	Executive Agency	Irrigation Scale	Type of Works	Type of Irrigation
Public	NIRC / ZIOs	・Large ・Medium	・Improvement ・Expansion (incl. completion of uncompleted) ・New Development	・Weir ・Pump in river ・Dam*1 ・Pond*2 ・Lake (pump) ・Groundwater (pump)
	LGAs	・Small		
Private	Private Firms	・Large ・Medium ・Small		

*Note: It is defined by JICA Project Team as *1= Dam height is 15 m or more, *2= Dam height is less than 15 m.*
Source: JICA Project Team

In principle, private-sector irrigation schemes are developed by private enterprises according to their respective management policies. Therefore, those are not subject to the action plan. However, the large-scale private irrigation scheme of "A" rating specified in Subsection 8.6.6 shall be included in the irrigation development area of Phase 1.

Next, the irrigation schemes will be classified based on the priority order of LGAs and NIRC. For example, in the case of a small-scale irrigation schemes, it is classified into three packages based on the priority assigned by the respective LGAs. A summary of the results is shown in Table 11.2.4 below.

Table 11.2.4 Breakdown of Irrigation Schemes by Irrigation Zone and Grouping

(Number of projects)

Irrigation Zone	Small Scale			Medium Scale		Large Scale	Total
	S1	S2	S3	M1	M2	L1	
Dodoma	14	14	14	8	9	4	63
Kilimanjaro	24	24	24	8	8	4	92
Mbeya	18	18	19	9	10	8	82
Morogoro	11	11	11	12	12	8	65
Mtwara	12	12	13	5	6	1	49
Mwanza	9	9	9	7	7	5	46
Tabora	6	7	7	7	8	3	38
Katavi	5	5	6	5	5	8	34
Total	**99**	**100**	**103**	**61**	**65**	**41**	**469**

Source: JICA Project Team

Table 11.2.5 summarises Table 11.2.1 by irrigation zone and type of works. It is clear from Table 11.2.5 that there are many improvement works in the Mbeya zone followed by Morogoro then by Dodoma and Kilimanjaro, while new development is mainly in Morogoro zone followed by Mwanza and Katavi.

Table 11.2.5 Breakdown of Irrigation Schemes by Irrigation Zone and Type of Works

Irrigation Zone	Existing Scheme		New Development Scheme		Total Area (ha)
	Improvement*1 (ha)	Expansion*1 (ha)	Gravity Type (ha)	Pressurized Type (ha)	
Dodoma	17,583	13,875	3,897	2,040	37,395
Kilimanjaro	17,293	6,132	16,142	0	39,567
Mbeya	19,450	29,948	13,381	0	62,779
Morogoro	8,504	17,231	36,374	0	62,199
Mtwara	4,657	7,650	6,600	200	19,107
Mwanza	5,955	9,522	28,442	225	44,144
Tabora	5,995	9,754	9,282	1,205	26,236
Katavi	16,841	17,081	19,140	0	53,062
Total	**96,278**	**111,193**	**133,258**	**3,670**	**344,399**

*Note: *1= Difference between the improvement and the expansion in principle either includes expansion of irrigation area or none.*
Source: JICA Project Team

Table 11.2.6 summarises Table 11.2.1 by irrigation zone and type of irrigation. It is clear from Table 11.2.5 that there are many weir irrigation in Kilimanjaro, followed by Mbeya and Mtwara and where water resources are abundant. Whereas dam and pond irrigations are relatively more in Mwanza, followed by Katavi and Dodoma which are located in semi-arid zones. From the above, it can be said that the irrigation schemes selected in Phase 1 are consistent with the local hydrological and weather conditions.

Table 11.2.6 Breakdown of Irrigation Schemes by Irrigation Zone and Type of Irrigation

Irrigation Zone	Weir Irrigation		River Pump Irrigation		Dam Irrigation*1		Pond Irrigation*2		Lake Water Irrigation		Groundwater Irrigation		Unknown		Total	
	(No.)	(ha)	(No.)	(ha)	(No.)	(ha)	(No.)	(ha)	(No.)	(ha)	(No.)	(ha)	(No.)	(ha)	(No.)	(ha)
Dodoma	28	17,503	2	600	2	7,000	24	8,142	-	-	7	4,150	-	-	63	37,395
Kilimanjaro	82	36,504	4	1,633	-	-	3	450	-	-	-	-	3	980	92	39,567
Mbeya	63	45,761	1	118	-	-	10	6,340	-	-	1	220	7	10,340	82	62,779

Irrigation Zone	Weir Irrigation		River Pump Irrigation		Dam Irrigation*1		Pond Irrigation*2		Lake Water Irrigation		Groundwater Irrigation		Unknown		Total	
	(No.)	(ha)	(No.)	(ha)	(No.)	(ha)	(No.)	(ha)	(No.)	(ha)	(No.)	(ha)	(No.)	(ha)	(No.)	(ha)
Morogoro	33	46,089	19	5,260	-	-	6	5,760	2	620	2	400	3	3,980	65	62,109
Mtwara	38	13,257	-	-	-	-	7	3,740	1	200	1	110	2	1,800	49	19,107
Mwanza	18	9,015	3	1,395	3	18,540	15	8,390	5	5,864	1	140	1	800	46	44,144
Tabora	9	7,607	1	450	-	-	19	14,850	8	3,079	1	250	-	-	38	26,236
Katavi	26	30,877	-	-	1	13,605	5	6,480	-	-	1	1,100	1	1,000	34	53,062
Total	**297**	**206,613**	**30**	**9,456**	**6**	**39,145**	**89**	**54,152**	**16**	**9,763**	**14**	**6,370**	**17**	**18,900**	**469**	**344,399**

*Notes: * 1= Dam height is 15 m or more, *2= Dam height is less than 15 m.*
Source: JICA Project Team

11.3 Action Plans for Soft Components in Phase 1

Implementation of soft-component activities in Phase 1 will be synchronized with that of hard component that is, the activities of "organisational strengthening (Action Plan 2) and capacity building (Action Plan 3) will be implemented in accordance with the project cycles of infrastructure development (Action Plan 1)". Coordination activities (Action Plan 4) will continue throughout the Phase I period to lay the groundwork of all action plans.

(1) Objective

Creation of conducive environment for Action Plan 1 implementation.

(2) Contents

The contents of soft-component activities and basic ideas of scheduling/phasing are described in the NIMP2018 (see Chapter 9). Based on these, the following articulates the Phase I activities:

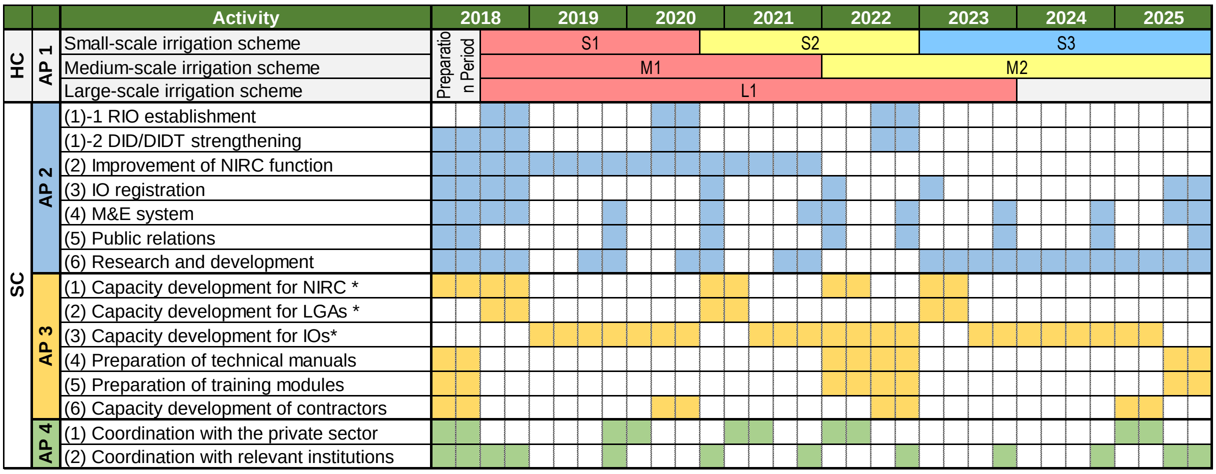
Table 11.3.1 Details of Action Plans 2 to 4 (Phase 1)

	Development Plan	Activity
AP 2: Organisation and Functional Strengthening	(1) Establishment of RIOs and strengthening of DIDTs/DIDs	[RIO establishment] ・ 6 RIOs will be established. ・ At least 1 engineer and 2 technicians are assigned to each RIO. [DIDT/DID strengthening] ・ Assignment of additional technical staff is promoted for the LGAs (1 engineer and 2 technicians per 2,500 ha). ・ 1 field officer is assigned for each scheme for monitoring and IO support. ・ Set-up of DIDs will be discussed between interested LGAs, PO-RALG, and NIRC.
	(2) Improvement of NIRC function (HQ, equipment, facilities)	・ Vacant posts are filled in the first half of the period. ・ New headquarters will be constructed in the first half of the period.
	(3) IO registration	・ Effective support system for IOs will be discussed with stakeholders in the preparation period. ・ Awareness raising for stakeholders continues throughout the period.
	(4) Establishment of project performance monitoring and evaluation system	・ Performance indicators will be set in the preparation period. ・ Monitoring system is introduced in the initial period and used for the whole period. ・ Performance evaluation will be conducted in the mid and end of the period.
	(5) Establishment of public relations system	・ NIRC website will be developed in the preparation period. ・ The contents are annually updated.
	(6) Research and development for irrigation	・ Where appropriate, researches are commissioned to academic/research institutes throughout the period. ・ A research centre for NIRC will be developed in the latter half of the period.

	Development Plan	Activity
AP 3: Capacity Building	(1) Capacity development training to NIRC irrigation staff in ZIOs/RIOs	・ ZIO/RIO staff will receive training in project management in the early stage of the period. ・ Practical training will be conducted on the job along the project cycles of the hard component.
	(2) Capacity development training to irrigation staff in LGAs (DIDTs/DIDs)	・ LGA staff will receive training in project management in the early stage of the period. ・ Practical training will be conducted on the job along the project cycles of the hard component.
	(3) Capacity development training of IOs	・ IO members receive practical training along the CGL project cycle. ・ Additional training will also be provided (e.g., group management, production, and marketing).
	(4) Establishment of design standards for irrigation in Tanzania	・ Technical standard manuals and checklists will be prepared in the preparatory period. ・ The manuals are periodically updated for the entire period.
	(5) Establishment of training modules for irrigation development	・ Training modules will be developed in the preparatory period. ・ The modules are periodically updated for the entire period.
	(6) Promotion of private contractors and enhancement of their engineering ability	・ Seminar for technical manuals and project management will be periodically conducted. ・ Commission to local firms will be promoted.
AP 4: Coord. Strengthening	(1) Coordination with private sector for irrigation investment	・ Seminars for private investors will be held periodically.
	(2) Coordination with relevant institutions for cross-cutting issues	・ Discussions will be made on crosscutting issues such as water right and land-use right with relevant ministries and agencies (including MOWI, MALF, and PO-RALG.

Sources: JICA Project Team

Accordingly, the figure below shows the implementation schedule of the Action Plans 2 to 4 along the project cycle of infrastructure development.



*Note: * Practical/ on-the-job training is continuous along project cycle.*
Source: JICA Project Team

Figure 11.3.1 Implementation Schedule of Soft Component (Action Plans 2 to 4)

11.4 Development Programs

11.4.1 Contents of Development Programs

A combination of action plans is defined as "development program". From the discussion so far, a combination shown in the table below can be considered. Broadly speaking, a development program for each irrigation zone on the horizontal axis and development programs for each action plan on the vertical axis is given. The development program for each irrigation zone, mainly ZIO, is more efficient from the viewpoint of implementation and operation. On the other hand, development programs by action plan are efficient in terms of nationwide deployment, but it is difficult to make a horizontal coordination between action plans. Here, the development program for each irrigation zone is proposed under the assumption that in principle soft components (AP2 to AP4) are implemented synchronously with the hard component (AP1). However, since the NIRC headquarter is involved in all action plans, an additional development program aiming at strengthening NIRC's organisation and functions (AP2), capacity building (AP3), and strengthening cooperation (AP4) is proposed.

Table 11.4.1 Combination of Development Programs

Development Program	AP1	AP2	AP3	AP4
1. NIRC HQ	●	●	●	●
2. Dodoma Zone Irrigation	●	●	●	-
3. Kilimanjaro Zone Irrigation	●	●	●	-
4. Mbeya Zone Irrigation	●	●	●	-
5. Morogoro Zone Irrigation	●	●	●	-
6. Mtwara Zone Irrigation	●	●	●	-
7. Mwanza Zone Irrigation	●	●	●	-
8. Tabora Zone Irrigation	●	●	●	-
9. Katavi Zone Irrigation	●	●	●	-
10. Large Commercial Irrigation	-	-	-	●

Note: NIRC-HQ shares the total cost of 20% for AP2 and AP3, 100% for AP4 but none for AP1.
Source: JICA Project Team

11.4.2 Summary Report of Development Program

The development program summary creates one program (inclusive of AP1 to AP4) for each irrigation zone for Phase 1 projects. Its contents include the program name, executing agency, location information (target region and district name), purpose (development potential area), scope (construction type and irrigation type), construction period, target crops, investment amount, financial and economic indicators as basic information. By comparing the basic information of each zone irrigation development program, it is possible to grasp the differences and features of each program. Also, the location maps of priority irrigation schemes will be attached to the program summary. Furthermore, a development program of NIRC will be proposed in view of the implementation and management of the NIMP2018. Its contents are basic information such as development program name, activity contents of AP2 to AP4, period, investment amount, etc. It is however that the private large-scale commercial irrigation program is to be implemented by private enterprises according to their respective management policies, and therefore no specific program will be formulated.

The summary of development programs is given in Attachment-11.4.1.

11.5 Investment Cost

11.5.1 Costs for Irrigation Infrastructure Development

(1) Costs for Engineering Services

In principle, external consultants are procured by an executing agency in the study, design, and construction supervision of the target projects. However, no cost related to bidding will be considered in this cost estimate.

The costs for infrastructure development are summarised as shown in Table 11.5.1 below and further details are given in Attachment-11.5.1.

Table 11.5.1 Costs for Engineering Services by Irrigation Zone and Grouping (USD)

Development Program	Survey	Design	Supervision	Total
Dodoma	6,306,390	9,148,365	18,296,731	33,751,486
Kilimanjaro	6,971,461	10,151,106	20,302,212	37,424,779
Mbeya	9,843,093	14,420,374	28,840,748	53,104,215
Morogoro	12,957,410	19,285,594	38,571,189	70,814,193
Mtwara	3,463,925	5,113,459	10,226,918	18,804,303
Mwanza	9,657,826	14,381,335	28,762,670	52,801,831
Tabora	5,324,394	7,880,479	15,760,958	28,965,831
Katavi	9,266,269	13,601,317	27,202,634	50,070,220
Total	**63,790,767**	**93,982,030**	**187,964,060**	**345,736,854**

Note: All figures include VAT18%.
Source: JICA Project Team

(2) Costs for Construction Works

The cost estimate for infrastructure development has been made on assumption that all the construction works would be carried out by a contractor. The summary is shown in Table 11.5.2 below, and the details of which are shown in Attachment-11.5.1.

Table 11.5.2 Costs for Construction Works by Irrigation Zone and Type of Works (USD)

Development Program	Existing Improvement	Existing Expansion	New Gravity Type	New Pressure Type	Total
Dodoma	62,243,820	49,117,500	25,751,376	36,108,000	173,220,696
Kilimanjaro	61,217,220	21,707,280	106,666,336	0	189,590,836
Mbeya	68,853,000	106,015,920	88,421,648	0	263,290,568
Morogoro	30,104,160	60,997,740	240,359,392	0	331,461,292
Mtwara	16,485,780	27,081,000	43,612,800	3,540,000	90,719,580
Mwanza	21,080,700	33,707,880	187,944,736	3,982,500	246,715,816
Tabora	21,222,300	34,529,160	61,335,456	21,328,500	138,415,416
Katavi	59,617,140	60,466,740	126,477,120	0	246,561,000
Total	**340,824,120**	**393,623,220**	**880,568,864**	**64,959,000**	**1,679,975,204**

Note: All figures include VAT18%.
Source: JICA Project Team

11.5.2 Soft Component

The following shows the cost of implementing the soft component (i.e., Action Plans 2 to 4) in the Phase 1. (See Attachment-9.7.2 for the breakdown of the cost estimates.)

Table 11.5.3 Costs of Soft Components (USD)

Action Plan		Amount (USD)
AP 2 (SC 1)	Organisation and Functional Strengthening	23,943,069
AP 3 (SC 2)	Capacity Building	3,336,814
AP 4 (SC 3)	Strengthening of Coordination	49,996
Total		27,329,879

Note: All figures include VAT18%.
Source: JICA Project Team.

The cost breakdown of soft components is summarised as follows:

Table 11.5.4 Cost Breakdown of Soft Components (USD)

Development Program	AP2 (SC1)	AP3 (SC2)	AP4 (SC3)	Total
NIRC HQ	4,788,614	667,363	49,996	5,505,973

Development Program	AP2 (SC1)	AP3 (SC2)	AP4 (SC3)	Total
Dodoma	2,079,799	289,850	0	2,369,650
Kilimanjaro	2,200,600	306,685	0	2,507,285
Mbeya	3,491,583	486,603	0	3,978,185
Morogoro	3,454,319	481,409	0	3,935,729
Mtwara	1,062,675	148,099	0	1,210,774
Mwanza	2,455,159	342,162	0	2,797,321
Tabora	1,459,169	203,356	0	1,662,525
Katavi	2,951,152	411,286	0	3,362,438
Total	**23,943,069**	**3,336,814**	**49,996**	**27,329,879**

Note: All figures include VAT18%.
Source: JICA Project Team

11.5.3 Total Costs of Phase 1

Table 11.5.5 indicates the cost breakdown of Phase 1 by irrigation zone and action plan.

Table 11.5.5 Cost Breakdown of Phase 1 (USD)

Development Program	AP1 (Hard Component)	AP2 to AP4 (Soft Components)	Total
NIRC HQ	0	5,505,973	5,505,973
Dodoma	206,972,182	2,369,650	209,341,832
Kilimanjaro	227,015,615	2,507,285	229,522,900,
Mbeya	316,394,783	3,978,185	320,372,968
Morogoro	402,275,485	3,935,729	406,211,214
Mtwara	109,523,883	1,210,774	110,734,657
Mwanza	299,517,647	2,797,321	302,314,968
Tabora	167,381,247	1,662,525	169,043,772
Katavi	296,631,220	3,362,438	299,993,658
Total	**2,025,712,060**	**27,329,879**	**2,053,041,941**

Note: All figures include VAT18%.
Source: JICA Project Team

Incidentally, the annual disbursement schedule of Phase 1 has been summarised in Table 9.9.4.

11.6 Evaluation of Phase 1

The overall evaluation results of the NIMP2018 (2018-2035) is discussed in Section 9.9. In this section, the evaluation is made to several cases for Phase 1 (2018-2025) including eight zonal irrigation development programs.

(1) Financial Evaluation

Annual incremental benefit of beneficiary farmers under without project condition and with project condition for Phase 1 and each zonal development programs. The results are summarised as follows:

Table 11.6.1 Net Returns of Beneficiary Farmers by Zone in Phase 1

Irrigation Zone	Shifting from Rainfed to Irrigation by NIMP2018			Shifting from Existing Irrigation to Irrigation by NIMP2018		
	w/o Project (TZS/ha/yr)	with Project (TZS/ha/yr)	Net Increment (TZS/ha/yr)	w/o Project (TZS/ha/yr)	with Project (TZS/ha/yr)	Net Increment (TZS/ha/yr)
Phase 1	▲397,754	3,922,448	4,230,202	805,754	3,922,448	3,116,695
Dodoma	▲315,567	3,899,413	4,214,981	712,903	3,899,413	3,186,511
Kilimanjaro	▲201,973	5,391,120	5,593,093	1,353,113	5,391,120	4,038,007
Mbeya	▲284,490	3,504,072	3,788,562	647,090	3,504,072	2,856,983
Morogoro	▲199,577	4,879,839	5,079,416	1,254,672	4,879,839	3,625,116

Irrigation Zone	Shifting from Rainfed to Irrigation by NIMP2018			Shifting from Existing Irrigation to Irrigation by NIMP2018		
	w/o Project (TZS/ha/yr)	with Project (TZS/ha/yr)	Net Increment (TZS/ha/yr)	w/o Project (TZS/ha/yr)	with Project (TZS/ha/yr)	Net Increment (TZS/ha/yr)
Mtwara	▲141,130	7,321,132	7,462,262	1,956,406	7,321,132	5,364,726
Mwanza	▲158,418	4,146,282	4,304,700	1,263,647	4,146,282	2,882,635
Tabora	▲360,246	2,656,424	3,016,670	415,115	2,656,424	2,241,309
Katavi	▲283,109	3,017,050	3,300,159	504,684	3,017,050	2,512,366

*Note: *1= Net return is defined as gross return minus production cost per ha per year,*
w/o= without
Source: JICA Project Team

From the table above, the net return of beneficiary farmers would drastically increase to TZS 3,920,000 /ha/year on average with project condition; which is almost as five times as net return without project condition.

(2) Economic Evaluation

Economic indicators of Phase 1 and eight zonal irrigation development programs have been calculated using economic costs and benefits, which are summarised in the table below. The calculation sheets of economic analysis are given in Attachment-11.6.1.

Table 11.6.2 EIRR of Zonal Irrigation Development Programs

Development Program	Net Present Value (NPV) (TZS in Million)	Benefit/Cost Ratio (B/C)	EIRR (%)
Phase 1	**986,555**	**1.38**	**16.4**
Dodoma	109,929	1.42	16.7
Kilimanjaro	83,618	1.29	15.4
Mbeya	153,530	1.35	16.0
Morogoro	275,571	1.57	18.3
Mtwara	79,662	1.57	18.3
Mwanza	206,078	1.54	18.0
Tabora	54,322	1.26	15.0
Katavi	104,549	1.28	15.2

Source: JICA Project Team

From the table above, the B/C ratio is in the range of 1.26 to 1.57, and the economic internal rate of return (EIRR) is in the range of 15.0% to 18.3%. Besides one for Phase 1, each zonal irrigation development program shows high economic viability.

Chapter 12 Strategic Environmental Assessment

This chapter describes completed results based on the final report of the Strategic Environmental Assessment (SEA) study during the reporting period of the National Irrigation Master Plan 2018 (NIMP2018). The scheduled date of SEA study is as shown in Table 12.1.1.

Table 12.1.1 Summary of the SEA Activities for NIMP2018

S/N	SEA Activity	Scheduled Date	Progress
1	Commencement of Work	3/1/2018	Done
2	Preparation and Submission of Inception Report	18/1/2018	Done
3	Presentation of Inception Report	22/1/2018	Done
4	Scoping and Preparation of ToR	23/1-12/2/2018	Done
5	Approval of Scoping Report and ToR by Vice President Office- Department of Environment (VPO-DOE)	19/2/2018	Done
6	SEA Study	20/2-21/5/2018	Done
7	SEA Workshop – Draft Report Presentation	29/5/2018	Done
8	Submission of Draft SEA Report to VPO-DOE	2/6/2018	Done
9	VPO-DOE Site Verification	7/6-14/6/2018	Done
10	VPO-DOE Meeting to Discuss SEA Report	19/6/2018	Done
11	SEA Final Report Submission	30/6/2018	Done

Source: JICA Project Team

12.1 Scope of SEA

According to the scoping report of the SEA for the NIMP2018, the scope of SEA (Terms of Reference (ToR) for the SEA) was identified as follows. Further key issues of concern have been clarified during scoping and how various stakeholders will be involved have been suggested.

(1) Task 1: Establish Baseline Conditions

In order to establish baseline conditions for the SEA study, environmental and social baseline conditions of the areas concerned with the master plan should be described. This should include other ongoing or potential/proposed activities by both public and private sector that may influence the master plan. Some of this information is available through the Japan International Cooperation Agency (JICA) Project Team interim report on NIMP2018, while some must be collected from other sources. Enhanced data management techniques, such as the use of geographic information system (GIS), as appropriate or where possible, should be utilized to ensure that environmental assessment and planning are done using the best available, consistent baseline information, particularly in areas of high biological diversity and social/cultural significance.

This task includes to:

- Critically review, qualitatively and quantitatively, the key physical, biological, socioeconomic characteristics of the areas concerned with the master plan. Given the size of the area covered by the master plan, an appropriate subdivision for analytical purposes is presented. Such subdivision may be done according to ecosystem/landscape, basin/catchment wide scenarios, and conduct environmental and social assessments in the respective areas as appropriate.
- Describe, to the extent possible, the past trends in distribution, quantity and/or quality of

important environmental and social components, and how such key trends might change with the master plan.

- Describe key environmental issues of the areas concerned with the master plan (e.g., pressures on protected areas, biodiversity hot spots and other areas qualifying as critical habitats, competing demand for water resources, settlement expansion). Based on recent trends and future outlook with the master plan concept, understand the threats (e.g., pollution, water scarcity, etc.) and opportunity (e.g., improved service provision) in the areas concerned. Identify how best to monitor these trends and threats.
- Identify the areas well-suited for achieving master plan objectives from environmental and social perspective, and the limitations on development in different areas.
- Identify a sub-set of core environmental and social indicators that needs to be tracked in the implementation of the master plan. Using existing data, identify baseline levels for these indicators. Identify data gaps.

(2) Task 2: Legal and Institutional Framework

The existing Tanzanian legal and institutional framework has been identified during the scoping, thus, during SEA study they will assess and describe how they affect the master plan implementation from an environmental and social perspective. Specifically, this task is useful to:

- Review/assess the Government of Tanzania (GoT) policies, legislation (including international treaties and obligations), regulations, and plans relevant to the master plan.
- Discuss the extent to which the master plan is affected by and consistent with this Tanzanian framework, with JICA Environmental and Social Guideline, and with international environmental and social assessment norms.

(3) Task 3: Conduct a Scenario Analysis of the Potential Environmental and Social Impacts

The development of the Environmental and Social Management Framework and associated monitoring framework of the master plan, need to be informed by a closer look at alternative scenarios for the revised national irrigation master plan. A detailed methodology of this scenario analysis is conducted.

This task is essential to:

- Describe alternative scenarios proposed in the revised national irrigation master plan to achieve the objectives of the master plan with the JICA Project Team. (The information on the scenarios will be provided by the JICA Project Team. See section 12.3.)
- Establish the scenario analysis framework to analyse environmental and social impacts of the master plan. This impact assessment will emphasize the identification of environmental, economic, and social effects of the irrigation development by the master plan, together with potential indirect and/or cumulative impacts expected from other programs, initiatives, and trends that are going on in the region.
- Impacts will be defined with significance criteria. Where possible, identify key environmental, social, and economic indicators that can be used to compare alternative development scenarios. The SEA will include a matrix of impacts identifying and discussing the severity of

consequences/hazards, the probability or risk of impact events occurring, the major groups affected and the potential to manage the event if it does occur.

- Analyse the scenarios based on impacts on the significance criteria, with indicators identified if available. Develop a consequence table/matrix to summarise, visualise, and compare the impacts of the scenarios on the significance criteria and indicators.
- Bounded by the sustainable development principles of the National Environmental Policy and considering potential future environmental constrains (e.g., water, land use) and socio-economic circumstances, look backwards from a desired future endpoint to the present to determine the environmental and social consideration to be included in each scenario, what measures would be included to reach that point.
- Evaluate these scenario options considering above impacts, and environmental and social considerations to be included. In the evaluation, suggestions to each scenario may be included such as possible change to subcomponent.

(4) Task 4: Select one best scenario with the JICA Project Team, National Irrigation Commission (NIRC).

Describe the reasons why this scenario is selected.

(5) Task 5: Identify mitigation measures for the risks posed by the selected scenario.

The SEA will be a resource for acceptable mitigation measures to be included into the short- and long-term policy and planning tools developed by the NIRC and other actors. Mitigation measures can be fiscal, regulatory, educational, technical/modal, spatial, etc.

(6) Task 6: Develop the Strategic Environmental and Social Management and Monitoring Framework for the selected development scenario to avoid, minimize, and/or mitigate potential negative environmental social impacts.

- Possible components of the management framework may include: recommendations for practical and cost-effective mitigation actions associated with typical projects in the selected scenario; and responsibilities and actions to strengthen local or national institutions and other major stakeholders.
- The monitoring framework may include an environmental monitoring plan, including defining measurable environmental indicators. This framework helps identify negative impacts during the implementation phase and ensures that mitigation measures proposed in the SEA are implemented.

12.2 SEA Steps (Procedures), Approach, and Methodology

12.2.1 SEA Steps (Procedures)

According to SEA regulations, SEA process should start at the commencement of the preparation of a policy, bill, regulations, strategy, plan, or program and continue throughout the process to the stage of their promulgation. In addition, the SEA guideline provides SEA procedures, which is composed of the following seven major steps specified in Regulation 11 of the SEA regulations:

(1) Screening

(2) Scoping and Terms of Reference,

(3) Preparation of the draft SEA report;

(4) Consultation and decision-making

(5) Revision of draft SEA report;

(6) Approval of SEA report; and

(7) Implementation, monitoring, and evaluation

The step-by-step framework for conducting SEA is summarised in Table 12.2.1.

Table 12.2.1 Summary Step-by-step Framework for Conducting SEA

SEA step	Main Tasks	Purpose	Responsible	Time frame (days)
Step 1: Screening	1.1 Prepare a summary of views as to whether or not the proposal is likely to have significant environmental effects	・ To determine whether or not a SEA is required. ・ To determine the need and type of SEA.	Responsible Authority (NIRC)	
	1.2 Submit the summary to the Director of Environment and other relevant ministries for consideration	・ To obtain views and comments of stakeholders.	Responsible Authority (NIRC)	
	1.3 Provide views and comments on the summary	・ To engage stakeholders in determination of the need for SEA.	Sector ministries and other stakeholders	21 days
	1.4 Consolidate and analyze views of stakeholders for decision	・ To facilitate determination on whether or not SEA is required.	Director of Environment	14 days
	1.5 Determine whether SEA is required or not	・ To advise responsible authority to conduct SEA or not	Director of Environment Minister responsible for Environment	14 days
Step 2: Scoping and Terms of Reference	2.1 Establish level of details of the information to be included; key authorities to be consulted; opportunities for public consultation; the consultation period it intends to use.	・ To determine the scope of the assessment and focus of the SEA ・ To prevent the production of unnecessary data and to ensure an efficient process. ・ To streamline the assessments and avoid duplication of assessment.	Responsible Authority (NIRC)	
	2.2 Develop Terms of Reference	・ To provide formal guidance to the responsible authority on the range of issues that must be addressed in SEA process. ・ To form a basis for subsequent review process.	Responsible Authority (NIRC)	
	2.3 Prepare and submit scoping report to the Director of Environment	・ To consult stakeholders.	Responsible Authority (NIRC)	
	2.4 Approve the scope and Terms of Reference of SEA	・ To determine adequacy of details covered. ・ To approve the Terms of Reference.	Director of Environment	14 days
Step 3: Preparation of Draft SEA Report	3.1 Identify and assess likely impacts	・ To predict the significant environmental effects of the proposal. ・ To evaluate the predicted effects of the proposal and assist in its refinement.	Responsible Authority (NIRC)	

SEA step	Main Tasks	Purpose	Responsible	Time frame (days)
	3.2 Identify alternatives	· To develop and refine strategic alternatives.	Responsible Authority (NIRC)	
	3.3 Prepare draft SEA report	· To present the predicted environmental effects of the plan or program, including alternatives, in a form suitable for public consultation and use by decision-makers.	Responsible Authority (NIRC)	
Step 4: Consultation and Participation	4.1 Consult stakeholders to obtain their views and comments on the Draft SEA report	· To give the public and the consultation bodies an opportunity to express their opinions on the findings of the SEA report. · To gather more information from stakeholders and the public.	Responsible Authority (NIRC)	
	4.2 Prepare draft final SEA report and submit to the Director of Environment for revision	· To present the findings of SEA for revision.	Responsible Authority (NIRC)	
	5.1 Engage team of experts for site verification visits in case of physical plans, projects which are within the scope of EMA and SEA regulations 5.2 Engage Technical Review Committee (TRC) in revising the draft final report	· To assess the adequacy of the report and provide appropriate recommendations. ·	Director of Environment	
	5.3 Submit site verification report to the TRC 5.4 Submit TRC comments to the responsible authority	· To review and incorporate comments from all stakeholders and TRC.	Director of Environment	**14 days**
	5.5 Prepare and submit final SEA report to the minister responsible for environment	· To seek approval from the minister.	Responsible Authority (NIRC)	
Step 6: Approval of Strategic Environmental Assessment report	6.1 Approval of SEA report and issuance of SEA Approval Notice	· To make final decision on implementation of the proposed policy, bill, regulations, strategy, plans, and programs.	Minister responsible for Environment	**21 days**
Step 7: Monitoring	7.1 Monitor significant environmental impacts of implementation of the approved policies, bills, regulations, strategies, plans, and programs.	· To track the environmental effects of the approved policies, bills, regulations, strategies, plans. and programs and identify any unforeseen adverse effects at the early stage and undertake appropriate remedial measures.	Responsible Authority (NIRC)	
	7.2 Prepare periodic reports on implementation of approved policies, bills, regulations, strategies, plans, and programs and submit to the Director of Environment.	· To evaluate the extent to which environmental objectives or recommendations made in the SEA report are being met.	Responsible Authority (NIRC)	

Source: National Guidelines For Strategic Environmental Assessment (Draft) Vice President'S Office August, 2016

12.2.2 Approach

(1) Introduction

The approach and methodology for the scoping report (Step 2) and SEA (Step 3) are described, for both the scoping phase and the SEA reporting phase. The approaches for the scoping phase and the main report phase are essentially the same. The difference in the two approaches is the level of detail. During the scoping phase, consultation with relevant stakeholders to determine the scope and level of detail of information to be included in the forthcoming SEA Environmental Report is carried out.

During the scoping and SEA report phase, the following are considered:

i) Initial consultations concentrating on the details of various activities to be covered in SEA study
ii) Identification of key issues in all sectors
iii) Identification of alternatives and their likely impacts
iv) Developing the Terms of Reference (TOR) for SEA study
v) Analysis of alternatives and conducting of likely impacts
vi) Preparation of draft SEA report
vii) Detailed consultation and participation
viii) Development of draft SEA report
ix) Preparing a matrix containing potential generic environmental and social impacts associated with the implementation of the plans with corresponding mitigation and monitoring measures

(2) General Approach

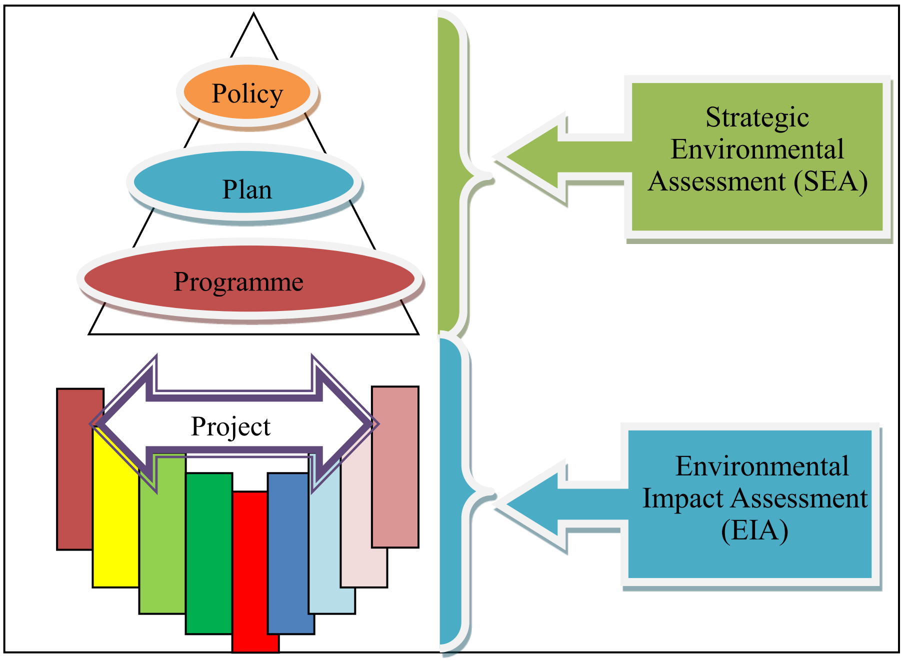
The approaches taken to all aspects of the SEA project are based on:

- Participation; and
- Knowledge transfer.

(3) SEA Specific Approach

There is a hierarchy of levels in decision-making comprising projects, programs, plans, and policies (see Figure 12.2.1). Logically, policies shape the subsequent plans, programs, and projects that put those policies into practice. Policies are top of the decision-making hierarchy. As one moves down the hierarchy from policies to projects, the nature of decision-making changes, as does the nature of environmental assessment needed. Policy-level assessment tends to deal with more flexible proposals and a wider range of scenarios. Project-level assessment usually has well defined and prescribed specifications.

Policies, bills, regulations, plans, strategies, or programs are more strategic as they determine the general direction or approach to be followed towards broad goals. SEA is applied to these strategic levels. Environmental Impact Assessment (EIA) is used on projects that put policies, plans, strategies or programs into tangible effect. Table 12.2.2 shows the comparison between SEA and EIA.



Source: National Guidelines For Strategic Environmental Assessment (Draft) Vice President'S Office August, 2016

Figure 12.2.1 Decision-making Hierarchy of SEA

Table 12.2.2 Comparison between SEA and EIA

EIA	SEA
Applied to specific and relatively short-term (life-cycle) projects and their specifications.	Applied to policies, plans, programs, and bills with a broad and long-term strategic perspective.
Takes place at an early stage of project planning once parameters are set.	Ideally, takes place at an early stage in strategic planning.
Considers limited range of project alternatives.	Considers a broad range of alternative scenarios.
Usually prepared and/or funded by the project proponents.	Conducted independently of any specific project proponent.
Focus on obtaining project permission, and rarely with feedback to policy, plan, or program consideration.	Focus on decision on policy, bills, regulations, strategies, plan, and program implications for future lower-level decisions.
Well-defined, linear process with clear beginning and end (e.g., from feasibility to project approval).	Multi-stage, iterative process with feedback loops.
Preparation of an EIA document with prescribed format and contents is usually mandatory. This document provides a baseline reference for monitoring.	May not always be formally documented.
Emphasis on mitigating environmental and social impacts of a specific project, but with identification of some project opportunities, off-sets, etc.	Emphasis on meeting balanced environmental, social and economic objectives in policies, plans, programs, and bills. Includes identifying macro-level development outcomes.
Limited review of cumulative impacts, often limited to phases of a specific project. Does not cover regional-scale developments or multiple projects.	Inherently incorporates consideration of cumulative impacts.

Source: National Guidelines For Strategic Environmental Assessment (Draft) Vice President'S Office August, 2016

12.2.3 Methodology

(1) Introduction

The methodology is divided into two parts: the scoping phase and the SEA phase. A preliminary assessment of the available relevant data for the assignment is conducted. Based on the results of the preliminary data review, gaps need to be addressed to carry out the SEA study are assessed. A comprehensive list of the data on the study areas required to undertake the environmental and social assessment and to prepare the strategic management and monitoring plans is reviewed/prepared.

A data collection work plan to gather the required missing data/information by examining other potential sources of 'existing' data which need to be investigated such a research studies, national departmental / government records, non-governmental organisation (NGO) or private firms' assessments, and records in zonal, regional, and district offices are reviewed/prepared.

(2) Methodology for the Scoping Report

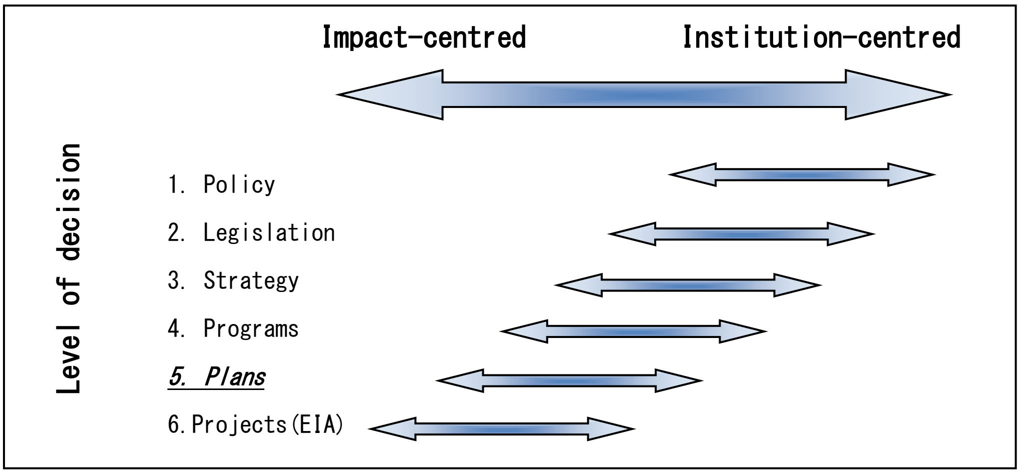
The methodology during the scoping phase consisted of:

- Literature review on available documents including the NIMP2018;
- Legislation review;
- Stakeholders consultations; and
- Field study for some primary data collection.

Implementation of this methodology is effective to prepare the list of issues that will be further studied during the SEA study phase.

(3) Methodology for the SEA Report

SEAs constitute a family of approaches that can be broadly classified on a continuum from impact-centred SEAs to institution-centred SEAs. Impact centred SEAs assess likely environmental and social effects and propose mechanisms to avoid, mitigate, or compensate these effects. In focusing on a proposed sector-wide investment or instrument, they share similarities with EIAs, although shifted upstream to the strategic decision-making level. Impact-centred SEAs for programs and plans are often carried out at the regional level. Institution-centred SEAs focus on the analysis of institutions and governance structures and frameworks because of the non-linear and overtly political nature in which policies and their supporting legislations are developed. Institution-centred SEAs are normally applied to policy and legislation because of the greater remoteness of these levels of decision-making from specific actions whose impacts can be assessed. Figure 12.2.2 illustrates conceptually the shift from impact-centred to institution-centred SEAs at different levels of decision-making.



Source: World Bank 2007

Figure 12.2.2 Relationship between Type of SEA and Level of Decision-Making

Institution-centred involve assessments of cross-sectoral collaboration, capacity for environmental protection, and legislative and policy backing. In reality, some SEAs are both institution-centred and impact-centred.

In the identification and Analysis of Alternatives (Scenarios), the analysis of alternatives is to consider both positive and negative impacts and to use the yardsticks of environmental, socioeconomic, and cultural integrity. Using the Multi-Criteria Analysis (MCA) technique, an alternative will be selected. Preliminarily, the following alternatives are considered and later coincided with those proposed in the NIMP2018.

12.3 Examination of Alternatives and Scoping

12.3.1 Comparative Review of Alternatives

According to the basic concept of NIP (2010), the NIP provides a vision and step-wise prioritization of irrigation development in the country. It defines the irrigation roles and responsibilities of different institutions and their relationships with the district level planning process. In light of the basic strategy of NIP, the irrigation development scenario of SESA 2011 has been examined on the following alternatives as “the type of implementation method (implementing entity)” from a viewpoint of environmental and social consideration. On the other hand, the NIMP2018 has been made according to “the basic principle of the irrigation development using available water resources at the project site”. From this aspect, Alternative II was proposed to promote all types of irrigation development. Hence, the following six alternatives including Alternative 0 were examined.

Alternative 0: Do not implement the strategic measures and plans in the NIMP 2018;

Alternative I: Promote improvement of traditional irrigation schemes only;

Alternative II: Promote all types of existing irrigation schemes concurrently with new smallholders and commercial irrigation schemes of all scales (i.e. small, medium and large) which are accessible;

Alternative III: Government plays coordination and policy roles and the private sector manages irrigation;

Alternative IV: Promote Public Private Partnership (PPP) in irrigation investment and management; and

Alternative V: Promote sharing of O&M such that IOs manage irrigation facilities in tertiary canals and below while government does the rest.

The review results of the above development alternatives are discussed in the following section.

12.3.2 Scoping

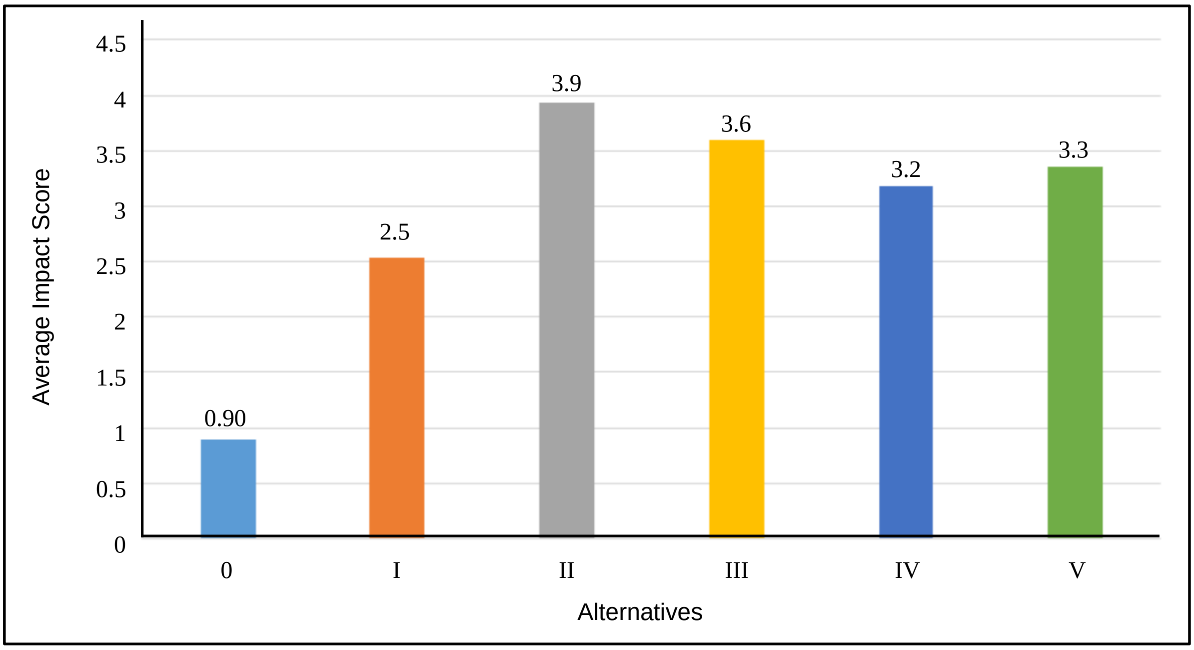
Proposed alternatives in the NIMP2018 (as described in the section 12.3.1) have been examined through reviewing of scoping items and methods as indicated in Table 12.3.1. From a viewpoint of environmental and social consideration, this evaluation matrix has been examined. This analysis was done using the Multi-Criteria Analysis (MCA) technique, which applies a numerical analysis of performance through scoring and weighting of alternatives. As indicated in the Table 12.3.1, forty-five (45) of criteria were defined based scoping evaluation item, and numerical analysis has done by five-level rating to the each alternative.

Table 12.3.1 Scoping Evaluation Matrix for Alternatives

Scoping Evaluation Item	Multi-Criteria (45 items)	Alternative I	Alternative II	------
Irrigation: Existing Situation of Irrigation Schemes, Irrigation Research and Development, Promotion of Appropriate Irrigation, Technologies, Institutional Capacity	Xxxx	1	3	
	Yyyy	2	5	
Physical Environment Data: Geology and Groundwater Hydrology, Aquifer Formations in Tanzania, Topography, Soils, Climate, Water Resources, Surface Water, Hydrology, Land Use	Zzzz	4	2	
Water Quality Problems Associated with Irrigation: Overview on Water Quality and Irrigation, Water Quality Data to Establish the Baseline Situation. Water Resource Allocation Case Study, Water and Soil Chemistry Impacts Case Study, Data and Capability Gaps, Key issues on Physical/Chemical Environment		*Scoring*		
Biological Environment Data: Terrestrial Fauna, Terrestrial Flora, Sensitive Habitats Including Wetlands, Wildlife Corridors in Tanzania, Natural Sites of Significant Size, Threatened Species in Danger				
Degradation of River Catchments and Riparian Ecosystems, Degradation of Ecologically Sensitive Areas, Land Degradation, Soil Erosion and Water Pollution, Impacts on Soils				
Blockage of Fish Movement and Consequent, Interference with Fish Migration and Breeding, Impacts Associated with Single Resource Management Approach, Key issues on Biological Environment				
Socioeconomic and Cultural Data: Demographic Profile, Ethnic Groups and Cultural Aspects, Housing, Resettlement, Human Migration, Gender and Minority Vulnerable Groups, Employment, Economic Activities, Social services infrastructure, Comprehensiveness of the Baseline Data				

Source: JICA Project Team

A scoping evaluation result of the alternatives is indicated in the Figure 12.3.1. The figure shows that the higher average impact score means the more positive impact (effect) in each alternative. As a result, Alternative II get the highest score of 3.9 which means Alternative II has a largest positive impact among other alternatives.



Source: SEA Final Report (June 2018)

Figure 12.3.1 Scoping Evaluation Result of each Alternative

12.4 Environmental Evaluation

12.4.1 Baseline Environmental Conditions Focusing on Areas Potentially Affected

The existing situation, "baseline", refers to the collection of information on the current status of biophysical, social, and economic variables in an area of interest. Baseline data were collected for two main purposes:

i) To provide a description of the status and trends of environmental factors (e.g., air pollutant concentrations) against which predicted changes can be compared and evaluated in terms of importance, and

ii) To provide a means of detecting actual change by monitoring once a project has been initiated.

Review/collection of baseline data was designed to satisfy information requirements relevant to SEA analysis as contained in the ToR, and only baseline data needed to assist in the prediction of the impacts were reviewed/collected.

The baseline data collection was at the regional level based on the existing reports. However, the SEA study incorporated findings from stakeholder consultations at the regional level. The baseline data was used to describe the existing situation in terms of physical environment, biological environment, and socioeconomic environment. The following environmental conditions listed in Table 12.4.1 were identified. The details on the baseline study will be provided in the separate volume of the SEA study report.

Table 12.4.1 Summary of Baseline Conditions/Area Potentially Affected

Condition/Area Potentially Affected	
Irrigation	Existing Situation of Irrigation Schemes
	Irrigation Research and Development

Condition/Area Potentially Affected	
	Promotion of Appropriate Irrigation Technologies
	Institutional Capacity
Physical Environment Data	Geology and Groundwater Hydrology
	Aquifer Formations in Tanzania
	Topography
	Soils
	Climate
	Water Resources
	Surface Water Hydrology
	Land Use
Water Quality Problems in Tanzania Associated with Irrigation	Overview on Water Quality and Irrigation
	Water Quality Data to Establish the Baseline Situation
	Water Resource Allocation Case Study
	Water and Soil Chemistry Impacts Case Study
	Data and Capability Gaps
	Key Issues on Physical/Chemical Environment
Biological Environment Data	Terrestrial Fauna
	Terrestrial Flora
	Sensitive Habitats Including Wetlands
	Wildlife Corridors in Tanzania
	Natural Sites of Significant Size
	Threatened Species in Danger
	Degradation of River Catchments and Riparian Ecosystems
	Degradation of Ecologically Sensitive Areas
	Land Degradation, Soil Erosion and Water Pollution
	Impacts on Soils
	Blockage of Fish Movement and Consequent Interference with Fish Migration and Breeding
	Impacts Associated with Single Resource Management Approach
	Key issues on Biological Environment
Socioeconomic and Cultural Data	Demographic Profile
	Ethnic Groups and Cultural Aspects
	Housing
	Resettlement
	Human Migration
	Gender and Minority Vulnerable Groups
	Employment
	Economic Activities
	Social Services Infrastructure
	Comprehensiveness of the Baseline Data

Source: SEA Scoping Report

12.4.2 Relevant Legislative Framework and Related Policy, Plan, and Program

The NIMP2018 makes reference to the need for the creation of a legal environment which will support the planned development and expansion of the irrigation sector. This NIMP2018 raises a broad range of legal issues which must be addressed in order to permit a smooth and efficacious implementation of the NIMP2018, which anticipates a very significant expansion of the irrigation sector. The expansion of the irrigation sector at the level anticipated in the NIMP2018 has environmental, land tenure, organisational, and social implications with their associated legal implications.

Under Article 27 of the Constitution, the public is called upon to ensure that the natural resources of the country are managed properly:

(1) Every person is obliged to safeguard and protect the natural resources of the United Republic, state property, and all properties jointly owned by the people.

(2) All persons shall by law be required to safeguard state and communal property, to combat all forms of misappropriation and wastage and to run the economy of the nation assiduously, with the attitude of people who are masters of the fate of their nation.

In addition, the GoT has promulgated laws, regulations, and standards for the protection, conservation, rehabilitation, and improvement of the environment. Among these legislations are the Proclamation on Environment (EMA 2004) and the Proclamation on SEA (SEA regulation, 2008).

International guidelines applicable to this NIMP2018 include the World Bank's Operational Policies on Environmental Assessment (OP 4.01), Natural Habitats (OP 4.04), Forests (OP 4.36), Involuntary Resettlement (OP 4.12), and Cultural Property (OP 11.03).

Tanzania is also a signatory to several regional and international conventions, protocols, and treaties and is therefore bound by the requirements of these conventions, protocols, and safeguard policies. These have to be complied with throughout the SEA study. There are international, regional, and trans-boundary treaty obligations that must be considered in the implementation of the NIMP2018. A preliminary desk examination of the NIMP2018 has brought attention to a number of issues, which will need to be addressed in the context of SEA.

Detailed information on relevant legislative framework and related policy, plan, and program can be referred to in Chapter 8 and Chapter 10, respectively.

12.4.3 Overview of Consultation and Public/Stakeholders' Engagement Activities

(1) Introduction

The general purpose of the public consultation process is to:

i) Solicit stakeholders' environmental and social views and concerns on the NIMP2018,
ii) Explore ways of avoiding or mitigating identified concerns, and
iii) All concerns that should be addressed already reached a consensus in the Final SEA report.

The key stakeholder groups (e.g., those people likely to be affected by the development of irrigation and drainage schemes) that should be involved in the SEA study were identified. Consultation involved all stakeholder groups, including businesses, community leaders, private sector, and government agencies and authorities that have a stake in the implementation of NIMP2018 and its effects.

(2) Stakeholder/Public Identification

The categories and groups of key stakeholders that had been identified and some have so far been consulted include:

1) VPO-DOE
2) NIRC

3) Ministry of Water and Irrigation (MoWI)
4) Ministry of Agriculture (MoA)
5) Ministry of Livestock and Fisheries (MoLF)
6) Ministry of Energy and Mineral (MEM)
7) Ministry of Natural Resources and Tourism (MNRT)
8) Ministry of Lands, Housing and Human Settlements Development (MLHHSD)
9) Ministry of Finance and Planning (MoFP)
10) Regional Administration and Local Government, President's Office (PO-RALG)
11) All zonal irrigation offices
12) All basin water offices
13) National Environmental Management Council (NEMC)
14) Selected representatives district level offices, including district council representatives and district agriculture and livestock development offices;
15) Selected representative of contractors
16) Selected representative of consultant
17) Local business people, especially those engaged in agribusiness
18) Residents of selected irrigation schemes and rural communities
19) Regional secretariats

(3) Consultation Methods

Initial sets of questions were prepared, administered, and refined during the inception phase consultations. The organisation of the consultations and the questions asked are designed to stir up discussion among the participants.

From the inception phase field survey, it is evident that for all practical purposes, the only potential resettlement issues will be those associated with the construction of large storage dams. However, for all types of new irrigation development, the SEA Study Team sought to determine the extent of involuntary resettlement by placing a major focus on groups and individuals that will be directly affected including downstream communities.

(a) Individual Meetings

The SEA Study Team conducted individual consultations with stakeholders. These key informant interviews were used to gather and supplement information obtained through focused, small group discussions. This involved individuals with particular knowledge and opinion on specific issues.

(b) Focus Group Meetings

Focused Group Discussions (FGDs) were conducted with a range of stakeholders including community members in particular irrigation scheme areas, project operators, irrigation organisations leaders, village leaders, local leaders, community based organisations, non-governmental organisations, faith-based organisations, youth groups, and women's groups (both for irrigators and non-irrigators). Table 12.4.2 shows a representative sample of stakeholders to be invited.

Table 12.4.2 Groups of Stakeholders Consulted

Level	Groups of Participants
Ministry Level	Representatives (MoWI, MoA)
Government Agency Level	Representatives (BWOs, NEMC)
Zonal Irrigation Unit Level	Engineer
	Agronomist
	Sociologist
	Surveyor
	Environmental Experts
District Authorities Level	Irrigation Subject Matter Specialist
	Planning Officer
	Environmental Officers
	Water Engineers
	District Community Development Officer
	District Land Officer
Irrigation Scheme Level	IO Management Committee members
	Project Committee
	Prominent farmers
Non-governmental Organisations	Representatives from non-governmental organisations (including women and youth)
Private Investors/Businessmen	Representatives
Contractors	Representatives
Consultancy	Representatives
Ward Level	Ward Executive Officers
Village Level	Village Executive Officers
	Irrigation technician/scheme extension agent

Source: SEA Scoping Report

(c) Meeting/Workshops

Several meetings were organised throughout scoping and SEA study period. In addition, one workshop was organised and conducted to present the draft SEA reports. A wide and representative sample of the stakeholders attends the workshops and that the program encourages comments and suggestions as feedback to integrate in the final SEA.

(4) Stakeholder Consultations

During the SEA scoping study phase, individuals, and focus group consultations were held. Local community representatives of all key stakeholder categories were invited to participate in the public consultations. Identifying and contacting the local community representatives were done through the zonal irrigation offices. For this phase of the assignment, the SEA Study Team conducted focused, small group consultations. This was made in the selected irrigations zones based on ecological, water resources, and conflict prone areas so as to set the scope of work. In these selected irrigation zones, it was designed to elicit the concerns and views of representatives of all stakeholder categories. This is so as to meet the requirements of the EMA 2004, the SEAR 2009, and international SEA best practices. The SEA Study Team travelled to the consultation meeting sites, to the zonal irrigation offices, the river basin offices, and local government agency offices in their respective towns as well as to selected regional and district offices and irrigation schemes.

Table 12.4.3 Schedule of Stakeholder Public Consultations and Actual Visits

S/N	Date	Activity	Place/LGA
1st Trip – MOROGORO IRRIGATION ZONE			
1	Thursday 4 January 2018	Travel to Morogoro, Meet stakeholders at Morogoro Zone Irrigation Office (ZIO), LGA, and BWO level, Businessmen, NGO Visit Dakawa, Mgongola and Mkindo, Irrigation schemes and have discussion with stakeholders	Mvomero Morogoro
2	Friday 5 January 2018	Meet stakeholders at Zone, LGA, and BWO level, Businessmen, NGO	Morogoro
3	Saturday 6 January 2018	Visit Bagamoyo Irrigation scheme and have discussion with stakeholders	Coast
Consultation in Dar (During Scoping and SEA Study)			
1	Monday 22 January 2018	Presentation of Inception Report and Stakeholder Consultation Meeting Stakeholders: NIRC, MoA and MoWI Staff who are in Dar es salaam	Dar Es Salaam
2	24 January to 05 February /2018	Continue with stakeholders' consultation at NIRC, MoA and MoWI, VPO and other Ministry Staff and institutions/Agencies who are in Dar es salaam	Dar Es Salaam
3	From 24th to 31st January 2018	Consultations in the Agricultural Lead Ministries in Dar and other Leaders	
2nd Trip – MBEYA IRRIGATION ZONE			
1	Tues 6 February 2018 Morning	Travel to Iringa-Mbeya	Start early in the morning
2	Wed 7 February 2018 Morning	Pay Courtesy call and Consultation at Zonal Irrigation Staff	Mbeya zone office
		Pay Courtesy call and Consultation at Regional Level	RAS/RC
		Travel to Kapunga Rice Farm (Private)	
	Afternoon	Pay Courtesy call and Consultation at Mbarali District Council, Businessmen, NGO etc.	Mbarali
		Visit 1 schemes and have discussion with stakeholders	Mbarali, Night at Rujewa
3	Thursday 8th February 2018	Visit Madibira Irrigation Scheme a scheme located near Ihefu and Ruaha National Park	Madibira,
		Travel Madibira - Songea	Songea
4	Friday 9th February 2018	Pay Courtesy call and Consultation at Regional Level	Songea
		Pay Courtesy call and Consultation at Zonal Irrigation Staff (Representative who is in Songea)	
		Visit Madaba Irrigation scheme on the way to Iringa	
		Pay Courtesy call and Consultation at Rufiji Basin Water Board/Office	Night in Iringa
5	Saturday 10th February 2018	Travel Back to Dar es salaam	
3rd Trip – DODOMA AND TABORA IRRIGATION ZONES			
1	Tues 6th March 2018	Travel to Dodoma	Dodoma
2	Wednesday 7th March 2018	Pay Courtesy call and Consultation at Dodoma Zonal Irrigation Office	Dodoma
		Consultation at Ministerial Level	Dodoma
		Pay Courtesy call and Consultation at Dodoma Regional Office	Dodoma
3	Thursday 8th March 2018	Pay Courtesy call and Consultation at Bahi District Council	Bahi
		Visit 1 schemes and have discussion with stakeholders	Bahi
		Travel to Tabora	Tabora
4	Friday 9th March 2018	Pay Courtesy call and Consultation at Tabora Zonal Irrigation Office	Tabora
		Pay Courtesy call and Consultation at Tabora Regional Office	Tabora
		Pay Courtesy call and Consultation at District Level	Tabora
		Visit 1 schemes and have discussion with stakeholders	Tabora
5	Saturday 10th March 2018	Travel back to Dar es salaam	

S/N	Date	Activity	Place/LGA
4th Trip – KILIMANJARO IRRIGATION ZONE			
1	Sunday 25th March 2018	Travel to Kilimanjaro	Moshi
	Monday 26th March 2018	Pay Courtesy call and Consultation at Zonal Irrigation Staff	Moshi
		Pay Courtesy call and Consultation at Regional Level	RC/RAS
		Pay Courtesy call and Consultation at District Level	DC/DED
		Visit 1 schemes and have discussion with stakeholders	Moshi
2	Tuesday 27th March 2018	Travel to Tanga VIA Pangani Basin Water Office	Moshi
		Pay Courtesy call and Consultation at Pangani Basin Water Board/Office	Moshi
		Pay Courtesy call and Consultation at Korogwe District Council, Businessmen, NGO etc.	DC/DED
3	Wednesday 28th March 2018	Visit Mombo Irrigation scheme and have discussion with stakeholders	Mombo
		Travel Back to Dar es salaam	
Workshop to Review Draft SEA Report for NIMP2018			
1	Tuesday 29th May 2018	Presentation on Draft SEA Report, Questions and Answers	Dodoma

Source: SEA final Report (June 2018)

12.4.4 Prediction an Evaluation of Impacts including Cumulative Effects

(1) Introduction

One of the key purposes of the scoping phase is the identification of the social and environmental issues that should be considered in the main assessment phase of SEA study. Issue identification is also an important step towards the development of appropriate SEA objectives, indicators, and targets that will be used in the process to develop and analyse alternative options during the SEA study phase. The identification of key social and environmental issues has been based upon the baseline data collected during the Project on the revision of the Irrigation Master Plan and the review of other plans and programs, which are relevant to the SEA study. The identification process has retained a strategic perspective and has been focused upon those issues that are particularly relevant in view of the nature and scale of the proposed irrigation interventions. The key issue raised at the preliminary consultation is the enforcement of existing laws and regulations. Stakeholders expressed the opinion that without enforcement policies, laws and regulations have no meaning. As the SEA develops with further stakeholder involvement the scope of key issues is likely to develop. The results of the first (Inception phase) analysis of potential key social and environmental issues associated with the NIMP2018 were presented in the SEA report.

(2) Identification of Potentially Significant Issues

The implementation of NIMP2018 and its impacts is categorized into six main issues:

i) Institutional strengthening
ii) Financing mechanisms and funding support for irrigation development
iii) Regulatory framework
iv) Land tenure and ownership rights
v) Water resource development
vi) Promote the development of new irrigation schemes – diversification and intensification

Specifically, this categorization framework is designed to help identify the spread of issues that may arise from the implementation of the NIMP2018 as well as to facilitate an assessment approach that is appropriate, systematic and focused to in-depth analysis of the potential impacts of the NIMP2018 implementation.

(3) Key Issues and Concerns

The key issues are the potential impacts on water resources, land, public health, and socioeconomic matters. It has been identified that irrigation practices in Tanzania are characterized by low water use efficiency, low water productivity, and absence of a mechanism for exercising socioeconomic mobility of water and over dependency on surface water as a major source for irrigation development. In addition, irrigation also happens to be one user that has been in the centre of most water use conflicts amongst themselves and/or with other users if not well organised under a Water Users Organisation, which can easily be subjected to water use conflicts as a result of inequitable water allocations.

Little consideration which has been given to water sources conservation and catchment management has negative impacts on water availability to downstream users; and inappropriate water use practices and the resulting degradation threaten the sustainability of ecosystem, human health, food security, and productivity; and constrain investment in various social and economic sectors. Most of the cultivated area under irrigation is held by small-scale smallholder farmers who hold it through customary right of occupancy and most of them are unaware of the importance of land registration for title deeds. Land administration procedures are not streamlined to the extent that the granting of title deeds is painstakingly slow. On the other hand, land can become waterlogged or chemically compromised as a result of poor irrigation and drainage.

Moreover, in most cases, land earmarked or developed under irrigation has no protection against conversion into other uses. Another fundamental problem land is that inappropriate land use practices results into accelerated run-off, reduced groundwater recharge, soil erosion, and increased sediment transported by rivers and silt accumulation in reservoirs and irrigation systems.

Women are playing a major role in developing and practicing irrigated agriculture but are hampered by low level of social status in the community, illiteracy, low entrepreneur skills, inadequate access to productive resources and services.

Despite the negative potential impacts under the irrigation sector, irrigated agriculture has contributed to the improvement of crop production, productivity, and profitability to the farmers in particular and the nation at large. For example, production in irrigated agriculture is higher by three to four times than that under rainfed agriculture

The following are summary of major issues and impacts:

Table 12.4.4 Summary of Major Issues and Impacts

■ <u>Major Issues</u> ・ Inadequate funding and delays in disbursement. ・ Inadequate access to micro-credits by farmers. ・ Conflicts over water uses within irrigation schemes and between upstream and downstream users. ・ Low productivity in irrigation schemes. ・ Inadequate land use planning and allocation of irrigation land. ・ Inefficient marketing systems for agricultural products. ・ Immigration of people into irrigation schemes. ・ Inadequate farm management, operation and maintenance (O&M) skills. ・ Ineffective monitoring and evaluation system for irrigation schemes. ・ Inadequate compliance to irrigation scheme development guidelines. ・ Inadequate contribution and participation in operation & maintenance activities by farmers. ・ Lack of reliable and sustainable water sources for irrigation. ・ Human-Wildlife attacks/accidents. ・ Vandalism of irrigation infrastructures, border raids, and boundary disputes. ・ Inadequate access to social services.
■ <u>Impacts Related to the Physical Environment</u> ・ Some of the irrigation schemes lack cross bridges for livestock and human in canals hence causing destructions in canals. Most of irrigation canals are not lined and lacking on on-farm roads. Inadequate funding and delays in disbursement. ・ Dam construction creating water bodies ・ Poor compaction of earth canal and mismanagement of water within irrigation schemes results into localized soil erosion. ・ Loss of farms, habitat for flora and fauna as a result of clearing and inundation for damming. ・ Inadequate drainage systems which comply with recognized safety measures in irrigation systems leading into flooding damages. ・ High levels of sedimentation in the irrigation schemes resulting from other land uses activities within the catchment.
■ <u>Impacts Related to the Biological Environment</u> ・ Pollution of land and water bodies due to fertilizers and agrochemical utilization*. ・ Implications on aquatic and water sensitive biodiversity and wildlife habitats due to possible reduction in environmental flows. ・ Degradation of river catchments and riparian ecosystems. ・ Degradation of ecologically sensitive areas. ・ Single resource management approach on irrigation scheme planning.
■ <u>Impacts Related to the Institutional and Legal</u> ・ Unclear institutional setup and line of command in irrigation services provision. ・ Insufficient human resources at the zonal irrigation unit offices, district council offices and at schemes*. ・ NIMP2018 is not well understood at the zonal and district levels. ・ Inadequacy of well-established Irrigator Organisations (IOs). ・ Inadequate incentives for the private sector to participate in irrigation. ・ Inadequate research and development in irrigation sector. ・ Issuance of water use permits which does not conform to available water.
■ <u>Impacts Related to the Cross-cutting</u> ・ Increase in HIV/AIDS incidences in the irrigation schemes. ・ Uncertainty of water supplies due to climate change. ・ Inequitable sharing of irrigation benefits (gender inequality).

Source: SEA Scoping Report

12.5 Proposed Mitigation Measures

Potential impacts have been identified and evaluated for the NIMP2018 as planning document. The specific potential mitigation measures on the physical, biological, socio-economic and environmental impacts are presented under the six strategic themes and the detailed discussion is provided in Chapter 10 of the SEA Report under the strategic management plan and monitoring. The six strategic themes as identified in the analysis of NIMP2018 are:

i) Regulatory framework and institutional strengthening
ii) Financing mechanism and funding support to irrigation development
iii) Land tenure and ownership rights
iv) Irrigation water resources development
v) Development and management of irrigation schemes
vi) Cross-cutting issues

A summary of proposed mitigation measures to the potential impact with high priority are presented in the Table 12.5.1(see Table 9-1 of SEA Report for more details).

Table 12.5.1 Summary of Proposed Mitigation Measures to Potential Impacts with High Priority for NIMP2018 Implementation

No.	Issues and Concerns	Potential Negative Impacts	Potential Mitigation Measures	Priority
Regulatory Framework and Institutional Strengthening				
1	Unclear institutional setup and line of command in irrigation services provision	・ Unproductive and marginalized irrigation development	・ Create and develop and institutional set up for irrigation development	HIGH
2	Insufficient human resources at all levels and low capacity in managing irrigation development	・ Increase in substandard and inefficient irrigation schemes ・ Moral erosion and overstressing the existing staff ・ Delayed implementation	・ Recruit and institute capacity building programs for irrigation and environmental related human resources	HIGH
5	Inadequacy of well established Irrigator Organisations (IOs)	・ Poor O&M ・ Loss of livelihood, water productivity and increase in water use conflicts	・ Facilitate the establishment and strengthening of IOs ・ Promote and ensure use of O&M guidelines by farmers and extension workers	HIGH
6	Inadequate incentives for the private sector to participate in irrigation	・ Few private investor in irrigation sector ・ Increased burden to the government	・ Promote, build confidence and provide incentives for engagement of the potential private sector to participate in irrigation	HIGH
7	Inefficient marketing systems for agricultural products	・ Deterioration of livelihood of small farmers	・ Strengthen and empower smallholder marketing associations and build their capacity to manage the entire production and marketing chain	HIGH
Financing Mechanism and funding support for Irrigation Development				
8	Inadequate funding and delays in disbursement	・ Retarded growth in irrigation development	・ Strengthen financial accounting, accountability and proper budgeting ・ Funds to be disbursed according to agreed critical path ・ Establish Irrigation Fund	HIGH
Land tenure and ownership rights				
14	Limited understanding of land governing policies, laws and regulations	・ Conflict among users ・ Land degradation	・ Provide training to Land Committees	HIGH
Irrigation Water Resources Development				
15	Inadequacy of reliable and sustainable surface water resources for irrigation	・ Low farm productivity, low income and retarded economic growth	・ Develop other sources of water for irrigation such as ground water, rainwater harvesting and dams	HIGH
17	Reduction in environmental flows and its implications on aquatic and water sensitive biodiversity and wildlife habitats	・ Loss of wildlife habitats and biodiversity	・ Promote and ensure integrated water resources management ・ Conduct environmental flows assessment and allocation ・ Conduct stream flow monitoring	HIGH

No.	Issues and Concerns	Potential Negative Impacts	Potential Mitigation Measures	Priority
18	Uncertainty of water supplies due to climate change	• Crop failure and increased food insecurity • Loss of livelihood • Deprived ecosystem services • Increase in maintenance cost	• Enhance early warning and disaster preparedness • Promoting water saving technologies • Promote drought resistant crops	HIGH
Development and Management of Irrigation Schemes				
21	Deficient criteria for establishment of irrigation potential areas in the NIMP	• Wrongly quoted irrigation potential areas • Loss of investment planning	• Review NIMP, map and demarcate identified irrigation potentials area by considering water resources potentials for reliable water supply and land ownership status in addition to the former criteria	HIGH
22	Issuance of water use permits which does not conform to available water	• Reduced environmental flows • Degradation of aquatic biodiversity • Conflict over water use	• Conduct water demand assessment and inventory of water users and permits • Assess the response of aquatic biodiversity to flow regimes	HIGH
24	Inadequate farm management, operation and maintenance (O&M) skills	• Low agricultural productivity, low income and retardation in economic growth	• Provide extension services and training on O&M guidelines	HIGH
31	Sedimentation from catchment and within irrigation schemes	• Increased sedimentation in canals and rivers • Loss of arable land and low crop productivity • Reduced storage capacity of reservoirs	• Promote soil and water conservation measures	HIGH
36	Degradation of river catchments and riparian ecosystems including ecologically sensitive areas	• Loss of water sensitive species dependent on the riparian ecosystems • Habitats fragmentation, • Loss of gene flow among populations • Decline of wildlife populations to below minimum viable levels • Local extinction of sensitive flora and fauna	• Adherence to regulations and standards for management of riparian buffers and ecologically sensitive areas	HIGH

Note: Listed the High Priority only. As a whole, 15 items are categorized as high priority, 18 items as medium and 7 items as low.
Source: SEA final Report (June 2018)

12.6 Strategic Environmental Management and Monitoring Plan

For projects, funded through ASDP, including irrigation projects, an Environmental and Social Management Framework (ESMF) was prepared by Ministry of Agriculture Food Security and Cooperatives (MAFS) which establishes a mechanism to determine and assess future potential environmental and social impacts of all program activities to be financed under ASDP, and then to set out mitigation, monitoring and institutional measures to be taken during implementation and operation of the program activities to eliminate adverse environmental and social impacts, offset them, or reduce them to acceptable levels, while at Plan (NIMP2018) level a SEMMP is required based on the anticipated environmental and social impacts that might occur.

In the NIMP2018, process management and the status of project effect are monitored and evaluated. Specifically, at the implementation stage of NIMP2018, monitoring and evaluation (M&E) cover environmental and social status at implementation for individual projects/program from all inputs to outputs, and the O&M stage mainly deals with ripple effects of projects.

The development of SEMMP is based on the strategic elements of the six themes indicated in the section 12.5.

A summary of proposed Strategic Environmental Management and Monitoring Plan (SEMMP) with estimated budget are presented in the Table 12.6.1 (see Table 10-5 of the SEA Report for more details).

Table 12.6.1 Summary of Strategic Environmental Management and Monitoring Plan with High Priority for NIMP2018 Implementation

No.	Issues and Concerns	Monitoring Indicators	Monitoring Frequency	Responsible Institution	Time Frame	Estimated monitoring Costs (TZS in Mil.)
Regulatory Framework and Institutional Strengthening						
1	Unclear institutional setup and line of command in irrigation services provision	A well functioning institutional setup established and working	Once	GoT MoWI	2018 to 2025	10,000
2	Insufficient human resources at all levels and low capacity in managing irrigation development	・ No. of staff recruited and trained, ・ No. of furnished office ・ No. of vehicles procured ・ No. of in-service staff trained ・ No. of retooling training and outreach activities conducted	Annually	Ministry responsible for irrigation	2019 to 2030	20,000
5	Inadequately established Irrigators' Organisations (IOs)	・ No. of registered IOs ・ Amount of funds set aside for O&M ・ No. of operating irrigation schemes	Annually	NIRC LGAs	2018 to 2025	100
6	Inadequate incentives for the private sector to participate in irrigation	・ No. of investors in irrigation	Annually	NIRC TIC*1	2018 to 2025	300
7	Inefficient marketing systems for agricultural products	・ No. of small holder marketing associations established and trained ・ No. of training conducted	Annually	MoA	2018 to 2025	300
Financing Mechanism and funding support for Irrigation Development						
8	Inadequate funding and delays in disbursement	・ No. of trained accountants ・ Amount of funds allocated ・ Development Fund established	Quarterly	LGAs Responsible Ministry	2018 to 2025	25
Land tenure and ownership rights						
14	Limited understanding of land governing policies, laws and regulations	・ No. of training conducted	Annually	LGAs	2018 to 2025	250
Irrigation Water Resources Development						
15	Inadequacy of reliable and sustainable surface water resources for irrigation	・ No. of developed water sources	Annually	ZIOs, NIRC	2018 to 2035	900,000
17	Reduction in environmental flows and its implications on aquatic and water sensitive biodiversity and wildlife habitats	・ % change in the number observed bio-indicators ・ % change in area of vegetated riparian zones that receive periodic inundation	Seasonal Seasonal	BWOs	2018 to 2035	9,500
		・ Quantity of discharge in the river	Daily			

No.	Issues and Concerns	Monitoring Indicators	Monitoring Frequency	Responsible Institution	Time Frame	Estimated monitoring Costs (TZS in Mil.)
18	Uncertainty of water supplies due to climate change	· No. of established weather monitoring stations · % of farmers using weather forecast information · % of farmers adopting water saving technologies · % of farmers adopting drought resistance crops	Annually	TMA*2 Ministry responsible for agriculture LGAs	2018 to 2025	1,000
Development and Management of Irrigation Schemes						
21	Deficient criteria for establishment of irrigation potential areas in the NIMP	· NIMP2018	Once	NIRC	2018 to 2020	9,000
22	Issuance of water use permits which does not conform to available water	· Established quantities of water demand per sector	Annually	Ministry responsible for water research institutions	2018 to 2025	900
24	Inadequate farm management, operation and maintenance (O&M) skills	· Farm productivity · No. of IOs trained in O&M	Annually	LGAs Responsible Ministry	2018 to 2025	700
31	Sedimentation from catchment and within irrigation schemes	· Sediment load in canal, rivers and reservoirs · Presence of stable river banks · Intact riparian zones · Incidences of large-scale erosion denuding landscapes · Incidences of excessive fine-scale sediment deposition in river channel	Quarterly	BWOs	2018 to 2035	900
36	Degradation of river catchments and riparian ecosystems including ecologically sensitive areas	· Species composition · No. of rivers with clearly demarcated buffer zones · No. of protected areas	Annually	LGAs Ministry responsible for environment	2018 to 2025	70

*Note: *1= Tanzania Investment Centre, *2= Tanzania Metheorological Agency*
Source: SEA Final Report (June 2018)

12.7 Conclusions and Recommendations

12.7.1 Conclusions

This SEA work concludes that implementing the NIMP2018 on the Tanzanian mainland will have both potential positive and potential negative impacts. Tanzanian agriculture mainly relies on rain, and suffers from the inadequacy, seasonality, and unreliability of rainfall. Thus, crop yields are generally low, and although irrigation is considered necessary to mitigate climate constraints and to stabilize agricultural production and ensure local food security, its systems have not been extensively developed.

Although the local Governments (District Council) and Zonal Irrigation Units are the main custodian of all irrigation development plans within the district, it has been noted that most Districts and Zones have inadequate capacity to effectively prepare and implement integrated plans. Some of the main limiting factors include inadequate manpower, inadequate capacity to coordinate and mainstream environmental issues into the district plans as directed by Environmental Management Act (Cap. 191). Other limiting factors include poor harmonization of plans between local and central government, poverty, which is putting more pressure on the unsustainable use of natural resources.

In most areas, agriculture has limited production due to poor farming technologies and inadequate sufficient water to practice irrigation farming. Modern small to large scale irrigation is an upcoming economic activity, involving several privately owned schemes, especially in the Moshi, Arusha and Mbeya areas where large irrigation schemes are already found.

Implementation of the NIMP2018 proposes private sector development and ownership of irrigation schemes, preferably in partnership with smallholder farmers will stimulate further private investor in irrigation. This increased irrigation development may increase demand for large scale land holdings, increased food production, increased growth of the service sector that will benefit the local people and local economy.

Irrigation development activities may also trigger potential negative impacts such as, increasing pollution (from solid and liquid waste), increasing demand on fixed or declining water supplies, and degradation of land and other natural resources.

Other potential negative impacts may be the introduction of new cultures and behaviors, increased competition for resources, increased social tension and conflict over access to resources and to their unsustainable use. Other possible impacts include increasing exposure to HIV/AIDS, either from emigrants or from increased incomes and the concomitant increased access to prostitutes. With increased populations and incomes, there will increased stresses on social services. Other additional effects could be an increase in the vulnerability of the Project Affected Parties (PAPs) which will be exacerbated by the protected land for irrigation

Livelihood strategies can be improved and diversified if the proposed mitigation measures put in place are implemented effectively. In the long term, such changes could influence positive livelihood outcomes. In light of the insufficient institutional and human resource capacity to provide the necessary coordination and guidance for development, the socio-economic and ecological sustainability of irrigation development is highly questionable without heavy investment by the central government in supporting key planning initiatives and activities. The Central Government therefore must set as a priority for institutional strengthening and provision of technical and financial support to the proposed recommendations.

Overall, the implementation of NIMP2018 suggests some immediate measures and attention to include:

i) Strengthen institutional set up and coordination mechanism for the irrigation sector;
ii) Accurate assessment on the quantity, quality and location, and advocate the use of ground water potential in all nine river basins for irrigation purposes;
iii) Irrigation staff are provided with appropriate training on short and long term basis; and provide capacity building for irrigators organisations;
iv) Adequate number of qualified staff at all levels are available to oversee irrigation development in Tanzania;
v) Awareness is created among irrigators on their roles and responsibilities in initiation,

implementation and management of their irrigation schemes; and

vi) Undertake mapping and demarcation of the potential land for new irrigation schemes development:

12.7.2 Recommendations

The implementation of NIMP2018 is likely to cause significant changes in the way resources are utilized. It is therefore important to undertake comprehensive planning in order to determine various resource uses and ensure their conservation. Based on the six strategic themes, specific recommendations are made as follows (details are presented in the SEA report).

(1) Recommendation on Regulatory Framework and Institutional Strengthening

Managing the potential impacts associated with the implementation of NIMP2018 and their associated economic activities requires improvement in governance – in the administration and management of their responsibilities for administering the natural resources within their local areas.

(2) Recommendation on Financing Mechanism and funding support for Irrigation Development

The institution responsible for irrigation, including LGAs has to ensure effective irrigation development and management through enhancement in financial accounting, accountability and budgeting.

(3) Recommendation on Land tenure and ownership rights

The institution responsible for irrigation in collaboration with the Ministry responsible for Lands has to prepare and implement an Integrated Land Use Master Plan for all LGAs, which, apart from demarcating the planned irrigated area.

(4) Recommendation on Irrigation Water Resources Development

Water resources development is vital for successful implementation of NIMP2018. Such development should take into considerations the change in climate, the existing inefficient water use, environmental flow requirements and ecosystem sustainability.

(5) Recommendation on Development and Management of Irrigation Schemes

Development of irrigation and drainage infrastructure is crucial for ensuring reliable availability of water in a sustainable way for higher crop production in a bid to enhance food security and poverty reduction.

(6) Recommendation on Cross-cutting issues

Irrigation development and management to be sustainable the following cross-cutting issues are recommended for considerations during implementation:

i) Promote gender mainstreaming program in the irrigation sector;
ii) Awareness campaigns on health and safety including behaviour change;
iii) Provision of AIDS-associated Retrovirus for HIV/AIDS victims; and
iv) Expansion of irrigation schemes to go hand in hand with the construction of health and sanitation facilities like improved pit latrines etc.

Chapter 13 Conclusion and Recommendation

13.1 Conclusion

In this Chapter, based on the objectives of the National Irrigation Master Plan 2018 (NIMP2018), the significance of implementing the NIMP2018 will be examined from the viewpoint of five (5) evaluation principles.

Objectives of the NIMP2018: Tanzania mainland will achieve the one million ha of irrigation area by the year 2035 through irrigation infrastructure development along with organisational and functional strengthening; capacity building of the executing agencies and irrigators' organisations; strengthening of coordination with relevant government organisations and other stakeholders. Furthermore, it is expected to improve livelihood of beneficiary farmers by productive and profitable agriculture, which could contribute toward attaining the government development goals such as GDP growth rate and poverty reduction.

13.1.1 Relevance of NIMP2018

The "relevance" of the NIMP2018 will be evaluated from the viewpoint of consistency with the national development goals and policies, international targets, and development partners' aid policies, etc.

(1) Consistency with National Development Goals and Policies

In the Tanzania Development Vision 2025, the Government of Tanzania has set the basic goal of entering a middle-income country by the year 2025. As its policy, through modernisation of agriculture and improvement of productivity, Tanzania is moving away from the low productivity type agricultural economy and advocating for a transformation into a semi-industrial economy. In the Agricultural Sector Development Program Phase 2 (ASDP2), which is the development plan of the agriculture sector, important issues to be addressed include improvement of the capacity of agricultural personnel, conservation of water resources and land resources, promotion of irrigation agriculture, strengthening value chain and value-addition, cluster approach development and collaboration with the private sector (see above, Section 2.5). In addition, the Water Sector Development Program (WSDP), which is the water sector development plan, is formulating an integrated water resources management and development plan (IWRMDP) in each of the nine major river basins with setting the target years of 2015, 2025, 2035 (See section 3.3). Furthermore, in the Second Five-Year Development Plan (FYDP II), the agricultural sector is positioned as the nucleus of Tanzania's industrialization and people's livelihood improvement, promoting irrigation development, improving research and development, improving agricultural extension, improving land planning, development of markets; aiming to achieve agricultural sector growth rate of 6.0% by the year 2020. The Japan International Cooperation Agency (JICA) Project Team has formulated the concept, approaches, and plans of irrigation development, taking into account the above-mentioned cross-sectoral goals and issues, and it is judged that the significance and relevance of implementing the NIMP2018 is high (See Chapter 9).

(2) Consistency with Development Needs

To prioritise the irrigation schemes, the questionnaire survey on priority of each Local Government Authorities (LGA), Reginal Secretariat (RS), and National Irrigation Commission (NIRC)/Zonal Irrigation Office (ZIO) has been conducted to reflect those into the NIMP2018 (See Section 7.5). Also, beneficiary farmers, who are engaged in agriculture in partially completed irrigation schemes, were expecting early completion of irrigation systems, as well as timely and reliable supply of irrigation water. In response to this situation, the NIMP2018 places importance on completing and making functional such existing irrigation schemes as soon as possible. In this way, the NIMP2018 has been formulated reflecting the development needs of LGAs and other stakeholders. Hence, the NIMP2018 is highly consistent with the development needs.

(3) Consistency with Development Partners' Aid Policies

In recent years, development partners in agricultural sector of Tanzania are putting their priority on establishment of agricultural value chain from production to processing, distribution and marketing. Under such conditions, the World Bank (WB) and United States Agency for International Development (USAID) are taking on irrigation infrastructure development subject to capacity building of irrigators organisations in planning of agriculture business and water management. Among others, the Japanese government has been continuously assisting Tanzania in popularization of irrigated rice farming through a unique program approach; Small-Scale Irrigation Development Project (SSIDP) (Yen Loan) on hard component side, and Capacity Development for the Promotion of Irrigation of Scheme Development under the District Agricultural Development Plan, Phase 2 (TANCAID2), and Project for Supporting Rice Industry Development in Tanzania (TANRICE2) on soft component side. Thus, the NIMP2018, which include irrigation infrastructure development and soft components, is highly consistent with the development partners' and aid's policies (See Section 5.10).

13.1.2 Effectiveness of NIMP2018

How the "effectiveness" of the NIMP2018 is secured to achieve the development targets is examined hereunder.

(1) Enhancement of Crop Productivity with Irrigation

The effect of irrigation in crop productivity would be examined by the comparison of crop yield between irrigated condition and rainfed condition. According to GOGA's research, a unit yield of paddy under irrigated condition (4.49 ton/ha) would be over three times of one under rainfed condition (1.35 ton/ha). The research paper reports that a potential yield of paddy would be as high as 6.0 to 7.5 ton/ha. A combination of irrigation and good farming techniques would produce 5.0 ton/ha or more on a national average. Moreover, irrigation is well known as an adaptation measure to climate change. Properly designed irrigation systems are considerably effective not only for dry season cultivation but also supplemental irrigation during the wet season (See Section 8.3).

(2) Quick Project Effects by Full Development of Irrigation Infrastructure

A budget ceiling was set for District Irrigation Development Fund (DIDF) projects under the Agricultural Sector Development Programme 1 (ASDP1). Because of fund shortage, many irrigation schemes were left incomplete. There are cases that some medium and/or large irrigation schemes were improved with DIDF, which had resulted in patchwork improvement (See Section 8.6). Based on the above reflections, the main and secondary canals from the water source facilities and the main and secondary drainage are integrally constructed in new development in order to realise the early project effect, in the NIMP2018. Moreover, it aims to foster ownership and burden a part of construction cost to beneficiaries in constructing a tertiary canal system by beneficiary participation. Therefore, in order to guarantee the effectiveness, it is necessary to eliminate the maximum amount per project set by the ASDP1 and revise the operation rule to calculate the project cost with unified design standard and estimate standard.

(3) Irrigation Potential Analysis based on Assessment of Water Resources and Land Resources

In formulating the NIMP2018, the water allocation for irrigation (in the years 2015, 2025, 2035) determined by the IWRMDP was regarded as a precondition for calculating the irrigation potential area. In addition, the suitable land for agriculture was classified based on the latest land use map, and the agricultural land potential was appropriately evaluated using the Analytical Hierarchy Process (AHP) method. As a result, the agricultural land potential was about 27% (about 25.6 million ha) of the mainland Tanzania, of which about 20 million ha was confirmed to be relatively suitable as paddy field (See Chapter 7). In this way, the JICA Project Team proposes a realistic irrigation development plan based on water availability and suitable land for agriculture.

(4) Realistic Irrigation Development Plan by Using a Comprehensive Information System

Intake points of almost all irrigation schemes were surveyed by respective district irrigation staffs using GPS. In addition, the existing irrigation database has been updated with cooperation of respective district irrigation staffs under the guidance of an IT engineer of each ZIO. The JICA Project Team has developed a comprehensive information system integrating GPS coordinates and updated irrigation database using GIS technology. This will be a very effective and powerful tool for formulating a realistic NIMP2018.

(5) Irrigation Development Plan linking with Agricultural Value Chain

In the NIMP2018, priority irrigation schemes selected by Step 1 were further divided into two development phases by market accessibility (distance from regional centre and trunk roads) connecting irrigation schemes to agricultural value chain, as Step 2 (See Section 7.5). In such a way, out of 2,946 irrigation schemes identified by the NIMP2018, 469 priority schemes for Phase 1 and 643 priority schemes have been selected.

13.1.3 Efficiency of NIMP2018

How the "efficiency" of the NIMP2018 is secured in implementing projects is examined hereunder.

(1) Project Management and Monitoring and Evaluation Systems with a Central Focus on NIRC/ZIOs

There are many districts where irrigation staff (engineers and technicians) are not sufficiently secured in implementing the NIMP2018. Considering this situation from the viewpoint of efficient project implementation, the JICA Project Team has proposed a project management system centred on ZIOs (See Section 9.8), and that NIRC centrally monitor and evaluate project progress and outcomes in collaboration with ZIOs (See Section 9.9).

(2) Smooth Project Operation and Management though Capacity Building of Irrigation Staff in NIRC/ZIOs and LGAs

To cope with the difficulties that may be encountered while implementing the NIMP2018 and to carry out the project as planned, it is essential to strengthen the capacity of irrigation staff. Therefore, the JICA Project Team recommends to intensively implement capacity building programs for NIRC/ZIOs staff and district irrigation staff especially in the initial stage of Phase 1.

(3) Efficient Project Operation and Management through Strengthening of Coordination with Other Relevant Sectors

As stated repeatedly, cooperation with Ministry of Water and Irrigation (MoWI), Ministry of Agriculture (MoA) and President's Office-Regional Administration and Local Government (PO-RALG) in particular is indispensable in order to implement the NIMP2018 efficiently. Hence, DG/NIRC shall participate in the ASDP2 Steering Committee with the aim of efficiently implementing the NIMP2018. The Steering Committee considers as the opportunity to strengthen collaboration with other sectors especially permanent secretary classes, DG/NIRC attends cooperation on various issues and measures across sectors, and participates in various meetings and committees related to the ASDP2. (See Section 9.8)

13.1.4 Impact of NIMP2018

The NIMP2018 has variety of positive impacts, apart from the financial and economic viability as described in Section 9.9. Hereunder, they are briefly summarised as “impact” of the NIMP2018.

(1) Increase in Agricultural Incomes

Assuming that the NIMP2018 would be implemented as planned and applying the national average of farm land area of 1.6 ha per household, the master plan will raise agricultural incomes of approximately 470,000 farm households by TZS 6.8 million (in case the change from rainfed to irrigation). With such a significant improvement, it is expected that the master plan has genuine impact on the reduction of rural poverty rate and food poverty rate. Thus, it can be said that the NIMP2018 will contribute to achieve SDGs of Tanzania.

(2) Becoming Food Basket of East Africa

As already discussed, Tanzania is blessed with natural resources, and the potential of agricultural production is high in comparison with neighbouring countries. In particular, with regard to rice, it is estimated that only Tanzania can achieve self-sufficiency (fully satisfying domestic demands with substantial surplus) as of 2035. Further assuming that surplus rice is exported to neighbouring countries, it can cover about 90% of the required amount of rice in the neighbouring East African countries. Assuming that the NIMP2018 will be implemented as scheduled, rice production will further increase and it will contribute greatly to rice self-sufficiency in East African countries.

(3) Irrigation Development as Adaptation Measures for Climate Change

Climate change prediction by the Tanzania Meteorological Agency predicts that global warming will progress from the year 2025 to 2100, especially in southwest highlands and western areas, the temperature will rise by 3.8°C by the year 2100. It is also expected that annual average rainfall will increase by 11% centred on the north-eastern plateau by the year 2100 (See Section 3.4). On the other hand, the global circulation model (GCM) shows the prediction that rainfall will increase during the wet season and rainfall will decrease during the dry season (See Section 10.4). In the NIMP2018, countermeasures against climate change are proposed as cross-cutting issues; watershed conservation and management by MoWI, construction of rainwater storage facilities such as small dams and ponds by NIRC, introduction of drought-resilient crop varieties and water-saving cultivation by MoA.

13.1.5 Sustainability of NIMP2018

In order to ensure "sustainability" of irrigation projects, what kinds of activities and mechanisms are proposed in the NIMP2018 will be examined below.

(1) Sustainable Irrigation Development through Capacity Building of Irrigation Staff in NIRC/ZIOs and LGAs

In the capacity building of the NIMP2018, the JICA Project Team will propose two different approaches. In Phase 1, while utilizing external resources, NIRC/ZIOs and district staff will be strengthened their capacity through training and practice. On the other hand, in Phase 2, from the viewpoint of ensuring sustainability, they are supposed to formulate a detailed irrigation development plan by themselves and practice it.

(2) Securing Sustainable Irrigation Schemes through Capacity Building of Irrigators' Organisations

In the case of irrigation projects, operation and maintenance (O&M) after the completion of the irrigation facilities is important, and the performance of the O&M affects the sustainability of irrigation projects. In Tanzania, O&M of small-scale irrigation schemes is entrusted to Irrigators' Organisation (IOs). While the district government manages large structures (headworks, dams, etc.) of medium and large-scale irrigation schemes, in principle the irrigators' organisations are in charge of O&M in the rest. Therefore, irrespective of the development scale, strengthening the capacity of IOs is indispensable for securing the sustainability of irrigation schemes. Taking the above into account, the JICA Project Team proposes to incorporate O&M training into implementation process of irrigation development and advance the capacity building of IOs. The capacity building of IOs will widely cover not only O&M but also production, marketing, organisation management, etc., thus improve the incentives of IOs and ensure sustainability of irrigation schemes.

(3) Motivation to Beneficiary Farmers through Increasing Agricultural Incomes

Experience of profitable agriculture is a strong incentive for beneficiary farmers. Therefore, the increase in agricultural income will be an important factor in the sustainability of the projects. As described in the preceding Clause 13.1.4 (1), if the NIMP2018 is implemented as planned, farmers' net-return is expected to increase by five times or TZS 4 million/ha on annual average. This is not merely achieved by construction of irrigation facilities. It will be achieved if an irrigation system is operated and maintained efficiently and effectively; crops are cultivated in a good practice; and traded at a reasonable price. The NIMP2018 contains a comprehensive program to strengthen cooperation with related sectors and to develop capacity of irrigation staff.

13.2 Recommendations

In implementing the NIMP2018, the JICA Project Team recommends about the roles and activities to be performed by the NIRC, the executing agency, and other related government agencies, herein below.

13.2.1 Recommendations to MoFP

(a) Securing Financial Resources for Implementation of IWRMDP, NIMP2018, and ASDP2

As stated in Section 8.2, irrigation sector plays a role of a bridge connecting the water sector and the agricultural sector. To achieve the development target of 1 million ha, GoT needs to implement IWRMDP, NIMP2018 and ASDP2 as planned. Hence, MoFP examines the plans, and needs to secure the funds for implementation of the plans.

(b) Full Disbursement of Approved Annual Budgets of NIRC

The ratio of NIRC’s annual budget execution of National Irrigation Development Fund (NIDF) for the last 5 years has decreased drastically from 46.7% in 2012/2013 to 9.4% in 2016/2017. Similarly, the operation expenditure has reduced from TZS 751 million in 2012/2013 to TZS 300 million in 2016/2017. On the other hand, the staff salary expenditure in 2016/2017 has increased by 1.5 times compared to the previous year. As annual budget proposal is usually prepared based on annual work plan, it means that the human resources of NIRC is not fully unutilized under the current condition. Accordingly, MoFP needs to make a full disbursement of the approved annual budgets of NIRC to achieve its annual work target of NIRC (See Section 5.5).

13.2.2 Recommendations to NIRC

(a) Clarification of Roles in Irrigation Administration

Since 1986, the NIRC has been driving irrigation development in Tanzania as an execution force. However, in recent years, severe reputation to NIRC's performance can be seen. With the retirement of experienced senior staff, empty seats at major posts, reduction in activity budget and so on, the function of the organisation is deteriorating. NIRC's human resources plan will be greatly influenced by whether the continued surveying, designing and constructing directly under the government, or outsourcing these to private contractors as a so-called management and coordination organisation. Many developing countries (e.g., Myanmar) are moving to the latter form aiming for a small government. It is necessary for NIRC to clarify its future role and review the human resources development plan.

(b) Improvement of Communication using ICT

NIRC is composed of the headquarters in Dar es Salaam and 8 ZIOs. Since Tanzania has a large national land, it is planned to establish a directly operated irrigation office in all region in stages under the NIMP2018. In the future, it is recommendable to utilise ICT for achieving good communication between the NIRC headquarters and 8 ZIOs or 26 regional irrigation offices. For example, it is possible to utilise video conferences, irrigation database for unified irrigation information management, NIRC website for public relations activities and electronic libraries (publications), etc. It could contribute to reduce traveling time and transportation expenses from irrigation offices in various places.

(c) Development of Design Standard for Irrigation in Tanzania

In Tanzania, the operation guidelines (CGL) for small-scale irrigation projects has been organised by TANCAID, whereas standard technical manuals are not yet in place. To secure the quality of the irrigation project, it is important to develop a design standard for irrigation that the NIRC technical staff can use in common. The activities of the NIMP2018 include the creation of the design standard, and NIRC technical officials are required to acquire skills on-the-job through involving in irrigation infrastructure development projects in addition to training.

(d) Development of Support System for IOs

Regarding the capacity development of IOs, the NIMP2018 proposes to include training on agricultural production and marketing, which is normally targeted at agricultural cooperatives. On the other hand, the NIRC currently lacks the experience to conduct such training. Thus, the NIRC is required to cooperate with relevant agencies for designing and conducting the training programs, such as the training division of the MoA, Tanzania Cooperative Development Commission (TCDC), and education and training institutes.

To provide effective service, moreover, the NIRC needs to promote IO registration in collaboration with TCDC. In addition, the commission is required to operationalize the fee collection system set in the regulations of NIA and the ways to utilize it for the support on IO's scheme management.

(e) Strengthening of Cooperation with Relevant Government Ministries and Agencies

In irrigation development, cooperation with relevant ministries and agencies is indispensable for improving the performance of NIRC. For example, watershed conservation, construction of a large-scale multipurpose dam, allocation of water for irrigation are all mainly related to MoWI (including Tanzania Electric Supply Company Limited (TANESCO)), whereas agriculture extension services by MoA, and distribution, processing and export of agricultural products are mainly under the jurisdiction of Ministry of Industry and Trade. In addition, collaboration with the LGAs under the umbrella of PO-RALG is also indispensable for promoting small-scale irrigation projects. NIMP2018 proposes to establish its implementation system within ASDP2 management committee. It is strongly desired that NIRC actively participates in various conferences of ASDP2, the agricultural sector working group, the water sector working group, the basin water authority, etc., to share information and encouraging to respond to cross-cutting issues.

13.2.3 Recommendations to MoWI

(1) For implementing the NIMP2018

(a) Steady Implementation of IWRMDPs

The NIMP2018 is formulated on the promise that the IWRMDPs are fully implemented by 2035. Therefore, in order to implement the irrigation development plan proposed by the NIMP2018, the MoWI is supposed to implement the water resources management and development plans as scheduled. Especially, the MOWI will be required to take necessary actions for construction and utilisation of 70 dams proposed by IWRMDP and Power Supply Master Plan as scheduled.

(b) Early Formulation of the Remaining IWRMDPs

In parallel with the implementation of the previously formulated IWRMDPs, early formulation of IWRMDPs for the Pangani, Wami/Ruvu and Lake Victoria basins are required. If water resources to be allocated for irrigation within these basins are largely changed from that of the NIMP2018, the MoWI needs to discuss with the NIRC based on technical justification. Furthermore, development plans of water storage facilities need to be appropriately incorporated into the IWRMDPs for the Pangani and Lake Victoria basins in order to ensure irrigation water to be supplied to the irrigation areas proposed by the NIMP2018.

(c) Review of Environmental Flow Requirement for Rufiji Basin and Other Basins

Although the Rufiji basin has plenty of surface water, monthly water deficit may not be covered by storage facilities in the dry season if the environmental flow requirement (EFR) estimated in the basin's IWRMDP is fully secured particularly for the Kilombero sub-basin.

NAWAPO 2002 provides the second priority in water allocation to EFR followed by basic human needs. However, it is less-than-reasonable to construct water storage facilities for the purpose of securing the EFR from the perspective that practical and feasible water resources development plan needs to be formulated. In this regard, it is recommended to allocate appropriate water resources to EFR considering the actual river flow.

(d) Necessary Actions for Transboundary Water Use

The NIMP2018 includes some irrigation schemes that may require water use from transboundary lakes. And there is a possibility of implementing these schemes depending on the result of the feasibility study (F/S). Accordingly, the MoWI will be required to take necessary actions for coordinating with surrounding countries directly and/or through NBI facilitation.

(2) For Better Water Resources Management

(a) Accumulation of Hydrological Data

Reliable and long-term hydrological data is essential for formulating appropriate water resources management and development plans. It is strongly recommended to accumulate hydrological data for conducting more precise studies at subsequent implementation stages as well as updating the IWRMDPs in the future.

Although data management can be practiced at a basin level by the respective Basin Water Offices (BWOs), it is desirable to standardise a monitoring system, a data quality checking method, a database format, etc., among all the nine basins.

(b) Consideration of Reliability of Water Utilisation

Understanding the reliability of water utilisation is quite important in considering the necessity of newly developing water resources. If an occasion to improve the reliability of water utilisation arises, it is recommended to incorporate the concept of reliability of water utilisation into the water resources development plans in the course of updating the IWRMDPs in the future.

(c) Collection of Water Fee

There are many non-approved water uses and therefore the water used in that manner is not properly billed. In order for BWOs to secure the funds required for performing their functions, BWOs should collect water fees from those water users as well. It will be important to increase income for enhancing financial autonomy of BWOs by 2025.

13.2.4 Recommendations to MoA

(a) Implement of ASDP2 with Firm Commitment

ASDP2 is the most important agricultural policy/ program for the coming ten years (until 2025) and has already been officially endorsed by the government. The program contains the irrigation development as component 1.2. Being a custodian of ASDP2, the Ministry of Agriculture needs to implement, together with NIRC, the program with firm commitment.

(b) Facilitating Private Sector in Undertaking Development of Large-scale Irrigation Schemes

There have been several large-scale irrigation development projects envisaged in FYDP II (Agricultural City of Mkulazi) or in BRN (Bagamoyo sugarcane project). They are planned to be carried out by private initiatives. Ministry of Agriculture is expected to play a major role, together with other ministries such as Ministry of Land, Ministry of Water and Irrigation, to ensure that the projects are to be implemented as planned.

(c) Providing Extension Services Timely to those who have less Experience of Irrigation Management and Irrigation Farming

Irrigation development can obviously expand possibilities of cultivation for various crops and enable to increase and stabilize agricultural productivities since it secures water for crop growth not only in the dry season but also in rainy seasons with supplemental water supply. However most farmers have only limited knowledge on irrigation farming, operation and maintenance of irrigation facilities. To materialize expected benefits of irrigation development, efficient, proper and long-term utilisation of the developed irrigation facilities is indispensable. Hence it is extremely important to provide appropriate extension services (technical support) to those who have less experience on irrigation farming and facility management by the time when irrigation water is available at their fields.

To provide timely extension services to these farmers, close coordination between irrigation and extension officers at regional/district levels is crucial. It is assumed that the Crop Development Division and Training Division will take an important role for these tasks. Moreover, the extension services must be coordinated with TCDC which is in charge of farmers' organisations including IOs.

(d) Developing and Promoting Water-saving Agricultural Technologies

Considering the recent climate change situations in Tanzania, it is possible to have more areas with drier conditions in the future. This means that value of the limited water resources will become more precious and conflicts on water allocation may consequently occur.

To prepare for the occasion of water scarcity, the development of water-saving cultivation technologies in advance is very important in order to utilise the irrigation water as efficiently as possible. In case that there are no severe water scarcity areas in the future, introduction of water-saving cultivation technologies enables the expansion of irrigated land by utilising the water amount saved. Together with the 16 Tanzania Agricultural Research Institutes across the country, it is expected that the Agricultural Research and Development Division of the MALF will take the initiatives in developing and expanding the water-saving cultivation technologies.

(e) Promoting Value Chains with Attention to the Private Sector Involvement

It is expected that agricultural production will increase by irrigation development through crop productivity improvement. Therefore, functional and practical value chain will be indispensable to handle those increased agricultural production and subsequently to improve farmers' income and livelihood. As ASDP2 gives considerable importance to value chain development, MoA has significant responsibility for the task together with Ministry of Industry, Trade, and Investment. It would be greatly facilitating if MoA will take an initiative in preparing and implementing policies or guidance specifically supportive to agricultural value chain development.

Such policies or guidance should include proper encouragement for private sector to get involved in value chain development, as they are one of major players in the chain in addition to farmers. This is especially relevant in the context of irrigation development as it demands a great amount of financial resources. It is therefore vital to mobilise as much private resources as possible for steady development. As part of the effort of expanding the involvement of the private sector, the scope and composition of PPP should further be elaborated.

(f) Promoting Export of Irrigation Products to Neighbouring Countries

Although actual selection of crops under irrigation is left to farmers, it is expected that the facilities will be used for the production of cash crops, which will be greatly helped by better market access. Thanks to its agroecological conditions, Tanzania has significant potential for a variety of crops and to become a food basket for the East African countries. In this regard, a comprehensive market research of neighbouring countries with respect to Tanzania's comparative advantage of agricultural commodities should be highly desired. The Ministry of Agriculture should take advantage of the potential by proactively promoting agricultural export to neighbouring countries.

(g) Promoting Farmers' Access to Financial Resources in concert with the Tanzania Agricultural Development Bank (TADB)

In irrigation development, while public undertakings based on government or DPs' resources are important, efforts by farmers, even though the scales are much smaller, are indispensable and should be encouraged nonetheless. For their exercises, farmers need to have easy access to financial resources. The issues of farmers' easy access to loans has only recently been addressed by establishment of TADB. The Ministry of Agriculture should work closely with TADB to expand the loan access further across the country.

13.2.5 Recommendations to PO-RALG

As the supervisory authority which oversees the local government authorities and regional administration, the PO-RALG is expected to support LGA-level irrigation development.

(a) Overall Coordination Between NIRC and LGAs through RS

Under the NIMP2018, the NIRC plans to extend and increase its support to the LGA, including RIO establishment, promotion of small-scale irrigation development and capacity development of LGA staff and IOs. On the other hand, decentralisation policy and issue of jurisdiction hinder direct involvement of the NIRC in LGA-level irrigation development. As such, it is advisable that the PO-RALG promote the coordination between the NIRC and LGAs through its division of sector coordination and RS.

(b) Promotion of Proper Staff Allocation and Organisational Arrangement

It is estimated that two-thirds of LGAs have no irrigation engineer, and many of them lack sufficient number of technicians, too. This condition will expose the implementation of small-scale irrigation projects at risk. In addition, the establishment of DID has yet to take place as the NIA stipulates. Thus, the PO-RALG is expected to encourage and promote the addition of irrigation staff, especially in the LGAs where further irrigation development is expected under the NIMP2018. As for the establishment of DID, PO-RALG is recommended to coordinate the discussion between interested LGAs and the NIRC.

(c) Promotion of Sufficient Budget Allocation

To make the investment in irrigation more effective, proper follow-up of irrigation schemes is important. Besides the initial investment for scheme development, LGAs are required to set aside the budget for scheme maintenance, monitoring of the schemes, and IO support. Therefore, the PO-RALG is advised to encourage the LGAs to secure and allocate sufficient budget for these activities.

(d) Support for Irrigation Data Collection

To confirm the progress of NIMP2018 implementation, regular monitoring and data collection are required at the LGA level. In principle, LGA irrigation staff are supposed to take these roles; however, the data collection process may face a difficulty because the NIRC and its zonal arms are not in the position of giving direct order to LGAs. Therefore, the PO-RALG is expected to support the NIRC on data collection and management. The data to be collected include the information on individual schemes for the database update, LGA irrigation staff assignment, information of IOs.

13.2.6 Recommendations to VPO-DOE and NIRC

NIRC is a responsible organisation to formulate/implement the Strategic Environmental Assessment (SEA) study for NIMP2018. The SEA study was carried out by the SEA Study Team which was organised by NIRC. Based on the guidance from the VPO-DOE, the following major issues have been analysed and evaluated in the SEA study:

- Baseline environmental conditions focusing on areas potentially affected
- Relevant legislative framework and related policy, plan, and program
- Overview of consultation and public/stakeholders' engagement activities
- Prediction and evaluation of impacts including cumulative effects
- Alternatives considered

As a result of the SEA study, following environmental management and monitoring plan were recommended when implementing the NIMP2018:

- Strategic Environmental Management Plan (SEMP)
- Strategic Environmental Monitoring Plan (SEMoP)

Detailed recommendations from a view point of environmental and social considerations are described in the SEA report for NIMP2018. Regarding the future, based on the environment related law of the GoT and JICA environmental and social consideration guidelines, it is expected to implement the NIMP2018 in a proper and reliable manner in accordance with the recommendations of the SEA report.

In order to perform the recommendations related to SEA, it will be expected continuous instruction, cooperation and support from the VPO-DOE. Furthermore, it is important for NIRC to act fully and have a sense of ownership in the implementation of environmental and social consideration for NIMP2018.

Attachments

Note:	After consultation with NIRC, the JICA Project Team changed the abbreviation of the National Irrigation Master Plan 2018, which is a product of the Project on the Revision of National Irrigation Master Plan, from "RNIMP" to "NIMP2018" in May 2018. Consequently, "RNIMP" has been replaced by "NIMP2018" except the minutes of JCCs in this report.

MINUTES OF THE JOINT COORDINATION COMMITTEE (JCC) MEETING ON REVIEW OF THE NATIONAL IRRIGATION MASTER PLAN (RNIMP)

Held at the Ministry of Water and Irrigation Conference Room

6th December 2016

Agenda

1. Registration
2. Opening speech
3. Future direction of irrigation development
4. Inception report on the project for revising national irrigation master plan
5. Questions and answers
6. Closing

1.0Registration

The invitees to the workshop were the members of the Joint Coordination Committee of the Revision of the National Irrigation Master Plan who include Directors from different Ministries/Institutions whose activities relate with National Irrigation Commission (NIRC)activities. Other invitees were Directors, Assistant Directors and Zonal Irrigation Engineers from the National Irrigation Commission.

2.0 Opening Speech

The Permanent Secretary, Eng. Mbogo Futakamba of the Ministry of Water and Irrigation opened the meeting at 10:12 a.m. by welcoming participants to this important meeting. He appreciated to have an opportunity to officiate the meeting by saying that he is in the fore front with irrigation development in the country. The JCC is a very important organ to give guidance in implementation of this project. He cited an example "In Ethiopia there are occasional hunger and irrigation is a sole solution to the problems". He further narrated that Tanzania is moving into an industrialized based economy, we therefore need irrigation to support food production and raw materials to support processing industries. The Permanent Secretary further elaborated the purpose of the formulation of the Joint Coordination Commit (JCC) that is to enhance inter-organizational coordination with the specific objectives of approving work plans and reports, reviewing overall progress, and exchanging opinions on major issues that arise during the implementation of the Project.

Finally he thanked the Government of Japan through JICA for the continued cooperation and support especially in the irrigation sub sector and assured them that, the Government of Tanzania will continue to recognize the efforts of JICA and urged the Study Team to proceed with Revision of the Master Plan through a participatory process such that the outcome will attract sound investments. He also, thanked the JICA Chief Representative and other JICA experts for accepting to participate in the JCC meeting.

On the other hand, the JICA Senior Representative Mr. Kuniaki AMATSU gave an opening remarks by saying a few words. He pointed out on the remarkable achievement of the irrigation sector since the National Irrigation Master Plan of 2002 was formulated. He mentioned some achievements in terms of institutional improvement; National Irrigation Commission has been established under National Irrigation Act. As a guiding principle, Comprehensive Guideline (CGL) of irrigation development was developed. The CGL is the guideline consolidated for all necessary procedures for irrigation development including Planning, Implementation and Management of Irrigation schemes in participatory manner.

On infrastructure development he pointed out that about 460,000 ha was equipped with irrigation infrastructure against 407,000 ha which was set as the target in the 2002 National Irrigation Master Plan to be achieved by 2017. He thanked the Government of Tanzania and Development Partners for the efforts put in irrigation development. He further pointed out that new issues that were not fully considered in the previous National Irrigation Master Plan have been raised, such as cross-sectoral water competition, climate change and more consideration to environmental and social aspects and that these issues will be fully considered in the Revised Master Plan.

Finally, he urged that with the Revised Master Plan, the Tanzanian side will take a strong leadership to implement irrigation development activities according to the outcomes of the Revised Master Plan.

3.0 Future Direction of Irrigation Development

The Director General of the National Irrigation Commission (NIRC) presented the future direction of irrigation development in Tanzania. He presented the background of the Commission that it was established under Section 3 of the National Irrigation Act No. 5 of 2013 as an Independent Department of the Government under the Ministry responsible for irrigation and is designated by Vote 05.

He said out of the total potential area for irrigation, only 461,326 Ha, equivalent to 1.6%, has been put under irrigation by June 2014 and contributes about 24% of National Food Requirement. The target is to increase the area under irrigation from

461,326 Ha up to 1,000,000 Ha by 2020/21, through collaboration with various stakeholders.

He further stressed that, the National Irrigation Policy and its Strategy forms the base framework for implementation of the envisaged Revised National Irrigation Master Plan.

4.0 Presentation of the Inception Report

The JICA Project Team presented the Inception Report by giving background of the project, Goal and Outputs; Objectives of the RNIMP, Target Area and the Methodology to be used. After presentation the members of the JCC had an opportunity to discuss the inception report and asked questions.

5.0 Questions and Responses

Q1. Technical approach No. 3 use of GIS Technology for data collection: What if you find that, the existing GIS data are outdated, what other methods can the review team consider?.

Response: If there will be no reliable source of data for GIS, this is not a research project, if data are not available will reject it. Some GIS data will be updated such as population, road map, Climate change etc. The Permanent Secretary advised that " data which are not reliable should not be thrown away instead plot them all and draw a line of best fit statistically and come up with a solution. Use all scientific methods available. Questionnaires can also be used but carefulness is required in selection of sample population. Be guided by ground true-thing in some areas. ASDP II Program document is in place, will be mainstreamed into the RNIMP

Advise: Referring to approach No. 2 on key performance indicators: Accommodate key performance indicators from developed ASDP II program document.

Q2.was on selection procedure for new irrigation schemes: How Zonal Offices will identify new irrigation schemes?

Response: How to identify new irrigation schemes: Clarification on, basic data such as water, soils, and agricultural data. New irrigation schemes can be the existing tradition schemes or schemes on a new area which have never been intervened. The RNIMP team was advised to get a good definition of new irrigation from the National Irrigation Policy.

Advice on Financial arrangement
The Development Partners who have plans for supporting irrigation development, should use the information that will be contained in the RNIMP on priority schemes. NIRC was advised to share the outcome of the Revised National Irrigation Master Plan with potential funding agencies including the private sector..

Q3. What are the ToRs for the JCC.

Response: The roles of JCC were cleanly outlined in the invitation letter to the JCC meeting. These are establishment of an inter-organizational coordination, with specific objectives of approving work plans and reports, reviewing overall progress, and exchange opinions on major issues that arise during the implementation of the Project..

Q4:In the presentations it is highlighted that one (1)million hectors will be achieved by 2025 but the Government in its other documents it is indicated that this goal will be achieved by 2020. There should be a consistence in documentation of pans.

Response: The RNIMP will observe the Government 5 year development plans.

Q.5: Schedule of JCC meeting and timing. Suppose things are not moving well in between, will the JCC wait until such time reach to resolve them?

Response: Communication will be there in between. The JCC to meet twice a year is put as a guide but it is further indicated that it can meet sooner than the timing set if there is any need to do so.

Q6: Part 3 on the methodology: Irrigation sector is a multi-disciplinary, on the institution development and capacity building, it is indicated as the irrigated area is increased only engineers are involved in capacity building plan, leaving out other disciplines.

Response: In order to increase area under irrigation a number of engineers should be increased and also the number of Irrigators Organizations should be increased. This presentation is a preliminary, when it will come to further planning detailed information will be covered involving different staff disciplines.

Q7: For the existing master plan. What was achieved in the old NIMP and what were the weaknesses.

Response: There were no prioritizations of irrigation schemes in the past NIMP, there were no potential financiers and no awareness to them was made.

Financing modalities of the RNIMP: identify the gape, amount of investments required and the available resources. The National Irrigation Act provides for establishment of the Irrigation Development Fund, therefore the provision of establishing an Irrigation Development Fund is there in principle. The Permanent Secretary of the Ministry of Finance and Planning pointed out that the sources of funds which were indicated in the write up were weak. Therefore dialog is going on with the Ministry of Finance and Planning to harmonies on potential sources of Funds for NIRC.

6.0 Closing

The JCC meeting was closed at 12: 45 pm and the Chairman urged the members to make the RNIMP to be more popular.

Eng. Mbogo FUTAKAMBA **Chairperson- PS MoWI**	Eng. Seth P. LUSWEMA **Secretary- Ag. DG-NIRC**
天津邦明 Mr. Kuniaki AMATSU **JICA Senior Representative**	渋田健一 Eng. Kenichi SHIBUTA **T/L - JICA Project Team**

Date 20/12/2016

Attachments

I: Opening Speech by PS MoWI.
II: Opening Remark by JICA Representative.
III: Presentation of Inception Report.
IV. List of Participants.

THE PROJECT ON THE REVISION OF NATIONAL IRRIGATION MASTER PLAN (RNIMP)

Minutes of the Second Joint Coordination Committee (JCC) Meeting

Held at Morena Hotel Conference Room- Dodoma
21st September 2017

1.0 Participants: (see attached annex for details)
2.0 Introduction
2.1 Arrival and Registration
3.0 Opening Remarks
4.0 Presentation of Interim Report on the Revision of National Irrigation Master Plan
5.0 Closing

2.0 Introduction

The Second Joint Coordination Committee (JCC) Meeting, was held on 21st September 2017 at Morena Hotel Conference Room- Dodoma. The purpose of the meeting was to present and discuss the Interim report for RNIMP project.

3.0 Opening Remarks

3.1 Remarks by the Director General.

The meeting commenced with introductions from all participants and the Director General of the National Irrigation Commission (NIRC) Eng. Seth, P. Luswema gave a pre-opening remark, that the National Irrigation Master Plan (NIMP) was prepared in 2002; many changes have taken place and therefore the Government found it expedient to review the NIMP. In this regard the Government of Tanzania requested the Government of Japan through JICA to support the review of NIMP and to that effect the request was accepted.

3.2 Opening Remarks by the Chief Guest.
The Permanent Secretary of the Ministry of Water and Irrigation, Prof. Kitila Mkumbo opened the meeting officially at 10:09a.m. by welcoming participants to this important meeting. He appreciated to have an opportunity to officiate the meeting and gave thanks to the organizers for agreeing to reschedule the meeting, a move which enabled him to attend the session. He further thanked the Government of Japan for continued support to the Country not only for irrigation development but also in other sectors and that their assistance does not come with many conditions.

He stressed that Agriculture is very important in our country because it is a primary source of our national food supply and income, in that regard irrigation is one of the supporting aspects. Further agriculture contributes largely to the national GDP, and by national development plans, the Government gives a high priority to irrigation. He underlined the fact that "we have spent more time in promoting irrigation but less time in irrigation advocacy". In this aspect he pioneered to take a lead role in promoting/ advoting for the irrigation sector and especially to the leaders also, he underscored the fact that, the issue of planning is one side but how to implement the plan is another challenge.

In a similar note he empresized that water is not increasing and at the same time irrigation uses a lot of water. Traditionally irrigation uses 70-80% of water in most countries and thus implies that irrigation is a big consumer of water. Therefore we have to advocate and promote irrigation systems that use less water but gives more yields. The question is how we modernize our irrigation systems and move away from flood irrigation. Let us plan for using less water with more yields and in order to achieve that we need to employ new technologies to make sure that irrigation consumes little water but produces high yields.
He further highlighted that, plans are being prepared and reviewed, but most of the plans are implemented before concluding their review. The review of this Master plan will be completed, but the harder part will be its implementation. He mentioned that only 1.6% of the potential area has been developed for irrigation so far, but most of the areas continue to

depend on rainfall. It's high time that we should make advocacy more on irrigation sector development and show that irrigation is an important area in order to attract the Government leadership and other Development Partners. Currently, we are doing less to attract intended parties and therefore we should find a way of engaging the top three Government leaders, business community, citizens and media on irrigation development.

Finally, he thanked the Government of Japan for the continued cooperation and support through JICA especially in the irrigation sector and assured them that, the Government of Tanzania will continue to recognize the efforts of JICA and urged the Study Team to complete the revision of the Master Plan as planned. He also thanked the JICA Senior Representative and other JICA experts for accepting to participate in the second JCC meeting. With those remarks, he declared that the second JCC meeting officially opened at 10.09 am after which he joined the floor to listen to the presentations.

The Director General accorded a vote of thanks to PS on a very precise and informative opening speech after which he invited the Jica Senior Representative for a brief note.

3.3 Remarks by the JICA Senior Representative

The JICA Senior Representative Mr. Kuniaki Amatsu started by recognizing irrigation development, as an effective approach to achieve food security and poverty reduction, because it improves productivities of crops, and assuring stable expansion of agricultural production. He reminded, that JICA has been supporting irrigation infrastructure development since 1980s starting by Lower Moshi Irrigation Scheme, followed by Ndugu in Same, Bagamoyo Irrigation Development Project (BIDP) in Bagamoyo Mwega in Kilosa, and currently, ODA loan project on "Small Scale Irrigation Development Project" (SSIDP) for supporting rehabilitation of more than 100 irrigation schemes nationwide.

He said, that in order to achieve 1 million ha of irrigated land, which is a target under Five Year Development Plan II, it may require more water allocation from other sectors to irrigation purposes. In addition, finance is another challenge.

He reminded the participants, that there are three purposes in this meeting. The First is to validate planning approach, and the Second is to discuss and confirm framework of master plan such as contents, schedule, organizational arrangement, etc., then The Third is about development target by 2035.

He concluded his remarks by urging that, with the Revised National Irrigation Master Plan (RNIMP), Tanzanian side should take a strong leadership to implement irrigation development activities according to the outcomes of the Revised Master Plan.

4.0 Presentations of the RNIMP interim report.

The RNIMP Team presented the interim report to JCC members in the presence of the PS. The presentation touched on the following important areas:

4.1 Approach to RNIMP
4.2 Basic Development Plan
4.3 Development Components
4.4 Implementation Schedule
4.5 Organization Arrangements for Implementation
4.6 Possible Financial Arrangements
4.7 Environmental and Social Consideration
4.8 Discussions (Q&A)

The presentation covered the background of the project, Approach to RNIMP; Basic development plan and the Methodology used.

4.1 Approach to RNIMP

The presentation clarified that the RNIMP will take into consideration the following approach; Prioritization of irrigation scheme in a scientific manner such as water allocation on monthly basis by 71 sub-basins and updating irrigation database; export-oriented agriculture development ;phasing development plan to enable linkage with value chain development by ASDP-2; Irrigation infrastructure development with locally available water resources; full development of irrigation schemes and strengthening of supporting system for irrigation infrastructure development.

4.2 Basic Development Plan

The review team presented the Basic Development Plan for implementation of RNIMP that the overall goal will be to contribute to the achievement of KPIs for ASDP2. The objective of the RNIMP is to contribute to national economy and food security by improving agricultural productivity and profitability through irrigation development, consequently reduce rural poverty and strengthen climate change resilience. The implementation plan will targeted for the year 2025 for phase I and year 2035 for phase II. The team also highlight that the target irrigation projects will be selected considering the superiority of market access (domestic distribution and export).

4.3 Development Component

The Development component of the RNIMP consist of hard component and soft component for which the hard component will focus on irrigation infrastructure development for effective use of water and soft component will include capacity building at all levels and strengthening of coordination, organizational and functional.

4.4 Implementation schedule

The presentation clarified that Irrigation Infrastructure Development will be implemented with a timeframe of RNIMP of 18 years; defined as Phase-1 for 8 years from 2018 to 2025 and Phase-2 for 10 years from 2026 to 2035 in the same target years as the Integrated Water Resources Management Development Plans (IWRMDPs). The soft components of RNIMP will be designed so as to support the infrastructure development smoothly and efficiently in the implementation period and beyond.

4.5 Organization Arrangement for implementation

The review team presented the institution arrangement for implementation of RNIMP that the main executing agency of the RNIMP will be the National Irrigation Commission (NIRC). Since irrigation development is a major component of ASDP-2, in principle, the implementation system of the RNIMP will be in accordance with the implementation system of ASDP-2. In addition, NIRC qualifies as a member of ASDP-2 and will share policies and information by participating in various committees. In the case of a project supported by a development partner, it is proposed to establish a project unit within NIRC (or ZIO) and to establish a system that enables NIRC and the project staff to keep a good communication to each other on a daily basis.

4.6 Possible Financial Arrangement

The review team presented the revised irrigation master plan that it has a target period of 18years from 2018/19 to 2035/36. The conditions that irrigation development is highly capital intensive, requiring substantial amount of resources and the target period is long to make the financial projection of the plan inherently demanding. Moreover the situation that in the past, significant parts of development activities of the country have been facilitated by Development Partner's financial supports adds further uncertainty to the projection. However the review team gave three development options; option 1 development of 1,000,000 hectares would require US$ 3,281,800,000; option 2 developments of 850,000 hectares would require US$ 2,441,800,000 and option 3 developments of 535, 000 hectares would require US$ 414,400,000. This financial requirement is substantial and therefore need a very concise and focused resources mobilization.

4.7 Environmental and Social Consideration

The Strategic Environmental Assessment (SEA) study of RNIMP will be designed to comply with all environmental laws of the United Republic of

Tanzania and the Environmental and Social Safeguard Policies of JICA as well as World Bank. Full SEA study shall be conducted based on the Revised Master Plan by the end of June, 2018.

After presentation the members of the JCC had an opportunity to discuss the presented part of the report and asked questions.

4.8 DISCUSSIONS

4.8.1 Recommendations from the PS

The presentation was very good and the quality is very high with a lot of update data that is pleasing, however the team should prepare a brief summary (1-5pages) and share with the Government so that it can be utilized in inter-ministerial meetings for decision making. Also, we should start implementing as we plan without delay.

4.8.2 Issue

- Some of irrigation schemes are in protected areas like Igomelo irrigation scheme because the GN came later after the irrigation scheme has been developed. On the other hand in some cases the sources of water for irrigation are located in protected areas. Key stakeholders like Livestock, Natural Resources Officers' and Industry and Trade should be invited in the coming JCC. If the scheme is located close to the wildlife, what mitigation measures are provided in the RNIMP?

Clarifications

- The key mitigation measure is to embrace a participatory planning approach. The REGROW project was cited as an example which is being planned in collaboration with the Ministry of Natural Resources and Tourism. In this manner conflicts over water and land resources will be minimized.

4.8.3 Issue

- Consider water resources management as a key component for interventions. For example the Great Ruaha water management can affect negatively on irrigation development if the issue of water management is not addressed properly.

Clarifications

- The review of the NIMP has made reference to various water resources assessment report under IWRMDP, and therefore as much as possible the RNIMP has observed the available water resources in the basin both surface and groundwater.

4.8.4 Issue

- Climate Change issues are very important to be considered when reviewing the master plan. Adaptive measures should come out clearly in the RNIMP.

Clarifications:

- Irrigation itself is an in eminent measure against climate change. Irrigation alone cannot address issues of climate change, therefore other ministries will also play big roles, and the important thing is to share the plans with key stakeholders. Also the revised National Irrigation Master Plan will address water storage reservoirs as essential steps in enhancing resilience.

4.8.5 Issues:

- The ASDPII budget allocated for irrigation is less than compared to the estimated budget indicated in the RNIMP. The question is where the deficit will come from.

Clarifications:

- The ASDPII time frame is for 10 years while the RNIMP is for 18 years up to 2035. Therefore the budget for RNIMP is higher than the budget estimate in the ASDPII. The RINMP will have a more focused resources mobilization. The National Irrigation Act also provides for establishment of the Irrigation Development Fund which all together addresses the issue of resource mobilization for implementation of RNIMP.

4.8.6 Issues:

- Institution set up: We have the District Irrigation Development Plan (DIDP), who will take care of these? Where is the role of PO-RALG mentioned? If not involving the PO-RALG you will experience some problems like the previous implementation of NIMP if not given their mandates. Generally there is no any uniqueness for irrigation to comply with existing institution set up under the President's Office, Regional Administration and Local Government Authorities.

Clarifications:

- The institutional set up for irrigation development is well defined in the National Irrigation Act No. 5 of 2013 with mandates and functions of different stakeholders well defined including PO-RALG however, the set up entals review of legal requirements as we revise the National Irrigation Master Plan involving key stakeholders

4.8.7 Issues:

- There is no clear job demarcation between the zonal irrigation officer and regional. Is it easy to establish the irrigation department at the district level?

Clarifications

As stated in above a in depth analysis is required by involving relevant key stakeholder

4.8.8 Issues:

- Conflicts between livestock and farmers are common in most irrigation schemes because livestock trespass fields after harvesting. The RINMP should help farmers to harvest by-products of crops for livestock.

Provide water sources for the livestock in irrigation schemes. Aquaculture should also be encouraged in irrigated agriculture.

Clarifications:

- Currently water for livestock is being provided in some irrigation schemes depending on prevailing condition. The National Irrigation Act also has a provision for irrigation for livestock pasture, however it is prohibited to graze in irrigated area because livestock destroy irrigation infrastructure which is being developed at a high cost.

4.8.9 Comments

The comment from JICA study team underlined the fact that, implementation of the plan is important, therefore there is a need to commit funds before the plan is approved. Also, dissemination of information to TAMISEMI on the scale of irrigation development and also see possibility of increasing funding from other Development Partners. The last comment come from the hydrologist of the Ministry of Water and Irrigation who pointed out the importance if the market access is a key in prioritization of irrigation schemes, therefore, the Ministry of Industry, Trade and Marketing are important stakeholders in this meeting and needs to be involved in the future JCCs.

The study team were also requested to consider a mechanism of getting fund from different potential sources/people such as to approach LGAs for small scale irrigation scheme and development partners(DPs) for medium and large scale irrigation schemes.

The Master plan should also draw lesson from the National Irrigation Programme of Mozambique which has planned irrigation Development in respect of the basins.

Closing

The Second JCC meeting was closed at 13:40 p.m. by thanking all members of the JCC for their participation and their comments will which help enrich the document not only having the RNIMP but also the issue of financing.

Prof. Kitila MKUMBO
Chairperson-PS MOWI

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Eng. Seth P.LUSWEMA
Secretary-Ag. DG-NIRC

....

Mr. Kuniaki AMATSU
JICA Senior Representative

for ....

Eng. Kenichi SHIBUTA
T/L-JICA Project Team

渋田健一

Date: 21st March 2018

Attachments

List of Participants
Presentation of Interim Report

NIPPON KOEI
IDCJ

THE PROJECT ON THE REVISION OF NATIONAL IRRIGATION MASTER PLAN (RNIMP)

Minutes of the Third Joint Coordination Committee (JCC) Meeting

Held at Royal Village Hotel Conference Room-Dodoma
4th April 2018

1.0 Arrival and Registration
2.0 Introduction
3.0 Opening Remarks
4.0 Presentation of Draft Final report on the Revision of National Irrigation Master Plan
5.0 Closing

1.0 ARRIVAL AND REGISTRATION

The JCC members and other invited guests started arriving at the venue since 09:30 and registered their names on the registration form.

2.0 INTRODUCTION

The third joint Coordination Committee (JCC) Meeting was held on 4th April 2018 at Royal Village Hotel Conference Room-Dodoma. The purpose of the meeting was to present and discuss the draft final RNIMP document.

3.0 OPENING REMARKS

3.1 Remarks by the Director General

The meeting commenced with introductions from all participants and the Director General of the National Irrigation Commission (NIRC) Eng. Seth P. Luswema gave a pre-opening remark, that this meeting is very important and crucial, thus your presence is highly appreciated. After that he welcomed the Chief Guest to officiate the meeting.

3.2 Opening Remarks by the Chief Guest

The Permanent Secretary of the Ministry of Water and Irrigation, Prof. Kitila Mkumbo opened the meeting officially at 10:30a.m. by welcoming participants to this important meeting. He appreciated to be a guest of honor and have an opportunity to officiate the meeting and gave thanks to the organizers for the invitation. He thanked the JICA and the RNIMP team for the support to the Government specifically on Revision of the National Irrigation Master Plane and narrates a well written draft report of the revised master plan received in his office with scientific analysis to meet political expectations. He stressed that for the commission which is mandated on the supervision and promotion of irrigation sector the issue of Staff Acting on managerial position (directors and assistant directors) within the commission for long time pull behind the speed of irrigation development. He promised to make follow up on that matter so that the cycle of management can be completed.

In a similar note he emphasized an importance of agriculture in industrial development and realize irrigation as a heart of agriculture with the slogan of No Agriculture no Industries and no Irrigation no Agriculture. About years now we fail to be a food self-sufficient since we rely on rain fed agriculture and call upon a relook on the way we plan on irrigation development. Therefore, the RNIMP has a role to retool and reposition the irrigation sector for betterment of the National development.

He further highlighted that we as a government, we have never discussed on the huge use of trans-boundaries waters like that of Lake Victoria for irrigation despite our fellows neighboring countries do highly utilize lake waters for irrigation. Therefore, it is high time for the RNIMP to make provision of using Lake Victoria water and other trans-boundaries rivers for irrigation. He also emphasized that water is no longer abundantly available, so much care is needed when planning for irrigation development since irrigation utilize about 80% of water so that the available water can be efficiently utilized. NIRC must plan and develop irrigation infrastructures in line with scientific proof on water availability and try to manage and balance with the political ambitions.

Finally, he thanked the Government of Japan for the continued cooperation and support through JICA especially in the irrigation sector, he also asked Japan to extend their support in the development of Dodoma capital city. He advised the participants to be kin in reading and understanding the document and providing comments before implementation. We should take this exercise seriously to provide input within the document in order to improve it. Having a plan document is less than 30% success, what is really important is to implement the plans/document and now it is the time for NIRC Staff to exercise their professionalism in irrigation development. With those remarks, he declared that the third JCC meeting was officially opened and wished participants to actively participate in the meeting.

3.3 Opening Remarks by the JICA Senior Representative

The JICA Senior Representative Mr. Kentaro AKUTSU started by acknowledging that agriculture continued to support livelihoods of the majority of Tanzanians and provide about 66.9% of the employment, accounting for about 23% of GDP, 30% of export and 65% of industrial input. Abundant agricultural land, water for irrigation, sunlight and rich natural resources show a comparative advantage for agriculture led to economic development as well as poverty reduction. Therefore, irrigation development, is an effective approach to achieve food security and poverty reduction, because it improves productivities of crops, and assuring stable expansion of agricultural production.

He further pointed out that in 2002, JICA assisted Government of Tanzania to prepare National Irrigation Master Plan which had projected to develop 362,000ha of irrigated land by 2017 from 218,000 ha in 2003. With efforts of various actors, the country achieved 461,000ha of irrigated area in 2016 which exceeded the set target. However, 461,000ha is still less than 2% of the 25 million ha of potential farm land in the country. Investment into irrigation development is still indispensable to unlock country's great potential.

He further said that based on its needs, JICA as one of active Development Partners is currently implementing ODA loan project "Small Scale Irrigation Development Project - SSIDP" aiming to add 37,000 ha of irrigated area through upgrading more than 100 schemes. In parallel, capacity building of GoT engineers, IO members and rice growers have been done by several technical cooperation projects so that the infrastructures are fully utilized for agricultural production.

He also underlined the purpose of reviewing the National Irrigation Master Plan is to prepare National Irrigation Master Plan covering 2018 to 2035, with due consideration of alignment with country's development policies, water resource management, scientific-based implementable plan, and combination of hard and soft components. The draft plan proposes the target of 1 million ha irrigated land development by 2035. The cost to achieve 1 million ha is estimated as 3,805 million USD in 18 target years which is equivalent to 8,524 billion TZS. This huge amount should be injected by the Government, Development Partners, or Private Sectors. The team prepared one soft component development program and seven hard component development programs that contain 469 priority irrigation schemes. Having these programs or list of priority irrigation schemes, potential financers can easily find potential schemes for their investment consideration. He concluded by requesting all participants of the meeting to give thoughtful comments to enrich the master plan to be more implementable one.

4.0 PRESENTATIONS OF THE RNIMP DRAFT FINAL REPORT

The RNIMP Team Leader presented the draft final report to JCC members in power point form. The presentation touched on the following important areas:

4.1 Outlines of the RNIMP (2018-2035) which include
4.1.1 Summary of RNIMP
4.1.2 Water Resources
4.1.3 Land Resources
4.1.4 Agriculture
4.1.5 Irrigation Human Resources
4.1.6 Irrigation Water Balance
4.1.7 Irrigation Scheme Prioritization
4.1.8 Development Scenario
4.1.9 Basic Framework
4.1.10 Development Concept
4.1.11 Approach to RNIMP
4.1.12 Development Plan
4.1.13 Development Components
4.1.14 Implementation Schedule
4.1.15 Organization Arrangement for Implementation
4.1.16 Investment Cost
4.1.17 Project Evaluation

4.2 Outlines of Development Programs for Phase 1 (2018-2025)
4.2.1 Action Plan1: Hard Components
4.2.2 Action Plans 2 to 4: Soft Components
4.2.3 Development Programs

4.3 Conclusion and Recommendations

After presentation the Participants had an opportunity to discuss and present comment to the presentation.

4.1 DISCUSSION SESSION

After presentation of the draft final RNIMP report, participants were given opportunity to comment on the document followed by questions and answers as follows:

4.1.1 Issue

The indicative cost is not divided into components of the master plan, it provides only the total cost for the project without detailed breakdown. The financial arrangement which illustrate who and how much will be contributed by each player (e.g. Government, DPs, and Private sector) is not indicated. The implementation schedule does not show the cross-cutting issues.

Clarifications:

The detailed cost breakdown for each component is indicated in the main report. Irrigation development has multi financiers not only the government but various development partners are also earmarked for financing irrigation development. The crosscutting issues will be implemented by the responsible sector ministries while NIRC will do the coordination during implementation.

4.1.2 Issue

Does the RNIMP assess the previous irrigation potential? How does RNIMP relate with ASDP II? What lessons leant from the previous NIMP? Are the supervision issues indicated on the implementation plan?

Clarifications:

The RNIMP considers the allocated water for planning hence targets development of 1 million ha by 2035 according to the water allocated by IWRDP. NIRC is mandated to promote and develop irrigation schemes as well as to play the supervision role.

4.1.3 Issue

There is an opportunity to get finance from the root of climate change through Green Climate Fund as irrigation is one of the mitigation measures against climate change effects. Irrigation sector seems to be multisectoral involving Agriculture and Water sectors, were these sectors involved in the preparation of the master plan.

Clarifications:

Financing opportunity from GCF will be looked at by NIRC. The preparations of RNIMP has involved all sectors.

4.1.4 Issue

Does the RNIMP analyze the water resource potential especially ground water potential? RNIMP should indicate how much we will get on the use of water harvesting and groundwater taking into consideration that water harvesting technology in irrigation development is crucial. RNIMP indicate the value chain approach, which value chain do we need to focus? We should refer the ASDP II value chain approach.

Clarifications:

The review of the NIMP2002 has made reference to various water resources assessment reports under IWRMDP, and therefore as much as possible the RNIMP has observed the available water resources in the basin both surface and groundwater. The RNIMP has already indicated the comparative advantage of investing in crops with the value chain and cost benefit analysis.

4.1.5 Issue
The RNIMP should show relevant institutions for irrigation development, since irrigation sector need many players; the implementation Framework of the master plan should indicate relevant players.

Clarifications:
The institutional setup for irrigation development is well defined in the National Irrigation Act No.5 of 2013 with mandates and functions of different stakeholders well defined including PO-RALG, However, the set-up entails review of legal requirements as we revise the National Irrigation Master Plan involving key stakeholders. The Implementation Framework will be looked at and shown in the RNIMP.

4.1.6 Issue
The relationship between irrigation master plan and ASDP 2 should be indicated.

Clarifications:
The RNIMP has been prepared with reference of ASDP2 document, hence irrigation aspects in ASDP2 are reflected in the RNIMP.

4.1.7 Issue
The lesson learned from the implementation of NIMP2002 should be indicated so that the good practices can be replicated during implementation of the RNIMP.

Clarifications:
A study of implementation of NIMP2002 was made, therefore RNIMP has been prepared with proposals avoiding the past negative implementation aspects and holding on the positive ones.

4.1.8 Issue
The strategies to develop and manage the human resource on the implementation of the master plan should be well elaborated.

Clarifications:
The RNIMP has indicated the human resource required to implement the plan. This will be done by NIRC in collaboration with PO-RALG.

4.1.9 Issue
The RNIMP should indicate how livestock can benefit from the implementation of irrigation development e.g. provision of using crop residues for livestock feeding, drinking water troughs and irrigation of pasture.

Clarifications:
Currently water for livestock is being provided in some irrigation schemes depending on prevailing conditions. The National Irrigation Act also has a provision for irrigation of livestock pasture, however it is prohibited to graze in irrigated areas because livestock destroy irrigation infrastructure which is being developed at a high cost.

4.1.10 Issue
To accelerate the implementation of Master Plan, we share the Master Plan with Development Partners to invite them on support irrigation sector. JICA is on the discussion with the government to develop an irrigation project based on the output from the master plan. How do the net return

being calculated? How realistic is it, and is there any condition to achieve the net return? Do you think the net return imply feasibility of irrigation development under PPP arrangement?

Clarifications:
JICA is on discussion with the Government to have a project which will pick up schemes from the Revised Master Plan apart from the ongoing SSIDP. Furthermore, it was encouraged that NIRC should make efforts to make relevant information readily available which can be shared to Development Partners willing and interested to support irrigation development in Tanzania.

4.1.11 Issue
Has the irrigation research issue been incorporated in the RNIMP? If not, I suggest it to be made out clear in the master plan

Clarifications:
The research issue has been considered in the RNIMP.

4.1.12 Issue
In the process of making RNIMP to become a public document, a stage of getting it through the Inter-Ministerial Technical Committee (IMTC) should be included, before it is presented to the cabinet secretariat.

Clarifications:
The issue was noted, the IMTC will be included in the procedure for the document to get approval before it will become a public document.

5.0 WAY FORWARD

The JICA study team presented the way forward towards completion of the RNIMP whereby all steps to follow was presented including finalization of the SEA document.

5.1 SEA follow-up

The National Irrigation Commission through the Environment and Social Management Unit will make follow up on completion of SEA by the Consultant.

5.2 Government procedure for making RNIMP as public document

The government approval procedure for the RNIMP will follow the following sequence:

1. Organize stakeholders' meetings on the report, inviting relevant Ministries, RSs, LGAs, DPs and PSC.
2. Modify the report based on the comments.
3. DPP of the responsible ministry submits the modified report to IMTC.
4. IMTC reviews the report and submits it to the Cabinet.
5. The Cabinet reviews the report.

Once it is agreed, the report will be inaugurated by responsible Minister, or Vice-president or President

5.3 Review the issues on protected area and environmental flow requirement looking toward the future development beyond 2035

The RNIMP sets the final target year of 2035. For the further growth of the agricultural sector, continuous efforts would be placed on developing irrigation schemes after 2035. Here, Points to pay attention in considering irrigation development beyond 2035 have been summarized below.

Review of Land Use
Land reform is an urgent task of the government of Tanzania. However latest land use map that is fundamental for designing a comprehensive land use plan is absent. First of all, land use maps should be created. Then, while formulating land use plan, it is necessary to review coverage of protected areas and prohibition of diversion of farmlands for other purposes.

Review of Environmental Flow Requirement (EFR)
Water demands in Tanzania will increase with population increase and economic growth continuously even after the year 2035. The Ministry of Water and Irrigation needs to implement the next National Water Resource Master Plan targeting for example the year 2055 at an appropriate timing. A fundamental review of environmental flows would be discussed by that time.

6.0 CLOSING

The third JCC meeting was closed at 13:40 p.m. by thanking all members of the JCC for their active participation and their comments will which help enrich the document not only having the RNIMP but also the issue of its implementation.

Prof. Kitila MKUMBO
Chairperson (PS-MoWI)

Signature.......................

Date: 24-4-2018

Eng. Seth P. LUSWEMA
Secretary (Ag. DG-NIRC)

Signature: ....

Date: 12th April 2018

Mr. Kentaro AKUTSU
JICA Senior Representative

Signature: ....

Date: 12 Apr 2018

Eng. Kenichi SHIBUTA
T/L-JICA Project Team

Signature: 渋田健一

Date: 12th April 2018

Attachments
List of Participants
Presentation of Draft Final Report of RNIMP

Attachment-1.7.4 List of Meetings and Interviews with Stakeholders

To formulate the National Irrigation Master Plan 2018 (NIMP2018), the JICA Project Team had a number of interviews to various stakeholders for this report. A list of those interviewees follows.

SN.	Date	Organization	Main Intervewee	Participants	Agenda
1	10/10/2016	JICA Tanzania Office	Chief Representative, Mr. Nagase	Amatsu Senior Rep. Suzuki Rep. Ikeda Rep	Courtesy call and kick-off meeting
2	11/10/2016	Embassy of Japan in Tanzania	Ambassedar Mr. Yoshida	Ban incharge of Economic Cooperation	Courtesy call and project briefing
3	11/10/2016	Minsitry of Water and Irrigation (MoWI)	Parmanent Secretary Eng. M. Futakamba	N.M.Kalobelo, S.P. Luswema	Courtesy call and project briefing
4	17/10/2016	MoWI, Water Resources Department	Director Mr. Hamza Sadik	Grace Z Nsanya, Peter Kismir and other 6 officer	Data collection on hydrology and water resources developme
5	20/10/2016	MoWI, Water Resources Department	GIS & Hydrology Officer Eng. H. Lema	Renalde Mulcaja, Modestus Zacharia	Data collection on hydrology, environmental flow requirement in IWRMD
6	24/10/2016	AfDB Office	Agriculture Officer Mr. R. Salema	-	Project briefing and request for relevant data and informatio
7	26/10/2016	FAO Office	Acting Representative Mr. Z. Tadesse	Charles Tulahi, Silvia J. Tirweshobwa	Project briefing and request for relevant data and informatio
8	27/10/2016	IFAD Office	IFAD Representative and Country Director Mr. Francisco Pichon	-	Project briefing and request for relevant data and information
9	28/10/2016	USAID Office	Infrastructure Lead Mr. Thomas Kaluzny	David Charles	Project briefing and request for relevant data and informatio
10	31/10/2016	MoWI, Water Resources Division	Asst. Director Dr. George Lugomela	William Mabula	Confirmation of contents of IWRMDP
11	02/11/2016	JICA Office	Director, Asai (JICA Headquarter)	Shimazaki Senior Tech Officer, Noguchi and Teaminam	TV confference for project implementation
12	02/11/2016	DFID Office	Water Resources Officer, Eng. Lucas Kwej	-	Project briefing and request for relevant data and informatio
13	03/11/2016	SAGCOT Office	CEO Mr. Geoffrey Kirenga	Tulalmba Mloge	Project briefing and request for relevant data and informatio
14	07/11/2016	MoWI, Water Resources Division	Asst. Director Dr. George Lugomela	-	Data collection on IWRMDP reports and Ruvuma Water Sector Projec
15	15/11/2016	MALF, ARDS	Co-Team Leader Ara	-	Activities and outputs of ARDS
16	16/11/2016	WB Office	Senior Agriculture Specialist Dr. Sarah Simon	-	Project briefing and request for relevant data and informatio
17	17/11/2016	2030WRG	Annual Confference	Government Officals, Private, NGO, etc.	Data collection on water sector reform (funding method, river basin management, collarboration with public sector
18	18/11/2016	University of Dar es Salaam (UDSM), Water Resour	Head of Department of Water Resources Engineering Dr. Joel Nobert	-	Inquiries about IWRMDP
19	22/11/2016	UDSM, College of Engineering and Technology (Co	Deputy Principal, CoET Dr. Bwire Ndaz	Felix Mtalo	Data collection and Inquiry on student enrollment and jo
20	24/11/2016	National Irrigation Commission (NIRC)	Director of Support Services, Dr. Moses Munzava	Magdalena Diyamett and other seve	Confirmation of direction of NIMP2018
21	25/11/2016	MoWI, Water Resources Department	Assist Director Dr. George Lugomela	-	Inquiries about IWRMDP Reports, confirmation of preference for water allocation and ground water, etc
22	25/11/2016	MoWI, Water Resources Department	Director Mr Hamza Sadik	-	Discussion of some issues concerning the projec
23	25/11/2016	SSIDP Office	Team Leader Kish	-	Hearing about SSIDP
24	01/12/2016	TANCAID 2 Office	Team Leader Taira	-	Hearing about TANCAID2 activities
25	02/12/2016	JICA Tanzania Office	Chief Representative, Nagase	Amatsu Senior Rep., Suzuki Rep., Ikeda Rep	Pre-discussion on JCC/SCM
26	02/12/2016	MoWI, Water Resources Department	Assist Director Dr. George Lugomela	Modestus Zacharia	Confirmation of preference for water allocation, Environmental Flow Assessment, ground water, Data collection, WSDS & WSDP and Dam & Reservo
27	06/12/2016	NIRC/MoWI	PS. M. Futakamba	Government Officials	1st JCC Meeting
28	07/12/2016	NIRC/MoWI	PS. M. Futakamba	DPs, TANESCO, NGO, Private, etc.	1st SCM Meeting
29	14/12/2016	FSDT Office	Head- Agriculture & Rural Finance Mr. Mwombeki Baregu	-	Data collection on irrigation development in PPP
30	19/12/2016	JICA Tanzania Office	Chief Representative, Mr. Nagase	Amatsu Senior Rep., Suzuki Rep., Ikeda Rep	Progress reporting to JICA Tanznaia Office
31	06/01/2017	JICA Headqurter, Dept. of Agriculture Development	Director, Asai (JICA Headquarter	Mr. Noguchi, Mr. Teraminam	Progress reporting to JICA Headquorte
32	20/01/2017	JICA Tanzania Office	Suzuki Represnentative	Ikeda Representative	Business meeting with JICA TanzanOffice
33	23/01/2017	Contractors Registration Board	CEO Mr. Rhoben Nkori	-	Hearing about civil contractors in irrigation secto
34	23/01/2017	Ministry of Agriculture, Livestock, Fisheries	Assistant Director Training Mr. Y.S. Mwesher	-	Hearing about MATI
35	25/01/2017	TANconsult Ltd	Director Mr. Joseph P. Chuwa	-	Hearing from consulting firms in irrigation secto
36	30/01/2017	Mbeya ZIO	ZIE. Jackson Bunyinyiga	Elibariki J. Mwendo and other sixtee	Roles and functions of Mbeya ZIO
37	30/01/2017	MATI Igurusi	Principal Eng. George Shund	Fredrick John and other two	Hearing on roles and functions of MATI Igurus
38	31/01/2017	Mbarali DC	Acting DED Ms. Tyatawelu Mongo	Dickson Maruchu and other four	Courtecy and hearing on district irrigation developme
39	31/01/2017	Mbarali Highland Estate	Farm Manager Mr. Sadiki Wigila	Widege	Site visit to a private irrigation farm
40	31/01/2017	Igomelo IO	Chairman Mr. Nelson Msemwa	Zachalia Ngela and other three	Igomelo IO's activities
41	31/01/2017	MoWI, Water Resources Department	Water Resources Environment Protection Section Mr. Modestus Zacharia	Rumadhani Hamza	Data collection on water register and dams
42	01/02/2017	Mbeya RS	Regional Irrigation Eng. Wilfred Kayombo	-	Roles and functions of region in irrigation developmen
43	02/02/2017	PMW Construction Ltd. Office	Director Eng. P. F. Kwek	-	Contractor's work in irrigation developmen
44	02/02/2017	Tunduma TC	Mr. Vaecry Kwenbe	Pamela Sfephen Ijumba	Border trande at Tunduma
45	03/02/2017	TANESCO Headquarter	(Principal Water Resources Engineer Eng. James Luchagulla	Clarence Makunda, James K. Kiraahuka	Discussion on potential for irrigation development in the downstream of hydropower plant
46	06/02/2017	Cholima Agro-Scientific Research Centre Dakawa	Research officer Ms. Fabiola	-	Activities of Cholima Agro-Scientific Research Centre in Dakaw
47	06/02/2017	Morogoro ZIO	ZIE. Senzia M. Maeda	Johnson Ombeni and other ten	Roles and functions of Morogoro ZIO
48	06/02/2017	Morogoro ZIO, Dakawa	Eng. Towa	Mtui	Site visit to proposed NIRTC
49	06/02/2017	Mvomero DC	DED Mr. Florent Laurent Kyombo	-	Courtecy and hearing on district irrigation developme
50	06-09/02/2017	Pangani Basin Water Office	Acting. Water Officer Mr. Philipo Patrick	Isaiah J.M Macha and other five	Data collection and field visi
51	07/02/2017	Dakawa irrigation scheme site	Chairman Mr. Thomas Kakema	Albert Gilbert Francis and other one	IO's activities in Dakawa irrigation schem
52	08/02/2017	Sokoine University of Agriculture (SUA)	Associate Professor in Irrigation Engineering Eng. F.C. Kahimba	Henry F. Mahoo and other five	To confirm SUA's facilities and research and consultancy activities
53	09/02/2017	Kilombero DC, DAICO Office	DAICO Mr. Mohamed Ramadhan	-	Courtecy and hearing on district irrigation developme
54	13-15/02/2017	Rufiji Basin Water Office	Basin Water Officer Mr. Idris A. Msuya	Ally Diwani and other fou	Data collection and field visi
55	15/02/2017	JICA Tanzania Office, Daima Associates	Senior Rep. Amatsu, Professor Samuel Wangwe	Government Officials, Private, Academic, etc	EAC economic development in terms of economic corrido
56	15/02/2017	Moshi DC, Kilimanjaro Region	DAICO Mr. Mohamed Ramadhan	Festo Massawe, Rajabu A. Mweta	Irrigation dveleopmnet in Moshi DC
57	15/02/2017	Kilimanjaro Agricultural Training Centre (KATC)	Principal Mr. Dominik Nkollo	-	KATC and TANRICE-2
58	15/02/2017	Kilimanjaro ZIO	ZIE Marco E. Kessi	Cyriacus Tegamaisho	Roles and functions of Kilimanjaro ZIO
59	15/02/2017	KADC Office	Coordinator Mr. Fredrick S. Mawolle	Benson O. Musui	Activities of Lower Moshi Irrigators Association (LOMIA
60	16/02/2017	Hai DC, Kilimanjaro Region	Acting DAICO Mr. David E. Leke	Daniel Silo	Courtecy and hearing on district irrigation developme
61	16/02/2017	Kikavu Chini Village Council Office	Village Chairman	Village extension officer and other te	Field visit to Kikavu Chini irrigation schem
62	16/02/2017	Musa Mwinjanga Village Council Office	Village Chairman	Village extension officer and other eleve	Field visit to Musa Mwinjanga irrigation schem
63	16/02/2017	Hai DC, Kilimanjaro Region	Project Committee Coordinato	-	Site visit to Nsanya irrigation scheme
64	16-17/02/2017	Wami/Ruvu Basin Water Office	Ag. Basin Water Officer Ms. Grace Chitanda	Rosemary Masikini and other five	Data collection and field visi
65	17/02/2017	Holili One Stop Boarder Post	Head of Customs Office Mr. Lazaro Magofonge	-	Overview of Holili One Stop Boarder Pos
66	17/02/2017	Institute of Continuing Co-operative Education and M	Director Mr. Justinian Bamanyisa	Bahati J. Rukiko	Issues of Irrigators Organizations
67	20/02/2017	AIHRD, Arusha Technical College (ATC)	Chief Advisor Matsuoka	Morii Expert, F.P. Malembek, and other tw	Outlines of Irrigation Engineering Course in ATC
68	20/02/2017	Buigiri Dam Site, Chamwino DC	Village Extension Officer Mr. Mariam Zablo	Members of UWAMABBU IO	Site visit to Buigiri dam irrigation schem
69	20/02/2017	Dodoma ZIO	ZIE Lucia Lema	Shida Lushinge, Daniel Manase	Roles and functions of Dodoma ZIO
70	20/02/2017	Chamwino DC, Dodoma Region	DAICO Mr. Godfrey Mnyamale	Kulwa Moshi, Godlisen Kinyaha	Courtecy and hearing on district irrigation developme
71	20/02/2017	CHABUMA Cooperative, Dodoma Region	Secretary Ms. Emaniel Chinangaz	Village extension officer Mr. Stivin Bari	Grapes cultivation with Drip Irrigatio
72	20-24/02/2017	Lake Victoria Basin Water Office	Acting Basin Water Officer Mr. Ogoma Mangasa	Emmanuel E. Kisendi and other seven	Data collection and field visi
73	21/02/2017	Bahi DC, Dodoma Region	DED Rachael Chuwa	District Eng. Chapah Solomon	Courtecy and hearing on district irrigation developme
74	21/02/2017	UWABANGU IO, Bahi DC, Dodoma Region	Charman Mr. Abdallah Rashid	Mohammed Yousuf and IO's member	Site visit to Bahi Sokoni irrigation schem
75	21/02/2017	Nelson Mandela African Institution of Science and T	Acting Deputy Vice Chancellor Professor Dr. K. N. Njau	Hans C. Komakech	Academic courses and research activities at NM-AIST
76	22/02/2017	Nelson Mandela African Institution of Science and T	Head of Water and Energy Eng. Edward Kazimot	-	Consulting firms in the irrigation secto
77	27/02/2017	Tabora ZIO	ZIE Eliafie W. Mwanga	Philip Sumuni and other five	Roles and functions of Tabora ZIO
78	28/02/2017	Simbo DC, Tabora Region	Simbo Division Officer Ms. Martha Teve	Hamis Athman and other one	Site visit to Simbo traditional irrigation schem
79	01/03/2017	Tabora MC, Tabora Region	Acting MAICO Mr. Ditrick Mwinuka	Mohamed Mnally	Courtecy and hearing on district irrigation developme
80	02/03/2017	Sikonge DC, Tabora Region	Deputy DED Mr. Gervas Magash	DAICO Mr. Francis Dominico Geay	Courtecy and hearing on district irrigation developme
81	02/03/2017	Sikonge DC, Tabora Region	Chairman Mr. Dickson Simbila	Simon Kalossa and other three	Site visit to Ulyanyama dam irrigation schem
82	03/03/2017	Urambo DC, Tabora Region	Absalama A. Kajuna DAICO	Frednick Ndewesc, Kilawe Living	Courtecy and hearing on district irrigation developme
83	03/03/2017	Urambo DC, Tabora Region	Chairman Mr. Braison Y. Kazara	Jumanne M. Mbulula	Site visit to Ussoke Mlimani dam irrigation schem
84	06/03/2017	Mwanza ZIO	ZIE Wilson Kalumuna	Fredrick Magusi	Roles and functions of Mwanza ZIO
85	06/03/2017	Kwimba DC, Mwanza Region	District Commissioner Mr. Mtemi M. Simeon	DAICO Mr. Pancras Lugaimukya and other fev	Courtecy and hearing on district irrigation developme
86	07/03/2017	Rorya DC, Mara Region	DAICO Mr. Dominick Ndyetabura	Emmanuel Lutego	Courtecy and hearing on district irrigation developme
87	08/03/2017	Bunda DC, Mara Region	Acting DAICO Mr. Balisimaki Shija	Anthony Mugaya	Courtecy and hearing on district irrigation developme
88	08/03/2017	Mara RS Office, Mara Region	Regional Agricultural Officer Eng. Denis M. Nyakisinda	Okayo Mwita, Ruge K. Genchwere	Courtecy and hearing on roles and function of RAS in irrigation development
89	09/03/2017	Lake Zone Agriculture Science Institute	Acting Director Mr. Elmens L. Kabon	Rashid Killoh Lussewa	LZARDI activities and rice in the Mwanza Zone
90	22/03/2017	JICA Tanzania Office	Policy advisor Dr. David Nyange	Suzuki Rep., Veronica	Feedback of Dr. Nyange's experiences into NIMP2018
91	28/03/2018	MoWI, Water Resources Division	Assist. Director Grace Z Nsanya	Head of BWOs (from 9 basins)	Harmonization of IWRMDP and NIMP2018
92	12/04/2017	MoWI, Water Resources Division	Asst. Director Dr. George Lugomela	-	Inquiries about IWRMDPs and issues identified in the water resources secto
93	12/04/2017	MALF, TANRICE2	Chief Advisor Mr. Tomitaka	-	Lessons learnt from TANRICE2 in irrigation developmen
94	09/05/2017	NIRC, Environmental and Social Management Unit	Assit. Director Simukanga	Komanga, Rushomesa	Discussion on schedule of SEA
95	16/05/2017	NIRC, Human Resources Division	Director Ms. Mary Mwangisa		Reporting about study result of human resources developme
96	17/05/2017	NIRC	Dr. Eliakim Matekere	Pascal Shayo and other two	Report to NIRC about resview result of IWRMDP
97	17/05/2017	JICA Tanzania Office	Chief Representative, Nagase	Amatsu Senior Rep., Suzuki Rep., Ikeda Rep	Reporting the NIMP2018 work progress
98	18/05/2017	MoWI, Water Resources Division	Asst. Director Dr. George Lugomela	-	Reporting the IWRMDP review resul
99	22/05/2017	NIRC	DG. Eng. Luswema	Eliakim Matekere and others	Reporting the NIMP2018 work progress
100	29/05/2017	JICA Tanzania Office	Chief Representative, Nagase	JICA Experts in Agriculture and Irrigation	Presentation on NIMP2018 progress at JICA agriculture sector expert meetin
101	07/06/2017	JICA Headqurter, Dept. of Agriculture Development	Director, Asai (JICA Headquarter	Noguchi Rep., Teraminami Rep	Reporting the NIMP2018 work nprogress
102	22/07/2017	NIRC, SSIDP	DG. Eng. Luswema	Ikeda Rep., Kimasa, and others	SSIDP Tripartite Meeting No.2に参加
103	25/07/2017	VPO-DOE	Principal Environmental Officer Mr. Joseph Kihaule	-	Project briefing and hearing about procedure of SEA to NIMP201
104	16/08/2017	MoWI, Water Resources Division	Asst. Director Dr. George Lugomela	-	Reporting the study results including recommendations to MoW
105	21/08/2017	NIRC	DG. Eng. Luswema	Eliakim Matekere and others	Reporting the NIMP2018 work progress
106	25/08/2017	MoWI, Rural Water Supply Division	Head of CDMT Mr. Blangson	His staff	Request for sharing the data of water point
107	28/08/2017	JICA Tanzania Office	Chief Representative, Nagase	Suzuki Rep.	Reporting the NIMP2018 work progress
108	11/09/2017	NIRC	DG. Eng. Luswema	Eliakim Matekere and others	Explanation about interim repor
109	18/09/2017	JICA Tanzania Office	Chief Representative, Nagase	Amatsu Senior Rep. and Suzuki Rep	Pre-meeting for JCC
110	21/09/2017	NIRC/MoWI	Parmanent Secretary Prof. Kitila Mkumbo	Government Officials	2nd JCC Meeting
111	21/09/2017	NIRC/ZIOs	DG. Eng. Luswema	Staffs of NIRC	Hearing about prospective new irrigation projec
112	27/09/2017	NIRC/MoWI	Parmanent Secretary Prof. Kitila Mkumbo	DPs, TANESCO, NGO, Private, etc.	2nd SCM meeting
113	12/10/2017	JICA Headqurter, Dept. of Agriculture Development	Director, Asai (JICA Headquarter	Morita Rep.	Reporting the NIMP2018 work nprogress
114	08/12/2017	JICA Tanzania Office	Chief Representative, Nagase	Suzuki Rep., Yamada Rep	Reporting the NIMP2018 work progress
115	15/12/2017	NIRC	DG. Eng. Luswema	Eliakim Matekere and others	Reporting the NIMP2018 work progress
116	13/12/2017	Mtwara Region	Aman Lusaki Assistant Regional Administrative Secretary, Economics and Production Sectio		Courtecy and hearing on regional irrigation development
117	13/12/2017	Mtwara ZIO	ZIE Philip M. Sumuni	Eng. Macklera Mrutu, Mr. Juma Bendera	Hearing on irrigation development in Mtwara zon
118	14/12/2017	Lilido Village, Mtwara DC	Salum Rashid Ndambalilo village chie		Visiting Kitere irrigation scheme and Ndanda irrigation schen
119	15/12/2017	Lindi RA	Majid Myao Assistant Regional Administrative Secretary, Economic and Production Sectio	Eng. Benjamin Mwakabala and two	Coutecy and visiting Kinyope irrigation scheme
120	12/01/2018	JICA Headqurter, Dept. of Agriculture Development	Director, Asai (JICA Headquarter	Morita Rep.	Reporting the NIMP2018 work nprogress
121	22/02/2018	SEA Study Team (FBNE)	Mwanuzi, Team Leade	30 officers from NIRC, MoWI, MOA	Presentation meeting on SEA inception repo
122	08/02/2018	e-Government Agency	Omari Kigod	Two officers from NIRC	NIRC website design
123	09/02/2018	NIRC	DG. Eng. Luswema	Eliakim Matekere and others	Discussion on comments to Interim Repor
124	12/02/2018	JICA Tanzania Office	Chief Representative, Nagase	Amatsu Senior Rep., Suzuki Rep., Yamada Rep	Reporting the NIMP2018 work nprogress
125	22/02/2018	NIRC	Citutu, Simkanga	Ten NIRC Management Officers	Discussion on list of priority irrigation scheme
126	06/03/2018	NIRC	Citutu, Simkanga	10 NIRC management officers	Discussion on list of priority irrigation scheme
127	06/03/2018	JICA Tanzania Office	Suzuki Rep.	Akutsu Senior Rep. and Yamada Rep	Discussion on presentation material for Dodoma meeting

Attachment-1.7.4 List of Meetings and Interviews with Stakeholders

To formulate the National Irrigation Master Plan 2018 (NIMP2018), the JICA Project Team had a number of interviews to various stakeholders for this report. A list of those interviewees follows.

SN.	Date	Organization	Main Intervewee	Participants	Agenda
128	07/03/2018	MOA	Simkanga DPP	21 MOA management officers	Presentation and discussion on NIMP2018
129	13/03/2018	PO-RALG	Komba Director of Sector Coordinator (Agri	6 PO-RALG management officers	Presentation and discussion on NIMP2018
130	14/03/2019	MoWI	PS Mkumbo	11 MoWI management officres	Presentation and discussion on NIMP2018
131	16/03/2018	SEA Study Team (FBNE)	Mwanuzi, Team Leade	NIRC Rushomesa, Christa	Exchage obsearvation and finding on environmental and social issue
132	19/03/2018	NIRC	DG. Eng. Luswema	6 NIRC management officers	Review of priority irrigation schmes and discussion on arrangements of JCC3, SCM3, National Seminar, Technical Worksho
133	20/03/2018	JICA Tanzania Office	Chief Representative, Nagase	Akutsu Senior Rep., Suzuki Rep., Yamada Rep	Discussion on JCC3, SCM3, National Semina
134	22/03/2018	e-Government Agency	Omari Kigod	Two officers from NIRC	NIRC website desig
135	27/03/2018	NIRC	Ag. DG/NIRC	NIRC/ZIO engineers and LGA irrigation sta	Technical Workshop on GIS and Irrigation Databas
136	04/04/2018	NIRC/MoWI	Parmanent Secretary Prof. Kitila Mkumb	Government Officials	3rd JCC Meeting
137	05/04/2018	NIRC/MoWI	Parmanent Secretary Prof. Kitila Mkumb	PO-RALG, RASs, DEDs, etc.	National Seminar on NIMP2018
138	07/04/2018	NIRC/MoWI	Chair Person of Members of Parliament	Ministers of MoWI and MoA, Members of Parliament, and other Governemnt Official	Pariamentary Standing Committee (PSC) Meeting
139	09/04/2018	NIRC/MoWI	Ag. DG/NIRC	DPs, TANESCO, NGO, Private, etc.	3rd SCM Meeting
140	10/04/2018	SEA Study Team (FBNE)	Mwanuzi, Team Leade	NIRC Komanga, Rushomesa, Christa	Discussion on work progress and schedule of SEA staud
141	12/04/2018	e-Government Agency	Omari Kigod	Two officers from NIRC	NIRC website desig
142	13/04/2018	Embassy of Japan in Tanzania	Ambassedar Mr. Yoshida	Ban incharge of Economic Cooperatio	Courtesy call and project briefing
143	13/04/2018	JICA Tanzania Office	Chief Representative, Nagase	Akutsu Senior Rep., Suzuki Rep., Yamada Rep	Discussion on NIRC's follow up for NIMP2018
144	13/04/2018	NIRC	DG. Eng. Luswema	6 NIRC management officers	Reporting on work progress and schedule of NIMP201

Source: JICA Project Team

Attachment 3.5.1: List of Dams Planned in IWRMDP

No.	Basin Code	Sub-basin Name	Dam Name	Reservoir Capacity (MCM)	Source	Remarks
1	WR	Kinyasungwe	Dabalo	0.91	Final Report, Summary, Table 4.3	
2			Hombolo	5.7		Heightening of Existing Dyke
3			Buigili	0.15		
4			Ikowa	0.7		
5			Msagali	6.31		New Construction
6			Ngipa	2.03		
7			Ngomai	1.02		
8			Farkwa	34.39		
9		Mkondoa	Ilonga	1.07		
10			Wami	42		
11			Kisangata	52		
12			Tami	32		
13		Wami	Mvomelo	4.46		
14			Dihinda	3.75		
15		Upper Ruvu	Ruvu Kibungo	28		
16			Mvuha	30		
17			Mungazi	23		
18			Mgeta	28		
19			Kidunda	191		
20		Ngerengere	Mindu	4		Heightening
21			Morogoro	8		New Construction
22	RF	Great Ruaha	Lukosi	-	Final Report, Vol.I, Appendix 1	
23			Ndembera / Lugoda	210		
24			Little Ruaha	-		
25	RV	Lower Middle Ruvuma	Malombe Hills	6.5	Final Report, Comp.4, Table 6.13	
26			Ruanda	33		
27		Lower Ruvuma	Chingulun- gulu	14		
28			Mahinyo Hills	42		
29			Makanyama	4.5		
30			Sindano	3.8		
31		Lukuledi	Mtua	15.2		
32		Mbwemkuru	Nanjirinji	16.7		
33			Mitonono	76.5		
34			Singira	16		
35			Mbondo	27.5		
36		Mavuji	Mbiliwia	24		
37		Matandu	Miguruwe	5.4		
38			Muhinje	44		
39			Mtumbei	6		
40			Liwale 1	7.2		
41			Liwale 2	16		
42	LN	Ruhuhu	Kikonge	6200	PSMP2016, Table 3-5 (1)	
43	LR	Katuma	Sitalike watershed	18	FR, Vol.I, Section 7.3	
44			Usevya watershed (site 23, option 3)	44.3	FR, Vol.II(a), Table 4.4	
45			Katuma Northern watershed	25.1	FR, Vol.I, Section 7.3	
46		Songwe River	Galula watershed (site 31, option 5)	103	FR, Vol.II(b), Table 4.5	
47			Lupa watershed	36.9	FR, Vol.I, Section 7.3	
48			Songwe Eastern watershed (site 2)	31.3	FR, Vol.I, Section 7.3	
49		Momba	Within Momba Sub-basin	2.3	FR, Vol.I, Section 7.3	
50			Out of Momba Sub-basin	454.3	FR, Vol.II(c), Table 4.3	
51		Luiche River	Option 3	39.9	FR, Vol.II(d), Section 4.2.1	
52		Muze	Option 2	7.3	FR, Vol.II(e), Section 4.2.1	
53	ID	Bahi Swamp	Farkwa	195	Final Report, Vol.6, Table 5.4	For Dodoma
54			Mbwasa	8		For Bahi
55			Mianji	7		
56			Mponde	25		
57			Dams in south of Bahi Swamp	5		
58		Lake Manyara	Dudumera	225.4	Final Report, Vol.6, Table 5.8	For Lake Manyara, Monduli A, Monduli B, and Masai Steppe
59			Kolo	18		
60			Makuyuni	25.4		
61			Small dams in Monduli	7		
62		Lake Natron	Pinyini	6.5	Final Report, Vol.6, Table 5.12	For Lake Natron and Namanga
63			Munik	6.8		
64		Namanga	Namanga	0.358		
65			Namanga small dams	7		
66		Lake Eyasi	Igunga Dams	31	Final Report, Vol.6, Table 5.16	For Lake Eyasi and Olduvai
67			Nzega Dams	7.4		
68			Shinyanga Dams	38.8		
69			Manonga 1 Dam	30		
70			Manonga 2 Dam	50		

Note: Proposed dams are not found from the IWRMDP reports for the Pangani, Tanganyika and Lake Nyasa basins.
Source: IWRMDP reports, Power Supply Master Plan (PSMP) 2016

Attachment-7.4.1 (1/2) Sample Calculation of Adjusted Crop Coefficient : Arusha Region

(Paddy : Improved)

P: Transplanting, H: Harvesting

		Sep		Oct		Nov		Dec		Jan		Feb		Mar		Apr		May		Jun		Jul		Aug	
	Existing Pattern	=	=	=	=	=	>	***H***	***H***	***H***	***P***	***P***	***P***	=	=	=	>	***H***	***H***	***H***	***H***	***P***	***P***	=	=
Croppping Pattern	Pattern 1	=	=	=	=	=	>	H			P	=	=	=	=	=	>	H				P	=	=	=
	Pattern 2	>	=	=	=	=	=	>	H			P	=	=	=	=	=	>	H				P	=	=
	Pattern 3												P	=	=	=	=	=	>	H					
Crop Coefficent (Kc)	Pattern 1	1.20	1.20	1.20	1.20	1.20	0.80	0.80			1.05	1.10	1.10	1.20	1.20	1.20	0.80	0.80				1.05	1.10	1.10	1.20
	Pattern 2	1.20	1.20	1.20	1.20	1.20	1.20	0.80	0.80			1.05	1.10	1.10	1.20	1.20	1.20	0.80	0.80				1.05	1.10	1.10
	Pattern 3												1.05	1.10	1.10	1.20	1.20	1.20	0.80	0.80					
	Average Kc	1.20	1.20	1.20	1.20	1.20	1.00	0.80	0.40	0.00	0.35	0.72	1.08	1.13	1.17	1.20	1.07	0.93	0.53	0.27	0.00	0.53	1.08	1.10	1.15

(Paddy : Traditional)

P: Transplanting, H: Harvesting

		Sep		Oct		Nov		Dec		Jan		Feb		Mar		Apr		May		Jun		Jul		Aug	
	Existing Pattern		***P***	***P***	***P***	=	>	***H***	***H***	***H***	***P***	***P***	***P***	***P***	***P***	***P***	=	=	=	>	***H***	***H***	***H***		
Croppping Pattern	Pattern 1		P	=	=	=	>	H			P	=	=	=	=	=	=	=	=	>	H				
	Pattern 2			P	=	=	=	>	H			P	=	=	=	=	=	=	=	=	>	H			
	Pattern 3				P	=	=	=	>	H			P	=	=	=	=	=	=	=	=	>	H		
	Pattern 4													P	=	=	=	=	=	>	H				
	Pattern 5														P	=	=	=	=	=	>	H			
	Pattern 6															P	=	=	=	=	=	>	H		
Crop Coefficent (Kc)	Pattern 1		1.05	1.1	1.2	1.2	1.2	0.8			1.05	1.1	1.1	1.2	1.2	1.2	1.2	1.2	1.2	0.8	0.8				
	Pattern 2			1.05	1.1	1.2	1.2	1.2	0.8			1.05	1.1	1.1	1.2	1.2	1.2	1.2	1.2	1.2	0.8	0.8			
	Pattern 3				1.05	1.1	1.2	1.2	1.2	0.8			1.05	1.1	1.1	1.2	1.2	1.2	1.2	1.2	1.2	0.8	0.8		
	Pattern 4													1.05	1.1	1.1	1.2	1.2	1.2	0.8	0.8				
	Pattern 5														1.05	1.1	1.1	1.2	1.2	1.2	0.8	0.8			
	Pattern 6															1.05	1.1	1.1	1.2	1.2	1.2	0.8	0.8		
	Average Kc		0.35	0.72	1.12	1.17	1.2	1.07	0.67	0.27	0.21	0.43	0.65	0.89	1.13	1.37	1.4	1.42	1.44	1.28	1.12	0.64	0.32		

(Tomato)

		Sep		Oct		Nov		Dec		Jan		Feb		Mar		Apr		May		Jun		Jul		Aug	
	Existing Pattern	***H***	***H***	***H***	***H***	***H***								***S***	***S***	***S***	***S***	=	=	=	=	=	>	***H***	***H***
Croppping Pattern	Pattern 1													S	=	=	=	=	=	>	H				
	Pattern 2														S	=	=	=	=	=	>	H			
	Pattern 3															S	=	=	=	=	=	>	H		
	Pattern 4																S	=	=	=	=	=	>	H	
	Pattern 5																	S	=	=	=	=	=	>	H
	Pattern 6	H																	S	=	=	=	=	=	>
Crop Coefficent (Kc)	Pattern 1													0.60	0.80	0.80	1.15	1.15	1.15	0.70	0.70				
	Pattern 2														0.60	0.80	0.80	1.15	1.15	1.15	0.70	0.70			
	Pattern 3															0.60	0.80	0.80	1.15	1.15	1.15	0.70	0.70		
	Pattern 4																0.60	0.80	0.80	1.15	1.15	1.15	0.70	0.70	
	Pattern 5																	0.60	0.80	0.80	1.15	1.15	1.15	0.70	0.70
	Pattern 6	0.70																	0.60	0.80	0.80	1.15	1.15	1.15	0.70
	Average Kc	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.23	0.37	0.56	0.75	0.94	0.96	0.94	0.81	0.62	0.43	0.23

Source: JICA Project Team

Attachment-7.4.1 (2/2)   Sample Calculation of Net Water Requirement : Bahi Manyoni Sub Basin

	Sep		Oct		Nov		Dec		Jan		Feb		Mar		Apr		May		Jun		Jul		Aug	
Region Name and Kc Values																								
Dodoma	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.35	0.72	1.08	1.13	1.17	1.20	1.07	0.93	0.53	0.27	0.00	0.00	0.00	0.00	0.00
Singida	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.35	0.72	1.08	1.13	1.17	1.20	1.07	0.93	0.53	0.27	0.00	0.00	0.00	0.00	0.00
Manyara	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.35	0.72	1.08	1.13	1.17	1.20	1.20	1.20	1.07	0.93	0.80	0.53	0.27	0.00	0.00	0.00	0.00
Kc (Paddy Improved/ Wet Season)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.09	0.44	0.77	1.09	1.14	1.17	1.20	1.07	0.93	0.56	0.30	0.03	0.00	0.00	0.00	0.00
ETo/ETp (mm)	75.30	75.30	83.00	82.90	79.60	79.60	78.00	78.00	76.10	76.10	70.10	70.00	74.00	74.00	65.80	65.90	62.00	62.00	58.50	58.50	61.50	61.50	67.60	67.70
ETc (mm)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.24	6.51	33.23	53.89	76.35	84.24	86.84	78.96	70.51	57.66	34.85	17.60	1.88	0.00	0.00	0.00	0.00
Rainfall (mm)	0.20	0.30	2.80	2.70	19.00	19.10	67.30	67.30	69.80	69.90	56.50	56.40	59.80	59.90	39.80	39.90	7.70	7.80	1.00	1.10	0.00	0.00	0.00	0.00
Effective Rainfall (mm)	0.00	0.00	0.00	0.00	6.40	6.40	41.30	41.30	43.40	43.40	32.70	32.70	35.40	35.40	19.40	19.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Puddling Water (mm)									67.00	67.00	67.00													
									67.00	67.00	67.00													
							67.00	67.00	67.00															
Weighted Puddling Water (mm)	0.00	0.00	0.00	0.00	0.00	0.00	7.96	7.96	67.00	59.04	59.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Percolation (mm)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	48.00	45.00	48.00	45.00	39.00	45.00	48.00	45.00	45.00	45.00	48.00	45.00	45.00	0.00	0.00	0.00	0.00
Unit Net Irri. Requirement (mm/ha)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	17.90	75.11	96.87	125.23	82.65	93.84	99.44	104.56	96.11	102.66	82.85	62.60	46.88	0.00	0.00	0.00	0.00
Region Name and Kc Values																								
Dodoma	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.35	0.72	1.08	1.13	1.17	1.20	1.07	0.93	0.53	0.27	0.00	0.00	0.00	0.00	0.00
Singida	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.35	0.72	1.08	1.13	1.17	1.20	1.07	0.93	0.53	0.27	0.00	0.00	0.00	0.00	0.00
Manyara	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.35	0.72	1.08	1.13	1.17	1.20	1.20	1.20	1.07	0.93	0.80	0.53	0.27	0.00	0.00	0.00	0.00
Kc (Paddy Traditional)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.09	0.44	0.77	1.09	1.14	1.17	1.20	1.07	0.93	0.56	0.30	0.03	0.00	0.00	0.00	0.00
ETo/ETp (mm)	75.30	75.30	83.00	82.90	79.60	79.60	78.00	78.00	76.10	76.10	70.10	70.00	74.00	74.00	65.80	65.90	62.00	62.00	58.50	58.50	61.50	61.50	67.60	67.70
ETc (mm)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.24	6.51	33.23	53.89	76.35	84.24	86.84	78.96	70.51	57.66	34.85	17.60	1.88	0.00	0.00	0.00	0.00
Rainfall (mm)	0.20	0.30	2.80	2.70	19.00	19.10	67.30	67.30	69.80	69.90	56.50	56.40	59.80	59.90	39.80	39.90	7.70	7.80	1.00	1.10	0.00	0.00	0.00	0.00
Effective Rainfall (mm)	0.00	0.00	0.00	0.00	6.40	6.40	41.30	41.30	43.40	43.40	32.70	32.70	35.40	35.40	19.40	19.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Puddling Water (mm)									67.00	67.00	67.00													
									67.00	67.00	67.00													
							67.00	67.00	67.00															
Weighted Puddling Water (mm)	0.00	0.00	0.00	0.00	0.00	0.00	7.96	7.96	67.00	59.04	59.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Percolation (mm)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	48.00	45.00	48.00	45.00	39.00	45.00	48.00	45.00	45.00	45.00	48.00	45.00	45.00	0.00	0.00	0.00	0.00
Unit Net Irri. Requirement (mm/ha)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	17.90	75.11	96.87	125.23	82.65	93.84	99.44	104.56	96.11	102.66	82.85	62.60	46.88	0.00	0.00	0.00	0.00
Region Name and Kc Values																								
Dodoma	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.23	0.37	0.56	0.75	0.94	0.96	0.94	0.81	0.62	0.43	0.23
Singida	0.70	0.35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.30	0.70	0.80	0.98	1.15	1.15	1.15	0.93	0.70	0.70
Manyara	0.23	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.23	0.37	0.56	0.75	0.94	0.96	0.94	0.93	0.73	0.54	0.35
Kc (Tomato 1/ Wet Season)	0.33	0.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.15	0.35	0.61	0.77	0.95	1.02	1.01	0.94	0.74	0.54	0.40
ETo/ETp (mm)	75.30	75.30	83.00	82.90	79.60	79.60	78.00	78.00	76.10	76.10	70.10	70.00	74.00	74.00	65.80	65.90	62.00	62.00	58.50	58.50	61.50	61.50	67.60	67.70
ETc (mm)	24.92	10.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.88	11.21	22.77	40.05	47.56	59.13	59.95	59.18	57.82	45.44	36.18	27.39
Rainfall (mm)	0.20	0.30	2.80	2.70	19.00	19.10	67.30	67.30	69.80	69.90	56.50	56.40	59.80	59.90	39.80	39.90	7.70	7.80	1.00	1.10	0.00	0.00	0.00	0.00
Effective Rainfall (mm)	0.00	0.00	0.00	0.00	6.40	6.40	41.30	41.30	43.40	43.40	32.70	32.70	35.40	35.40	19.40	19.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Unit Net Irri. Requirement (mm/ha)	24.92	10.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.37	20.65	47.56	59.13	59.95	59.18	57.82	45.44	36.18	27.39

Source: JICA Project Team

Attachment-7.5.1 (1/18) Priority Irrigation Schemes for Phase 1 Implementation by 2025 in Dodoma ZIO

SN	Name of Scheme	ZIO name	Region Name	District Name	Potential Area (ha)	Designed Area (ha)	Developed Area (ha)	Irrigated Area (Wet) in ha	Irrigated Area (Dry) in ha
	Large Scale Scheme								
1	Kisese (dam)	Dodoma	Dodoma	Kondoa	2,000	660	40	40	
2	Kiru Six	Dodoma	Manyara	Babati	2,000			1,500	
3	Ngage	Dodoma	Manyara	Simanjiro	5,000	657	100	525	888
4	Mbwasa	Dodoma	Singida	Manyoni	5,000			5,000	
	Medium Scale Scheme								
1	Chinangali II	Dodoma	Dodoma	Chamwino	500	240	120	120	120
2	Huzi	Dodoma	Dodoma	Chamwino	500	80	80	80	80
3	Mvumi Makulu	Dodoma	Dodoma	Chamwino	1,100	130			
4	Mvumi Mission	Dodoma	Dodoma	Chamwino	1,500	160	160		
5	Paranga	Dodoma	Dodoma	Chemba	1,000		100	100	20
6	Munguri	Dodoma	Dodoma	Kondoa TC	1,000	1,000		1,000	8
7	Kizi	Dodoma	Dodoma	Mpwapwa	500		50	120	50
8	Mafene	Dodoma	Dodoma	Mpwapwa	600			400	250
9	Malolo	Dodoma	Dodoma	Mpwapwa	800		70	500	400
10	Mlembule	Dodoma	Dodoma	Mpwapwa	600		190	250	180
11	Msagali	Dodoma	Dodoma	Mpwapwa	800	210	310	160	
12	Mawemairo	Dodoma	Manyara	Babati	628	365	365	365	100
13	Kiruani	Dodoma	Manyara	Simanjiro	500		20	50	418
14	Lemkuna	Dodoma	Manyara	Simanjiro	800	309	309	120	130
15	Malila	Dodoma	Manyara	Simanjiro	600	216		80	140
16	Isuna	Dodoma	Singida	Ikungi	500			500	5
17	Msingi	Dodoma	Singida	Mkalama	1,200	200		1,200	
	Small Scale Scheme								
1	Mtazamo	Dodoma	Dodoma	Bahi	400	165	165	165	
2	Buigiri	Dodoma	Dodoma	Chamwino	60	32	32	32	15
3	Chalinze	Dodoma	Dodoma	Chamwino	220	96	96	96	24
4	Kidoka Drip	Dodoma	Dodoma	Chemba	200	100		200	5
5	Chihanga	Dodoma	Dodoma	Dodoma MC	100			100	
6	Matumbulu	Dodoma	Dodoma	Dodoma MC	120			120	15
7	Mbabala B-Chiteleche	Dodoma	Dodoma	Dodoma MC	150			50	
8	Mpunguzi Azimio	Dodoma	Dodoma	Dodoma MC	200		40	40	40
9	Vikonje	Dodoma	Dodoma	Dodoma MC	60	48		60	
10	Zepisa	Dodoma	Dodoma	Dodoma MC	240	150		100	
11	Hurui	Dodoma	Dodoma	Kondoa	250	200	150	150	100
12	Kikore	Dodoma	Dodoma	Kondoa	350		150	150	50
13	Kwamadebe	Dodoma	Dodoma	Kondoa	300	200	80	60	20
14	Mnenia	Dodoma	Dodoma	Kondoa	140		80	40	
15	Mseta Bondeni	Dodoma	Dodoma	Kongwa	120	120	64	64	64
16	Kwamshangoo	Dodoma	Dodoma	Mpwapwa	200		40	120	50
17	Lufusi	Dodoma	Dodoma	Mpwapwa	400		20	120	50
18	Endamajek	Dodoma	Manyara	Babati	206	206	206	206	30
19	Gidigwari	Dodoma	Manyara	Babati	250		150	100	80

Attachment-7.5.1 (1/18) Priority Irrigation Schemes for Phase 1 Implementation by 2025 in Dodoma ZIO

SN	Name of Scheme	ZIO name	Region Name	District Name	Potential Area (ha)	Designed Area (ha)	Developed Area (ha)	Irrigated Area (Wet) in ha	Irrigated Area (Dry) in ha
20	Kisangaji	Dodoma	Manyara	Babati	450			450	70
21	Matufa	Dodoma	Manyara	Babati	386				
22	Dawar	Dodoma	Manyara	Babati TC	265			265	70
23	Hanadeco	Dodoma	Manyara	Babati TC	350			150	50
24	Endagaw	Dodoma	Manyara	Hanang	276	276	189	180	100
25	Gidahababieg	Dodoma	Manyara	Hanang	60	30		60	50
26	Mara	Dodoma	Manyara	Hanang	290		290	290	30
27	Measkron	Dodoma	Manyara	Hanang	54			54	15
28	Ngipa/Ngonyongoni	Dodoma	Manyara	Kiteto	400	200	100		
29	Mangisa Dam	Dodoma	Manyara	Mbulu	400			220	220
30	Tlawi (dam scheme)	Dodoma	Manyara	Mbulu TC	250	120	120	250	35
31	Kambi Ya Chokaa	Dodoma	Manyara	Simanjiro	400	135		35	35
32	Londoto	Dodoma	Manyara	Simanjiro	400			220	220
33	Msitu Wa Tembo	Dodoma	Manyara	Simanjiro	300			200	200
34	Olbil	Dodoma	Manyara	Simanjiro	110			70	70
35	Mang'onyi	Dodoma	Singida	Ikungi	450	450	50	50	50
36	Itagata	Dodoma	Singida	Itigi	200	180			
37	Chikuyu Nyamagogo	Dodoma	Singida	Manyoni	250	180	180	180	
38	Lusilile	Dodoma	Singida	Manyoni	160	160		160	
39	Mtiwe	Dodoma	Singida	Manyoni	200	150		200	
40	Mwangeza	Dodoma	Singida	Mkalama	200	150	150	150	
41	Sagara 1 (dam scheme proposed)	Dodoma	Singida	Singida	300			300	15
42	Kisasida	Dodoma	Singida	Singida MC	150	16	16	16	16

Sources: JICA Project Team

Attachment-7.5.1 (2/18) Priority Irrigation Schemes for Phase 1 Implementation by 2025 in Kilimanjaro ZIO

SN	Name of Scheme	ZIO name	Region Name	District Name	Potential Area (ha)	Designed Area (ha)	Developed Area (ha)	Irrigated Area (Wet) in ha	Irrigated Area (Dry) in ha
	Large Scale Scheme								
1	Mapama	Kilimanjaro	Arusha	Meru	4,930			2,430	1,000
2	Maweni	Kilimanjaro	Arusha	Meru	2,000		100	100	50
3	Kimwangamao	Kilimanjaro	Kilimanjaro	Moshi	2,000	1,000	300	250	250
4	Kituani Mwezae	Kilimanjaro	Tanga	Lushoto	2,000			600	
	Medium Scale Scheme								
1	Jobaj	Kilimanjaro	Arusha	Karatu	733		600	508	200
2	Maleckchand	Kilimanjaro	Arusha	Karatu	700		650	560	200
3	Kikafu Chini	Kilimanjaro	Kilimanjaro	Hai	600			600	340
4	Mawala	Kilimanjaro	Kilimanjaro	Moshi	1,425	1,425	987	769	680
5	Ushirika	Kilimanjaro	Kilimanjaro	Moshi	520	400	340	340	120
6	Kileo	Kilimanjaro	Kilimanjaro	Mwanga	650		320	230	100
7	Kirya	Kilimanjaro	Kilimanjaro	Mwanga	1,500		680	800	700
8	Kituri	Kilimanjaro	Kilimanjaro	Mwanga	1,600		800	800	200
9	Kivulini	Kilimanjaro	Kilimanjaro	Mwanga	900		410	410	200
10	Shimbi Mashariki	Kilimanjaro	Kilimanjaro	Rombo	700				
11	Mto Washi (rhn)	Kilimanjaro	Kilimanjaro	Same	500		100	80	80
12	Kwasunga	Kilimanjaro	Tanga	Korogwe	500		100	100	40
13	Kwemkumbo	Kilimanjaro	Tanga	Korogwe	1,500	1,500	500	600	100
14	Mafuleta	Kilimanjaro	Tanga	Korogwe	900	350	300	350	250
15	Wekeza - Kweisewa	Kilimanjaro	Tanga	Korogwe	1,000	10		10	10
16	Kwemgiriti	Kilimanjaro	Tanga	Lushoto	1,500		200	200	20
	Small Scale Scheme								
1	Ilkidinga	Kilimanjaro	Arusha	Arusha	230		68	195	168
2	Kigongoni	Kilimanjaro	Arusha	Arusha	150		75	145	100
3	Kimnyaki	Kilimanjaro	Arusha	Arusha	130		100	95	65
4	Kiranyi	Kilimanjaro	Arusha	Arusha	65		60	60	55
5	Maji Moto	Kilimanjaro	Arusha	Arusha	130		130	130	95
6	Mlangarini	Kilimanjaro	Arusha	Arusha	200		200	200	164
7	Olevolosi	Kilimanjaro	Arusha	Arusha	100		100	100	80
8	Themi Ya Simba	Kilimanjaro	Arusha	Arusha	300		290	280	150
9	Timbolo	Kilimanjaro	Arusha	Arusha	120		120	120	80
10	Timbolo 2/ Shiboro	Kilimanjaro	Arusha	Arusha	150		145	140	100
11	Daraja II	Kilimanjaro	Arusha	Arusha CC	50		40	5	3
12	Lemara I	Kilimanjaro	Arusha	Arusha CC	65		50	45	15
13	Lemara II	Kilimanjaro	Arusha	Arusha CC	58		40	20	12
14	Moshono	Kilimanjaro	Arusha	Arusha CC	115		36	22	10
15	Olasiti	Kilimanjaro	Arusha	Arusha CC	75		45	30	20
16	Sokon I	Kilimanjaro	Arusha	Arusha CC	80		48	16	10
17	Kiseriani	Kilimanjaro	Arusha	Longido	300	100	198	200	100
18	Imbasen	Kilimanjaro	Arusha	Meru	180		90	180	140
19	Mahande	Kilimanjaro	Arusha	Monduli	427	427		115	69
20	Migombani Chini	Kilimanjaro	Arusha	Monduli	80			80	20

Attachment-7.5.1 (2/18) Priority Irrigation Schemes for Phase 1 Implementation by 2025 in Kilimanjaro ZIO

SN	Name of Scheme	ZIO name	Region Name	District Name	Potential Area (ha)	Designed Area (ha)	Developed Area (ha)	Irrigated Area (Wet) in ha	Irrigated Area (Dry) in ha
21	Migombani Juu	Kilimanjaro	Arusha	Monduli	200			200	50
22	Migombani Kati	Kilimanjaro	Arusha	Monduli	100			90	25
23	Abdul Fadhil	Kilimanjaro	Kilimanjaro	Hai	70				
24	Chapa Mwaka	Kilimanjaro	Kilimanjaro	Hai	120			90	70
25	Ismaili	Kilimanjaro	Kilimanjaro	Hai	420			300	200
26	Kimashuku	Kilimanjaro	Kilimanjaro	Hai	250			200	120
27	Mapacha	Kilimanjaro	Kilimanjaro	Hai	68				
28	Meleaki	Kilimanjaro	Kilimanjaro	Hai	100				
29	Musa Mwijanga	Kilimanjaro	Kilimanjaro	Hai	450			400	330
30	Nsanya	Kilimanjaro	Kilimanjaro	Hai	170			160	120
31	Nzeganzega	Kilimanjaro	Kilimanjaro	Hai	60				
32	Semendo	Kilimanjaro	Kilimanjaro	Hai	69				
33	Tolu	Kilimanjaro	Kilimanjaro	Hai	87				
34	Katanini	Kilimanjaro	Kilimanjaro	Moshi	190				
35	Kyoyo B	Kilimanjaro	Kilimanjaro	Moshi	52		39	39	31
36	Lyalenga	Kilimanjaro	Kilimanjaro	Moshi	123	123	107	107	72
37	Soko	Kilimanjaro	Kilimanjaro	Moshi	370		370	250	125
38	Kaloleni	Kilimanjaro	Kilimanjaro	Moshi MC	250	250	118	118	118
39	Msaranga Ng'ambo	Kilimanjaro	Kilimanjaro	Moshi MC	78	78	78	78	36
40	Keryo	Kilimanjaro	Kilimanjaro	Rombo	492	110	15	8	2
41	Mmomwe	Kilimanjaro	Kilimanjaro	Rombo	275	80	80	50	20
42	Mgambo	Kilimanjaro	Kilimanjaro	Same	128		128	114	98
43	Kasaisa	Kilimanjaro	Kilimanjaro	Siha	165		83	83	38
44	Kishisha	Kilimanjaro	Kilimanjaro	Siha	134	134	73	73	20
45	Mowonjamu	Kilimanjaro	Kilimanjaro	Siha	190	180		34	10
46	Oromwi	Kilimanjaro	Kilimanjaro	Siha	180			58	32
47	Jambe	Kilimanjaro	Tanga	Handeni	231			10	10
48	Masatu	Kilimanjaro	Tanga	Handeni	352			48	20
49	Sezakofi	Kilimanjaro	Tanga	Handeni	100			10	4
50	Chekelei	Kilimanjaro	Tanga	Korogwe	300	100	100	200	100
51	Kwedulu	Kilimanjaro	Tanga	Korogwe	200		100	120	100
52	Madala	Kilimanjaro	Tanga	Korogwe	300	200	200	250	100
53	Magoma	Kilimanjaro	Tanga	Korogwe	400		300	300	250
54	Mandera	Kilimanjaro	Tanga	Korogwe	350	250	200	250	200
55	Mbaghai	Kilimanjaro	Tanga	Korogwe	300		200	210	180
56	Moagoma Songea	Kilimanjaro	Tanga	Korogwe	400		200	200	150
57	Kwamngumi	Kilimanjaro	Tanga	Korogwe TC	210	210	60	60	60
58	Mahenge	Kilimanjaro	Tanga	Korogwe TC	480	310	310	400	310
59	Boheloi	Kilimanjaro	Tanga	Lushoto	320		210	100	210
60	Dochi Ng	Kilimanjaro	Tanga	Lushoto	250		100	100	50
61	Goka Kisirui	Kilimanjaro	Tanga	Lushoto	100		20	50	20
62	Kigunga	Kilimanjaro	Tanga	Lushoto	100	80	80	80	80
63	Kilole Kwenkindo A	Kilimanjaro	Tanga	Lushoto	60		60	60	30

Attachment-7.5.1 (2/18) Priority Irrigation Schemes for Phase 1 Implementation by 2025 in Kilimanjaro ZIO

SN	Name of Scheme	ZIO name	Region Name	District Name	Potential Area (ha)	Designed Area (ha)	Developed Area (ha)	Irrigated Area (Wet) in ha	Irrigated Area (Dry) in ha
64	Kitopeni Kwapunda	Kilimanjaro	Tanga	Lushoto	80		50	50	30
65	Kohoai	Kilimanjaro	Tanga	Lushoto	60		60	50	40
66	Kwanguruwe	Kilimanjaro	Tanga	Lushoto	200		80	50	80
67	Lwandai Nkindoi	Kilimanjaro	Tanga	Lushoto	70		70	70	70
68	Mbokoi	Kilimanjaro	Tanga	Lushoto	300		200	150	100
69	Misozwe	Kilimanjaro	Tanga	Muheza	100		30	44	24
70	Kipumbwi	Kilimanjaro	Tanga	Pangani	250			50	40
71	Mapojoni	Kilimanjaro	Tanga	Tanga	50			5	
72	Golani Shutashuta	Kilimanjaro	Tanga	Tanga TC	50	17	10	10	

Sources: JICA Project Team

Attachment-7.5.1 (3/18) Priority Irrigation Schemes for Phase 1 Implementation by 2025 in Mbeya ZIO

SN	Name of Scheme	ZIO name	Region Name	District Name	Potential Area (ha)	Designed Area (ha)	Developed Area (ha)	Irrigated Area (Wet) in ha	Irrigated Area (Dry) in ha
	Large Scale Scheme								
1	Mboliboli	Mbeya	Iringa	Iringa	7,000		3,000	2,000	
2	Mgambalenga	Mbeya	Iringa	Kilolo	3,000	2,000	160	30	
3	Gwiri	Mbeya	Mbeya	Mbarali	2,133		500	500	80
4	Naming'ongo	Mbeya	Songwe	Momba	5,000	1,500		3,000	
5	Masimavalafu	Mbeya	Njombe	Ludewa	2,700			40	
6	Mgowelo	Mbeya	Iringa	Kilolo	3,500		63	45	25
7	Mwendamtitu	Mbeya	Mbeya	Mbarali	6,700		3,000	1,500	50
8	Pawaga Mlenge	Mbeya	Iringa	Iringa	8,000		3,170	3,000	
	Medium Scale Scheme								
1	Luganga	Mbeya	Iringa	Iringa	700		400	400	200
2	Mkombilenga	Mbeya	Iringa	Iringa	500		300	300	100
3	Mlambalasi	Mbeya	Iringa	Iringa	500		200	200	100
4	Msosa	Mbeya	Iringa	Kilolo	1,200	80	80	59	39
5	Ruaha Mbuyuni	Mbeya	Iringa	Kilolo	903	903	256	256	121
6	Maduma (proposed)	Mbeya	Iringa	Mafinga TC	500				
7	Ikweha	Mbeya	Iringa	Mufindi	560	560	560	560	450
8	Mbaka	Mbeya	Mbeya	Busokelo	600	600	100	100	80
9	Fao Mswiswi	Mbeya	Mbeya	Mbarali	500		300	300	100
10	Uturo	Mbeya	Mbeya	Mbarali	1,220		900	900	
11	Wia Mahango	Mbeya	Mbeya	Mbarali	964		864	864	
12	Idunda	Mbeya	Mbeya	Mbeya	615	300	300	300	260
13	Mpakani	Mbeya	Mbeya	Rungwe	500			150	
14	Manda	Mbeya	Njombe	Ludewa	1,080	800		20	
15	Sasenga (mbebe)	Mbeya	Songwe	Ileje	600	540	475	475	
16	Mkombozi Mponela	Mbeya	Songwe	Mbozi	600	300	150		150
17	Sasenga (msamba I)	Mbeya	Songwe	Mbozi	820	540	270	270	
18	Usoche	Mbeya	Songwe	Momba	500			300	
19	Nanjembo	Mbeya	Songwe	Songwe	1,400				
	Small Scale Scheme								
1	Igingilanyi	Mbeya	Iringa	Iringa	40		25	5	5
2	Isaka	Mbeya	Iringa	Iringa	200		40	40	20
3	Mangalali	Mbeya	Iringa	Iringa	150		100	100	90
4	Mkungugu/kigasi	Mbeya	Iringa	Iringa	150				
5	Ulongambi	Mbeya	Iringa	Iringa	150		100	50	50
6	Cherehani Mkoga	Mbeya	Iringa	Iringa MC	350	350	120	120	80
7	Kitwiru	Mbeya	Iringa	Iringa MC	100		40	40	35
8	Magana	Mbeya	Iringa	Kilolo	426	426	206	134	19
9	Mdahila	Mbeya	Iringa	Kilolo	258	258	152	110	5
10	Padep	Mbeya	Iringa	Kilolo	120		56	30	56
11	Nundwe	Mbeya	Iringa	Mufindi	60	60	60	60	35
12	Katela / Ntaba I	Mbeya	Mbeya	Busokelo	250	250	80	80	80
13	Kingiri Kanga	Mbeya	Mbeya	Kyela	300			200	100

Attachment-7.5.1 (3/18) Priority Irrigation Schemes for Phase 1 Implementation by 2025 in Mbeya ZIO

SN	Name of Scheme	ZIO name	Region Name	District Name	Potential Area (ha)	Designed Area (ha)	Developed Area (ha)	Irrigated Area (Wet) in ha	Irrigated Area (Dry) in ha
14	Mabunga	Mbeya	Mbeya	Kyela	200			200	50
15	Igomelo	Mbeya	Mbeya	Mbarali	450		312	162	140
16	Imezu Mjini	Mbeya	Mbeya	Mbeya	80	50	50	50	45
17	Itewe	Mbeya	Mbeya	Mbeya	400	160	160	160	154
18	Mshewe	Mbeya	Mbeya	Mbeya	350	150	150	120	40
19	Shamwengo-itondwe	Mbeya	Mbeya	Mbeya	300	170	170	170	150
20	Imbega / Iziwa	Mbeya	Mbeya	Mbeya CC	101		101	101	101
21	Ntundu	Mbeya	Mbeya	Mbeya CC	139		139	139	139
22	Lifua	Mbeya	Njombe	Ludewa	80	80	60	60	30
23	Ngaliwipwa	Mbeya	Njombe	Ludewa	150		35	50	35
24	Bwawani	Mbeya	Njombe	Makambako TC	75			15	
25	Manga/Mkolango	Mbeya	Njombe	Makambako TC	200			35	
26	Mtulingala	Mbeya	Njombe	Makambako TC	104			15	
27	Luwumbu	Mbeya	Njombe	Makete	170	68	68	48	38
28	Mfumbi	Mbeya	Njombe	Makete	400		400	149	149
29	Usungilo	Mbeya	Njombe	Makete	100			10	
30	Ikuna	Mbeya	Njombe	Njombe	123		70	70	52
31	Itipingi	Mbeya	Njombe	Njombe	162	60	100	100	60
32	Kivitu	Mbeya	Njombe	Njombe	286		114	114	54
33	Upami	Mbeya	Njombe	Njombe	200		80	80	64
34	Katendo	Mbeya	Songwe	Ileje	250		150	33	
35	Mapogoro	Mbeya	Songwe	Ileje	200	120	120	80	
36	Mbande	Mbeya	Songwe	Ileje	200	176	100	54	
37	Bara	Mbeya	Songwe	Mbozi	112	84	30	40	30
38	Hasamba - Manyala	Mbeya	Songwe	Mbozi	52			52	15
39	Hasamba - Shumba	Mbeya	Songwe	Mbozi	100			52	15
40	Ibembwa Basin	Mbeya	Songwe	Mbozi	220			100	80
41	Idunda	Mbeya	Songwe	Mbozi	197	140		140	80
42	Imalawantu (mahenje)	Mbeya	Songwe	Mbozi	320	320	180		180
43	Ipunga	Mbeya	Songwe	Mbozi	94	60	60	60	49
44	Ipyana	Mbeya	Songwe	Mbozi	120				35
45	Jikomboe	Mbeya	Songwe	Mbozi	200	100	100		150
46	Lesa (ukwile)	Mbeya	Songwe	Mbozi	211	70	70	108	35
47	Mbulumlowo	Mbeya	Songwe	Mbozi	160	88	80	80	40
48	Mkombozi (mponela)	Mbeya	Songwe	Mbozi	416	150		60	
49	Mlangali (mbewe)	Mbeya	Songwe	Mbozi	80				35
50	Msia	Mbeya	Songwe	Mbozi	150				10
51	Shiwanda	Mbeya	Songwe	Mbozi	118		80	40	10
52	Songwe - Mwandeku	Mbeya	Songwe	Mbozi	291			40	10
53	Ulundambulu I	Mbeya	Songwe	Mbozi	160	52	80	70	52
54	Wasa	Mbeya	Songwe	Mbozi	89	50	30		30
55	Welu II (Ruanda)	Mbeya	Songwe	Mbozi	120	40	40	55	40

Sources: JICA Project Team

Attachment-7.5.1 (4/18) Priority Irrigation Schemes for Phase 1 Implementation by 2025 in Morogoro ZIO

SN	Name of Scheme	ZIO name	Region Name	District Name	Potential Area (ha)	Designed Area (ha)	Developed Area (ha)	Irrigated Area (Wet) in ha	Irrigated Area (Dry) in ha
	Large Scale Scheme								
1	Kisegese	Morogoro	Morogoro	Kilombero	6,210				
2	Mpanga / Ngalimila	Morogoro	Morogoro	Kilombero	9,855			300	
3	Kilangali Seed Farm	Morogoro	Morogoro	Kilosa	3,000		600	50	
4	Msimba - Mikumi	Morogoro	Morogoro	Kilosa	2,800		165	165	20
5	Kilosa Mpepo	Morogoro	Morogoro	Malinyi	2,100				
6	Hembeti	Morogoro	Morogoro	Mvomero	3,600		30	30	20
7	Mbogo	Morogoro	Morogoro	Mvomero	2,500	350	350	350	350
8	Lupilo	Morogoro	Morogoro	Ulanga	4,000	4,000	1,006	1,006	250
	Medium Scale Scheme								
1	Msolwa Ujamaa	Morogoro	Morogoro	Kilombero	675	675	74	74	24
2	Sonjo	Morogoro	Morogoro	Kilombero	1,300	1,300	300	300	50
3	Udagaji	Morogoro	Morogoro	Kilombero	1,529	1,529	12	12	12
4	Kitete Msindazi	Morogoro	Morogoro	Kilosa	500			60	20
5	Lengewaha	Morogoro	Morogoro	Kilosa	1,000			6	25
6	Rudewa	Morogoro	Morogoro	Kilosa	400			500	100
7	Dala	Morogoro	Morogoro	Morogoro	980				
8	Manza	Morogoro	Morogoro	Morogoro	500			20	
9	Mbalangwe (msonge River)	Morogoro	Morogoro	Morogoro	950		98	120	50
10	Tulo/Kongwa	Morogoro	Morogoro	Morogoro	1,500		600	600	250
11	Dihinda	Morogoro	Morogoro	Mvomero	800			400	400
12	Kigugu	Morogoro	Morogoro	Mvomero	1,500			480	250
13	Komtonga	Morogoro	Morogoro	Mvomero	520			24	
14	Mgongola	Morogoro	Morogoro	Mvomero	620			80	
15	Wami Luhindo	Morogoro	Morogoro	Mvomero	1,000			120	100
16	Minepa	Morogoro	Morogoro	Ulanga	1,800	600	426	387	168
17	Gama	Morogoro	Pwani	Bagamoyo	500		300	300	
18	Makurunge B	Morogoro	Pwani	Bagamoyo	500		120	120	50
19	Kidogozero (potential Area)	Morogoro	Pwani	Chalinze	500	480	20	20	
20	Matipwili	Morogoro	Pwani	Chalinze	500			20	
21	Ruvu Rice Farm	Morogoro	Pwani	Chalinze	1,500		720	720	
22	Mafizi	Morogoro	Pwani	Kisarawe	500			80	
23	Nyani	Morogoro	Pwani	Kisarawe	530				
24	Lower Rufiji Valley	Morogoro	Pwani	Rufiji	500		50	10	10
	Small Scale Scheme								
1	Madale	Morogoro	Dar es Salaam	Kinondoni MC	73			4	
2	Chamazi	Morogoro	Dar es Salaam	Temeke MC	250	175	175	175	175
3	Ukwamani	Morogoro	Morogoro	Gairo	300			20	20
4	Maki	Morogoro	Morogoro	Kilombero	300	300		300	60
5	Mkula	Morogoro	Morogoro	Kilombero	255	254	175	254	175
6	Aliqadiriya Salama Children Assoc	Morogoro	Morogoro	Kilosa	200		120	90	
7	Chabima	Morogoro	Morogoro	Kilosa	90			10	
8	Mwega	Morogoro	Morogoro	Kilosa	300			493	290

Attachment-7.5.1 (4/18) Priority Irrigation Schemes for Phase 1 Implementation by 2025 in Morogoro ZIO

SN	Name of Scheme	ZIO name	Region Name	District Name	Potential Area (ha)	Designed Area (ha)	Developed Area (ha)	Irrigated Area (Wet) in ha	Irrigated Area (Dry) in ha
9	Euga	Morogoro	Morogoro	Ulanga	440	440			
10	Lukande	Morogoro	Morogoro	Ulanga	400	540			
11	Ruaha	Morogoro	Morogoro	Ulanga	440	100	400		73
12	Bagamoyo (bidp)	Morogoro	Pwani	Bagamoyo	100		72	72	72
13	Kitame	Morogoro	Pwani	Bagamoyo	400		30	30	30
14	Makurunge A	Morogoro	Pwani	Bagamoyo	200		200	200	50
15	Msoga	Morogoro	Pwani	Chalinze	200	150	150		
16	Madimla	Morogoro	Pwani	Kibaha	120				
17	Mongomole	Morogoro	Pwani	Kibaha	300	45	45	60	45
18	Mwanabwito - Kiembaemba	Morogoro	Pwani	Kibaha	100				
19	Ruvu Jkt - Old Rice Scheme	Morogoro	Pwani	Kibaha	52			2	2
20	Lumyozi	Morogoro	Pwani	Kibiti	300	40	40	40	40
21	Mng'aru	Morogoro	Pwani	Kibiti	220				
22	Mtunda	Morogoro	Pwani	Kibiti	250				
23	Ngurakula	Morogoro	Pwani	Kibiti	300				
24	Nyatanga	Morogoro	Pwani	Kibiti	100				
25	Ikwiriri South	Morogoro	Pwani	Rufiji	260		60	60	20
26	Ikwiriri- Vegetable Gardening	Morogoro	Pwani	Rufiji	60		30	30	
27	Ngorongo	Morogoro	Pwani	Rufiji	240		60	60	
28	Nyakitope	Morogoro	Pwani	Rufiji	200		40	40	
29	Nyamwage	Morogoro	Pwani	Rufiji	200		40	40	
30	Nyamweke	Morogoro	Pwani	Rufiji	320	80	80	30	
31	Ruwe	Morogoro	Pwani	Rufiji	300		70	70	10
32	Segeni	Morogoro	Pwani	Rufiji	120	120	60	60	40
33	Utunge	Morogoro	Pwani	Rufiji	50		10	10	5

Sources: JICA Project Team

Attachment-7.5.1 (5/18) Priority Irrigation Schemes for Phase 1 Implementation by 2025 in Mtwara ZIO

SN	Name of Scheme	ZIO name	Region Name	District Name	Potential Area (ha)	Designed Area (ha)	Developed Area (ha)	Irrigated Area (Wet) in ha	Irrigated Area (Dry) in ha
	Large Scale Scheme								
1	Lituhii	Mtwara	Ruvuma	Nyasa	3,000	3,000	2,710	290	
	Medium Scale Scheme								
1	Kinyope	Mtwara	Lindi	Lindi	600				
2	Narunyu	Mtwara	Lindi	Lindi	1,200				
3	Ngongowele	Mtwara	Lindi	Liwale	500	230	230		
4	Kitere	Mtwara	Mtwara	Mtwara	960	250	60	50	30
5	Chikwedu-chipamanda	Mtwara	Mtwara	Newala	1,200	1,200	800	450	350
6	Ng'apa / Mchichira	Mtwara	Mtwara	Tandahimba	1,200	200	200	200	
7	Litumbandyosi	Mtwara	Ruvuma	Mbinga	600	600	204	204	204
8	Chiulu	Mtwara	Ruvuma	Nyasa	800	800	240	70	490
9	Litisha	Mtwara	Ruvuma	Songea	700			17	17
10	Subira	Mtwara	Ruvuma	Songea MC	800	300	100	100	700
11	Kitanda	Mtwara	Ruvuma	Tunduru	600	455	110	80	30
	Small Scale Scheme								
1	Matapata	Mtwara	Lindi	Lindi MC	400	400	200	200	
2	Mloweka	Mtwara	Lindi	Lindi MC	100	100		40	
3	Ng'ongo	Mtwara	Lindi	Lindi MC	120			52	
4	Tandangongoro	Mtwara	Lindi	Lindi MC	92	36	36		
5	Mtawango	Mtwara	Lindi	Liwale	230	230	230	230	
6	Mtawatawa	Mtwara	Lindi	Liwale	400	400	200	200	
7	Nanganga	Mtwara	Lindi	Ruangwa	400	144		94	45
8	Mkungu	Mtwara	Mtwara	Masasi	190	190	100	70	30
9	Ndanda	Mtwara	Mtwara	Masasi	350	120	290	86	150
10	Mkonye Drip	Mtwara	Mtwara	Mtwara	200	14			
11	Mmuru	Mtwara	Mtwara	Mtwara	300	300	34	34	
12	Rwelu	Mtwara	Mtwara	Mtwara MC	110	1	24	24	10
13	Gumbiro	Mtwara	Ruvuma	Madaba	250	250			
14	Hanga Ngadinda	Mtwara	Ruvuma	Madaba	250	250	100	100	
15	Luhimba	Mtwara	Ruvuma	Madaba	50	50	20	20	
16	Mbangamawe	Mtwara	Ruvuma	Madaba	300	300	34	34	
17	Likonde	Mtwara	Ruvuma	Mbinga	55		31	28	19
18	Mawasiliano Mkako B	Mtwara	Ruvuma	Mbinga	50		40	40	25
19	Mawasiliano Mkako C	Mtwara	Ruvuma	Mbinga	100		31	31	31
20	Amani	Mtwara	Ruvuma	Namtumbo	90			290	
21	Kitanda A	Mtwara	Ruvuma	Namtumbo	100	60		152	1,026
22	Masuguru	Mtwara	Ruvuma	Namtumbo	150			42	42
23	Msanjesi	Mtwara	Ruvuma	Namtumbo	100		5	88	88
24	Msindo Lumecha	Mtwara	Ruvuma	Namtumbo	150			22	22
25	Mtakuja	Mtwara	Ruvuma	Namtumbo	350	270		96	96
26	Mwangaza	Mtwara	Ruvuma	Namtumbo	250	217		28	28
27	Njomlole	Mtwara	Ruvuma	Namtumbo	100	50		50	50

Attachment-7.5.1 (5/18) Priority Irrigation Schemes for Phase 1 Implementation by 2025 in Mtwara ZIO

SN	Name of Scheme	ZIO name	Region Name	District Name	Potential Area (ha)	Designed Area (ha)	Developed Area (ha)	Irrigated Area (Wet) in ha	Irrigated Area (Dry) in ha
28	Litapwasi	Mtwara	Ruvuma	Songea	50			28	28
29	Magima	Mtwara	Ruvuma	Songea	150			42	42
30	Morogoro	Mtwara	Ruvuma	Songea	200			11	11
31	Muhukuru Lilahi	Mtwara	Ruvuma	Songea	350	350		22	22
32	Nakahuga	Mtwara	Ruvuma	Songea	270	270		96	96
33	Namatuhi	Mtwara	Ruvuma	Songea	220			128	128
34	Njoka	Mtwara	Ruvuma	Songea	120	33	33	33	18
35	Parangu	Mtwara	Ruvuma	Songea	60			21	21
36	Kihekwa	Mtwara	Ruvuma	Songea MC	170	45	45	45	120
37	Lekindo	Mtwara	Ruvuma	Tunduru	120	90	90	69	45

Sources: JICA Project Team

Attachment-7.5.1 (6/18) Priority Irrigation Schemes for Phase 1 Implementation by 2025 in Mwanza ZIO

SN	Name of Scheme	ZIO name	Region Name	District Name	Potential Area (ha)	Designed Area (ha)	Developed Area (ha)	Irrigated Area (Wet) in ha	Irrigated Area (Dry) in ha
	Large Scale Scheme								
1	Ibanda	Mwanza	Geita	Geita TC	2,000	480		500	
2	Ngono Valley	Mwanza	Kagera	Bukoba	5,200			190	
3	Buligi	Mwanza	Kagera	Muleba	5,000	5,000			
4	Bugwema Giant	Mwanza	Mara	Musoma	4,000				
5	Mara Valley	Mwanza	Mara	Serengeti	8,340			350	
	Medium Scale Scheme								
1	Kibumba	Mwanza	Geita	Chato	1,630			750	
2	Makurugusi Valley I	Mwanza	Geita	Chato	800			18	
3	Masasi	Mwanza	Geita	Chato	500			95	
4	Kibale	Mwanza	Kagera	Biharamulo	1,000			350	
5	Karazi	Mwanza	Kagera	Karagwe	800	570			
6	Mwisa	Mwanza	Kagera	Karagwe	1,200	300	300	45	150
7	Buchurago - Kabajuga	Mwanza	Kagera	Missenyi	995	995			
8	Kyamyorwa	Mwanza	Kagera	Muleba	500	120	120	60	60
9	Muhongo	Mwanza	Kagera	Ngara	1,500			90	
10	Maliwanda	Mwanza	Mara	Bunda	1,040	220	220	180	30
11	Tamau	Mwanza	Mara	Bunda TC	1,374	150	60	25	2
12	Igongwa	Mwanza	Mwanza	Misungwi	525	220	220	220	150
13	Lwanhima	Mwanza	Mwanza	Nyamagana	800		100	66	30
14	Katunguru	Mwanza	Mwanza	Sengerema	600	200			
	Small Scale Scheme								
1	Bukandwe	Mwanza	Geita	Bukombe	400			100	
2	Mwabasabi	Mwanza	Geita	Chato	450			45	
3	Lwenge	Mwanza	Geita	Geita	130		100	70	
4	Nyamgogwa	Mwanza	Geita	Nyangh'wale	140				
5	Mwiruzi	Mwanza	Kagera	Biharamulo	120			120	
6	Omulwoga	Mwanza	Kagera	Bukoba	172			43	
7	Buhangaza	Mwanza	Kagera	Muleba	200	95	95	60	60
8	Buyaga	Mwanza	Kagera	Muleba	100	80	80	80	60
9	Kyota	Mwanza	Kagera	Muleba	300	120	120	120	60
10	Mpanyula	Mwanza	Kagera	Ngara	430			231	
11	Kalukekele	Mwanza	Mara	Bunda	200		100	15	5
12	Nyatwali	Mwanza	Mara	Bunda TC	210	210	208	40	16
13	Baraki Sisters	Mwanza	Mara	Rorya	150	150	150	150	
14	Chereche	Mwanza	Mara	Rorya	300	300	300	300	
15	Irienyi	Mwanza	Mara	Rorya	350	350	220	250	
16	Ochuna	Mwanza	Mara	Rorya	60	60	60	60	30
17	Rabour	Mwanza	Mara	Rorya	450	450	450	450	
18	Kasela	Mwanza	Mwanza	Buchosa	80	80	80	40	20
19	Nyamadoke	Mwanza	Mwanza	Ilemela	250	101		50	12
20	Jojilo (mwamanga)	Mwanza	Mwanza	Kwimba	480				
21	Bugando-chabula	Mwanza	Mwanza	Magu	187			100	80

Attachment-7.5.1 (6/18) Priority Irrigation Schemes for Phase 1 Implementation by 2025 in Mwanza ZIO

SN	Name of Scheme	ZIO name	Region Name	District Name	Potential Area (ha)	Designed Area (ha)	Developed Area (ha)	Irrigated Area (Wet) in ha	Irrigated Area (Dry) in ha
22	Buluga Farm	Mwanza	Mwanza	Magu	350		250	250	3
23	Kitongo	Mwanza	Mwanza	Magu	300		250	250	
24	Sawenge	Mwanza	Mwanza	Magu	200	150		150	
25	Simiyu	Mwanza	Mwanza	Magu	50		10	2	
26	Nyambeho	Mwanza	Mwanza	Misungwi	200	180	180		
27	Kasomeko	Mwanza	Mwanza	Sengerema	80	80	80	40	20

Sources: JICA Project Team

Attachment-7.5.1 (7/18) Priority Irrigation Schemes for Phase 1 Implementation by 2025 in Tabora ZIO

SN	Name of Scheme	ZIO name	Region Name	District Name	Potential Area (ha)	Designed Area (ha)	Developed Area (ha)	Irrigated Area (Wet) in ha	Irrigated Area (Dry) in ha
	Large Scale Scheme								
1	Mwamapuli	Tabora	Tabora	Igunga	3,000	630	630	630	
2	Simbo	Tabora	Tabora	Igunga	2,500			1,200	
3	Lyamalagwa (Manonga River)	Tabora	Tabora	Nzega	3,000		100	20	
	Medium Scale Scheme								
1	Itilima	Tabora	Shinyanga	Kishapu	700	250	250	560	
2	Nendegese	Tabora	Shinyanga	Kishapu	650				
3	Masengwa	Tabora	Shinyanga	Shinyanga	1,200	333	333	333	
4	Nyida	Tabora	Shinyanga	Shinyanga	800	421	421	421	
5	Chamgasa 1	Tabora	Simiyu	Busega	518			518	
6	Ilumya	Tabora	Simiyu	Busega	540				
7	Mkula	Tabora	Simiyu	Busega	600	165			
8	Mwamanyili	Tabora	Simiyu	Busega	1,200	819		893	
9	Choma Cha Nkola	Tabora	Tabora	Igunga	1,600	320	320		
10	Kahama Nhalanga	Tabora	Tabora	Nzega	1,000	500			
11	Lusu	Tabora	Tabora	Nzega	600	330	330		
12	Nata	Tabora	Tabora	Nzega	1,200	600	300		
13	Iyombo	Tabora	Tabora	Tabora MC	500				
14	Ussoke Mlimani	Tabora	Tabora	Urambo	500	211			
15	Loya	Tabora	Tabora	Uyui	1,000	500			
	Small Scale Scheme								
1	Lunguya	Tabora	Shinyanga	Kishapu	350	300		150	
2	Nyenze	Tabora	Shinyanga	Kishapu	450	222	100	50	10
3	Iwelyangula	Tabora	Shinyanga	Shinyanga MC	300		200	150	
4	Ikungulyambeshi	Tabora	Simiyu	Bariadi	432	100		58	
5	Mwasubuya	Tabora	Simiyu	Bariadi	280	165	165	165	41
6	Sapiwi	Tabora	Simiyu	Bariadi	200				
7	Kalemera	Tabora	Simiyu	Busega	62	10	10	10	
8	Lukungu	Tabora	Simiyu	Busega	350			44	
9	Lutubiga	Tabora	Simiyu	Busega	250	200	200		
10	Nyamikoma	Tabora	Simiyu	Busega	179			179	
11	Shimanilwe 1	Tabora	Simiyu	Busega	132			132	
12	Shimanilwe 2	Tabora	Simiyu	Busega	98			98	
13	Bukangilija	Tabora	Simiyu	Maswa	450	400	400	307	
14	Ngongwa	Tabora	Simiyu	Maswa	250	200	25	5	5
15	Imalamihayo	Tabora	Tabora	Tabora MC	220	82			
16	Inala	Tabora	Tabora	Tabora MC	400	250	250		
17	Kakulungu	Tabora	Tabora	Tabora MC	100				
18	Magoweko	Tabora	Tabora	Tabora MC	150	25	32		
19	Izimbili	Tabora	Tabora	Urambo	100			12	
20	Shitage	Tabora	Tabora	Uyui	375		60	60	20

Sources: JICA Project Team

Attachment-7.5.1 (8/18) Priority Irrigation Schemes for Phase 1 Implementation by 2025 in Katavi ZIO

SN	Name of Scheme	ZIO name	Region Name	District Name	Potential Area (ha)	Designed Area (ha)	Developed Area (ha)	Irrigated Area (Wet) in ha	Irrigated Area (Dry) in ha
	Large Scale Scheme								
1	Mwamkulu - Kabage and Kakese	Katavi	Katavi	Mpanda , Mpanda TC	2,775	967	967	938	
2	Mwamapuli	Katavi	Katavi	Mpimbwe	13,605		10,425	10,415	
3	Nyakitonto	Katavi	Kigoma	Kasulu	2,384	106	450	450	120
4	Luiche (Luiche Valley)	Katavi	Kigoma	Kigoma MC	3,000				
5	Katuka	Katavi	Rukwa	Kalambo	2,500	2,500	250	250	250
6	Katongolo	Mbeya	Rukwa	Nkasi	3,200	3,200	100	180	
7	Maleza	Katavi	Rukwa	Sumbawanga	7,500			400	
8	Sakalilo	Katavi	Rukwa	Sumbawanga	4,000	650	250	250	200
	Medium Scale Scheme								
1	Ipati	Katavi	Katavi	Mlele	1,100			80	
2	Mwamkulu - Kakese	Katavi	Katavi	Mpanda MC	1,333	1,333		1,333	2
3	Biharu	Katavi	Kigoma	Buhigwe	600				
4	Titye	Katavi	Kigoma	Kasulu	575	700	575		
5	Nyankara	Katavi	Kigoma	Kigoma	890			60	
6	Kashagulu	Katavi	Kigoma	Uvinza	1,000	400			
7	Mgambazi	Katavi	Kigoma	Uvinza	1,000	750			
8	Singiwe	Katavi	Rukwa	Kalambo	1,000	1,000	400	400	400
9	Ulumi	Katavi	Rukwa	Kalambo	1,000		50	50	50
10	Lwanji	Katavi	Rukwa	Sumbawanga	1,500			450	100
	Small Scale Scheme								
1	Shula Basin	Katavi	Katavi	Nsimbo	106				
2	Katengera	Katavi	Kigoma	Kakonko	207		207	207	100
3	Mganza	Katavi	Kigoma	Kakonko	100				
4	Ruhwiti	Katavi	Kigoma	Kakonko	300	140	140		
5	Rungwe Mpya	Katavi	Kigoma	Kasulu	300	250	125	60	56
6	Mgondogondo	Katavi	Kigoma	Kibondo	213	188	188	188	188
7	Nyendara	Katavi	Kigoma	Kibondo	400	124	160	160	160
8	Kidahwe Bwawani Traditional	Katavi	Kigoma	Kigoma	200			100	
9	Muganga	Katavi	Kigoma	Kigoma	200			60	20
10	Nyangova	Katavi	Kigoma	Kigoma	150			5	
11	Nyanganga	Katavi	Kigoma	Uvinza	320				
12	Kalundi	Katavi	Rukwa	Nkasi	154			13	35
13	Lwafi Dam Scheme (lwafi River)	Katavi	Rukwa	Nkasi	480		120	120	
14	Kasekela/msila	Katavi	Rukwa	Sumbawanga	270			270	30
15	Kifinga	Katavi	Rukwa	Sumbawanga	300			150	20
16	Kisa	Katavi	Rukwa	Sumbawanga	400			252	100

Sources: JICA Project Team

Attachment-7.5.1 (9/18) High Priority National Project

SN	Name of Scheme	ZIO name	Region Name	District Name	Potential Area (ha)	Remarks
1	Participatory Dams Development Program in Semi-Arid Areas of Tanzania (Existing Dams)	Dodoma, Tabora, Mwanza	Manyara, Dodoma, Singida, Mara, Tabora		13,444	A Strategic Action, September 2016
2	Participatory Dams Development Program in Semi-Arid Areas of Tanzania (Proposed Dams)	Dodoma, Tabora, Mwanza	Singida, Manyara, Mwanza, Mara, Geita, Shinyanga, Kigoma, Tabora		97,648	A Strategic Action, September 2016
3	Promotion of Micro Irrigation System for Improved Crop Production for Smallholder Farmers in Tanzania	Dodoma, Morogoro		18 District Councils and 1 Municipality	16,710	Project proposal was prepared in Jun 2016
4	Songwe River Basin Development Project	Mbeya	Mbeya	Kyela	3,005	Lower Songwe River Irrigation Scheme, A F/S level study has conducted.
5	Ruhuhu Irrigation Project	Mbeya, Mtwara	Ruvuma	Nyasa, Ludewa	3,700	Kikonge Dam, Mini-Hydropower Project in the Main Derivery Canal Pre-F/S was prepared in Mar 2014.
6	Ruvuma River Basin Irrigation Developemnt	Mtwara	Ruvuma, Mtwara	Songe, Songea MC, Tunduru, Tandahimba, Namtumbo	26,066	Dvelopment of the Ruvuma River Basin Monograph abd Joint IWRM Strategy Report Potential : 26,066 ha Existing : 6,836 ha

Sources: JICA Project Team

Attachment-7.5.1 (10/18) List of Priority Dams for Phase 1 Implementation

Serial No	Dam Name	Zone Name	Region Name	District Name	Site Name	Dam Type	Gross Storage Capacity (m^3)	Active Storage Capacity (m^3)	Commanding Irrigation Scheme	Potential Irrigation Area (ha)	Current Status
1	Buigiri	Dodoma	Dodoma	Chamwino	Buigiri	Earth Fill	750,000	187,500	Buigiri	50	Partially operational
2	Ikowa	Dodoma	Dodoma	Chamwino	Ikowa	Earth Fill	2,100,000	720,000	Chalinze	124	Partially operational
3	Matumbulu	Dodoma	Dodoma	Dodoma MC	Matumbulu					120	Potential (Identified), Minimal irrigation
4	Vikonje	Dodoma	Dodoma	Dodoma MC	Vikonje					60	Design
5	Kisese	Dodoma	Dodoma	Kondoa	Mapinduzi	Earth & Rock Fill		2,172,160	Kisese	2,000	Preliminary study done, Partially operational
6	Mlembule	Dodoma	Dodoma	Mpwapwa	Mlembule					300	
7	Endamajek	Dodoma	Manyara	Babati	Qash					206	Minimal irrigation
8	Kisangaji	Dodoma	Manyara	Babati						1,700	Reconnaisasnce survey done
9	Endagaw	Dodoma	Manyara	Hanang						260	
10	Gidahababieg	Dodoma	Manyara	Hanang						40	
11	Ngipa /ngonyongoni	Dodoma	Manyara	Kiteto			2,030,000				Reconnaisasnce survey done
12	Mangisa	Dodoma	Manyara	Mbulu			450		Mangisa	750	in Operation
13	Tlawi	Dodoma	Manyara	Mbulu TC	Tlawi	Earth & Rock Fill	257,534	181,521	Tlawi, Boboa, Guneneda, Jaranja	250	Preliminary study done, Partially operational
14	Isuna	Dodoma	Singida	Ikungi	Isuna	Earth Fill	250		Isuna A, Isuna B, Nongosolo, Nkhui, Manjalo	3,500	Partially operational
15	Mang'onyi	Dodoma	Singida	Ikungi	Mang'onyi				Mang'onyi	400	F/S and D/D completed
16	Itagata	Dodoma	Singida	Itigi							Tender documents in place
17	Mbwasa	Dodoma	Singida	Manyoni	Mbwasa	Earth & Rock Fill	8,000,000		Mbwasa, Chikuyu, Ktiwe, Mwiboo	1,835	F/S and D/D completed
18	Msingi	Dodoma	Singida	Mkalama	Msingi	Earth Fill			Msingi, Ishinsi, Ndala	1,200	Construction, Not operational
19	Mwangeza	Dodoma	Singida	Mkalama	Mwangeza	Earth Fill			Mwangeza, Kinyambuli, Dominiki	3,000	Not operational, Breached dam embankment, tender documents in place
20	Sagara - 1	Dodoma	Singida	Singida	Sagara					300	Existing
21	Mwamapuli	Katavi	Katavi	Mpimbwe	Mwamapuli	Earth Fill				13,605	Partially operational
22	Mganza	Katavi	Kigoma	Kakonko	Kanyonza					100	Potential (Identified)
23	Nyendara	Katavi	Kigoma	Kibondo	Twabagondozi					400	Partially operational
24	Katuka	Katavi	Rukwa	Kalambo	Katuka		418,350			2,500	
25	Lwafi (Iwafi River)	Katavi	Rukwa	Nkasi	Masolo				Lwafi (420ha, 1050person), Katongolo (3200 ha, 8000person)	3,620	Study / Feasibility
26	Luiche Valley	Kigoma	Kigoma	Kigoma MC		Earth Fill					
27	Kiseriani	Kilimanjaro	Arusha	Longido	Kiseriani	Concrete Gravity					Not operational
28	Mapangoni	Kilimanjaro	Tanga	Korogwe	Mayuyu	Earth Fill			Mapangoni, Mahenge	300	
29	Misozwe	Kilimanjaro	Tanga	Muheza						100	Potential (Identified), Study / Feasibility Study, Design, Construction, Operational
30	Isaka	Mbeya	Iringa	Iringa	Nyakavangala				Isaka	500	Reconnaisasnce survey done
31	Ulongambi	Mbeya	Iringa	Iringa	Ugwachanya					100	
32	Magana	Mbeya	Iringa	Kilolo	Magana						
33	Mdahila	Mbeya	Iringa	Kilolo	Mdahila						
34	Mgambalenga	Mbeya	Iringa	Kilolo	Kitonga						
35	Mgowelo	Mbeya	Iringa	Kilolo	Mgowelo						
36	Manda	Mbeya	Njombe	Ludewa							
37	Mkombozi	Mbeya	Songwe	Mbozi	Mponela					416	
38	Msia	Mbeya	Songwe	Mbozi					Msia	150	Preliminary study and design done
39	Ulundambulu I	Mbeya	Songwe	Mbozi	Kimani and Mabadaga					160	Operational
40	Usoche	Mbeya	Songwe	Momba	Usoche					500	Not Operational
41	Mbalangwe (msonge River)	Morogoro	Morogoro	Morogoro	Msonge, Mbalangwa					950	Operational
42	Lupiro	Morogoro	Morogoro	Ulanga	Lupiro , Nakafuku, Igota					200	Preliminary study and design done
43	Msoga	Morogoro	Pwani	Chalinze	Msoga		970,480			200	Upgrading
44	Ikwiriri South	Morogoro	Pwani	Rufiji	Mtanange					260	Potential (Identified)
45	Ruwe	Morogoro	Pwani	Rufiji	Ruwe					300	Potential (Identified)
46	Utunge	Morogoro	Pwani	Rufiji	Utunge					50	Operational
47	Nanganga	Mtwara	Lindi	Ruangwa	Nanganga and Nyangao				Nanganga, Nyangao	1,600	Reconnaisasnce survey done
48	Mkungu	Mtwara	Mtwara	Masasi	Mkungu					190	Construction, Operational
49	Kitere	Mtwara	Mtwara	Mtwara	Chemchemlilido And Nakada					1,540	Partially operation /Also under construction
50	Chikwedu-chipamanda	Mtwara	Mtwara	Newala	Chikwedu					1,200	Operational
51	Litumbandyosi/ Sangamabuni	Mtwara	Ruvuma	Mbinga	Litumbandyosi/ Sangamabuni				Litumbandyosi, Sangamabuni	350	Pre F/S for irrigation scheme
52	Nakahuga	Mtwara	Ruvuma	Songea	Nakahuga				Nakahuga	150	Reconnaisasnce survey done

Attachment-7.5.1 (10/18) List of Priority Dams for Phase 1 Implementation

Serial No	Dam Name	Zone Name	Region Name	District Name	Site Name	Dam Type	Gross Storage Capacity (m^3)	Active Storage Capacity (m^3)	Commanding Irrigation Scheme	Potential Irrigation Area (ha)	Current Status
53	Lekindo	Mtwara	Ruvuma	Tunduru	Lelolelo					120	Potential (Identified), Study / Feasibility Study, Design, Construction, Operational, Minimal irrigation
54	Kibumba	Mwanza	Geita	Chato						10,000	
55	Lwenge	Mwanza	Geita	Geita	Lwenge					130	
56	Ibanda	Mwanza	Geita	Geita TC	Ibanda	Earth Fill	4,000,000			800	Preliminary study and design done
57	Ngono	Mwanza	Kagera	Misenyi	Ngono				Ngono	13,680	Feasibility studies done under NELSAP and Detail design is currently going on
58	Buligi	Mwanza	Kagera	Muleba	Buligi					5,000	Preliminary study and design done
59	Mpanyula	Mwanza	Kagera	Ngara	Kashinga	Earth Fill, Earth & Rock Fill				430	Preliminary study and design done
60	Maliwanda	Mwanza	Mara	Bunda	Maliwanda	Earth Fill	1,105,580	668,075	Maliwanda	1,040	in Operation
61	Baraki	Mwanza	Mara	Rorya	Baraki					100	
62	Baraki Sisters	Mwanza	Mara	Rorya	Baraki	Earth Fill	950,000	780,000		150	in Operation
63	Chereche	Mwanza	Mara	Rorya	Chereche	Earth Fill	650,000	520,000		300	Not operational
64	Ochuna	Mwanza	Mara	Rorya	Ochuna	Earth Fill	560,000	440,000		150	in Operation
65	Rabour	Mwanza	Mara	Rorya	Rabour	Earth Fill	740,000	600,000		450	Not operational
66	Mara Valley	Mwanza	Mara	Serengeti	Mara Valley					6,340	Feasibility studies done under NELSAP and Detail design is corrently going on
67	Nyamadoke	Mwanza	Mwanza	Ilemela	Nyamadoke					250	Design completed
68	Kasela	Mwanza	Mwanza	Sengerema	Kasela	Earth Fill				80	Partially operational
69	Katunguru	Mwanza	Mwanza	Sengerema	Katunguru	Earth Fill	3,400,000	3,400,000		600	Dam embankment not completed
70	Nendegese	Tabora	Shinyanga	Kishapu	Nendegese	Earth & Rock Fill				600	Potential, Operational but not improved
71	Masengwa	Tabora	Shinyanga	Shinyanga	Masengwa	Earth Fill			Masengwa	450	Dam embankment not completed
72	Nyida	Tabora	Shinyanga	Shinyanga						1,000	
73	Sapiwi	Tabora	Simiyu	Bariadi	Sapiwi					200	Potential (Identified)
74	Lutubiga	Tabora	Simiyu	Busega	Lutubiga					250	Not operational
75	Mkula	Tabora	Simiyu	Busega	Mkula					600	Potential (Identified), Study / Feasibility Study, Design
76	Choma Cha Nkola	Tabora	Tabora	Igunga	Choma Cha N	Earth Fill				600	Preliminary study done
77	Simbo	Tabora	Tabora	Igunga	Simbo	Earth Fill				25,000	Design completed
78	Kahama Nhalanga	Tabora	Tabora	Nzega						1,000	Under Construction, partially operational
79	Lusu	Tabora	Tabora	Nzega	Lusu	Earth Fill					
80	Lyamalagwa	Tabora	Tabora	Nzega	Lyamalagwa				Lyamalagwa	600	Preliminary study done
81	Imalamihayo	Tabora	Tabora	Tabora MC	Imalamihayo					220	Potential (Identified), partially operational, pre-feasibility Studies done
82	Inala	Tabora	Tabora	Tabora MC	Inala	Earth Fill		1,376,000		400	in Operation
83	Iyombo	Tabora	Tabora	Tabora MC	Iyombo	Earth Fill			Iyombo	500	Preliminary study done
84	Kakulungu	Tabora	Tabora	Tabora MC						100	Potential (Identified)
85	Magoweko	Tabora	Tabora	Tabora MC	Magoweko	Earth Fill		318,971		47	in Operation
86	Izimbili	Tabora	Tabora	Urambo	Izimbili				Izimbili	1,000	Preliminary study done
87	Ussoke Mlimani	Tabora	Tabora	Urambo	Ussoke Mlimani					500	Partially operational
88	Loya	Tabora	Tabora	Uyui	Loya	Earth Fill			Loya	1,000	Preliminary study done

Sources: JICA Project Team

Attachment-7.5.1 (11/18) Priority Irrigation Schemes for Phase 2 Implementation by 2035 in Dodoma ZIO

SN	Name of Scheme	ZIO name	Region Name	District Name	Potential Area (ha)	Designed Area (ha)	Developed Area (ha)	Irrigated Area (Wet) in ha	Irrigated Area (Dry) in ha
Large Scale Schemes									
1	Ndoroboni	Dodoma	Dodoma	Chemba	3,000		100	100	20
2	Mkoyo	Dodoma	Dodoma	Dodoma MC	3,000	0			0
3	Mongoroma/Serya	Dodoma	Dodoma	Kondoa TC	2,000	2,000		2,000	3
4	Mugungira	Dodoma	Singida	Ikungi	5,000			30	30
5	Wembere	Dodoma	Singida	Iramba	2,000				
Medium Scale Schemes									
1	Kongogo	Dodoma	Dodoma	Bahi	1,000	220			
2	Chali	Dodoma	Dodoma	Bahi	1,200	242	106	42	
3	Manda	Dodoma	Dodoma	Chamwino	600			20	5
4	Suli	Dodoma	Dodoma	Chamwino	620	40	40		
5	Kelema Balai	Dodoma	Dodoma	Chemba	500	0	0	300	40
6	Idodoma	Dodoma	Dodoma	Mpwapwa	600	Not designed		200	120
7	Izonvu	Dodoma	Dodoma	Mpwapwa	500			300	20
8	Nduga	Dodoma	Dodoma	Mpwapwa	700		250	300	200
9	Wazaganza / Chabi	Dodoma	Dodoma	Mpwapwa	1,100		200	300	50
10	Inzomvu	Dodoma	Dodoma	Mpwapwa	500			300	
11	Seluka	Dodoma	Dodoma	Mpwapwa	700			40	
12	Wiyenzele	Dodoma	Dodoma	Mpwapwa	600			5	
13	Takanya	Dodoma	Dodoma	Mpwapwa	700		200	200	10
14	Madunga	Dodoma	Manyara	Babati	800	0		400	300
15	Laiseri	Dodoma	Manyara	Kiteto	600				
16	Kimana	Dodoma	Manyara	Kiteto	800				
17	Dongobesh	Dodoma	Manyara	Mbulu	625	0	236		140
18	Ruvu Remit	Dodoma	Manyara	Simanjiro	700	176			50
19	Masimba	Dodoma	Singida	Iramba	1,470		750	750	
20	Tyeme / Masagi	Dodoma	Singida	Iramba	1,177		177	177	
21	Mlandala	Dodoma	Singida	Iramba	1,350		300	300	
22	Lugongo	Dodoma	Singida	Mkalama	1,050			1,050	
23	Tatazi	Dodoma	Singida	Mkalama	1,500			1,500	
24	Gumanga	Dodoma	Singida	Mkalama	1,750		230	230	230
25	Dominiki	Dodoma	Singida	Mkalama	800			800	
26	Mkiko	Dodoma	Singida	Mkalama	1,800			1,800	
27	Msange Drip	Dodoma	Singida	Singida	1,000	560	10	10	10
28	Msange / Suke	Dodoma	Singida	Singida	1,000			1,000	15
Small Scale Schemes									
1	Dabalo	Dodoma	Dodoma	Chamwino	360	120		30	8
2	Mpwayungu	Dodoma	Dodoma	Chamwino	447	140		18	
3	Haneti	Dodoma	Dodoma	Chamwino	70			11	4
4	Fufu	Dodoma	Dodoma	Chamwino	56	40			
5	Chiboli	Dodoma	Dodoma	Chamwino	442	40			
6	Babayu	Dodoma	Dodoma	Chemba	200			10	5
7	Jogolo	Dodoma	Dodoma	Chemba	450	0	30	30	15
8	Hombolo	Dodoma	Dodoma	Dodoma MC	300	300	120	120	60
9	Gawaye	Dodoma	Dodoma	Dodoma MC	300	40	40	300	40

Attachment-7.5.1 (11/18) Priority Irrigation Schemes for Phase 2 Implementation by 2035 in Dodoma ZIO

SN	Name of Scheme	ZIO name	Region Name	District Name	Potential Area (ha)	Designed Area (ha)	Developed Area (ha)	Irrigated Area (Wet) in ha	Irrigated Area (Dry) in ha
10	Nzuguni	Dodoma	Dodoma	Dodoma MC	240	0	100	0	0
11	Michese - Mkalama	Dodoma	Dodoma	Dodoma MC	150	0	0	150	0
12	Mahoma Makulu	Dodoma	Dodoma	Dodoma MC	50	0		30	3
13	Chididimo- Bihawana	Dodoma	Dodoma	Dodoma MC	135	0		135	0
14	Madege	Dodoma	Dodoma	Kondoa	250		60	50	50
15	Mkurumuzi	Dodoma	Dodoma	Kondoa	100		62	62	30
16	Itaswi Chubi	Dodoma	Dodoma	Kondoa	120		30	30	
17	Chamkoroma	Dodoma	Dodoma	Kongwa	126		30	30	30
18	Tubugwe Juu	Dodoma	Dodoma	Kongwa	150	150	120	120	120
19	Banyibanyi	Dodoma	Dodoma	Kongwa	161	161	40	40	40
20	Tubugwe Kibaoni	Dodoma	Dodoma	Kongwa	105		54	54	54
21	Mwenzele	Dodoma	Dodoma	Mpwapwa	200		20	105	70
22	Ipera - Kinusi	Dodoma	Dodoma	Mpwapwa	69		69	69	30
23	Tambi	Dodoma	Dodoma	Mpwapwa	90		90	90	40
24	Kitati	Dodoma	Dodoma	Mpwapwa	300		35	200	140
25	Mbori	Dodoma	Dodoma	Mpwapwa	160			160	
26	Makose	Dodoma	Dodoma	Mpwapwa	300			35	10
27	Winza	Dodoma	Dodoma	Mpwapwa	400			30	5
28	Mwanawotta	Dodoma	Dodoma	Mpwapwa	100		25	70	30
29	Galigali	Dodoma	Dodoma	Mpwapwa	130			48	13
30	Lumuma - Masememe	Dodoma	Dodoma	Mpwapwa	140			45	
31	Matonya	Dodoma	Dodoma	Mpwapwa	110			65	35
32	Iyuhwa	Dodoma	Dodoma	Mpwapwa	150		50	50	
33	Msagali Block Farm	Dodoma	Dodoma	Mpwapwa	200	100	60	60	
34	Isinghu	Dodoma	Dodoma	Mpwapwa	450			270	15
35	Nzugilo	Dodoma	Dodoma	Mpwapwa	200			45	4
36	Godegode	Dodoma	Dodoma	Mpwapwa	150			32	
37	Ruhundwa	Dodoma	Dodoma	Mpwapwa	200			20	
38	Mzogole	Dodoma	Dodoma	Mpwapwa	200			30	
39	Wiyenzele	Dodoma	Dodoma	Mpwapwa	400				
40	Lyuhwa - Chipogolo	Dodoma	Dodoma	Mpwapwa	150		50	50	
41	Hidet/Mara	Dodoma	Manyara	Hanang	100		100	100	24
42	Endasworld	Dodoma	Manyara	Hanang	100		100	100	60
43	Magungu	Dodoma	Manyara	Kiteto	200				
44	Guwangw	Dodoma	Manyara	Mbulu TC	250	110	110	250	25
45	Mangisa	Dodoma	Manyara	Mbulu	398	250	306	306	306
46	Mongahay	Dodoma	Manyara	Mbulu	300	0	0	200	200
47	Tumati	Dodoma	Manyara	Mbulu	270		190		
48	Arri	Dodoma	Manyara	Mbulu	259		168		
49	Harsha	Dodoma	Manyara	Mbulu	346		266	266	190
50	Diyomat	Dodoma	Manyara	Mbulu	375		250	250	237
51	Dirim dam	Dodoma	Manyara	Mbulu	335		150	150	78
52	Songoyo	Dodoma	Manyara	Simanjiro	320			40	40
53	Zaire	Dodoma	Manyara	Simanjiro	450			180	180
54	Gunge	Dodoma	Manyara	Simanjiro	300			150	150

Attachment-7.5.1 (11/18) Priority Irrigation Schemes for Phase 2 Implementation by 2035 in Dodoma ZIO

SN	Name of Scheme	ZIO name	Region Name	District Name	Potential Area (ha)	Designed Area (ha)	Developed Area (ha)	Irrigated Area (Wet) in ha	Irrigated Area (Dry) in ha
55	Shambarai	Dodoma	Manyara	Simanjiro	470			225	225
56	Kairo	Dodoma	Manyara	Simanjiro	350			140	140
57	Kilombero	Dodoma	Manyara	Simanjiro	170			90	90
58	Kituntu Valley	Dodoma	Singida	Ikungi	400			400	
59	Unyangwe	Dodoma	Singida	Ikungi	100			100	10
60	Saranda	Dodoma	Singida	Manyoni	200	60		60	
61	Udimaa	Dodoma	Singida	Manyoni	200	200	150	200	
62	Msemembo	Dodoma	Singida	Manyoni	300	250		300	
63	Ngaiti	Dodoma	Singida	Manyoni	150			80	
64	Maweni	Dodoma	Singida	Manyoni	300			300	
65	Kitalalo	Dodoma	Singida	Manyoni	80			80	
66	Mng'anda	Dodoma	Singida	Mkalama	80			80	10
67	Miganga	Dodoma	Singida	Mkalama	127		32	24	24
68	Mwanga	Dodoma	Singida	Mkalama	200			40	40
69	Ilunda	Dodoma	Singida	Mkalama	250			115	5
70	Marera	Dodoma	Singida	Mkalama	175			175	
71	Kidarafa	Dodoma	Singida	Mkalama	210		210	120	
72	Kisuluiga	Dodoma	Singida	Mkalama	140		40	40	20
73	Ikhanoda - Deep Well (proposed)	Dodoma	Singida	Singida	200			200	50

Sources: JICA Project Team

Attachment-7.5.1 (12/18) Priority Irrigation Schemes for Phase 2 Implementation by 2035 in Kilimanjaro ZIO

SN	Name of Scheme	ZIO name	Region Name	District Name	Potential Area (ha)	Designed Area (ha)	Developed Area (ha)	Irrigated Area (Wet) in ha	Irrigated Area (Dry) in ha
Large Scale Schemes									
1	Ntalanda	Kilimanjaro	Kilimanjaro	Same	2,000		1,000	800	650
Medium Scale Schemes									
1	Mang'ola Barazan	Kilimanjaro	Arusha	Karatu	880		750	715	300
2	Pinyinyi	Kilimanjaro	Arusha	Ngorongoro	680			400	106
3	Oldonyo Sambu	Kilimanjaro	Arusha	Ngorongoro	550			300	200
4	Kikongo	Kilimanjaro	Kilimanjaro	Same	545		545	545	205
5	Kadando/rushoto	Kilimanjaro	Kilimanjaro	Same	585		585	585	200
6	Ranzi Dam Scheme	Kilimanjaro	Kilimanjaro	Same	1,500		800	420	340
7	Ndungu	Kilimanjaro	Kilimanjaro	Same	1,500		680	680	300
8	Mvungwe	Kilimanjaro	Kilimanjaro	Same	580		200	150	130
9	Makokane	Kilimanjaro	Kilimanjaro	Same	1,200		480	330	150
10	Chajula	Kilimanjaro	Tanga	Kilindi	500	100	30	50	20
11	Msiri	Kilimanjaro	Tanga	Kilindi	700			80	30
12	Mkomazi	Kilimanjaro	Tanga	Korogwe	536	200	300	500	120
13	Mwakijembe	Kilimanjaro	Tanga	Mkinga	1,450	1,450	100	20	30
Small Scale Schemes									
1	Meshorori	Kilimanjaro	Arusha	Arusha	110		110	110	76
2	Manyire	Kilimanjaro	Arusha	Arusha	300		230	300	220
3	Sasi	Kilimanjaro	Arusha	Arusha	110		105	100	80
4	Bangata	Kilimanjaro	Arusha	Arusha	150		75	120	92
5	Chemchem	Kilimanjaro	Arusha	Karatu	98		80	78	28
6	Majengo Juu	Kilimanjaro	Arusha	Monduli	200			200	50
7	Kabambe	Kilimanjaro	Arusha	Monduli	350			250	50
8	Kabambe Selela	Kilimanjaro	Arusha	Monduli	350			250	50
9	Block Farm	Kilimanjaro	Arusha	Monduli	150		140	120	20
10	Miwaleni	Kilimanjaro	Arusha	Monduli	328			328	32
11	Mungere	Kilimanjaro	Arusha	Monduli	62			35	5
12	Nadosoito	Kilimanjaro	Arusha	Monduli	100			50	35
13	Jangwani	Kilimanjaro	Arusha	Monduli	188			87	40
14	Kisangiro	Kilimanjaro	Arusha	Ngorongoro	450			350	315
15	Digidigo	Kilimanjaro	Arusha	Ngorongoro	400			200	130
16	Tinaga	Kilimanjaro	Arusha	Ngorongoro	90			70	20
17	Moniki	Kilimanjaro	Arusha	Ngorongoro	150			60	40
18	Eyasi Mdito	Kilimanjaro	Arusha	Ngorongoro	50			30	15
19	Sale	Kilimanjaro	Arusha	Ngorongoro	250			100	50
20	Samunge	Kilimanjaro	Arusha	Ngorongoro	200			180	175
21	Muholo	Kilimanjaro	Arusha	Ngorongoro	450				300
22	Kwa Sekati/kwakoa	Kilimanjaro	Kilimanjaro	Mwanga	250		150	210	50
23	Mgigili/kwakoa	Kilimanjaro	Kilimanjaro	Mwanga	250		150	210	50
24	Kwa Sekah/kwakoa	Kilimanjaro	Kilimanjaro	Mwanga	250		150	210	50
25	Mbakwe	Kilimanjaro	Kilimanjaro	Mwanga	75			20	10
26	Ikuini	Kilimanjaro	Kilimanjaro	Rombo	400	100	300	60	40
27	Miembeni Micro Dam Scheme	Kilimanjaro	Kilimanjaro	Same	50		50	50	38
28	Kalemani	Kilimanjaro	Kilimanjaro	Same	320		320	320	150

Attachment-7.5.1 (12/18) Priority Irrigation Schemes for Phase 2 Implementation by 2035 in Kilimanjaro ZIO

SN	Name of Scheme	ZIO name	Region Name	District Name	Potential Area (ha)	Designed Area (ha)	Developed Area (ha)	Irrigated Area (Wet) in ha	Irrigated Area (Dry) in ha
29	Maore/ Kalinga	Kilimanjaro	Kilimanjaro	Same	405		405	405	320
30	Chemchem	Kilimanjaro	Kilimanjaro	Same	200			150	100
31	Mramba	Kilimanjaro	Kilimanjaro	Same	95		95	85	72
32	Wariro Goma	Kilimanjaro	Kilimanjaro	Same	64		64	64	48
33	Chamma	Kilimanjaro	Kilimanjaro	Same	150		100	100	80
34	Fidia	Kilimanjaro	Kilimanjaro	Same	120		120	50	30
35	Makafara Micro Dam Scheme	Kilimanjaro	Kilimanjaro	Same	120		60	60	45
36	Shakaka	Kilimanjaro	Kilimanjaro	Same	340		255	150	100
37	Masae	Kilimanjaro	Kilimanjaro	Same	98		98	98	35
38	Chamamba	Kilimanjaro	Kilimanjaro	Same	200			200	
39	Maghaani Micro Dam Scheme	Kilimanjaro	Kilimanjaro	Same	78		78	78	50
40	Mataka	Kilimanjaro	Kilimanjaro	Same	130		130	130	50
41	Mbula	Kilimanjaro	Kilimanjaro	Same	190		165	165	122
42	Milala	Kilimanjaro	Kilimanjaro	Same	80			50	30
43	Gongo Juu	Kilimanjaro	Kilimanjaro	Same	100		80	80	40
44	Gamo Chini	Kilimanjaro	Kilimanjaro	Same	106			95	50
45	Gamo Juu	Kilimanjaro	Kilimanjaro	Same	160		100	60	40
46	Mombo	Kilimanjaro	Kilimanjaro	Same	120		120	120	50
47	Tangani	Kilimanjaro	Kilimanjaro	Same	330		190	120	108
48	Vumba	Kilimanjaro	Kilimanjaro	Same	120		120	120	98
49	Ibis	Kilimanjaro	Kilimanjaro	Same	222	222	46	46	38
50	Malila	Kilimanjaro	Kilimanjaro	Same	150		130	90	50
51	Mkanyeni	Kilimanjaro	Kilimanjaro	Same	220		210	190	150
52	Dimbwi	Kilimanjaro	Kilimanjaro	Same	320		120	120	80
53	Kankoro Micro Dam Scheme	Kilimanjaro	Kilimanjaro	Same	50		10	10	4
54	Gunge	Kilimanjaro	Kilimanjaro	Same	206		180	180	80
55	Kalemawe Dam Scheme	Kilimanjaro	Kilimanjaro	Same	380		380	380	380
56	Mbuyuni	Kilimanjaro	Kilimanjaro	Same	200		100	100	50
57	Kwanambache/nkungwini	Kilimanjaro	Kilimanjaro	Same	68		45	45	26
58	Munze/kampanga	Kilimanjaro	Kilimanjaro	Same	120		120	120	70
59	Majengo	Kilimanjaro	Kilimanjaro	Same	50		50	50	30
60	Maendeleo	Kilimanjaro	Kilimanjaro	Same	300		300	300	120
61	Makalivati	Kilimanjaro	Kilimanjaro	Same	200		200	200	120
62	Madege	Kilimanjaro	Kilimanjaro	Same	150		150	150	100
63	Njiro	Kilimanjaro	Kilimanjaro	Same	70		50		
64	Rosylene	Kilimanjaro	Kilimanjaro	Siha	100			45	18
65	Mosiny	Kilimanjaro	Kilimanjaro	Siha	182			95	10
66	Kisangara	Kilimanjaro	Kilimanjaro	Siha	250			75	15
67	Kwadundwa	Kilimanjaro	Tanga	Kilindi	250	120		60	40
68	Nkobe	Kilimanjaro	Tanga	Kilindi	350			30	15
69	Lusanga	Kilimanjaro	Tanga	Korogwe	100	100	80	80	30
70	Gombero	Kilimanjaro	Tanga	Korogwe	50	50	25	30	25
71	Sekioga Mkwajuni	Kilimanjaro	Tanga	Korogwe	150		80	100	50
72	Mswaha - Tabora	Kilimanjaro	Tanga	Korogwe	200		20	30	10

Attachment-7.5.1 (12/18) Priority Irrigation Schemes for Phase 2 Implementation by 2035 in Kilimanjaro ZIO

SN	Name of Scheme	ZIO name	Region Name	District Name	Potential Area (ha)	Designed Area (ha)	Developed Area (ha)	Irrigated Area (Wet) in ha	Irrigated Area (Dry) in ha
73	Mswaha Darajani	Kilimanjaro	Tanga	Korogwe	50	50	30	30	20
74	Mapangoni	Kilimanjaro	Tanga	Korogwe	200	200	50	30	20
75	Kitivo	Kilimanjaro	Tanga	Lushoto	420		420	300	60
76	Magwekuo	Kilimanjaro	Tanga	Lushoto	50		30	30	20
77	Wanga Ukolongwe	Kilimanjaro	Tanga	Lushoto	60		50		30
78	Mkumbara Zimbiri	Kilimanjaro	Tanga	Lushoto	120		100	60	30
79	Manzashai Kwemng'ong'o	Kilimanjaro	Tanga	Lushoto	200		100	90	50
80	Kwenkani	Kilimanjaro	Tanga	Lushoto	150		70	70	40
81	Mambo Kwem.	Kilimanjaro	Tanga	Lushoto	60		40	50	40
82	Ngaradai Zeta	Kilimanjaro	Tanga	Lushoto	240		100	50	100
83	Mdando	Kilimanjaro	Tanga	Lushoto	150		80	80	20
84	Nkukai Dindira	Kilimanjaro	Tanga	Lushoto	60		40	40	30
85	Mazia	Kilimanjaro	Tanga	Lushoto	100		60	60	40
86	Mavumo	Kilimanjaro	Tanga	Lushoto	100			60	
87	Ndelemai Magila	Kilimanjaro	Tanga	Lushoto	80		80	80	60
88	Churwa	Kilimanjaro	Tanga	Mkinga	400		15	15	15
89	Ndondondo (potwe)	Kilimanjaro	Tanga	Muheza	100		20	55	30
90	Kigurusimba Dam Scheme	Kilimanjaro	Tanga	Pangani	280				
91	Mafuriko	Kilimanjaro	Tanga	Tanga TC	90			10	

Sources: JICA Project Team

Attachment-7.5.1 (13/18) Priority Irrigation Schemes for Phase 2 Implementation by 2035 in Mbeya ZIO

SN	Name of Scheme	ZIO name	Region Name	District Name	Potential Area (ha)	Designed Area (ha)	Developed Area (ha)	Irrigated Area (Wet) in ha	Irrigated Area (Dry) in ha
Large Scale Schemes									
1	Mkombozi	Mbeya	Iringa	Iringa	3,050		1,000	3,200	34
2	Nyanzwa	Mbeya	Iringa	Kilolo	3,000		950		66
3	Songwe River Basin Development Project	Mbeya	Mbeya	Kyela	3,150				
4	Msesule	Mbeya	Mbeya	Mbarali	2,500		525	525	
5	Mbuyuni Kimani	Mbeya	Mbeya	Mbarali	3,000		1,500	1,500	
6	Lyanyula	Mbeya	Mbeya	Mbarali	2,000		768	768	8
7	Msangano	Mbeya	Songwe	Momba	3,000			500	
8	Kasinde	Mbeya	Songwe	Momba	8,000			2,000	
9	Iyendwe	Mbeya	Songwe	Momba	3,000			1,200	
Medium Scale Schemes									
1	Idodi	Mbeya	Iringa	Iringa	1,000		250	250	10
2	Magozi	Mbeya	Iringa	Iringa	1,300		400	600	50
3	Idodi Mbuyuni	Mbeya	Iringa	Iringa	1,000		250	250	10
4	Mafuruto	Mbeya	Iringa	Iringa	500		100	100	50
5	Kaning'ombe	Mbeya	Iringa	Iringa	588		388	388	50
6	Tungamalenga	Mbeya	Iringa	Iringa	500		300	300	100
7	Lwanga	Mbeya	Iringa	Iringa	1,000		164	164	64
8	Kiwere	Mbeya	Iringa	Iringa	600		300	300	300
9	Idodi Mpya	Mbeya	Iringa	Iringa	1,000		250	250	10
10	Mgololo	Mbeya	Iringa	Mufindi	1,000	700	80	80	580
11	Ifumbo	Mbeya	Mbeya	Chunya	600	200	151	200	151
12	Tenende	Mbeya	Mbeya	Kyela	500		160	30	10
13	Ngana	Mbeya	Mbeya	Kyela	600		209	200	60
14	Ikama	Mbeya	Mbeya	Kyela	600		325	300	100
15	Njombe	Mbeya	Mbeya	Mbarali	600		519	519	
16	Igumbilo Isitu	Mbeya	Mbeya	Mbarali	500		475	475	
17	Ipatagwa	Mbeya	Mbeya	Mbarali	1,240		550	550	50
18	Motombaya	Mbeya	Mbeya	Mbarali	800		600	600	
19	Isenyela	Mbeya	Mbeya	Mbarali	1,040		600	600	
20	Lwanyoe	Mbeya	Mbeya	Mbarali	1,000	1,000	1,000	1,000	400
21	Kapyo	Mbeya	Mbeya	Mbarali	600		329	329	100
22	Matebete	Mbeya	Mbeya	Mbarali	570		470	470	120
23	Mbalino	Mbeya	Mbeya	Mbarali	1,500				
24	Majengo	Mbeya	Mbeya	Mbarali	1,300		550	550	
25	Maendeleo	Mbeya	Mbeya	Mbarali	1,255		795	795	120
26	Mashala	Mbeya	Mbeya	Mbarali	500			400	
27	Manienga A	Mbeya	Mbeya	Mbarali	1,000			289	80
28	Lihamile Ukwavila	Mbeya	Mbeya	Mbarali	1,000		400	600	100
29	Njalalila	Mbeya	Mbeya	Mbarali	800		320	320	80
30	Kapunga Small Holder	Mbeya	Mbeya	Mbarali	875	875	800	800	
31	Kilocha	Mbeya	Njombe	Njombe TC	595		310	310	310
32	Yakobi	Mbeya	Njombe	Njombe TC	575		3	81	3
33	Ikombe (ilulu)	Mbeya	Songwe	Ileje	650	600	600	240	30
Small Scale Schemes									
1	Mapogoro 1	Mbeya	Iringa	Iringa	400		350	200	50

Attachment-7.5.1 (13/18) Priority Irrigation Schemes for Phase 2 Implementation by 2035 in Mbeya ZIO

SN	Name of Scheme	ZIO name	Region Name	District Name	Potential Area (ha)	Designed Area (ha)	Developed Area (ha)	Irrigated Area (Wet) in ha	Irrigated Area (Dry) in ha
2	Ipwasi Ndorobo	Mbeya	Iringa	Iringa	300		100	100	100
3	Nyamahana	Mbeya	Iringa	Iringa	150		109	100	50
4	Mapogoro 2	Mbeya	Iringa	Iringa	400		350	200	50
5	Makifu	Mbeya	Iringa	Iringa	300		20	20	5
6	Kalenga	Mbeya	Iringa	Iringa	300		225	225	100
7	Makuka	Mbeya	Iringa	Iringa	200		120	120	56
8	Kibebe	Mbeya	Iringa	Iringa	75		25	75	35
9	Ulete	Mbeya	Iringa	Iringa	200		134	134	
10	Ifunda	Mbeya	Iringa	Iringa	62		12	12	5
11	Ulongambi 1	Mbeya	Iringa	Iringa	150		100	50	50
12	Ulongambi 2	Mbeya	Iringa	Iringa	150		100	50	50
13	Pawaga Prizon Farm	Mbeya	Iringa	Iringa	160		45	38	5
14	Kitanewa Parish/mapogoro	Mbeya	Iringa	Iringa	400		350	200	50
15	Magubike	Mbeya	Iringa	Iringa	300		100	100	30
16	Kibena	Mbeya	Iringa	Iringa	82		10	8	2
17	Magunga	Mbeya	Iringa	Iringa	120		18	2	18
18	Kikiombwe	Mbeya	Iringa	Iringa	240		40	40	10
19	Wangama	Mbeya	Iringa	Iringa	150		25	25	25
20	Tanangozi Drip	Mbeya	Iringa	Iringa	100		25	25	25
21	Makongati	Mbeya	Iringa	Iringa	200			26	
22	Lupembelwasenga	Mbeya	Iringa	Iringa	110			48	
23	Malinzanga	Mbeya	Iringa	Iringa	400		200	200	
24	Mbaramo Mgama	Mbeya	Iringa	Iringa	300		50	10	10
25	Weru	Mbeya	Iringa	Iringa	100		72	72	35
26	Kitete	Mbeya	Iringa	Kilolo	120		30	8	12
27	Ihongole	Mbeya	Iringa	Kilolo	80		12	12	12
28	Ikula	Mbeya	Iringa	Kilolo	120	80	80	34	22
29	Mtula	Mbeya	Iringa	Mafinga TC	75	75	75	25	45
30	Igomaa	Mbeya	Iringa	Mufindi	100	100	100	100	60
31	Sele	Mbeya	Mbeya	Chunya	76			76	28
32	Mbuyuni	Mbeya	Mbeya	Chunya	478			371	97
33	Makwale 1	Mbeya	Mbeya	Kyela	200			200	120
34	Makwale 2	Mbeya	Mbeya	Kyela	200			200	120
35	Ikumbilo	Mbeya	Mbeya	Kyela	200		100	100	15
36	Katumba - Songwe	Mbeya	Mbeya	Kyela	300		480	200	50
37	Ruanda Majenje	Mbeya	Mbeya	Mbarali	371		371	370	30
38	Kongolo Mswiswi	Mbeya	Mbeya	Mbarali	320		329	329	100
39	Mtemela	Mbeya	Mbeya	Mbarali	350		230	230	
40	Chang'ombe	Mbeya	Mbeya	Mbarali	300		160	160	20
41	Magombole	Mbeya	Mbeya	Mbarali	282			120	
42	Shamwengo-mkoji	Mbeya	Mbeya	Mbeya	380	100	100	100	80
43	Imezu Mkombozi	Mbeya	Mbeya	Mbeya	90	50	50	50	46
44	Inyala A	Mbeya	Mbeya	Mbeya	200	150	150	150	130
45	Inyala B	Mbeya	Mbeya	Mbeya	153	120	120	120	112
46	Iyawaya	Mbeya	Mbeya	Mbeya	175	73	73	73	68
47	Ihombe	Mbeya	Mbeya	Mbeya	205	98	98	98	92

Attachment-7.5.1 (13/18) Priority Irrigation Schemes for Phase 2 Implementation by 2035 in Mbeya ZIO

SN	Name of Scheme	ZIO name	Region Name	District Name	Potential Area (ha)	Designed Area (ha)	Developed Area (ha)	Irrigated Area (Wet) in ha	Irrigated Area (Dry) in ha
48	Kasyabone	Mbeya	Mbeya	Busokelo	150	150	100	120	150
49	Kisegese	Mbeya	Mbeya	Busokelo	320	320	320	320	150
50	Mbambo	Mbeya	Mbeya	Busokelo	150	150	100	150	100
51	Kifunda I	Mbeya	Mbeya	Busokelo	140	140	140	140	80
52	Kifunda II	Mbeya	Mbeya	Busokelo	140	140	140	140	80
53	Kilugu	Mbeya	Mbeya	Busokelo	180	180			
54	Katungila	Mbeya	Mbeya	Busokelo	235	235			
55	Ndola	Mbeya	Mbeya	Busokelo	360	360			
56	Lusungo	Mbeya	Mbeya	Busokelo	105				
57	Mwabuke	Mbeya	Mbeya	Busokelo	175				
58	Ipyana	Mbeya	Mbeya	Busokelo	135				
59	Mkiu	Mbeya	Njombe	Ludewa	140	20	20		
60	Matenga	Mbeya	Njombe	Makete	400	150	400	149	149
61	Makoga	Mbeya	Njombe	Makete	50		5	5	5
62	Welela 1	Mbeya	Njombe	Njombe	66		50	50	42
63	Ibumila	Mbeya	Njombe	Njombe	108		60	60	42
64	Ibiki	Mbeya	Njombe	Njombe	105		60	60	52
65	Welela 2	Mbeya	Njombe	Njombe	56		48	48	37
66	Ninga	Mbeya	Njombe	Njombe	80		64	64	20
67	Lima	mbeya	Njombe	Njombe	92		57	57	47
68	Manima	Mbeya	Njombe	Njombe TC	74		3	39	3
69	Igola	Mbeya	Njombe	Njombe TC	143		64	91	64
70	Ngalanga	Mbeya	Njombe	Njombe TC	406		91	123	91
71	Mgala	Mbeya	Njombe	Njombe TC	451		8	84	8
72	Ng'elamo	Mbeya	Njombe	Njombe TC	151		111	111	111
73	Iboya	Mbeya	Njombe	Njombe TC	156		12	34	12
74	Boimanda	Mbeya	Njombe	Njombe TC	164	164	37	37	37
75	Miva	Mbeya	Njombe	Njombe TC	482		68	98	68
76	Lukumburu	Mbeya	Njombe	Njombe TC	345		4	67	4
77	Utengule A	Mbeya	Njombe	Njombe TC	356		59	59	59
78	Mmamongolo	Mbeya	Njombe	Njombe TC	331		86	104	86
79	Liwengi	Mbeya	Njombe	Njombe TC	185		43	74	43
80	Mikongo	Mbeya	Njombe	Njombe TC	59		4	53	4
81	Utengule B	Mbeya	Njombe	Njombe TC	96		7	7	7
82	Makanjaula	Mbeya	Njombe	Njombe TC	178		26	58	26
83	Nundu	Mbeya	Njombe	Njombe TC	84		47	47	47
84	Jikomboe (ikumbilo - Chitete)	Mbeya	Songwe	Ileje	420	420	200	100	259
85	Senga	Mbeya	Songwe	Ileje	220	158	120	106	15
86	Iyula	Mbeya	Songwe	Mbozi	250	180	60	180	60
87	Nambinzo	Mbeya	Songwe	Mbozi	90				12

Sources: JICA Project Team

Attachment-7.5.1 (14/18) Priority Irrigation Schemes for Phase 2 Implementation by 2035 in Morogoro ZIO

SN	Name of Scheme	ZIO name	Region Name	District Name	Potential Area (ha)	Designed Area (ha)	Developed Area (ha)	Irrigated Area (Wet) in ha	Irrigated Area (Dry) in ha
Large Scale Schemes									
1	Mgugwe	Morogoro	Morogoro	Kilombero	3,701	2,270		20	10
2	Likeya Traditional Irr. Scheme	Morogoro	Morogoro	Malinyi	3,070				68
3	Usangule Traditional Scheme	Morogoro	Morogoro	Malinyi	2,075				
4	Kilangali Smallholder	Morogoro	Morogoro	Kilosa	2,000			520	
5	Iyogwe/dibwige Valley	Morogoro	Morogoro	Kilosa	3,600			1,480	480
6	Bwage	Morogoro	Morogoro	Morogoro	3,600			30	30
7	Mngazi	Morogoro	Morogoro	Morogoro	3,000				
8	Lukenge	Morogoro	Morogoro	Mvomero	5,292		715	715	
9	Kisere	Morogoro	Pwani	Mkuranga	14,000		200		
10	Lukulilo	Morogoro	Pwani	Rufiji	5,000		100	100	
11	Muhoro	Morogoro	Pwani	Rufiji	5,000				
Medium Scale Schemes									
1	Mvumi	Morogoro	Morogoro	Kilosa	720		293	293	134
2	Ilonga	Morogoro	Morogoro	Kilosa	640	330		330	140
3	Chanzuru	Morogoro	Morogoro	Kilosa	680	240	240	240	10
4	Chabi Juu	Morogoro	Morogoro	Kilosa	1,190		700	300	
5	Ulaya	Morogoro	Morogoro	Kilosa	692			4	
6	Kihondo	Morogoro	Morogoro	Kilosa	500			10	
7	Mkobwe - Msowero	Morogoro	Morogoro	Kilosa	800			10	
8	Kidogobasi/kimamba	Morogoro	Morogoro	Kilosa	1,400		25	250	
9	Chabi - Itipi	Morogoro	Morogoro	Kilosa	1,190			700	
10	Kilombero Sugar (K2)	Morogoro	Morogoro	Kilosa	560		500	60	500
11	Usungura	Morogoro	Morogoro	Morogoro	500		200	500	100
12	Bwakira Chini	Morogoro	Morogoro	Morogoro	650			45	45
13	Gomero	Morogoro	Morogoro	Morogoro	500			34	34
14	Mbalangwe	Morogoro	Morogoro	Morogoro	1,000	230	200	200	200
15	Mkulazi	Morogoro	Morogoro	Morogoro	1,500				
16	Msufini	Morogoro	Morogoro	Mvomero	1,000			200	20
17	Lungo	Morogoro	Morogoro	Mvomero	1,500		15	15	
18	Lupiro 1 (Iuri River)	Morogoro	Morogoro	Ulanga	1,200		108	80	60
19	Luhomberi	Morogoro	Morogoro	Ulanga	840	840			
20	Lupiro 2 (Iuri River)	Morogoro	Morogoro	Ulanga	890		108	80	60
21	Lupiro 3 (Iuri River)	Morogoro	Morogoro	Ulanga	1,100		108	80	60
22	Mbuga	Morogoro	Morogoro	Ulanga	540	540			
23	Ilonga - Ulanga	Morogoro	Morogoro	Ulanga	840				
24	Mkoko (potential Area)	Morogoro	Pwani	Chalinze	500			10	
25	Mkongo	Morogoro	Pwani	Rufiji	500				
Small Scale Schemes									
1	Kawe	Morogoro	Dar es Salaam	Kinondoni MC	81			60	15
2	Nyange	Morogoro	Dar es Salaam	Kigamboni MC	200	32	32	32	
3	Chanjale/lukande	Morogoro	Morogoro	Gairo	250		160	80	80
4	Njage	Morogoro	Morogoro	Kilombero	325	325	175	175	100
5	Ibingu	Morogoro	Morogoro	Kilosa	110		50	15	15
6	Mzinga Rice Farm	Morogoro	Morogoro	Morogoro	200		12	12	

Attachment-7.5.1 (14/18) Priority Irrigation Schemes for Phase 2 Implementation by 2035 in Morogoro ZIO

SN	Name of Scheme	ZIO name	Region Name	District Name	Potential Area (ha)	Designed Area (ha)	Developed Area (ha)	Irrigated Area (Wet) in ha	Irrigated Area (Dry) in ha
7	Kibwaya	Morogoro	Morogoro	Morogoro	400			35	35
8	Msonge	Morogoro	Morogoro	Morogoro	150			120	50
9	Nakafulu Vegetable Gardening	Morogoro	Morogoro	Ulanga	50		10	10	3
10	Kichangani A -Veg Garden	Morogoro	Morogoro	Ulanga	160		12	12	10
11	Kigongoni Prison Farm	Morogoro	Pwani	Bagamoyo	200		200	200	200
12	Marui - Mipera (mtuna Bwawani)	Morogoro	Pwani	Kisarawe	120		70	70	25
13	Marui - Ngwata (kisoti Bwawani)	Morogoro	Pwani	Kisarawe	120		70	70	25
14	Marui - Mipera (mkongoroni)	Morogoro	Pwani	Kisarawe	120		70	70	25
15	Rubada - Mkongo	Morogoro	Pwani	Rufiji	60	20	20	20	20
16	Tawi/utunge	Morogoro	Pwani	Rufiji	50		10	10	5

Sources: JICA Project Team

Attachment-7.5.1 (15/18) Priority Irrigation Schemes for Phase 2 Implementation by 2035 in Mtwara ZIO

SN	Name of Scheme	ZIO name	Region Name	District Name	Potential Area (ha)	Designed Area (ha)	Developed Area (ha)	Irrigated Area (Wet) in ha	Irrigated Area (Dry) in ha
Large Scale Schemes									
1	Mbwemkulu	Mtwara	Lindi	Kilwa	2,800			200	20
2	Lukuledi Irrigation Project	Mtwara	Lindi	Lindi	4,680				
3	Mokondeko	Mtwara	Mtwara	Newala	2,000			120	
4	Mahurunga	Mtwara	Mtwara	Mtwara	3,200		0	100	100
5	Mokondeko	Mtwara	Mtwara	Newala	2,000			120	
6	Liganga Aviv	Mtwara	Ruvuma	Songea	3,000	270	270	278	270
7	Nambendo Missionary land	Mtwara	Ruvuma	Songea	10,000				
Medium Scale Schemes									
1	Mavuji Drip Irr.	Mtwara	Lindi	Kilwa	500		-	250	200
2	Mkwaya	Mtwara	Lindi	Lindi MC	500			150	
3	Mangirikiti	Mtwara	Lindi	Liwale	500	230	230		
4	Mapalagwe	Mtwara	Mtwara	Masasi	1,200	1,200	800	450	350
5	Chikwedu-chipamanda	Mtwara	Mtwara	Newala	1,200	1,200	800	450	350
6	Nacha	Mtwara	Mtwara	Tandahimba	1,120	980	980	980	200
7	Luhagara	Mtwara	Ruvuma	Mbinga	800	800	240	70	490
8	Ndongosi	Mtwara	Ruvuma	Songea	1,200	217		28	28
Small Scale Schemes									
1	Makangaga	Mtwara	Lindi	Kilwa	250		250	250	80
2	Mpindiro	Mtwara	Lindi	Kilwa	200			70	15
3	Mtualonga	Mtwara	Lindi	Lindi	300				
4	Mtama	Mtwara	Lindi	Lindi	400				
5	Matapata	Mtwara	Lindi	Lindi MC	400	400	200	200	
6	Kipule	Mtwara	Lindi	Liwale	200			40	
7	Mlembwe	Mtwara	Lindi	Liwale	150				
8	Tandamanga	Mtwara	Lindi	Liwale	300	150	75	90	20
9	Nduruka	Mtwara	Lindi	Liwale	200		10		
10	Mpengere	Mtwara	Lindi	Liwale	120				
11	Liwale	Mtwara	Lindi	Liwale	300		275	275	
12	Ntila	Mtwara	Lindi	Nachingwea	350	120	290	86	150
13	Ilolo	Mtwara	Lindi	Nachingwea	340	340		136	36
14	Mitumbati	Mtwara	Lindi	Nachingwea	120		100	34	
15	Matekwe	Mtwara	Lindi	Nachingwea	480		100	20	
16	Mkowe	Mtwara	Lindi	Ruangwa	340	340		136	36
17	Chikoko	Mtwara	Lindi	Ruangwa	400	48	48	30	0
18	Lipeleng'enye	Mtwara	Mtwara	Newala	190	190	100	70	30
19	Chikalule	Mtwara	Mtwara	Newala	180	180	150	45	105
20	Chilangala	Mtwara	Mtwara	Newala	58	58	9	3	6
21	Lukuledi Missionary	Mtwara	Mtwara	Masasi	100				
22	Lipeleng'enye	Mtwara	Mtwara	Newala	190	190	100	70	30
23	Chikalule	Mtwara	Mtwara	Newala	180	180	150	45	105
24	Litehu	Mtwara	Mtwara	Tandahimba	300	44	30	30	
25	Lipalwe	Mtwara	Mtwara	Tandahimba	450				

Attachment-7.5.1 (15/18) Priority Irrigation Schemes for Phase 2 Implementation by 2035 in Mtwara ZIO

SN	Name of Scheme	ZIO name	Region Name	District Name	Potential Area (ha)	Designed Area (ha)	Developed Area (ha)	Irrigated Area (Wet) in ha	Irrigated Area (Dry) in ha
26	Sangamabuni	Mtwara	Ruvuma	Mbinga	200	124	100	100	100
27	Mkungwe	Mtwara	Ruvuma	Mbinga	150	60	25	15	15
28	Nyamakula	Mtwara	Ruvuma	Mbinga	64		34	34	30
29	Nyamilola	Mtwara	Ruvuma	Mbinga	206		68	68	68
30	Nyati	Mtwara	Ruvuma	Mbinga	68		54	54	54
31	Sanga Luhagara	Mtwara	Ruvuma	Mbinga	150		18	18	18
32	Juhudi Nakalola	Mtwara	Ruvuma	Mbinga	60		48	48	30
33	Litorongi	Mtwara	Ruvuma	Mbinga	101	101	54	32	15
34	Mkako	Mtwara	Ruvuma	Mbinga	150	150	20	20	
35	Masepe	Mtwara	Ruvuma	Mbinga	61	61	33	33	
36	Namahoka	Mtwara	Ruvuma	Namtumbo	120			21	21
37	Mtonya	Mtwara	Ruvuma	Namtumbo	120			128	128
38	Namawala	Mtwara	Ruvuma	Namtumbo	61			100	100
39	Liyuni	Mtwara	Ruvuma	Namtumbo	400	270	270	278	270
40	Mchomoro	Mtwara	Ruvuma	Namtumbo	60			22	6
41	Magazini	Mtwara	Ruvuma	Namtumbo	150			17	17
42	Milonji	Mtwara	Ruvuma	Namtumbo	56			11	11
43	Likuyu Seka	Mtwara	Ruvuma	Namtumbo	55	40	22	11	7
44	Mkongogulioni	Mtwara	Ruvuma	Namtumbo	300	90	90	69	45
45	Luhimbalilo	Mtwara	Ruvuma	Namtumbo	50			28	28
46	Kimpuna	Mtwara	Ruvuma	Namtumbo	120			80	30
47	Naikesi	Mtwara	Ruvuma	Namtumbo	120	100	100	100	700
48	Kitanda B	Mtwara	Ruvuma	Namtumbo	100	100	81	81	
49	Mpitimbi B	Mtwara	Ruvuma	Songea	200		5	88	88
50	Likuyufusi	Mtwara	Ruvuma	Songea	50				
51	Mpitimbi A	Mtwara	Ruvuma	Songea	200				
52	Magagura	Mtwara	Ruvuma	Songea	60				
53	Chinunje	Mtwara	Ruvuma	Tunduru	374			50	10
54	Mbati	Mtwara	Ruvuma	Tunduru	100			50	30
55	Legezamwendo	Mtwara	Ruvuma	Tunduru	240	150	150	100	45
56	Madaba 1	Mtwara	Ruvuma	Tunduru	150	150	150	70	40
57	Madaba 2	Mtwara	Ruvuma	Tunduru	100	100	100	60	20
58	Masonya	Mtwara	Ruvuma	Tunduru	200			50	35
59	Mkotamo	Mtwara	Ruvuma	Tunduru	422			100	40
60	Wenje	Mtwara	Ruvuma	Tunduru	300	96		50	30
61	Misyaje	Mtwara	Ruvuma	Tunduru	280	120	120	80	45
62	Nasya	Mtwara	Ruvuma	Tunduru	218			40	20
63	Namasalau	Mtwara	Ruvuma	Tunduru	200			50	20

Sources: JICA Project Team

Attachment-7.5.1 (16/18) Priority Irrigation Schemes for Phase 2 Implementation by 2035 in Mwanza ZIO

SN	Name of Scheme	ZIO name	Region Name	District Name	Potential Area (ha)	Designed Area (ha)	Developed Area (ha)	Irrigated Area (Wet) in ha	Irrigated Area (Dry) in ha
Large Scale Schemes									
1	Kijjongo-nyakigando (Ngono Project)	Mwanza	Kagera	Bukoba	2,035	0	0	60	0
2	Buligi Plains	Mwanza	Kagera	Muleba	5,000	5,000			
3	Biswari	Mwanza	Mara	Tarime	2,000	40	0	87	0
Medium Scale Schemes									
1	Makurugusi Valley 2	Mwanza	Geita	Chato	1,500	0	0	600	0
2	Ichwankima	Mwanza	Geita	Chato	650	0	0	210	0
3	Luhuha/inyala	Mwanza	Geita	Geita	1,200	0	0	120	0
4	Nyarubanga East	Mwanza	Geita	Geita	500	0	0	100	0
5	Kanegele	Mwanza	Geita	Nyangh'wale	720		0	0	0
6	Migango	Mwanza	Kagera	Biharamulo	1,400	0	0	450	0
7	Kaniha	Mwanza	Kagera	Biharamulo	1,300	0	0	160	0
8	Mugozi	Mwanza	Kagera	Ngara	540	0	0	100	0
9	Suguti/kataryo	Mwanza	Mara	Musoma	600	200	40	40	0
10	Mahiga	Mwanza	Mwanza	Kwimba	800	400	300	242	75
11	Kimiza	Mwanza	Mwanza	Kwimba	600				0
12	Nyashidala	Mwanza	Mwanza	Misungwi	1,500	320	245	220	0
13	Isole /kishinda (Proposed)	Mwanza	Mwanza	Sengerema	1,000	600	0	0	0
Small Scale Schemes									
1	Bugelenga	Mwanza	Geita	Bukombe	96			150	0
2	Kalebezo	Mwanza	Geita	Chato	200			100	0
3	Buziba	Mwanza	Geita	Geita	111	0	0	50	0
4	Imalanguzu	Mwanza	Geita	Geita	200	0	0	120	0
5	Nyarubanga West	Mwanza	Geita	Geita	200	0	0	85	0
6	Mugelele	Mwanza	Geita	Mbogwe	400	350			0
7	Nyakasaluma	Mwanza	Geita	Mbogwe	200	0	0	40	0
8	Mimbili	Mwanza	Geita	Nyangh'wale	100	0	0	0	0
9	Lushimba	Mwanza	Geita	Nyangh'wale	280	0	0	0	0
10	Izunya	Mwanza	Geita	Nyangh'wale	78	0	0	0	0
11	Busolwa	Mwanza	Geita	Nyangh'wale	168	0	0	0	0
12	Kagera Tea Estate (Maruku)	Mwanza	Kagera	Bukoba	200	300			0
13	Kazinga (Ngono Project)	Mwanza	Kagera	Bukoba	64	0	0	15	0
14	Ikimba (Ngono project)	Mwanza	Kagera	Bukoba	300	0	0	50	0
15	Ngarama (Ngono Project)	Mwanza	Kagera	Bukoba	435	0	0	17	0
16	Buturage (Ngono project)	Mwanza	Kagera	Missenyi	453	141	0	0	0
17	Buchurago 1 (Ngono Project)	Mwanza	Kagera	Missenyi	269	179	0	0	0
18	Kafunzo (Ngono project)	Mwanza	Kagera	Missenyi	240	240			0
19	Kyakakera (Ngono project)	Mwanza	Kagera	Missenyi	405	405	48	48	0
20	Ngono (Mamba) (Ngono project)	Mwanza	Kagera	Missenyi	135	135	0	0	0
21	Bulembo North (Ngono project)	Mwanza	Kagera	Missenyi	214	214	0	0	0

Attachment-7.5.1 (16/18) Priority Irrigation Schemes for Phase 2 Implementation by 2035 in Mwanza ZIO

SN	Name of Scheme	ZIO name	Region Name	District Name	Potential Area (ha)	Designed Area (ha)	Developed Area (ha)	Irrigated Area (Wet) in ha	Irrigated Area (Dry) in ha
22	Bulembo South (Ngono Project)	Mwanza	Kagera	Missenyi	235	235	0	0	0
23	Nyakabango	Mwanza	Kagera	Muleba	100	0	0	10	10
24	Bigombo	Mwanza	Kagera	Ngara	110	0	0	80	0
25	Mpanyula	Mwanza	Kagera	Ngara	450	231	0	231	0
26	Kisangwa	Mwanza	Mara	Bunda TC	124	124	78	40	10
27	Namhula	Mwanza	Mara	Bunda	150	100	40	40	
28	Nansimo	Mwanza	Mara	Bunda	160	80	120	50	
29	Balili	Mwanza	Mara	Bunda TC	80	40	40	40	0
30	Rubana Farm	Mwanza	Mara	Bunda TC	400		100	50	20
31	Kibara Busambara	Mwanza	Mara	Bunda	150	0	50	10	7
32	Buswahili	Mwanza	Mara	Butiama	50		50	50	0
33	Bugwema Solar	Mwanza	Mara	Musoma	100			0	0
34	Rwang'enyi	Mwanza	Mara	Rorya	350			100	0
35	Nyamitita	Mwanza	Mara	Serengeti	150	100	92	92	50
36	Mesaga	Mwanza	Mara	Serengeti	300	200	0	100	0
37	Bugelela Farm Project	Mwanza	Mara	Serengeti	200	80	20	40	
38	Malya	Mwanza	Mwanza	Kwimba	300	200	200	200	0
39	Luhala	Mwanza	Mwanza	Kwimba	200			80	0
40	Goloma	Mwanza	Mwanza	Kwimba	420	0	0	0	0
41	Shilanona	Mwanza	Mwanza	Kwimba	250				
42	Shilanona I	Mwanza	Mwanza	Kwimba	250			201	100
43	Ngula	Mwanza	Mwanza	Kwimba	300	0	0	0	0
44	Shilanona II	Mwanza	Mwanza	Kwimba	200				100
45	Nyamatala I	Mwanza	Mwanza	Kwimba	380	0	0	0	0
46	Nyamatala II	Mwanza	Mwanza	Kwimba	350	0	0	0	0
47	Mwitambu	Mwanza	Mwanza	Kwimba	420	0	0	0	0
48	Mwankulwe	Mwanza	Mwanza	Kwimba	350	0	0	0	0
49	Chabula	Mwanza	Mwanza	Magu	216			50	
50	Igenge	Mwanza	Mwanza	Misungwi	116	53	53	30	
51	Ilujamate	Mwanza	Mwanza	Misungwi	365	185	185	185	0
52	Mbarika	Mwanza	Mwanza	Misungwi	200	100	100		0
53	Nyang'homango	Mwanza	Mwanza	Misungwi	250	195	120	75	0
54	Sukuma	Mwanza	Mwanza	Buchosa	200	200			0
55	Sukuma	Mwanza	Mwanza	Sengerema	200	200			0
56	Kafunzo	Mwanza	Mwanza	Buchosa	300	200	0	0	0
57	Kalebezo/magulukenda	Mwanza	Mwanza	Buchosa	200	200	0	0	0
58	Bugorola	Mwanza	Mwanza	Ukerewe	200	200	74		0
59	Miyogwezi	Mwanza	Mwanza	Ukerewe	120	120	40	40	0

Sources: JICA Project Team

Attachment-7.5.1 (17/18) Priority Irrigation Schemes for Phase 2 Implementation by 2035 in Tabora ZIO

SN	Name of Scheme	ZIO name	Region Name	District Name	Potential Area (ha)	Designed Area (ha)	Developed Area (ha)	Irrigated Area (Wet) in ha	Irrigated Area (Dry) in ha
Large Scale Schemes									
1	Nyamilangano	Tabora	Shinyanga	Ushetu	3,500	0	0	0	0
2	Amani	Tabora	Shinyanga	Shinyanga	6,000	1,000	0	0	0
3	Mwalunili	Tabora	Tabora	Igunga	2,000				
4	Ifumba	Tabora	Tabora	Nzega	2,200		600		
Medium Scale Schemes									
1	Chela	Tabora	Shinyanga	Msalala	1,000	354	100	100	400
2	Kahanga	Tabora	Shinyanga	Kahama TC	600	450	450	450	
3	Mwajiginya B	Tabora	Shinyanga	Kishapu	600				
4	Mihama	Tabora	Shinyanga	Kishapu	600	0	0	0	0
5	Mwajidalala	Tabora	Shinyanga	Kishapu	1,000	0	0	0	0
6	Nduguti	Tabora	Shinyanga	Shinyanga	1,300	420	420	420	0
7	Kasoli	Tabora	Simiyu	Bariadi	670	480	0	200	0
8	Lutubiga	Tabora	Simiyu	Busega	738	120	50	50	0
9	Bukigi	Tabora	Simiyu	Maswa	700	500	500	319	0
10	Ijinga	Tabora	Simiyu	Maswa	700	500	500	410	0
11	Pandagi	Tabora	Simiyu	Maswa	650	501	501	471	0
12	Kinamwigulu	Tabora	Simiyu	Maswa	500	100	200	65	0
13	Buyubi	Tabora	Simiyu	Maswa	650	501	501	471	0
14	Igurubi (Dam Scheme)	Tabora	Tabora	Igunga	1,500	334	334		
15	Makomelo	Tabora	Tabora	Igunga	1,500				
16	Mwashiku	Tabora	Tabora	Igunga	800	300			
17	Buhekela	Tabora	Tabora	Igunga	800	400	400		
18	Mnange	Tabora	Tabora	Kaliua	500				
19	Ikindwa (dam scheme)	Tabora	Tabora	Nzega	700	100	100		
20	Budushi	Tabora	Tabora	Nzega	500		250	400	
21	Sigili	Tabora	Tabora	Nzega	600		153	153	
22	Ulyanyama	Tabora	Tabora	Sikonge	500	300	200		
23	Mibono	Tabora	Tabora	Sikonge	650	400			
Small Scale Schemes									
1	Isagehe	Tabora	Shinyanga	Kahama TC	100	40	40	40	10
2	Mwagwila	Tabora	Simiyu	Meatu	250	120	30		0
3	Itumba	Tabora	Tabora	Igunga	200	158	158	158	
4	Igombe	Tabora	Tabora	Kaliua	300				
5	Ichemba B	Tabora	Tabora	Kaliua	150				
6	Ichemba A	Tabora	Tabora	Kaliua	200				
7	Makao	Tabora	Tabora	Kaliua	300				
8	Igwisi Mlimani	Tabora	Tabora	Kaliua	450				
9	Igwisi	Tabora	Tabora	Kaliua	350				
10	Mpakani Mwa Makazi	Tabora	Tabora	Kaliua	250				
11	Barabara Ya 60	Tabora	Tabora	Kaliua	300				
12	Imara	Tabora	Tabora	Kaliua	250				
13	Malolo A (dam scheme)	Tabora	Tabora	Nzega	203	170	120	83	
14	Mwasala	Tabora	Tabora	Nzega	300		226	226	
15	Lakuyi	Tabora	Tabora	Nzega	150		60	93	20

Attachment-7.5.1 (17/18) Priority Irrigation Schemes for Phase 2 Implementation by 2035 in Tabora ZIO

SN	Name of Scheme	ZIO name	Region Name	District Name	Potential Area (ha)	Designed Area (ha)	Developed Area (ha)	Irrigated Area (Wet) in ha	Irrigated Area (Dry) in ha
16	Mambali (dam scheme)	Tabora	Tabora	Nzega	300		50	50	20
17	Chamipulu	Tabora	Tabora	Nzega	400		329	329	
18	Nindo	Tabora	Tabora	Nzega	150				
19	Igigwa Irrigation Scheme	Tabora	Tabora	Sikonge	150	75	75	50	25
20	Goweko	Tabora	Tabora	Uyui	300			50	16
21	Miswaki	Tabora	Tabora	Uyui	225				

Sources: JICA Project Team

Attachment-7.5.1 (18/18) Priority Irrigation Schemes for Phase 2 Implementation by 2035 in Katavi ZIO

SN	Name of Scheme	ZIO name	Region Name	District Name	Potential Area (ha)	Designed Area (ha)	Developed Area (ha)	Irrigated Area (Wet) in ha	Irrigated Area (Dry) in ha
Large Scale Schemes									
1	Kilida	Katavi	Katavi	Mpimbwe	3,500	2,000	212	212	212
2	Ilalangulu Dam Scheme	Katavi	Katavi	Mpimbwe	13,000				
3	Itenka	Katavi	Katavi	Nsimbo	3,546				
4	Karema Dam Scheme	Katavi	Katavi	Mpanda	3,000	2,721	1,000	1,323	
5	Mnyagara	Katavi	Katavi	Mpanda	2,400				
6	Malagarasi	Katavi	Kigoma	Uvinza	6,000				
Medium Scale Schemes									
1	Mamba	Katavi	Katavi	Mpimbwe	1,000				
2	Ugalla	Katavi	Katavi	Nsimbo	520	225	225	225	225
3	Iloba (nkungwi)	Katavi	Katavi	Mpanda	1,540	1,540	0	738	4
4	Mnyamasi	Katavi	Katavi	Mpanda	1,200				
5	Mugera	Katavi	Kigoma	Buhigwe	600	120			
6	Murumba	Katavi	Kigoma	Kasulu	820	106			
7	Malalo	Katavi	Kigoma	Kasulu	500				
8	Asante Nyerere	Katavi	Kigoma	Kasulu	1,500				
9	Ilagala	Katavi	Kigoma	Uvinza	1,000				
10	Lufubu (valley)	Katavi	Kigoma	Uvinza	800				
11	Katuka Dam Scheme	Katavi	Katavi	Kalambo	500				
12	Kate Basin	Katavi	Rukwa	Nkasi	1,200			30	3
13	Masolo	Katavi	Rukwa	Nkasi	590			180	
Small Scale Schemes									
1	Msadya	Katavi	Katavi	Mpimbwe	275		120	137	
2	Ilalangulu/mirumba	Katavi	Katavi	Mpimbwe	150		100	100	
3	Ilunde Proposed Scheme	Katavi	Katavi	Mlele	388			62	
4	Masigo Proposed Scheme	Katavi	Katavi	Mlele	330				76
5	Ikondamoyo	Katavi	Katavi	Nsimbo	212				
6	Kambuzi Halt	Katavi	Katavi	Nsimbo	125				
7	Uruwira	Katavi	Katavi	Nsimbo	350	350	252	252	252
8	Usense	Katavi	Katavi	Nsimbo	106				
9	Kibaoni	Katavi	Katavi	Mpimbwe	50				
10	Lugonesi	Katavi	Katavi	Mpanda	96	96		76	8
11	Nsambara	Katavi	Katavi	Mpanda	136			115	
12	Kalege	Katavi	Kigoma	Buhigwe	300				
13	Gwanumpu	Katavi	Kigoma	Kakonko	200				
14	Msambara	Katavi	Kigoma	Kasulu	90		90	90	
15	Nyamnyusi	Katavi	Kigoma	Kasulu	400				
16	Kahambwe	Katavi	Kigoma	Kibondo	145	145	145	145	145
17	Kigina	Katavi	Kigoma	Kibondo	120	120	120	120	120
18	Lumpungu	Katavi	Kigoma	Kibondo	206	206	206	206	
19	Kibumba	Katavi	Kigoma	Kigoma	80			5	
20	Mkuti	Katavi	Kigoma	Kigoma	120	120	95	95	69
21	Nyabikele	Katavi	Kigoma	Kigoma	80			40	
22	Mtentema	Katavi	Kigoma	Kigoma	80			40	20
23	Lukaranga	Katavi	Kigoma	Kigoma	80			40	20

Attachment-7.5.1 (18/18) Priority Irrigation Schemes for Phase 2 Implementation by 2035 in Katavi ZIO

SN	Name of Scheme	ZIO name	Region Name	District Name	Potential Area (ha)	Designed Area (ha)	Developed Area (ha)	Irrigated Area (Wet) in ha	Irrigated Area (Dry) in ha
24	Kalya	Katavi	Kigoma	Uvinza	300				
25	Singiwe Dam Scheme	Katavi	Katavi	Kalambo	400				
26	Ulumi Dam Scheme	Katavi	Katavi	Kalambo	350				
27	Namansi	Katavi	Rukwa	Nkasi	450		200	20	
28	China	Katavi	Rukwa	Nkasi	50			37	6
29	Kizusi Basin	Katavi	Rukwa	Nkasi	50			40	15
30	Mpenge	Katavi	Rukwa	Nkasi	480			80	
31	Cherenganya	Katavi	Rukwa	Sumbawanga MC	150			45	15

Sources: JICA Project Team

Attachment-9,7.1 Irrigation Infrastructure Development Cost (Construction and Engineering Services)

PHASE 1

Type of Works	Unit Cost (USD)	Development Area (ha)	Construction Cost (USD)	F/S (USD)	D/D (USD)	SV (USD)	Engineering Services (USD)	Development Cost (USD)	Development Cost (TZS mil)
New Gravity-Type (All)	6,608	133,258	880,568,864	35,222,755	52,834,132	105,668,264	193,725,150	1,074,294,014	2,406,419
New Presure-Type (All)	17,700	3,670	64,959,000	2,598,360	3,897,540	7,795,080	14,290,980	79,249,980	177,520
Expansion	3,540	111,193	393,623,220	15,744,929	23,617,393	47,234,786	86,597,108	480,220,328	1,075,694
Improvement	3,540	96,278	340,824,120	10,224,724	13,632,965	27,265,930	51,123,618	391,947,738	877,963
Total		344,399	1,679,975,204	63,790,767	93,982,030	187,964,060	345,736,856	2,025,712,060	4,537,595

PHASE 2

Type of Works	Unit Cost (USD)	Development Area (ha)	Construction Cost (USD)	F/S (USD)	D/D (USD)	SV (USD)	Engineering Services (USD)	Development Cost (USD)	Development Cost (TZS mil)
New Gravity-Type (All)	6,608	166,233	1,098,467,664	43,938,707	65,908,060	131,816,120	241,662,886	1,340,130,550	3,001,892
New Presure-Type (All)	17,700	4,165	73,720,500	2,948,820	4,423,230	8,846,460	16,218,510	89,939,010	201,463
Expansion	3,540	141,711	501,656,940	20,066,278	30,099,416	60,198,833	110,364,527	612,021,467	1,370,928
Improvement	3,540	93,549	331,163,460	9,934,904	13,246,538	26,493,077	49,674,519	380,837,979	853,077
Total		405,658	2,005,008,564	76,888,708	113,677,245	227,354,489	417,920,442	2,422,929,006	5,427,361

NIMP2018 (PHASE 1 and PHASE 2)

Type of Works	Unit Cost (USD)	Development Area (ha)	Construction Cost (USD)	F/S (USD)	D/D (USD)	SV (USD)	Engineering Services (USD)	Development Cost (USD)	Development Cost (TZS mil)
New Gravity-Type (All)	6,608	299,491	1,979,036,528	79,161,461	118,742,192	237,484,383	435,388,036	2,414,424,564	5,408,311
New Presure-Type (All)	17,700	7,835	138,679,500	5,547,180	8,320,770	16,641,540	30,509,490	169,188,990	378,983
Expansion	3,540	252,904	895,280,160	35,811,206	53,716,810	107,433,619	196,961,635	1,092,241,795	2,446,622
Improvement	3,540	189,827	671,987,580	20,159,627	26,879,503	53,759,006	100,798,137	772,785,717	1,731,040
Total		750,057	3,684,983,768	140,679,475	207,659,274	415,318,549	763,657,298	4,448,641,066	9,964,956

Note: Cost includes VAT (18%).

Source: JICA Project Team

Attachment-9.7.2 : Cost Estimate of Soft Component Activities

1USD= 2,240 TZS

(Monetary Unit: USD)

	Activities	Phase 1 (-2025)			Phase 2 (-2035)		
		Unit Cost	Quantity	Amount	Unit Cost	Quantity	Amount
AP 2	**(1) Establishment of RIO and strengthening of DID/DIDT**						
	[1-1] RIO set-up						
	1) Office	446,428	6 offices	2,678,568	446,428	12 offices	5,357,136
	2) Office and survey equipment	43,125	6 sets	258,750	43,125	12 sets	517,500
	3) Vehicle	42,410	12 vehicles	508,920	42,410	24 vehicles	1,017,840
	[1-2] Awareness rasing on DID/DIDT roles and functions						
	1) Workshop for LGA staff	33,928	3 times	101,784	33,928	4 times	135,712
	(2) Improvement of NIRC function						
	[2-1] Establishment of new headquarters in Dodoma	5,032,188	1 lumpsum	5,032,188			
	(3) IO Registration						
	[3-1] Awareness raising on IO registration						
	1) Workshop for LGA staff	33,928	3 times	101,784	33,928	4 times	135,712
	(4) Establishment of Project Performance Monitoring and Evaluation System						
	[4-1] Aannual performance review						
	1) Workshop on data collection for LGA staff	33,928	8 times	271,424	33,928	10 times	339,280
	[4-2] Mid-and final evaluation of NIMP2018						
	1) Field visit for data collection	11,400	3 times	34,200	11,400	3 times	34,200
	[4-3] Formulation of irrigation development beyond 2035						
	1) Commission for the study				333,120	1 contract	333,120
	(5) Establishment of public relations system						
	[5-1] Website development						
	1) Website development	3,125	1 time	3,125			
	2) Annual maintenance	223	7 years	1,561	223	10 years	2,230
	(6) Research and development for irrigation						
	[6-1] Research activities						
	1) Comission for individual studies	261,453	5 studies	1,307,265	261,453	5 studies	1,307,265
	[6-2] Establishment of NIRC research and training center						
	1) Project for establishment of NIRTC	13,643,500	1 project	13,643,500			
	Subtotal			**23,943,069**			**9,179,995**
AP3	**(1)-(3) Capacity development training (Level 1-3)**						
	[1-1] Training for NIRC HQ and ZIO/RIO technical staff (Level 1)						
	1) Training on technical standards, project management and CGL	34,375	4 times	137,500	34,375	5 times	171,875
	[1-2] CGL Training for LGA (Level 2)						
	1) Training on technical standards and CGL for LGA techncial staff	47,321	3 times	141,963	47,321	4 times	189,284
	[1-3] Comprehenisve CGL Training for LGA and IO (Level 2 and 3)						
	1) Formulation	12,857	60 schemes	771,420	12,857	98 schemes	1,259,986
	2) Implementation	10,714	60 schemes	642,840	10,714	98 schemes	1,049,972
	3) O&M	4,361	60 schemes	261,660	4,361	98 schemes	427,378
	[1-4] Production/ Subject-matter Training (Level 3)						
	1) Production	16,017	60 schemes	961,020	16,017	98 schemes	1,569,666
	2) Organizational Strengthening	467	60 schemes	28,020	467	98 schemes	45,766
	3) Marketing	621	60 schemes	37,260	621	98 schemes	60,858
	4) Gender	1,000	60 schemes	60,000	1,000	98 schemes	98,000
	(4) Establishment of irrigation technical manuals and checklists						
	[4-1] Development of technical manuals and checklists						
	1) Commission for the work	119,700	1 contract	119,700	119,700	1 contract	119,700
	[4-2] Dissemination of technical manuals and checklists						
	1) Workshop	27,232	3 times	81,696	27,232	3 times	81,696
	(5) Establishment of training modules for irrigation development						
	[5-1] Development and review of training modules						
	1) Commission for the work	43,167	1 times	43,167	43,167	1 times	43,167
	[5-2] Provision of manuals						
	1) Training materials	22	1,000 copies	22,000	22	1,000 copies	22,000
	(6) Promotion of private contractors and enhancement of their engineering ability						
	[6-1] Seminar for private service providers						
	1) Seminar	7,142	4 times	28,568	7,142	5 times	35,710
	Subtotal			**3,336,814**			**5,175,058**
AP4	**(1) Coordination with private sector for irrigation investment**						
	[1-1] Stakeholder workhop						
	1) Workshop	7,142	4 times	28,568	7,142	5 times	35,710
	(2) Coordination with relevant institutions for crosscutting issues						
	[2-1] Stakeholder workshop						
	1) Workshop	5,357	4 times	21,428	5,357	5 times	26,785
	Subtotal			**49,996**			**62,495**
			Phase 1 Total	**27,329,879**		**Phase 2 Total**	**14,417,548**

Note: VAT Included
Sources: JICA Project Team

Attachment-9.9.1 (1/3) Detail of Economic and Financial Costs Calculation

Economic Costs

in TZS

Total Project Costs (economic, without VAT) (Unit: Million TZS)【TZS 2,240/ USD】

	Cost component	Phase 1 (2018 - 2025)	Phase 2 (2026 - 2035)	Total (Phase 1+2) (2018 - 2035)
1	Hard Component	3,594,281	4,315,203	7,909,484
2	Soft Component	44,983	21,975	66,959
	Total	**3,639,264**	**4,337,178**	**7,976,442**

in USD

Total Project Costs (economic, without VAT) (Unit: Million USD)

	Cost component	Phase 1 (2018 - 2025)	Phase 2 (2026 - 2035)	Total (Phase 1+2) (2018 - 2035)
1	Hard Component	1,513	1,812	3,325
2	Soft Component	20	10	30
	Total	**1,533**	**1,822**	**3,355**

Financial Costs

in TZS

Total Project Costs (financial, with VAT) (Unit: Million TZS)【TZS 2,240/ USD】

	Cost component	Phase 1 (2018 - 2025)	Phase 2 (2026 - 2035)	Total (Phase 1+2) (2018 - 2035)
1	Hard Component	4,521,226	5,427,361	9,948,587
2	Soft Component	61,219	32,295	93,514
	Total	**4,582,445**	**5,459,656**	**10,042,102**

in USD

Total Project Costs (financial, with VAT) (Unit: Million USD)

	Cost component	Phase 1 (2018 - 2025)	Phase 2 (2026 - 2035)	Total (Phase 1+2) (2018 - 2035)
1	Hard Component	2,018	2,423	4,441
2	Soft Component	27	14	42
	Total	**2,046**	**2,437**	**4,483**

//

1. HC (Hard Component) Cost (Construction Cost)

Construction combined (and w/ VAT) unit cost (Financial cost and Economic cost)

Unit cost case	Cost item	Combin'd Unit cost (Usd/ ha) (FU. Cost)	Combin'd Unit cost (Usd/ ha) (EU. Cost)
1 New, Full development (Suraface)	Engineering	*1,232*	*1,232*
	Construction	*5,600*	*5,183*
	Combined	**6,832**	**6,415**
	Combn'd (w/ VAT)	**8,062**	**n.a.**
2 New, Full development (Pressure)	Engineering	*3,300*	*3,300*
	Construction	*15,000*	*13,808*
	Combined	**18,300**	**17,108**
	Combn'd (w/ VAT)	**21,594**	**n.a.**
3 New, Canal extension	Engineering	*660*	*660*
	Construction	*3,000*	*2,777*
	Combined	**3,660**	**3,437**
	Combn'd (w/ VAT)	**4,319**	**n.a.**
4 Improvement (Suraface)	Engineering	*450*	*450*
	Construction	*3,000*	*2,777*
	Combined	**3,450**	**3,227**
	Combn'd (w/ VAT)	**4,071**	**n.a.**

Attachment-9.9.1 (2/3) Detail of Economic and Financial Costs Calculation

Financial HC Costs (with VAT) 【in TZS】 Exch.Rt : TZS / USD = 2,240

Development mode	Crop season	Combined HC Unit Cost (USD/ ha)	Combined HC Unit Cost (TZS/ ha)	Phase 1 (2018 - 2025)		Phase 2 (2026 - 2035)		Total (Phase 1+2: 2018 - 2035)	
				Area to be developed (ha)	Cost of Irrigation Development (million TZS)	Area to be developed (ha)	Cost of Irrigation Development (million TZS)	Area to be developed (ha)	Cost of Irrigation Development (million TZS)
1 New [Full Development] <Surface>	Wet	8,062	18,058,342	102,795	1,856,315	126,731	2,288,555	229,527	4,144,870
	Dry	8,062	18,058,342	31,003	559,855	39,502	713,337	70,504	1,273,192
2 New [Full Develoopment] <Pressure>	Wet	21,594	48,370,560	2,405	116,319	3,175	153,590	5,580	269,909
	Dry	21,594	48,370,560	725	35,081	990	47,874	1,715	82,955
3 New [Canal Extension]	Wet	4,319	9,674,112	85,428	826,443	108,036	1,045,156	193,465	1,871,598
	Dry	4,319	9,674,112	25,765	249,251	33,675	325,773	59,439	575,023
4 Improvement	Wet	4,071	9,119,040	73,969	674,529	71,319	650,361	145,288	1,324,890
	Dry	4,071	9,119,040	22,309	203,434	22,230	202,716	44,539	406,150
				344,399	**4,521,226**	**405,658**	**5,427,361**	**750,057**	**9,948,587**

Financial HC Costs (with VAT)【in USD】 Exch.Rt : TZS / USD = 2,240

Development mode	Crop season	Combined HC Unit Cost (USD/ ha)	Combined HC Unit Cost (TZS/ ha)	Phase 1 (2018 - 2025)		Phase 2 (2026 - 2035)		Total (Phase 1+2: 2018 - 2035)	
				Area to be developed (ha)	Cost of Irrigation Development (million TZS)	Area to be developed (ha)	Cost of Irrigation Development (million TZS)	Area to be developed (ha)	Cost of Irrigation Development (million TZS)
1 New [Full Development] <Surface>	Wet	8,062	18,058,342	102,795	829	126,731	1,022	229,527	1,850
	Dry	8,062	18,058,342	31,003	250	39,502	318	70,504	568
2 New [Full Develoopment] <Pressure>	Wet	21,594	48,370,560	2,405	52	3,175	69	5,580	120
	Dry	21,594	48,370,560	725	16	990	21	1,715	37
3 New [Canal Extension]	Wet	4,319	9,674,112	85,428	369	108,036	467	193,465	836
	Dry	4,319	9,674,112	25,765	111	33,675	145	59,439	257
4 Improvement	Wet	4,071	9,119,040	73,969	301	71,319	290	145,288	591
	Dry	4,071	9,119,040	22,309	91	22,230	90	44,539	181
				344,399	**2,018**	**405,658**	**2,423**	**750,057**	**4,441**

Economic HC Costs (without VAT)【in TZS】 Exch.Rt : TZS / USD = 2,240

Development mode	Crop season	Combined HC Unit Cost (USD/ ha)	Combined HC Unit Cost (TZS/ ha)	Phase 1 (2018 - 2025)		Phase 2 (2026 - 2035)		Total (Phase 1+2: 2018 - 2035)	
				Area to be developed (ha)	Cost of Irrigation Development (million TZS)	Area to be developed (ha)	Cost of Irrigation Development (million TZS)	Area to be developed (ha)	Cost of Irrigation Development (million TZS)
1 New [Full Development] <Surface>	Wet	6,415	14,369,152	102,795	1,477,083	126,731	1,821,020	229,527	3,298,103
	Dry	6,415	14,369,152	31,003	445,481	39,502	567,608	70,504	1,013,088
2 New [Full Develoopment] <Pressure>	Wet	17,108	38,320,800	2,405	92,152	3,175	121,679	5,580	213,831
	Dry	17,108	38,320,800	725	27,792	990	37,927	1,715	65,720
3 New [Canal Extension]	Wet	3,437	7,697,760	85,428	657,606	108,036	831,638	193,465	1,489,244
	Dry	3,437	7,697,760	25,765	198,331	33,675	259,220	59,439	457,550
4 Improvement	Wet	3,227	7,227,360	73,969	534,602	71,319	515,448	145,288	1,050,051
	Dry	3,227	7,227,360	22,309	161,233	22,230	160,664	44,539	321,897
				344,399	**3,594,281**	**405,658**	**4,315,203**	**750,057**	**7,909,484**

Economic HC Costs (without VAT)【in USD】 Exch.Rt : TZS / USD = 2,240

Development mode	Crop season	Combined HC Unit Cost (USD/ ha)	Combined HC Unit Cost (TZS/ ha)	Phase 1 (2018 - 2025)		Phase 2 (2026 - 2035)		Total (Phase 1+2: 2018 - 2035)	
				Area to be developed (ha)	Cost of Irrigation Development (million TZS)	Area to be developed (ha)	Cost of Irrigation Development (million TZS)	Area to be developed (ha)	Cost of Irrigation Development (million TZS)
1 New [Full Development] <Surface>	Wet	6,415	14,369,152	102,795	659	126,731	813	229,527	1,472
	Dry	6,415	14,369,152	31,003	199	39,502	253	70,504	452
2 New [Full Develoopment] <Pressure>	Wet	17,108	38,320,800	2,405	41	3,175	54	5,580	95
	Dry	17,108	38,320,800	725	12	990	17	1,715	29
3 New [Canal Extension]	Wet	3,437	7,697,760	85,428	294	108,036	371	193,465	665
	Dry	3,437	7,697,760	25,765	89	33,675	116	59,439	204
4 Improvement	Wet	3,227	7,227,360	73,969	239	71,319	230	145,288	469
	Dry	3,227	7,227,360	22,309	72	22,230	72	44,539	144
				344,399	**1,605**	**405,658**	**1,926**	**750,057**	**3,531**

Attachment-9.9.1 (3/3) Detail of Economic and Financial Costs Calculation

2. SC (Soft Component) Costs (Training, Workshop, Studies)

in TZS

Exch.Rt : TZS / USD = 2,240

Financial SC Costs (with VAT)

(Unit: Million TZS)

	Cost component	Phase 1 (2018 - 2025)	Phase 2 (2026 - 2035)	Total (Phase 1+2) (2018 - 2035)
1	Action Plan 2	53,632	20,563	74,196
2	Action Plan 3	7,474	11,592	19,067
3	Action Plan 4	112	140	252
	Total	**61,219**	**32,295**	**93,514**

Exch.Rt : TZS / USD = 2,240

Economic SC Costs (without VAT)

(Unit: Million TZS)

	Cost component	Phase 1 (2018 - 2025)	Phase 2 (2026 - 2035)	Total (Phase 1+2) (2018 - 2035)
1	Action Plan 2	40,835	15,617	56,453
2	Action Plan 3	4,089	6,283	10,372
3	Action Plan 4	60	75	134
	Total	**44,983**	**21,975**	**66,959**

in USD

Exch.Rt : TZS / USD = 2,240

Financial SC Costs (with VAT)

(Unit: USD)

	Cost component	Phase 1 (2018 - 2025)	Phase 2 (2026 - 2035)	Total (Phase 1+2) (2018 - 2035)
1	Action Plan 2	23,943,069	9,179,995	33,123,064
2	Action Plan 3	3,336,814	5,175,058	8,511,872
3	Action Plan 4	49,996	62,495	112,491
	Total	**27,329,879**	**14,417,548**	**41,747,427**

Exch.Rt : TZS / USD = 2,240

Economic SC Costs (without VAT)

(Unit: USD)

	Cost component	Phase 1 (2018 - 2025)	Phase 2 (2026 - 2035)	Total (Phase 1+2) (2018 - 2035)
1	Action Plan 2	18,229,970	6,972,060	25,202,030
2	Action Plan 3	1,825,265	2,805,049	4,630,313
3	Action Plan 4	26,648	33,310	59,958
	Total	**20,081,882**	**9,810,418**	**29,892,301**

Sources: JICA Project Team

Attachment-9.9.2 (1/6) Crop Budget (Financial Price)

Wet Season — **Lower Price**

Rice — **Conditions: [Unit price is adjusted to actual unit price in 2017]**
[Mark-up: 1.2 (based on the market survey in Dar es Salaam)]
[Paddy : Milled Rice = 1 : 0.65]
Note) Mark up: the ratio of total distribution expenses (transport costs, expenses for participating markets, storage expenses etc.)

(1) [Present: Rainfed → Future: Rainfed]

	Items	Unit	Unit Price (TZS)	Q'ty	Value (TZS)
I	Gross Return				
	Yield	kg/ha		1,850	
	Farmgate Price	TZS/kg	686		
	Gross Return	TZS/ha			**1,269,100**
II	Production Cost				
1. Farm Inputs					
	Seed	kg/ha	670	75	50,250
	Fertilizer (Urea)	kg/ha			
	Urea	kg/ha	1,000	100	100,000
	Agro-chemical (Pesticide)	kg/ha			
	Pesticide	kg/ha	12,000	0.5	6,000
	Packing Material (Bags (70kg))	nos/ha	700	50	35,000
	Sub-total				**191,250**
2. Labour Requirement					
	Land prep., Puddle and Bund	man/day	10,000	20	200,000
	Nursery	man/day	10,000	2	20,000
	Plant/Transplanting	man/day	10,000	25	250,000
	Weeding and Fertilizer	man/day	5,000	50	250,000
	Bird Scaring	man/day	660	30	19,800
	Harvesting	man/day	6,000	40	240,000
	Transport Marketing	man/day	5,000	7	35,000
	Irrigation, etc	man/day		0	0
	Threshing/Winnowing	man/day	4,400	30	132,000
	Sub-total				**1,146,800**
3. Machinery and Draught Animal					
	Tractor	LS	60,000	1	60,000
	Hand Tractor	LS			-
	Draught Animal	LS			-
	Sub-total				**60,000**
4. Miscellaneous Cost (5% of Cost)					**69,903**
	Total				**1,467,953**
III	Net Return				
					-198,853

Sources: JICA Project Team

(2) [Present: Irrigation → Future: Irrigation (w/o Project)]

The case that there are exiting irrigation schemes. It is assumed that the yeild shall increase by the improvement of these exiting schemes (2.5 ton/ha → 5.0 ton/ ha (refer to (3))).
Corresponding to "Improvement of exiting" among Irrigation types.

	Items	Unit	Unit Price (TZS)	Q'ty	Value (TZS)
I	Gross Return				
	Yield	kg/ha		2,500	
	Farmgate Price	TZS/kg	686		
	Gross Return	TZS/ha			**1,715,000**
II	Production Cost				
1. Farm Inputs					
	Seed	kg/ha	550	50	27,500
	Fertilizer (Urea)	kg/ha			
	Urea	kg/ha	1,000	125	125,000
	DAP	kg/ha	1,200	100	120,000
	Agro-chemical (Pesticide)	kg/ha			
	Pesticide	kg/ha	12,000	0.5	6,000
	Herbicide	kg/ha	15,000	2.5	37,500
	Packing Material (Bags (100kg))	nos/ha	1,000	75	75,000
	Sub-total				**391,000**
2. Labour Requirement					
	Land prep., Puddle and Bund	man/day	7,000	15	105,000
	Nursery	man/day	2,000	6	12,000
	Plant/Transplanting	man/day	8,000	22	176,000
	Weeding and Fertilizer	man/day	10,000	16	160,000
	Bird Scaring	man/day	10,000	21	210,000
	Harvesting	man/day	10,000	15	150,000
	Transport Marketing	man/day	15,000	10	150,000
	Irrigation, etc	man/day	12,500	10	125,000
	Threshing/Winnowing	man/day	10,000	10	100,000
	Sub-total				**1,188,000**
3. Machinery and Draught Animal					
	Tractor	LS			-
	Hand Tractor	LS	120,000	1	120,000
	Draught Animal	LS			-
	Sub-total				**120,000**
4. Miscellaneous Cost (5% of Cost)					**84,950**
	Total				**1,783,950**
III	Net Return				
					-68,950

(3) [Present: Irrigation → Future: Irrigation or Present: Irrigation → Future: Irrigation (with Project)]

At present, the areas which have no irrigation scheme or traditional irrigation is being done in. By implemention of NIMP2018, the yeild shall increase (1.85 ton/ ha (refer to (1)) → 5.0 ton/ ha).
Corresponding to "New full Development" or New canal extension".

	Items	Unit	Unit Price (TZS)	Q'ty	Value (TZS)
I	Gross Return				
	Yield	kg/ha		5,000	
	Farmgate Price	TZS/kg	686		
	Gross Return	TZS/ha			**3,430,000**
II	Production Cost				
1. Farm Inputs					
	Seed	kg/ha	550	50	27,500
	Fertilizer (Urea)	kg/ha			
	Urea	kg/ha	1,000	125	125,000
	DAP	kg/ha	1,200	100	120,000
	Agro-chemical (Pesticide)	kg/ha			
	Pesticide	kg/ha	12,000	0.5	6,000
	Herbicide	kg/ha	15,000	2.5	37,500
	Packing Material (Bags (100kg))	nos/ha	1,000	75	75,000
	Sub-total				**391,000**
2. Labour Requirement					
	Land prep., Puddle and Bund	man/day	7,000	15	105,000
	Nursery	man/day	2,000	6	12,000
	Plant/Transplanting	man/day	8,000	22	176,000
	Weeding and Fertilizer	man/day	10,000	16	160,000
	Bird Scaring	man/day	10,000	21	210,000
	Harvesting	man/day	10,000	15	150,000
	Transport Marketing	man/day	15,000	10	150,000
	Irrigation, etc	man/day	12,500	10	125,000
	Threshing/Winnowing	man/day	10,000	10	100,000
	Sub-total				**1,188,000**
3. Machinery and Draught Animal					
	Tractor	LS			-
	Hand Tractor	LS	120,000	1	120,000
	Draught Animal	LS			-
	Sub-total				**120,000**
4. Miscellaneous Cost (5% of Cost)					**84,950**
	Total				**1,783,950**
III	Net Return				
					1,646,050

Attachment-9.9.2 (2/6) Crop Budget (Financial Price)

Wet Season **Lower Price**

Tomato

Conditions: **[Unit price: average price from 2007 to 2016]**
[The yield in the case of "Future (with Project)": 40 ton/ha]
[Mark-up: 1.8]
[Because inputs will increase in irrigation agriculture, production costs in Present (Rainfed) condition is decreased by about 10% and the costs in future conditions is increased ab
Note) Mark up: the ratio of total distribution expenses (transport costs, expenses for participating markets, storage expenses etc.)

(1) [Present: Rainfed → Future: Rainfed]

	Items	Unit	Unit Price (TZS)	Q'ty	Value (TZS)
I	Gross Return				
	Yield	kg/ha		5,000	
	Farmgate Price	TZS/kg	624		
	Gross Return	TZS/ha			**3,120,000**
II	Production Cost				
1. Farm Inputs					
	Seed	kg/ha	1,000,000	0.50	500,000
	Fertilizer				
	Vig Max	kg/ha	8,000	10	80,000
	DAP	kg/ha	1,300	100	130,000
	NPK Winner	kg/ha	1,300	100	130,000
	CAN	kg/ha	900	100	90,000
	Booster	lit/ha	10,000	0	-
	Agro-chemical (Pestc, Fungc)				
	Pesticide (wiltigo, profecron, Ninja)	lit/ha	20,000	3	60,000
	Herbicide	lit/ha	0	0	-
	Fungicide defender, mupafidan)	lit/ha	30,000	3	90,000
	Packing Material (Wdn Crt 45kg)	nos/ha	1,000	500	500,000
	Sub-total				**1,580,000**
2. Labour Requirement					
	Land prep., Puddle and Bund	man/day	10,000	15	150,000
	Nursery	man/day	3,000	20	60,000
	Plant/Transplanting	man/day	10,000	10	100,000
	Weeding and Fertilizer	man/day	10,000	15	150,000
	Bird Scaring & plant upkeeping	man/day	10,000	20	200,000
	Harvesting	man/day	15,000	15	225,000
	Transport Marketing	man/day	10,000	5	50,000
	Irrigation, etc	man/day		0	-
	Threshing/Winnowing	man/day	8,000	10	80,000
	Sub-total				**1,015,000**
3. Machinery and Draught Animal					
	Tractor	LS	125,000	0	-
	Hand Tractor	LS			-
	Draught Animal	LS			-
	Sub-total				**0**
4. Miscellaneous Cost (5% of Cost)					**129,750**
	Total				**2,724,750**
III	Net Return				
					395,250

Sources: JICA Project Team

(2) [Present: Irrigation → Future: Irrigation (w/o Project)]

The case that there are exiting irrigation schemes. It is assumed that the yeild shall increase by the improvement of these exiting schemes (20.0 ton/ha → 40.0 ton/ ha (refer to (3))).
Corresponding to "Improvement of exiting" among Irrigation types.

	Items	Unit	Unit Price (TZS)	Q'ty	Value (TZS)
I	Gross Return				
	Yield	kg/ha		20,000	
	Farmgate Price	TZS/kg	624		
	Gross Return	TZS/ha			**12,480,000**
II	Production Cost				
1. Farm Inputs					
	Seed	kg/ha	1,000,000	1.00	1,000,000
	Fertilizer (Urea, DAP, CAN)				
	Vig Max	kg/ha	8,000	20	160,000
	DAP	kg/ha	1,300	150	195,000
	NPK Winner	kg/ha	1,300	150	195,000
	CAN	kg/ha	900	150	135,000
	Booster	lit/ha	10,000	15	150,000
	Agro-chemical (Pestc, Fungc)				
	Pesticide (wiltigo, profecron, Ninja)	lit/ha	20,000	10	200,000
	Herbicide	lit/ha	0	0	-
	Fungicide defender, mupafidan)	lit/ha	50,000	1	50,000
	Packing Material (Wdn Crt)	nos/ha	1,000	1000	1,000,000
	Sub-total				**3,085,000**
2. Labour Requirement					
	Land prep., Puddle and Bund	man/day	10,000	15	150,000
	Nursery	man/day	5,000	40	200,000
	Plant/Transplanting	man/day	10,000	20	200,000
	Weeding and Fertilizer	man/day	10,000	20	200,000
	Bird Scaring & plant upkeeping	man/day	13,000	30	390,000
	Harvesting	man/day	5,000	180	900,000
	Transport Marketing	man/day	12,500	30	375,000
	Irrigation, etc	man/day	10,000	20	200,000
	Threshing/Winnowing	man/day	4,412	35	154,420
	Sub-total				**2,769,420**
3. Machinery and Draught Animal					
	Tractor	LS	150,000	1	150,000
	Hand Tractor	LS			-
	Draught Animal	LS			-
	Sub-total				**150,000**
4. Miscellaneous Cost (5% of Cost)					**300,221**
	Total				**6,304,641**
III	Net Return				
					6,175,359

(3) [Present: Irrigation → Future: Irrigation or Present: Irrigation → Future: Irrigation (with Project)]

At present, the areas which have no irrigation scheme or traditional irrigation is being done in. By implemention of NIMP2018, the yeild shall increase (5.0 ton/ ha (refer to (1)) → 40.0 ton/ ha).
Corresponding to "New full Development" or New canal extension".

	Items	Unit	Unit Price (TZS)	Q'ty	Value (TZS)
I	Gross Return				
	Yield	kg/ha		40,000	
	Farmgate Price	TZS/kg	624		
	Gross Return	TZS/ha			**24,960,000**
II	Production Cost				
1. Farm Inputs					
	Seed	kg/ha	1,000,000	1.00	1,000,000
	Fertilizer (Urea, DAP, CAN)				
	Vig Max	kg/ha	8,000	20	160,000
	DAP	kg/ha	1,300	150	195,000
	NPK Winner	kg/ha	1,300	150	195,000
	CAN	kg/ha	900	150	135,000
	Booster	lit/ha	10,000	15	150,000
	Agro-chemical (Pestc, Fungc)				
	Pesticide (wiltigo, profecron, Ninja)	lit/ha	20,000	10	200,000
	Herbicide	lit/ha	0	0	-
	Fungicide defender, mupafidan)	lit/ha	50,000	1	50,000
	Packing Material (Wdn Crt)	nos/ha	1,000	1000	1,000,000
	Sub-total				**3,085,000**
2. Labour Requirement					
	Land prep., Puddle and Bund	man/day	10,000	15	150,000
	Nursery	man/day	5,000	40	200,000
	Plant/Transplanting	man/day	10,000	20	200,000
	Weeding and Fertilizer	man/day	10,000	20	200,000
	Bird Scaring & plant upkeeping	man/day	13,000	30	390,000
	Harvesting	man/day	5,000	180	900,000
	Transport Marketing	man/day	12,500	30	375,000
	Irrigation, etc	man/day	10,000	20	200,000
	Threshing/Winnowing	man/day	4,412	35	154,420
	Sub-total				**2,769,420**
3. Machinery and Draught Animal					
	Tractor	LS	150,000	1	150,000
	Hand Tractor	LS			-
	Draught Animal	LS			-
	Sub-total				**150,000**
4. Miscellaneous Cost (5% of Cost)					**300,221**
	Total				**6,304,641**
III	Net Return				
					18,655,359

Attachment-9.9.2 (3/6) Crop Budget (Financial Price)

Wet Season — **Lower Price**

Onion — **Conditions:** **Unit price: average price from 2007 to 2016**
[Mark-up:1.7]
[Because inputs will increase in irrigation agriculture, production costs in Present (Rainfed) condition is decreased by about 10% and the costs in future conditions is increased ab
Note) Mark up: the ratio of total distribution expenses (transport costs, expenses for participating markets, storage expenses etc.)

(1) [Present: Rainfed → Future: Rainfed]

	Items	Unit	Unit Price (TZS)	Q'ty	Value (TZS)
I	Gross Return				
	Yield	kg/ha		2,000	
	Farmgate Price	TZS/kg	571		
	Gross Return	TZS/ha			**1,142,000**
II	Production Cost				
1. Farm Inputs					
	Seed	kg/ha	40,000	3	120,000
	Fertilizer (Urea, DAP, CAN)				
	Urea (46% N)	kg/ha	1,200	200	240,000
	CAN	kg/ha	1,000	200	200,000
	DAP	kg/ha	0	0	-
	NPK	kg/ha	0	0	-
	Manure	ton/ha		0	-
	Agro-chemical (Pestc, Herbc, Fungc)				
	Pesticide (Ninja)	lit/ha	20,000	3	60,000
	Herbicide	lit/ha	39,000	1	39,000
	Fungicide (Ivory 72)	lit/ha	50,000	1	50,000
	Packing Material (Bag 100kg)	nos/ha	1,000	100	100,000
	Sub-total				**809,000**
2. Labour Requirement					
	Land prep., Puddle and Bund	man/day	15,000	5	75,000
	Nursery	man/day	3,300	15	49,500
	Plant/Transplanting	man/day	6,600	25	165,000
	Weeding and Fertilizer	man/day	25,000	4	100,000
	Animals Scaring	man/day	0	0	-
	Harvesting	man/day	13,300	15	199,500
	Transport Marketing	man/day	10,500	10	105,000
	Irrigation, etc	man/day	0	0	-
	Threshing/Winnowing	man/day	7,000	5	35,000
	Sub-total				**729,000**
3. Machinery and Draught Animal					
	Tractor	LS	125,000	1	125,000
	Hand Tractor	LS			-
	Draught Animal	LS			-
	Sub-total				**125,000**
4. Miscellaneous Cost (5% of Cost)					**83,150**
	Total				**1,746,150**
III	Net Return				
					-604,150

Sources: JICA Project Team

(2) [Present: Irrigation → Future: Irrigation (w/o Project)]

The case that there are exiting irrigation schemes. It is assumed that the yeild shall increase by the improvement of these exiting schemes (7.0 ton/ha → 10.0 ton/ ha (refer to (3))).
Corresponding to "Improvement of exiting" among Irrigation types.

	Items	Unit	Unit Price (TZS)	Q'ty	Value (TZS)
I	Gross Return				
	Yield	kg/ha		7,000	
	Farmgate Price	TZS/kg	571		
	Gross Return	TZS/ha			**3,997,000**
II	Production Cost				
1. Farm Inputs					
	Seed	kg/ha	40,000	10	400,000
	Fertilizer (Urea, DAP, V Max, Bstr)				-
	Urea (46% N)	kg/ha	1,000	150	150,000
	DAP	kg/ha	1,300	150	195,000
	Vig Max	kg/ha	8,000	20	160,000
	Booster	kg/ha	5,000	10	50,000
					-
	Agro-chemical (Pestc, Fungc)				-
	Pesticide (Ninja)	lit/ha	20,000	10	200,000
	Herbicide	lit/ha	39,000	5	195,000
	Fungicide (Ivory 72)	lit/ha	50,000	1	50,000
	Packing Material (Bag 100kg)	nos/ha	1,000	150	150,000
	Sub-total				**1,550,000**
2. Labour Requirement					
	Land prep., Puddle and Bund	man/day	12,000	30	360,000
	Nursery	man/day	3,000	40	120,000
	Plant/Transplanting	man/day	12,000	20	240,000
	Weeding and Fertilizer	man/day	10,000	40	400,000
	Animals Scaring	man/day	0	0	-
	Harvesting	man/day	10,000	20	200,000
	Transport Marketing	man/day	16,000	10	160,000
	Irrigation, etc	man/day	10,000	20	200,000
	Threshing/Winnowing	man/day	7,000	10	70,000
	Sub-total				**1,750,000**
3. Machinery and Draught Animal					
	Tractor	LS	125,000	1	125,000
	Hand Tractor	LS			-
	Draught Animal	LS			-
	Sub-total				**125,000**
4. Miscellaneous Cost (5% of Cost)					**171,250**
	Total				**3,596,250**
III	Net Return				
					400,750

(3) [Present: Irrigation → Future: Irrigation or Present: Irrigation → Future: Irrigation (with Project)]

At present, the areas which have no irrigation scheme or traditional irrigation is being done in. By implemention of NIMP2018, the yeild shall increase (2.0 ton/ ha (refer to (1)) → 10.0 ton/ ha).
Corresponding to "New full Development" or New canal extension".

	Items	Unit	Unit Price (TZS)	Q'ty	Value (TZS)
I	Gross Return				
	Yield	kg/ha		10,000	
	Farmgate Price	TZS/kg	571		
	Gross Return	TZS/ha			**5,710,000**
II	Production Cost				
1. Farm Inputs					
	Seed	kg/ha	40,000	10	400,000
	Fertilizer (Urea, DAP, V Max, Bstr)				-
	Urea (46% N)	kg/ha	1,000	150	150,000
	DAP	kg/ha	1,300	150	195,000
	Vig Max	kg/ha	8,000	20	160,000
	Booster	kg/ha	5,000	10	50,000
					-
	Agro-chemical (Pestc, Fungc)				-
	Pesticide (Ninja)	lit/ha	20,000	10	200,000
	Herbicide	lit/ha	39,000	5	195,000
	Fungicide (Ivory 72)	lit/ha	50,000	1	50,000
	Packing Material (Bag 100kg)	nos/ha	1,000	150	150,000
	Sub-total				**1,550,000**
2. Labour Requirement					
	Land prep., Puddle and Bund	man/day	12,000	30	360,000
	Nursery	man/day	3,000	40	120,000
	Plant/Transplanting	man/day	12,000	20	240,000
	Weeding and Fertilizer	man/day	10,000	40	400,000
	Animals Scaring	man/day	0	0	-
	Harvesting	man/day	10,000	20	200,000
	Transport Marketing	man/day	16,000	10	160,000
	Irrigation, etc	man/day	10,000	20	200,000
	Threshing/Winnowing	man/day	7,000	10	70,000
	Sub-total				**1,750,000**
3. Machinery and Draught Animal					
	Tractor	LS	125,000	1	125,000
	Hand Tractor	LS			-
	Draught Animal	LS			-
	Sub-total				**125,000**
4. Miscellaneous Cost (5% of Cost)					**171,250**
	Total				**3,596,250**
III	Net Return				
					2,113,750

Attachment-9.9.2 (4/6) Crop Budget (Financial Price)

Dry Season **Higher Price**

Rice

Conditions: [Unit price is adjusted to actual unit price in 2017]
[Mark-up: 1.2 (based on the market survey in Dar es Salaam)]
[Paddy : Milled Rice = 1 : 0.65]
Note) Mark up: the ratio of total distribution expenses (transport costs, expenses for participating markets, storage expenses etc.)

(1) [Present: Rainfed → Future: Rainfed]

Items	Unit	Unit Price (TZS)	Q'ty	Value (TZS)
I Gross Return				
Yield	kg/ha		1,850	
Farmgate Price	TZS/kg	788		
Gross Return	TZS/ha			**1,457,800**
II Production Cost				
1. Farm Inputs				
Seed	kg/ha	670	75	50,250
Fertilizer (Urea)	kg/ha			
Urea	kg/ha	1,000	100	100,000
Agro-chemical (Pesticide)	kg/ha			
Pesticide	kg/ha	12,000	0.5	6,000
Packing Material (Bags (70kg))	nos/ha	700	50	35,000
Sub-total				**191,250**
2. Labour Requirement				
Land prep., Puddle and Bund	man/day	10,000	20	200,000
Nursery	man/day	10,000	2	20,000
Plant/Transplanting	man/day	10,000	25	250,000
Weeding and Fertilizer	man/day	5,000	50	250,000
Bird Scaring	man/day	660	30	19,800
Harvesting	man/day	6,000	40	240,000
Transport Marketing	man/day	5,000	7	35,000
Irrigation, etc	man/day		0	0
Threshing/Winnowing	man/day	4,400	30	132,000
Sub-total				**1,146,800**
3. Machinery and Draught Animal				
Tractor	LS	60,000	1	60,000
Hand Tractor	LS			-
Draught Animal	LS			-
Sub-total				**60,000**
4. Miscellaneous Cost (5% of Cost)				**69,903**
Total				**1,467,953**
III Net Return				
				-10,153

Sources: JICA Project Team

(2) [Present: Irrigation → Future: Irrigation (w/o Project)]

The case that there are exiting irrigation schemes. It is assumed that the yeild shall increase by the improvement of these exiting schemes (2.5 ton/ha → 5.0 ton/ ha (refer to (3))).
Corresponding to "Improvement of exiting" among Irrigation types.

Items	Unit	Unit Price (TZS)	Q'ty	Value (TZS)
I Gross Return				
Yield	kg/ha		2,500	
Farmgate Price	TZS/kg	788		
Gross Return	TZS/ha			**1,970,000**
II Production Cost				
1. Farm Inputs				
Seed	kg/ha	550	50	27,500
Fertilizer (Urea)	kg/ha			
Urea	kg/ha	1,000	125	125,000
DAP	kg/ha	1,200	100	120,000
Agro-chemical (Pesticide)	kg/ha			
Pesticide	kg/ha	12,000	0.5	6,000
Herbicide	kg/ha	15,000	2.5	37,500
Packing Material (Bags (100kg))	nos/ha	1,000	75	75,000
Sub-total				**391,000**
2. Labour Requirement				
Land prep., Puddle and Bund	man/day	7,000	15	105,000
Nursery	man/day	2,000	6	12,000
Plant/Transplanting	man/day	8,000	22	176,000
Weeding and Fertilizer	man/day	10,000	16	160,000
Bird Scaring	man/day	10,000	21	210,000
Harvesting	man/day	10,000	15	150,000
Transport Marketing	man/day	15,000	10	150,000
Irrigation, etc	man/day	12,500	10	125,000
Threshing/Winnowing	man/day	10,000	10	100,000
Sub-total				**1,188,000**
3. Machinery and Draught Animal				
Tractor	LS			-
Hand Tractor	LS	120,000	1	120,000
Draught Animal	LS			-
Sub-total				**120,000**
4. Miscellaneous Cost (5% of Cost)				**84,950**
Total				**1,783,950**
III Net Return				
				186,050

(3) [Present: Irrigation → Future: Irrigation or Present: Irrigation → Future: Irrigation (with Project)]

At present, the areas which have no irrigation scheme or traditional irrigation is being done in. By implemention of NIMP2018, the yeild shall increase (1.85 ton/ ha (refer to (1)) → 5.0 ton/ ha).
Corresponding to "New full Development" or New canal extension".

Items	Unit	Unit Price (TZS)	Q'ty	Value (TZS)
I Gross Return				
Yield	kg/ha		5,000	
Farmgate Price	TZS/kg	788		
Gross Return	TZS/ha			**3,940,000**
II Production Cost				
1. Farm Inputs				
Seed	kg/ha	550	50	27,500
Fertilizer (Urea)	kg/ha			
Urea	kg/ha	1,000	125	125,000
DAP	kg/ha	1,200	100	120,000
Agro-chemical (Pesticide)	kg/ha			
Pesticide	kg/ha	12,000	0.5	6,000
Herbicide	kg/ha	15,000	2.5	37,500
Packing Material (Bags (100kg))	nos/ha	1,000	75	75,000
Sub-total				**391,000**
2. Labour Requirement				
Land prep., Puddle and Bund	man/day	7,000	15	105,000
Nursery	man/day	2,000	6	12,000
Plant/Transplanting	man/day	8,000	22	176,000
Weeding and Fertilizer	man/day	10,000	16	160,000
Bird Scaring	man/day	10,000	21	210,000
Harvesting	man/day	10,000	15	150,000
Transport Marketing	man/day	15,000	10	150,000
Irrigation, etc	man/day	12,500	10	125,000
Threshing/Winnowing	man/day	10,000	10	100,000
Sub-total				**1,188,000**
3. Machinery and Draught Animal				
Tractor	LS			-
Hand Tractor	LS	120,000	1	120,000
Draught Animal	LS			-
Sub-total				**120,000**
4. Miscellaneous Cost (5% of Cost)				**84,950**
Total				**1,783,950**
III Net Return				
				2,156,050

Attachment-9.9.2 (5/6) Crop Budget (Financial Price)

Dry Season — **Higher Price**

Tomato — **Conditions: [Unit price is adjusted to actual unit price in 2017]**
[The yield in the case of "Future (with Project)": 40 ton/ha]
[Mark-up: 2.0]
Note) Mark up: the ratio of total distribution expenses (transport costs, expenses for participating markets, storage expenses etc.)

(1) [Present: Rainfed → Future: Rainfed]

	Items	Unit	Unit Price (TZS)	Q'ty	Value (TZS)
I	Gross Return				
	Yield	kg/ha		5,000	
	Farmgate Price	TZS/kg	859		
	Gross Return	TZS/ha			**4,295,000**
II	Production Cost				
1. Farm Inputs					
	Seed	kg/ha	1,000,000	0.50	500,000
	Fertilizer				
	Vig Max	kg/ha	8,000	10	80,000
	DAP	kg/ha	1,300	100	130,000
	NPK Winner	kg/ha	1,300	100	130,000
	CAN	kg/ha	900	100	90,000
	Booster	lit/ha	10,000	0	-
	Agro-chemical (Pestc, Fungc)				
	Pesticide (wiltigo, profecron, Ninja)	lit/ha	20,000	3	60,000
	Herbicide	lit/ha	0	0	-
	Fungicide defender, mupafidan)	lit/ha	30,000	3	90,000
	Packing Material (Wdn Crt 45kg)	nos/ha	1,000	500	500,000
	Sub-total				**1,580,000**
2. Labour Requirement					
	Land prep., Puddle and Bund	man/day	10,000	15	150,000
	Nursery	man/day	3,000	20	60,000
	Plant/Transplanting	man/day	10,000	10	100,000
	Weeding and Fertilizer	man/day	10,000	15	150,000
	Bird Scaring & plant upkeeping	man/day	10,000	20	200,000
	Harvesting	man/day	15,000	15	225,000
	Transport Marketing	man/day	10,000	5	50,000
	Irrigation, etc	man/day		0	-
	Threshing/Winnowing	man/day	8,000	10	80,000
	Sub-total				**1,015,000**
3. Machinery and Draught Animal					
	Tractor	LS	125,000	0	-
	Hand Tractor	LS			-
	Draught Animal	LS			-
	Sub-total				**0**
4. Miscellaneous Cost (5% of Cost)					**129,750**
	Total				**2,724,750**
III	Net Return				
					1,570,250

(2) [Present: Irrigation → Future: Irrigation (w/o Project)]

The case that there are exiting irrigation schemes. It is assumed that the yeild shall increase by the improvement of these exiting schemes (20.0 ton/ha → 40.0 ton/ ha (refer to (3))).
Corresponding to "Improvement of exiting" among Irrigation types.

	Items	Unit	Unit Price (TZS)	Q'ty	Value (TZS)
I	Gross Return				
	Yield	kg/ha		20,000	
	Farmgate Price	TZS/kg	859		
	Gross Return	TZS/ha			**17,180,000**
II	Production Cost				
1. Farm Inputs					
	Seed	kg/ha	1,000,000	1.00	1,000,000
	Fertilizer (Urea, DAP, CAN)				
	Vig Max	kg/ha	8,000	20	160,000
	DAP	kg/ha	1,300	150	195,000
	NPK Winner	kg/ha	1,300	150	195,000
	CAN	kg/ha	900	150	135,000
	Booster	lit/ha	10,000	15	150,000
	Agro-chemical (Pestc, Fungc)				
	Pesticide (wiltigo, profecron, Ninja)	lit/ha	20,000	10	200,000
	Herbicide	lit/ha	0	0	-
	Fungicide defender, mupafidan)	lit/ha	50,000	1	50,000
	Packing Material (Wdn Crt)	nos/ha	1,000	1000	1,000,000
	Sub-total				**3,085,000**
2. Labour Requirement					
	Land prep., Puddle and Bund	man/day	10,000	15	150,000
	Nursery	man/day	5,000	40	200,000
	Plant/Transplanting	man/day	10,000	20	200,000
	Weeding and Fertilizer	man/day	10,000	20	200,000
	Bird Scaring & plant upkeeping	man/day	13,000	30	390,000
	Harvesting	man/day	5,000	180	900,000
	Transport Marketing	man/day	12,500	30	375,000
	Irrigation, etc	man/day	10,000	20	200,000
	Threshing/Winnowing	man/day	4,412	35	154,420
	Sub-total				**2,769,420**
3. Machinery and Draught Animal					
	Tractor	LS	150,000	1	150,000
	Hand Tractor	LS			-
	Draught Animal	LS			-
	Sub-total				**150,000**
4. Miscellaneous Cost (5% of Cost)					**300,221**
	Total				**6,304,641**
III	Net Return				
					10,875,359

(3) [Present: Irrigation → Future: Irrigation or Present: Irrigation → Future: Irrigation (with Project)]

At present, the areas which have no irrigation scheme or traditional irrigation is being done in. By implemention of NIMP2018, the yeild shall increase (1.85 ton/ ha (refer to (1)) → 5.0 ton/ ha).
Corresponding to "New full Development" or New canal extension".

	Items	Unit	Unit Price (TZS)	Q'ty	Value (TZS)
I	Gross Return				
	Yield	kg/ha		40,000	
	Farmgate Price	TZS/kg	859		
	Gross Return	TZS/ha			**34,360,000**
II	Production Cost				
1. Farm Inputs					
	Seed	kg/ha	1,000,000	1.00	1,000,000
	Fertilizer (Urea, DAP, CAN)				
	Vig Max	kg/ha	8,000	20	160,000
	DAP	kg/ha	1,300	150	195,000
	NPK Winner	kg/ha	1,300	150	195,000
	CAN	kg/ha	900	150	135,000
	Booster	lit/ha	10,000	15	150,000
	Agro-chemical (Pestc, Fungc)				
	Pesticide (wiltigo, profecron, Ninja)	lit/ha	20,000	10	200,000
	Herbicide	lit/ha	0	0	-
	Fungicide defender, mupafidan)	lit/ha	50,000	1	50,000
	Packing Material (Wdn Crt)	nos/ha	1,000	1000	1,000,000
	Sub-total				**3,085,000**
2. Labour Requirement					
	Land prep., Puddle and Bund	man/day	10,000	15	150,000
	Nursery	man/day	5,000	40	200,000
	Plant/Transplanting	man/day	10,000	20	200,000
	Weeding and Fertilizer	man/day	10,000	20	200,000
	Bird Scaring & plant upkeeping	man/day	13,000	30	390,000
	Harvesting	man/day	5,000	180	900,000
	Transport Marketing	man/day	12,500	30	375,000
	Irrigation, etc	man/day	10,000	20	200,000
	Threshing/Winnowing	man/day	4,412	35	154,420
	Sub-total				**2,769,420**
3. Machinery and Draught Animal					
	Tractor	LS	150,000	1	150,000
	Hand Tractor	LS			-
	Draught Animal	LS			-
	Sub-total				**150,000**
4. Miscellaneous Cost (5% of Cost)					**300,221**
	Total				**6,304,641**
III	Net Return				
					28,055,359

Sources: JICA Project Team

Attachment-9.9.2 (6/6) Crop Budget (Financial Price)

Dry Season **Higher Price**

Onion **Conditions:** [Unit price is adjusted to actual unit price in 2017]
[Mark-up] 1.7
Note) Mark up: the ratio of total distribution expenses (transport costs, expenses for participating markets, storage expenses etc.)

(1) [Present: Rainfed → Future: Rainfed]

	Items	Unit	Unit Price (TZS)	Q'ty	Value (TZS)
I	Gross Return				
	Yield	kg/ha		2,000	
	Farmgate Price	TZS/kg	785		
	Gross Return	TZS/ha			**1,570,000**
II	Production Cost				
1. Farm Inputs					
	Seed	kg/ha	40,000	3	120,000
	Fertilizer (Urea, DAP, CAN)				
	Urea (46% N)	kg/ha	1,200	200	240,000
	CAN	kg/ha	1,000	200	200,000
	DAP	kg/ha	0	0	-
	NPK	kg/ha	0	0	-
	Manure	ton/ha		0	-
	Agro-chemical (Pestc, Herbc, Fungc)				
	Pesticide (Ninja)	lit/ha	20,000	3	60,000
	Herbicide	lit/ha	39,000	1	39,000
	Fungicide (Ivory 72)	lit/ha	50,000	1	50,000
	Packing Material (Bag 100kg)	nos/ha	1,000	100	100,000
	Sub-total				**809,000**
2. Labour Requirement					
	Land prep., Puddle and Bund	man/day	15,000	5	75,000
	Nursery	man/day	3,300	15	49,500
	Plant/Transplanting	man/day	6,600	25	165,000
	Weeding and Fertilizer	man/day	25,000	4	100,000
	Animals Scaring	man/day	0	0	-
	Harvesting	man/day	13,300	15	199,500
	Transport Marketing	man/day	10,500	10	105,000
	Irrigation, etc	man/day	0	0	-
	Threshing/Winnowing	man/day	7,000	5	35,000
	Sub-total				**729,000**
3. Machinery and Draught Animal					
	Tractor	LS	125,000	1	125,000
	Hand Tractor	LS			-
	Draught Animal	LS			-
	Sub-total				**125,000**
4. Miscellaneous Cost (5% of Cost)					**83,150**
	Total				**1,746,150**
III	Net Return				
					-176,150

Sources: JICA Project Team

(2) [Present: Irrigation → Future: Irrigation (w/o Project)]

The case that there are exiting irrigation schemes. It is assumed that the yeild shall increase by the improvement of these exiting schemes (7.0 ton/ha → 10.0 ton/ ha (refer to (3))).
Corresponding to "Improvement of exiting" among Irrigation types.

	Items	Unit	Unit Price (TZS)	Q'ty	Value (TZS)
I	Gross Return				
	Yield	kg/ha		7,000	
	Farmgate Price	TZS/kg	785		
	Gross Return	TZS/ha			**5,495,000**
II	Production Cost				
1. Farm Inputs					
	Seed	kg/ha	40,000	10	400,000
	Fertilizer (Urea, DAP, V Max, Bstr)				-
	Urea (46% N)	kg/ha	1,000	150	150,000
	DAP	kg/ha	1,300	150	195,000
	Vig Max	kg/ha	8,000	20	160,000
	Booster	kg/ha	5,000	10	50,000
					-
	Agro-chemical (Pestc, Fungc)				-
	Pesticide (Ninja)	lit/ha	20,000	10	200,000
	Herbicide	lit/ha	39,000	5	195,000
	Fungicide (Ivory 72)	lit/ha	50,000	1	50,000
	Packing Material (Bag 100kg)	nos/ha	1,000	150	150,000
	Sub-total				**1,550,000**
2. Labour Requirement					
	Land prep., Puddle and Bund	man/day	12,000	30	360,000
	Nursery	man/day	3,000	40	120,000
	Plant/Transplanting	man/day	12,000	20	240,000
	Weeding and Fertilizer	man/day	10,000	40	400,000
	Animals Scaring	man/day	0	0	0
	Harvesting	man/day	10,000	20	200,000
	Transport Marketing	man/day	16,000	10	160,000
	Irrigation, etc	man/day	10,000	20	200,000
	Threshing/Winnowing	man/day	7,000	10	70,000
	Sub-total				**1,750,000**
3. Machinery and Draught Animal					
	Tractor	LS	125,000	1	125,000
	Hand Tractor	LS			-
	Draught Animal	LS			-
	Sub-total				**125,000**
4. Miscellaneous Cost (5% of Cost)					**171,250**
	Total				**3,596,250**
III	Net Return				
					1,898,750

(3) [Present: Irrigation → Future: Irrigation or Present: Irrigation → Future: Irrigation (with Project)]

At present, the areas which have no irrigation scheme or traditional irrigation is being done in. By implemention of NIMP2018, the yeild shall increase (2.0 ton/ ha (refer to (1)) → 10.0 ton/ ha).
Corresponding to "New full Development" or New canal extension".

	Items	Unit	Unit Price (TZS)	Q'ty	Value (TZS)
I	Gross Return				
	Yield	kg/ha		10,000	
	Farmgate Price	TZS/kg	785		
	Gross Return	TZS/ha			**7,850,000**
II	Production Cost				
1. Farm Inputs					
	Seed	kg/ha	40,000	10	400,000
	Fertilizer (Urea, DAP, V Max, Bstr)				-
	Urea (46% N)	kg/ha	1,000	150	150,000
	DAP	kg/ha	1,300	150	195,000
	Vig Max	kg/ha	8,000	20	160,000
	Booster	kg/ha	5,000	10	50,000
					-
	Agro-chemical (Pestc, Fungc)				-
	Pesticide (Ninja)	lit/ha	20,000	10	200,000
	Herbicide	lit/ha	39,000	5	195,000
	Fungicide (Ivory 72)	lit/ha	50,000	1	50,000
	Packing Material (Bag 100kg)	nos/ha	1,000	150	150,000
	Sub-total				**1,550,000**
2. Labour Requirement					
	Land prep., Puddle and Bund	man/day	12,000	30	360,000
	Nursery	man/day	3,000	40	120,000
	Plant/Transplanting	man/day	12,000	20	240,000
	Weeding and Fertilizer	man/day	10,000	40	400,000
	Animals Scaring	man/day	0	0	-
	Harvesting	man/day	10,000	20	200,000
	Transport Marketing	man/day	16,000	10	160,000
	Irrigation, etc	man/day	10,000	20	200,000
	Threshing/Winnowing	man/day	7,000	10	70,000
	Sub-total				**1,750,000**
3. Machinery and Draught Animal					
	Tractor	LS	125,000	1	125,000
	Hand Tractor	LS			-
	Draught Animal	LS			-
	Sub-total				**125,000**
4. Miscellaneous Cost (5% of Cost)					**171,250**
	Total				**3,596,250**
III	Net Return				
					4,253,750

Attachment-9.9.3 Farm Budget (Financial Price)

Financial Benefit

1. Financiall Net Benefit per ha

In TZS

Total Project Financial Net Benefit (Unit: million TZS) 【TZS 2,240/ USD】

	Net Benefit (Financial)	Phase 1 (2018 - 2025)	Phase 2 (2026 - 2035)	Total (Phase 1+2) (2018 - 2035)
1	**Net Benefit**	**1,036,936**	**1,240,925**	**2,277,862**

In UDS Exch. Rate 2,240 TZS/ USD

Total Project Financial Net Benefit (Unit: million USD)

	Net Benefit (Financial)	Phase 1 (2018 - 2025)	Phase 2 (2026 - 2035)	Total (Phase 1+2) (2018 - 2035)
1	**Net Benefit**	**463**	**554**	**1,017**

///

★ Crops: Rice (i.e. Paddy) and Vegetable (Tomato and Onion)

★ Cropoing pattern

	Rice/ Paddy	Tomato	Onion
Share	0.60	0.20	0.20

Assumed constant over the country

★ Cropping intensity

Because the master plan estimates irrigated land are for both wet and dry seasons, this study adopted the area directly instead of assuming cropping intensity as a general mode across the country.

★ Net return of crop production and Incremental Return by improvement of irrigation

Rice/ Paddy

Net Return (TZS/ ha)

	Rf→Rf(w/o Project)	Ir→Ir (w/o Project)	Rf→Ir or Ir→Ir (with Project)
Yield (kg/ ha)	1,850	2,500	5,000
Farmgate Price (Wet) (Paddy: TZS/ kg)	686	686	686
Farmgate Price (Dry) (Paddy: TZS/ kg)	788	788	788
Net Return (Wet) (TZS)	-198,853	-68,950	1,646,050
Net Return (Dry) (TZS)	-10,153	186,050	2,156,050
Net increase of net return (Rf ➔ Ir)	Wet		1,844,903
	Dry		2,166,203
Net increase of net return (Ir ➔ Ir)	Wet		1,715,000
	Dry		1,970,000

Note: Rf: Rainfed, Ir: Irrigation

Tomato

Net Return (TZS/ ha)

	Rf→Rf(w/o Project)	Ir→Ir (w/o Project)	Rf→Ir or Ir→Ir (with Project)
Yield (kg/ ha)	5,000	20,000	40,000
Farmgate Price (Wet) (TZS/ kg)	624	624	624
Farmgate Price (Dry) (TZS/ kg)	859	859	859
Net Return (Wet) (TZS)	395,250	6,175,359	18,655,359
Net Return (Dry) (TZS)	1,570,250	10,875,359	28,055,359
Net increase of net return (Rf ➔ Ir)	Wet		18,260,109
	Dry		26,485,109
Net increase of net return (Ir ➔ Ir)	Wet		12,480,000
	Dry		17,180,000

Note: Rf: Rainfed, Ir: Irrigation

Onion

Net Return (TZS/ ha)

	Rf→Rf(w/o Project)	Ir→Ir (w/o Project)	Rf→Ir or Ir→Ir (with Project)
Yield (kg/ ha)	2,000	7,000	10,000
Farmgate Price (Wet) (TZS/ kg)	571	571	571
Farmgate Price (Dry) (TZS/ kg)	785	785	785
Net Return (Wet) (TZS)	-604,150	400,750	2,113,750
Net Return (Dry) (TZS)	-176,150	1,898,750	4,253,750
Net increase of net return (Rf ➔ Ir)	Wet		2,717,900
	Dry		4,429,900
Net increase of net return (Ir ➔ Ir)	Wet		1,713,000
	Dry		2,355,000

Note: Rf: Rainfed, Ir: Irrigation

★ Combined Incremental Net Return by Irrigation Development

Note: Rice/Paddy : Tomato : Onion = 60 : 20 : 20

		Combined Incremental Net Return
Net increase of net return (Rf ➔ Ir)	Wet	2,971,212
	Dry	4,174,442
Net increase of net return (Ir ➔ Ir)	Wet	2,252,550
	Dry	2,865,250

Note) Each crop's net increase of net return is multipled by each crop intensity. Total of net increase of net returns shown as abov table.

2. Financial Benefit according to the irrigation development mode

Development mode	Yield change (kg/ ha)	Crop season	Net return increment (TZS / ha)	Phase 1 (2018 - 2025)		Phase 2 (2026 - 2035)		Total (Phase 1+2: 2018 - 2035)	
				Area to be developed (ha)	Benefit of Irrigation Development (million TZS)	Area to be developed (ha)	Benefit of Irrigation Development (million TZS)	Area to be developed (ha)	Benefit of Irrigation Development (million TZS)
1) New [Full Development] <Surface>	Paddy (1,850 ➔ 5,000)	Wet	2,971,212	102,381	304,194	126,731	376,545	229,112	680,740
	Tomato/ Onion (see below)	Dry	4,174,442	30,877	128,896	39,502	164,898	70379.25466	293,794
2) New [Full Develoopment] <Pressure>	Paddy (1,850 ➔ 5,000)	Wet	2,971,212	2,820	8,378	3,175	9,434	5994.892371	17,812
	Tomato/ Onion (see below)	Dry	4,174,442	850	3,550	990	4,132	1840.107629	7,681
3) New [Canal Extension]	Paddy (1,850 ➔ 5,000)	Wet	2,971,212	85,428	253,826	108,036	320,999	193464.6077	574,824
	Tomato/ Onion (see below)	Dry	4,174,442	25,765	107,553	33,675	140,573	59439.39231	248,126
4) Improvement	Paddy (2,500 ➔ 5,000)	Wet	2,252,550	73,969	166,619	71,319	160,650	145288.2845	327,269
	Tomato/ Onion (see below)	Dry	2,865,250	22,309	63,920	22,230	63,694	44538.71547	127,615
				344,399	**1,036,936**	**405,658**	**1,240,925**	**750,057**	**2,277,862**

	Tomato Yield change	Onion Yiled change
1)	5,000 ➔ 40,000	2,000 ➔ 15,000
2)	5,000 ➔ 40,000	2,000 ➔ 15,000
3)	5,000 ➔ 40,000	2,000 ➔ 15,000
4)	20,000 ➔ 40,000	7,000 ➔ 15,000

★ Combined (Rice/Tomato/Onion) Net Benefir per ha (Financial Price

Combined Net Benefit (TZS/ ha)

Wet : Dry =	*1.000*	*0.302*	
Rice : Tomato : Onion =	*0.600*	*0.050*	*0.350*

	Rf→Rf(w/o Project)	Ir→Ir (w/o Project)	Rf→Ir or Ir→Ir (with Project)
Combined Benefit per ha in A Year	-307,754	805,754	3,922,448

4,230,202 ←Net Benefit (Rf→Ir)/ ha
3,116,695 ←Net Benefit (Ir→Ir)/ ha

Natioan Average Farm Area per Farmer= 1.6 ha

6,768,323 ←Net Benefit (Rf→Ir)/ farmer
4,986,711 ←Net Benefit (Ir→Ir)/ farmer

	Rf→Rf(w/o Project)	Ir→Ir (w/o Project)	Rf→Ir or Ir→Ir (with Project)
Combined Benefit per farmer in A Year (per ha x 1.6 ha)	-492,406	1,289,206	6,275,917

Sources: JICA Project Team

Attachment-9.9.4 Cash Flow of NIMP2018 (2018-2035) (Financial Price)

(Unit: million TZS) | Present Value (Unit: million TZS)

	Year	Cost			Total Cost	Agriculture Benefit	Other Benefit	Total Benefit	Net Benefit	Present Value Total Cost	Present Value Total Benefit	Present Value Net Benefit
		Construction	Soft Component	O&M								
1	2018	136,180	9,201	0	**145,382**	0	0	0	**-145,382**	129,805	0	**-129,805**
2	2019	364,479	9,037	0	**373,515**	0	0	0	**-373,515**	297,764	0	**-297,764**
3	2020	623,536	9,695	11,242	**644,473**	0	0	0	**-644,473**	458,723	0	**-458,723**
4	2021	940,410	12,166	20,646	**973,222**	31,120	0	31,120	**-942,102**	618,500	19,777	**-598,723**
5	2022	1,076,136	7,065	31,407	**1,114,609**	114,411	0	114,411	**-1,000,198**	632,459	64,920	**-567,539**
6	2023	789,789	3,866	39,305	**832,961**	256,902	0	256,902	**-576,058**	422,004	130,155	**-291,849**
7	2024	371,235	5,391	43,018	**419,644**	477,893	0	477,893	**58,250**	189,826	216,175	**26,349**
8	2025	235,829	4,798	45,376	**286,003**	717,726	0	717,726	**431,723**	115,512	289,877	**174,366**
9	2026	56,191	2,902	45,938	**105,031**	898,209	0	898,209	**793,178**	37,875	323,903	**286,028**
10	2027	357,848	5,188	544,680	**907,715**	983,045	0	983,045	**75,329**	292,260	316,514	**24,254**
11	2028	427,335	3,296	53,790	**484,420**	1,036,936	0	1,036,936	**552,516**	139,259	298,094	**158,835**
12	2029	707,773	4,593	60,867	**773,233**	1,049,784	0	1,049,784	**276,551**	198,470	269,453	**70,984**
13	2030	952,164	4,836	70,389	**1,027,389**	1,131,603	0	1,131,603	**104,214**	235,451	259,334	**23,883**
14	2031	1,017,142	3,475	80,560	**1,101,178**	1,229,310	0	1,229,310	**128,132**	225,323	251,541	**26,218**
15	2032	862,976	1,891	89,190	**954,056**	1,391,137	0	1,391,137	**437,081**	174,303	254,156	**79,853**
16	2033	553,565	1,641	94,726	**649,932**	1,608,842	0	1,608,842	**958,910**	106,018	262,437	**156,419**
17	2034	256,446	2,705	97,290	**356,441**	1,841,404	0	1,841,404	**1,484,963**	51,914	268,190	**216,276**
18	2035	235,922	1,768	99,650	**337,340**	2,038,717	0	2,038,717	**1,701,377**	43,868	265,114	**221,246**
19	2036	0	0	99,650	**99,650**	2,165,285	0	2,165,285	**2,065,636**	11,570	251,404	**239,834**
20	2037	0	0	1,096,145	**1,096,145**	2,223,920	0	2,223,920	**1,127,775**	113,634	230,547	**116,913**
21	2038	0	0	99,650	**99,650**	2,277,862	0	2,277,862	**2,178,212**	9,224	210,838	**201,614**
22	2039	0	0	99,650	**99,650**	2,277,862	0	2,277,862	**2,178,212**	8,235	188,248	**180,013**
23	2040	0	0	99,650	**99,650**	2,277,862	0	2,277,862	**2,178,212**	7,353	168,079	**160,726**
24	2041	0	0	99,650	**99,650**	2,277,862	0	2,277,862	**2,178,212**	6,565	150,070	**143,505**
25	2042	0	0	99,650	**99,650**	2,277,862	0	2,277,862	**2,178,212**	5,862	133,991	**128,130**
26	2043	0	0	99,650	**99,650**	2,277,862	0	2,277,862	**2,178,212**	5,234	119,635	**114,401**
27	2044	0	0	99,650	**99,650**	2,277,862	0	2,277,862	**2,178,212**	4,673	106,817	**102,144**
28	2045	0	0	99,650	**99,650**	2,277,862	0	2,277,862	**2,178,212**	4,172	95,372	**91,200**
29	2046	0	0	99,650	**99,650**	2,277,862	0	2,277,862	**2,178,212**	3,725	85,154	**81,429**
30	2047	0	0	3,089,136	**3,089,136**	2,277,862	0	2,277,862	**-811,275**	103,109	76,030	**-27,079**
31	2048	0	0	99,650	**99,650**	2,277,862	0	2,277,862	**2,178,212**	2,970	67,884	**64,914**
32	2049	0	0	99,650	**99,650**	2,277,862	0	2,277,862	**2,178,212**	2,652	60,611	**57,959**
33	2050	0	0	99,650	**99,650**	2,277,862	0	2,277,862	**2,178,212**	2,367	54,117	**51,749**
34	2051	0	0	99,650	**99,650**	2,277,862	0	2,277,862	**2,178,212**	2,114	48,319	**46,205**
35	2052	0	0	99,650	**99,650**	2,277,862	0	2,277,862	**2,178,212**	1,887	43,142	**41,254**
36	2053	0	0	99,650	**99,650**	2,277,862	0	2,277,862	**2,178,212**	1,685	38,519	**36,834**
37	2054	0	0	99,650	**99,650**	2,277,862	0	2,277,862	**2,178,212**	1,505	34,392	**32,888**
38	2055	0	0	99,650	**99,650**	2,277,862	0	2,277,862	**2,178,212**	1,343	30,707	**29,364**
39	2056	0	0	99,650	**99,650**	2,277,862	0	2,277,862	**2,178,212**	1,199	27,417	**26,218**
40	2057	0	0	1,096,145	**1,096,145**	2,277,862	0	2,277,862	**1,181,716**	11,780	24,480	**12,700**
41	2058	0	0	99,650	**99,650**	2,277,862	0	2,277,862	**2,178,212**	956	21,857	**20,901**
42	2059	0	0	99,650	**99,650**	2,277,862	0	2,277,862	**2,178,212**	854	19,515	**18,661**
43	2060	0	0	99,650	**99,650**	2,277,862	0	2,277,862	**2,178,212**	762	17,424	**16,662**
44	2061	0	0	99,650	**99,650**	2,277,862	0	2,277,862	**2,178,212**	681	15,557	**14,877**
45	2062	0	0	99,650	**99,650**	2,277,862	0	2,277,862	**2,178,212**	608	13,890	**13,283**
46	2063	0	0	99,650	**99,650**	2,277,862	0	2,277,862	**2,178,212**	543	12,402	**11,860**
47	2064	0	0	99,650	**99,650**	2,277,862	0	2,277,862	**2,178,212**	484	11,073	**10,589**
48	2065	0	0	99,650	**99,650**	2,277,862	0	2,277,862	**2,178,212**	433	9,887	**9,454**
										4,687,510	**5,857,022**	**1,169,512**

Sources: JICA Project Team

Attachment-9.9.5 (1/6) Crop Budget (Economic Price)

Wet Season Lower Price

Rice

Conditions: **[Unit price is adjusted to actual unit price in 2017]**
[Mark-up: 1.2 (based on the market survey in Dar es Salaam)]
[Paddy : Milled Rice = 1 : 0.65]
[Farmgate price is estimated based on international price. Wet or Dry are not distinguished. Production cost are converted by SW and SCF]
Note) Mark up: the ratio of total distribution expenses (transport costs, expenses for participating markets, storage expenses etc.)

(1) [Present: Rainfed → Future: Rainfed]

	Items	Unit	Unit Price (TZS)	Q'ty	Value (TZS)
I	Gross Return				
	Yield	kg/ha		1,850	
	Farmgate Price	TZS/kg	422		
	Gross Return	TZS/ha			**780,671**
II	Production Cost				
1. Farm Inputs					
	Seed	kg/ha	670	75	50,250
	Fertilizer (Urea)	kg/ha			
	Urea	kg/ha	1,000	100	100,000
	Agro-chemical (Pesticide)	kg/ha			
	Pesticide	kg/ha	12,000	0.5	6,000
	Packing Material (Bags (70kg))	nos/ha	700	50	35,000
	Sub-total				**191,250**
2. Labour Requirement					
	Land prep., Puddle and Bund	man/day	10,000	20	200,000
	Nursery	man/day	10,000	2	20,000
	Plant/Transplanting	man/day	10,000	25	250,000
	Weeding and Fertilizer	man/day	5,000	50	250,000
	Bird Scaring	man/day	660	30	19,800
	Harvesting	man/day	6,000	40	240,000
	Transport Marketing	man/day	5,000	7	35,000
	Irrigation, etc	man/day		0	0
	Threshing/Winnowing	man/day	4,400	30	132,000
	Sub-total				**1,146,800**
3. Machinery and Draught Animal					
	Tractor	LS	60,000	1	60,000
	Hand Tractor	LS			-
	Draught Animal	LS			-
	Sub-total				**60,000**
4. Miscellaneous Cost (5% of Cost)					**69,903**
	Total				**1,080,254**
III	Net Return				
					-299,582

Sources: JICA Project Team

(2) [Present: Irrigation → Future: Irrigation (w/o Project)]

The case that there are exiting irrigation schemes. It is assumed that the yeild shall increase by the improvement of these exiting schemes (2.5 ton/ha → 5.0 ton/ ha (refer to (3))).
Corresponding to "Improvement of exiting" among Irrigation types.

	Items	Unit	Unit Price (TZS)	Q'ty	Value (TZS)
I	Gross Return				
	Yield	kg/ha		2,500	
	Farmgate Price	TZS/kg	422		
	Gross Return	TZS/ha			**1,054,961**
II	Production Cost				
1. Farm Inputs					
	Seed	kg/ha	550	50	27,500
	Fertilizer (Urea)	kg/ha			
	Urea	kg/ha	1,000	125	125,000
	DAP	kg/ha	1,200	100	120,000
	Agro-chemical (Pesticide)	kg/ha			
	Pesticide	kg/ha	12,000	0.5	6,000
	Herbicide	kg/ha	15,000	2.5	37,500
	Packing Material (Bags (100kg))	nos/ha	1,000	75	75,000
	Sub-total				**391,000**
2. Labour Requirement					
	Land prep., Puddle and Bund	man/day	7,000	15	105,000
	Nursery	man/day	2,000	6	12,000
	Plant/Transplanting	man/day	8,000	22	176,000
	Weeding and Fertilizer	man/day	10,000	16	160,000
	Bird Scaring	man/day	10,000	21	210,000
	Harvesting	man/day	10,000	15	150,000
	Transport Marketing	man/day	15,000	10	150,000
	Irrigation, etc	man/day	12,500	10	125,000
	Threshing/Winnowing	man/day	10,000	10	100,000
	Sub-total				**1,188,000**
3. Machinery and Draught Animal					
	Tractor	LS			-
	Hand Tractor	LS	120,000	1	120,000
	Draught Animal	LS			-
	Sub-total				**120,000**
4. Miscellaneous Cost (5% of Cost)					**84,950**
	Total				**1,387,793**
III	Net Return				
					-332,832

(3) [Present: Irrigation → Future: Irrigation or Present: Irrigation → Future: Irrigation (with Project)]

At present, the areas which have no irrigation scheme or traditional irrigation is being done in. By implemention of NIMP2018, the yeild shall increase (1.85 ton/ ha (refer to (1)) → 5.0 ton/ ha).
Corresponding to "New full Development" or New canal extension".

	Items	Unit	Unit Price (TZS)	Q'ty	Value (TZS)
I	Gross Return				
	Yield	kg/ha		5,000	
	Farmgate Price	TZS/kg	422		
	Gross Return	TZS/ha			**2,109,923**
II	Production Cost				
1. Farm Inputs					
	Seed	kg/ha	550	50	27,500
	Fertilizer (Urea)	kg/ha			
	Urea	kg/ha	1,000	125	125,000
	DAP	kg/ha	1,200	100	120,000
	Agro-chemical (Pesticide)	kg/ha			
	Pesticide	kg/ha	12,000	0.5	6,000
	Herbicide	kg/ha	15,000	2.5	37,500
	Packing Material (Bags (100kg))	nos/ha	1,000	75	75,000
	Sub-total				**391,000**
2. Labour Requirement					
	Land prep., Puddle and Bund	man/day	7,000	15	105,000
	Nursery	man/day	2,000	6	12,000
	Plant/Transplanting	man/day	8,000	22	176,000
	Weeding and Fertilizer	man/day	10,000	16	160,000
	Bird Scaring	man/day	10,000	21	210,000
	Harvesting	man/day	10,000	15	150,000
	Transport Marketing	man/day	15,000	10	150,000
	Irrigation, etc	man/day	12,500	10	125,000
	Threshing/Winnowing	man/day	10,000	10	100,000
	Sub-total				**1,188,000**
3. Machinery and Draught Animal					
	Tractor	LS			-
	Hand Tractor	LS	120,000	1	120,000
	Draught Animal	LS			-
	Sub-total				**120,000**
4. Miscellaneous Cost (5% of Cost)					**84,950**
	Total				**1,387,793**
III	Net Return				
					722,130

Attachment-9.9.5 (2/6) Crop Budget (Economic Price)

Wet Season Lower Price

Tomato Conditions: [Unit price: average price from 2007 to 2016]
[Mark-up: 1.8]
[Because inputs will increase in irrigation agriculture, production costs in Present (Rainfed) condition is decreased by about 10% and the costs in future conditions is increased about 10 %]
[Farmgate price: In assumption of efficient market, market price is used as it is. Production costs are converted by SW and SCF]
Note) Mark up: the ratio of total distribution expenses (transport costs, expenses for participating markets, storage expenses etc.)

(1) [Present: Rainfed → Future: Rainfed]

Items	Unit	Unit Price (TZS)	Q'ty	Value (TZS)
I Gross Return				
Yield	kg/ha		5,000	
Farmgate Price	TZS/kg	624		
Gross Return	TZS/ha			**3,120,000**
II Production Cost				
1. Farm Inputs				
Seed	kg/ha	1,000,000	0.50	500,000
Fertilizer				
Vig Max	kg/ha	8,000	10	80,000
DAP	kg/ha	1,300	100	130,000
NPK Winner	kg/ha	1,300	100	130,000
CAN	kg/ha	900	100	90,000
Booster	lit/ha	10,000	0	-
Agro-chemical (Pestc, Fungc)				
Pesticide (wiltigo, profecron, Ninja)	lit/ha	20,000	3	60,000
Herbicide	lit/ha	0	0	-
Fungicide defender, mupafidan)	lit/ha	30,000	3	90,000
Packing Material (Wdn Crt 45kg)	nos/ha	1,000	500	500,000
Sub-total				**1,580,000**
2. Labour Requirement				
Land prep., Puddle and Bund	man/day	10,000	15	150,000
Nursery	man/day	3,000	20	60,000
Plant/Transplanting	man/day	10,000	10	100,000
Weeding and Fertilizer	man/day	10,000	15	150,000
Bird Scaring & plant upkeeping	man/day	10,000	20	200,000
Harvesting	man/day	15,000	15	225,000
Transport Marketing	man/day	10,000	5	50,000
Irrigation, etc	man/day		0	-
Threshing/Winnowing	man/day	8,000	10	80,000
Sub-total				**1,015,000**
3. Machinery and Draught Animal				
Tractor	LS	125,000	0	-
Hand Tractor	LS			-
Draught Animal	LS			-
Sub-total				**0**
4. Miscellaneous Cost (5% of Cost)				**129,750**
Total				**2,384,621**
III Net Return				
				735,379

(2) [Present: Irrigation → Future: Irrigation (w/o Project)]

The case that there are exiting irrigation schemes. It is assumed that the yeild shall increase by the improvement of these exiting schemes (20.0 ton/ha → 40.0 ton/ ha (refer to (3))).
Corresponding to "Improvement of exiting" among Irrigation types.

Items	Unit	Unit Price (TZS)	Q'ty	Value (TZS)
I Gross Return				
Yield	kg/ha		20,000	
Farmgate Price	TZS/kg	624		
Gross Return	TZS/ha			**12,480,000**
II Production Cost				
1. Farm Inputs				
Seed	kg/ha	1,000,000	1.00	1,000,000
Fertilizer (Urea, DAP, CAN)				
Vig Max	kg/ha	8,000	20	160,000
DAP	kg/ha	1,300	150	195,000
NPK Winner	kg/ha	1,300	150	195,000
CAN	kg/ha	900	150	135,000
Booster	lit/ha	10,000	15	150,000
Agro-chemical (Pestc, Fungc)				
Pesticide (wiltigo, profecron, Ninja)	lit/ha	20,000	10	200,000
Herbicide	lit/ha	0	0	-
Fungicide defender, mupafidan)	lit/ha	50,000	1	50,000
Packing Material (Wdn Crt)	nos/ha	1,000	1000	1,000,000
Sub-total				**3,085,000**
2. Labour Requirement				
Land prep., Puddle and Bund	man/day	10,000	15	150,000
Nursery	man/day	5,000	40	200,000
Plant/Transplanting	man/day	10,000	20	200,000
Weeding and Fertilizer	man/day	10,000	20	200,000
Bird Scaring & plant upkeeping	man/day	13,000	30	390,000
Harvesting	man/day	5,000	180	900,000
Transport Marketing	man/day	12,500	30	375,000
Irrigation, etc	man/day	10,000	20	200,000
Threshing/Winnowing	man/day	4,412	35	154,420
Sub-total				**2,769,420**
3. Machinery and Draught Animal				
Tractor	LS	150,000	1	150,000
Hand Tractor	LS			-
Draught Animal	LS			-
Sub-total				**150,000**
4. Miscellaneous Cost (5% of Cost)				**300,221**
Total				**3,880,989**
III Net Return				
				8,599,011

(3) [Present: Irrigation → Future: Irrigation or Present: Irrigation → Future: Irrigation (with Project)]

At present, the areas which have no irrigation scheme or traditional irrigation is being done in. By implemention of NIMP2018, the yeild shall increase (5.0 ton/ ha (refer to (1)) → 40.0 ton/ ha).
Corresponding to "New full Development" or New canal extension".

Items	Unit	Unit Price (TZS)	Q'ty	Value (TZS)
I Gross Return				
Yield	kg/ha		40,000	
Farmgate Price	TZS/kg	624		
Gross Return	TZS/ha			**24,960,000**
II Production Cost				
1. Farm Inputs				
Seed	kg/ha	1,000,000	1.00	1,000,000
Fertilizer (Urea, DAP, CAN)				
Vig Max	kg/ha	8,000	20	160,000
DAP	kg/ha	1,300	150	195,000
NPK Winner	kg/ha	1,300	150	195,000
CAN	kg/ha	900	150	135,000
Booster	lit/ha	10,000	15	150,000
Agro-chemical (Pestc, Fungc)				
Pesticide (wiltigo, profecron, Ninja)	lit/ha	20,000	10	200,000
Herbicide	lit/ha	0	0	-
Fungicide defender, mupafidan)	lit/ha	50,000	1	50,000
Packing Material (Wdn Crt)	nos/ha	1,000	1000	1,000,000
Sub-total				**3,085,000**
2. Labour Requirement				
Land prep., Puddle and Bund	man/day	10,000	15	150,000
Nursery	man/day	5,000	40	200,000
Plant/Transplanting	man/day	10,000	20	200,000
Weeding and Fertilizer	man/day	10,000	20	200,000
Bird Scaring & plant upkeeping	man/day	13,000	30	390,000
Harvesting	man/day	5,000	180	900,000
Transport Marketing	man/day	12,500	30	375,000
Irrigation, etc	man/day	10,000	20	200,000
Threshing/Winnowing	man/day	4,412	35	154,420
Sub-total				**2,769,420**
3. Machinery and Draught Animal				
Tractor	LS	150,000	1	150,000
Hand Tractor	LS			-
Draught Animal	LS			-
Sub-total				**150,000**
4. Miscellaneous Cost (5% of Cost)				**300,221**
Total				**3,880,989**
III Net Return				
				21,079,011

Sources: JICA Project Team

Attachment-9.9.5 (3/6) Crop Budget (Economic Price)

Wet Season **Lower Price**

Onion

Conditions: Unit price: average price from 2007 to 2016
[Mark-up:1.7]
[Because inputs will increase in irrigation agriculture, production costs in Present (Rainfed) condition is decreased by about 10% and the costs in future conditions is increased about 10 %]
[Farmgate price: In assumption of efficient market, market price is used as it is. Production costs are converted by SW and SCF]
Note) Mark up: the ratio of total distribution expenses (transport costs, expenses for participating markets, storage expenses etc.)

(1) [Present: Rainfed → Future: Rainfed]

	Items	Unit	Unit Price (TZS)	Q'ty	Value (TZS)
I	Gross Return				
	Yield	kg/ha		2,000	
	Farmgate Price	TZS/kg	571		
	Gross Return	TZS/ha			**1,142,000**
II	Production Cost				
1. Farm Inputs					
	Seed	kg/ha	40,000	3	120,000
	Fertilizer (Urea, DAP, CAN)				
	Urea (46% N)	kg/ha	1,200	200	240,000
	CAN	kg/ha	1,000	200	200,000
	DAP	kg/ha	0	0	-
	NPK	kg/ha	0	0	-
	Manure	ton/ha		0	-
	Agro-chemical (Pestc, Herbc, Fungc)				
	Pesticide (Ninja)	lit/ha	20,000	3	60,000
	Herbicide	lit/ha	39,000	1	39,000
	Fungicide (Ivory 72)	lit/ha	50,000	1	50,000
	Packing Material (Bag 100kg)	nos/ha	1,000	100	100,000
	Sub-total				**809,000**
2. Labour Requirement					
	Land prep., Puddle and Bund	man/day	15,000	5	75,000
	Nursery	man/day	3,300	15	49,500
	Plant/Transplanting	man/day	6,600	25	165,000
	Weeding and Fertilizer	man/day	25,000	4	100,000
	Animals Scaring	man/day	0	0	-
	Harvesting	man/day	13,300	15	199,500
	Transport Marketing	man/day	10,500	10	105,000
	Irrigation, etc	man/day	0	0	-
	Threshing/Winnowing	man/day	7,000	5	35,000
	Sub-total				**729,000**
3. Machinery and Draught Animal					
	Tractor	LS	125,000	1	125,000
	Hand Tractor	LS			-
	Draught Animal	LS			-
	Sub-total				**125,000**
4. Miscellaneous Cost (5% of Cost)					**83,150**
	Total				**1,531,843**
III	Net Return				
					-389,843

Sources: JICA Project Team

(2) [Present: Irrigation → Future: Irrigation (w/o Project)]

The case that there are exiting irrigation schemes. It is assumed that the yeild shall increase by the improvement of these exiting schemes (7.0 ton/ha → 10.0 ton/ ha (refer to (3))).
Corresponding to "Improvement of exiting" among Irrigation types.

	Items	Unit	Unit Price (TZS)	Q'ty	Value (TZS)
I	Gross Return				
	Yield	kg/ha		7,000	
	Farmgate Price	TZS/kg	571		
	Gross Return	TZS/ha			**3,997,000**
II	Production Cost				
1. Farm Inputs					
	Seed	kg/ha	40,000	10	400,000
	Fertilizer (Urea, DAP, V Max, Bstr)				-
	Urea (46% N)	kg/ha	1,000	150	150,000
	DAP	kg/ha	1,300	150	195,000
	Vig Max	kg/ha	8,000	20	160,000
	Booster	kg/ha	5,000	10	50,000
					-
	Agro-chemical (Pestc, Fungc)				-
	Pesticide (Ninja)	lit/ha	20,000	10	200,000
	Herbicide	lit/ha	39,000	5	195,000
	Fungicide (Ivory 72)	lit/ha	50,000	1	50,000
	Packing Material (Bag 100kg)	nos/ha	1,000	150	150,000
	Sub-total				**1,550,000**
2. Labour Requirement					
	Land prep., Puddle and Bund	man/day	12,000	30	360,000
	Nursery	man/day	3,000	40	120,000
	Plant/Transplanting	man/day	12,000	20	240,000
	Weeding and Fertilizer	man/day	10,000	40	400,000
	Animals Scaring	man/day	0	0	-
	Harvesting	man/day	10,000	20	200,000
	Transport Marketing	man/day	16,000	10	160,000
	Irrigation, etc	man/day	10,000	20	200,000
	Threshing/Winnowing	man/day	7,000	10	70,000
	Sub-total				**1,750,000**
3. Machinery and Draught Animal					
	Tractor	LS	125,000	1	125,000
	Hand Tractor	LS			-
	Draught Animal	LS			-
	Sub-total				**125,000**
4. Miscellaneous Cost (5% of Cost)					**171,250**
	Total				**3,049,534**
III	Net Return				
					947,466

(3) [Present: Irrigation → Future: Irrigation or Present: Irrigation → Future: Irrigation (with Project)]

At present, the areas which have no irrigation scheme or traditional irrigation is being done in. By implemention of NIMP2018, the yeild shall increase (2.0 ton/ ha (refer to (1)) → 10.0 ton/ ha).
Corresponding to "New full Development" or New canal extension".

	Items	Unit	Unit Price (TZS)	Q'ty	Value (TZS)
I	Gross Return				
	Yield	kg/ha		10,000	
	Farmgate Price	TZS/kg	571		
	Gross Return	TZS/ha			**5,710,000**
II	Production Cost				
1. Farm Inputs					
	Seed	kg/ha	40,000	10	400,000
	Fertilizer (Urea, DAP, V Max, Bstr)				-
	Urea (46% N)	kg/ha	1,000	150	150,000
	DAP	kg/ha	1,300	150	195,000
	Vig Max	kg/ha	8,000	20	160,000
	Booster	kg/ha	5,000	10	50,000
					-
	Agro-chemical (Pestc, Fungc)				-
	Pesticide (Ninja)	lit/ha	20,000	10	200,000
	Herbicide	lit/ha	39,000	5	195,000
	Fungicide (Ivory 72)	lit/ha	50,000	1	50,000
	Packing Material (Bag 100kg)	nos/ha	1,000	150	150,000
	Sub-total				**1,550,000**
2. Labour Requirement					
	Land prep., Puddle and Bund	man/day	12,000	30	360,000
	Nursery	man/day	3,000	40	120,000
	Plant/Transplanting	man/day	12,000	20	240,000
	Weeding and Fertilizer	man/day	10,000	40	400,000
	Animals Scaring	man/day	0	0	-
	Harvesting	man/day	10,000	20	200,000
	Transport Marketing	man/day	16,000	10	160,000
	Irrigation, etc	man/day	10,000	20	200,000
	Threshing/Winnowing	man/day	7,000	10	70,000
	Sub-total				**1,750,000**
3. Machinery and Draught Animal					
	Tractor	LS	125,000	1	125,000
	Hand Tractor	LS			-
	Draught Animal	LS			-
	Sub-total				**125,000**
4. Miscellaneous Cost (5% of Cost)					**171,250**
	Total				**3,049,534**
III	Net Return				
					2,660,466

Attachment-9.9.5 (4/6) Crop Budget (Economic Price)

Dry Season **Higher Price**

Rice

Conditions: [Unit price is adjusted to actual unit price in 2017]
[Mark-up: 1.2 (based on the market survey in Dar es Salaam)]
[Paddy : Milled Rice = 1 : 0.65]
[Farmgate price is estimated based on international price. Wet or Dry are not distinguished. Production cost are converted by SW and SCF]
Note) Mark up: the ratio of total distribution expenses (transport costs, expenses for participating markets, storage expenses etc.)

(1) [Present: Rainfed → Future: Rainfed]

Items	Unit	Unit Price (TZS)	Q'ty	Value (TZS)
I Gross Return				
Yield	kg/ha		1,850	
Farmgate Price	TZS/kg	422		
Gross Return	TZS/ha			**780,671**
II Production Cost				
1. Farm Inputs				
Seed	kg/ha	670	75	50,250
Fertilizer (Urea)	kg/ha			
Urea	kg/ha	1,000	100	100,000
Agro-chemical (Pesticide)	kg/ha			
Pesticide	kg/ha	12,000	0.5	6,000
Packing Material (Bags (70kg))	nos/ha	700	50	35,000
Sub-total				**191,250**
2. Labour Requirement				
Land prep., Puddle and Bund	man/day	10,000	20	200,000
Nursery	man/day	10,000	2	20,000
Plant/Transplanting	man/day	10,000	25	250,000
Weeding and Fertilizer	man/day	5,000	50	250,000
Bird Scaring	man/day	660	30	19,800
Harvesting	man/day	6,000	40	240,000
Transport Marketing	man/day	5,000	7	35,000
Irrigation, etc	man/day		0	0
Threshing/Winnowing	man/day	4,400	30	132,000
Sub-total				**1,146,800**
3. Machinery and Draught Animal				
Tractor	LS	60,000	1	60,000
Hand Tractor	LS			-
Draught Animal	LS			-
Sub-total				**60,000**
4. Miscellaneous Cost (5% of Cost)				**69,903**
Total				**1,080,254**
III Net Return				
				-299,582

Sources: JICA Project Team

(2) [Present: Irrigation → Future: Irrigation (w/o Project)]

The case that there are exiting irrigation schemes. It is assumed that the yeild shall increase by the improvement of these exiting schemes (2.5 ton/ha → 5.0 ton/ ha (refer to (3))).
Corresponding to "Improvement of exiting" among Irrigation types.

Items	Unit	Unit Price (TZS)	Q'ty	Value (TZS)
I Gross Return				
Yield	kg/ha		2,500	
Farmgate Price	TZS/kg	422		
Gross Return	TZS/ha			**1,054,961**
II Production Cost				
1. Farm Inputs				
Seed	kg/ha	550	50	27,500
Fertilizer (Urea)	kg/ha			
Urea	kg/ha	1,000	125	125,000
DAP	kg/ha	1,200	100	120,000
Agro-chemical (Pesticide)	kg/ha			
Pesticide	kg/ha	12,000	0.5	6,000
Herbicide	kg/ha	15,000	2.5	37,500
Packing Material (Bags (100kg))	nos/ha	1,000	75	75,000
Sub-total				**391,000**
2. Labour Requirement				
Land prep., Puddle and Bund	man/day	7,000	15	105,000
Nursery	man/day	2,000	6	12,000
Plant/Transplanting	man/day	8,000	22	176,000
Weeding and Fertilizer	man/day	10,000	16	160,000
Bird Scaring	man/day	10,000	21	210,000
Harvesting	man/day	10,000	15	150,000
Transport Marketing	man/day	15,000	10	150,000
Irrigation, etc	man/day	12,500	10	125,000
Threshing/Winnowing	man/day	10,000	10	100,000
Sub-total				**1,188,000**
3. Machinery and Draught Animal				
Tractor	LS			-
Hand Tractor	LS	120,000	1	120,000
Draught Animal	LS			-
Sub-total				**120,000**
4. Miscellaneous Cost (5% of Cost)				**84,950**
Total				**1,387,793**
III Net Return				
				-332,832

(3) [Present: Irrigation → Future: Irrigation or Present: Irrigation → Future: Irrigation (with Project)]

At present, the areas which have no irrigation scheme or traditional irrigation is being done in. By implemention of NIMP2018, the yeild shall increase (1.85 ton/ ha (refer to (1)) → 5.0 ton/ ha).
Corresponding to "New full Development" or New canal extension".

Items	Unit	Unit Price (TZS)	Q'ty	Value (TZS)
I Gross Return				
Yield	kg/ha		5,000	
Farmgate Price	TZS/kg	422		
Gross Return	TZS/ha			**2,109,923**
II Production Cost				
1. Farm Inputs				
Seed	kg/ha	550	50	27,500
Fertilizer (Urea)	kg/ha			
Urea	kg/ha	1,000	125	125,000
DAP	kg/ha	1,200	100	120,000
Agro-chemical (Pesticide)	kg/ha			
Pesticide	kg/ha	12,000	0.5	6,000
Herbicide	kg/ha	15,000	2.5	37,500
Packing Material (Bags (100kg))	nos/ha	1,000	75	75,000
Sub-total				**391,000**
2. Labour Requirement				
Land prep., Puddle and Bund	man/day	7,000	15	105,000
Nursery	man/day	2,000	6	12,000
Plant/Transplanting	man/day	8,000	22	176,000
Weeding and Fertilizer	man/day	10,000	16	160,000
Bird Scaring	man/day	10,000	21	210,000
Harvesting	man/day	10,000	15	150,000
Transport Marketing	man/day	15,000	10	150,000
Irrigation, etc	man/day	12,500	10	125,000
Threshing/Winnowing	man/day	10,000	10	100,000
Sub-total				**1,188,000**
3. Machinery and Draught Animal				
Tractor	LS			-
Hand Tractor	LS	120,000	1	120,000
Draught Animal	LS			-
Sub-total				**120,000**
4. Miscellaneous Cost (5% of Cost)				**84,950**
Total				**1,387,793**
III Net Return				
				722,130

Attachment-9.9.5 (5/6) Crop Budget (Economic Price)

Dry Season **Higher Price**

Tomato

Conditions: [Unit price: average price from 2007 to 2016]
[Mark-up: 2.0]
[Farmgate price: In assumption of efficient market, market price is used as it is. Production costs are converted by SW and SCF]
Note) Mark up: the ratio of total distribution expenses (transport costs, expenses for participating markets, storage expenses etc.)

(1) [Present: Rainfed → Future: Rainfed]

Items	Unit	Unit Price (TZS)	Q'ty	Value (TZS)
I Gross Return				
Yield	kg/ha		5,000	
Farmgate Price	TZS/kg	859		
Gross Return	TZS/ha			**4,295,000**
II Production Cost				
1. Farm Inputs				
Seed	kg/ha	1,000,000	0.50	500,000
Fertilizer				
Vig Max	kg/ha	8,000	10	80,000
DAP	kg/ha	1,300	100	130,000
NPK Winner	kg/ha	1,300	100	130,000
CAN	kg/ha	900	100	90,000
Booster	lit/ha	10,000	0	-
Agro-chemical (Pestc, Fungc)				
Pesticide (wiltigo, profecron, Ninja)	lit/ha	20,000	3	60,000
Herbicide	lit/ha	0	0	-
Fungicide defender, mupafidan)	lit/ha	30,000	3	90,000
Packing Material (Wdn Crt 45kg)	nos/ha	1,000	500	500,000
Sub-total				**1,580,000**
2. Labour Requirement				
Land prep., Puddle and Bund	man/day	10,000	15	150,000
Nursery	man/day	3,000	20	60,000
Plant/Transplanting	man/day	10,000	10	100,000
Weeding and Fertilizer	man/day	10,000	15	150,000
Bird Scaring & plant upkeeping	man/day	10,000	20	200,000
Harvesting	man/day	15,000	15	225,000
Transport Marketing	man/day	10,000	5	50,000
Irrigation, etc	man/day		0	-
Threshing/Winnowing	man/day	8,000	10	80,000
Sub-total				**1,015,000**
3. Machinery and Draught Animal				
Tractor	LS	125,000	0	-
Hand Tractor	LS			-
Draught Animal	LS			-
Sub-total				**0**
4. Miscellaneous Cost (5% of Cost)				**129,750**
Total				**2,384,621**
III Net Return				
				1,910,379

Sources: JICA Project Team

(2) [Present: Irrigation → Future: Irrigation (w/o Project)]

The case that there are exiting irrigation schemes. It is assumed that the yeild shall increase by the improvement of these exiting schemes (20.0 ton/ha → 40.0 ton/ ha (refer to (3))).
Corresponding to "Improvement of exiting" among Irrigation types.

Items	Unit	Unit Price (TZS)	Q'ty	Value (TZS)
I Gross Return				
Yield	kg/ha		20,000	
Farmgate Price	TZS/kg	859		
Gross Return	TZS/ha			**17,180,000**
II Production Cost				
1. Farm Inputs				
Seed	kg/ha	1,000,000	1.00	1,000,000
Fertilizer (Urea, DAP, CAN)				
Vig Max	kg/ha	8,000	20	160,000
DAP	kg/ha	1,300	150	195,000
NPK Winner	kg/ha	1,300	150	195,000
CAN	kg/ha	900	150	135,000
Booster	lit/ha	10,000	15	150,000
Agro-chemical (Pestc, Fungc)				
Pesticide (wiltigo, profecron, Ninja)	lit/ha	20,000	10	200,000
Herbicide	lit/ha	0	0	-
Fungicide defender, mupafidan)	lit/ha	50,000	1	50,000
Packing Material (Wdn Crt)	nos/ha	1,000	1000	1,000,000
Sub-total				**3,085,000**
2. Labour Requirement				
Land prep., Puddle and Bund	man/day	10,000	15	150,000
Nursery	man/day	5,000	40	200,000
Plant/Transplanting	man/day	10,000	20	200,000
Weeding and Fertilizer	man/day	10,000	20	200,000
Bird Scaring & plant upkeeping	man/day	13,000	30	390,000
Harvesting	man/day	5,000	180	900,000
Transport Marketing	man/day	12,500	30	375,000
Irrigation, etc	man/day	10,000	20	200,000
Threshing/Winnowing	man/day	4,412	35	154,420
Sub-total				**2,769,420**
3. Machinery and Draught Animal				
Tractor	LS	150,000	1	150,000
Hand Tractor	LS			-
Draught Animal	LS			-
Sub-total				**150,000**
4. Miscellaneous Cost (5% of Cost)				**300,221**
Total				**3,880,989**
III Net Return				
				13,299,011

(3) [Present: Irrigation → Future: Irrigation or Present: Irrigation → Future: Irrigation (with Project)]

At present, the areas which have no irrigation scheme or traditional irrigation is being done in. By implemention of NIMP2018, the yeild shall increase (5.0 ton/ ha (refer to (1)) → 40.0 ton/ ha).
Corresponding to "New full Development" or New canal extension".

Items	Unit	Unit Price (TZS)	Q'ty	Value (TZS)
I Gross Return				
Yield	kg/ha		40,000	
Farmgate Price	TZS/kg	859		
Gross Return	TZS/ha			**34,360,000**
II Production Cost				
1. Farm Inputs				
Seed	kg/ha	1,000,000	1.00	1,000,000
Fertilizer (Urea, DAP, CAN)				
Vig Max	kg/ha	8,000	20	160,000
DAP	kg/ha	1,300	150	195,000
NPK Winner	kg/ha	1,300	150	195,000
CAN	kg/ha	900	150	135,000
Booster	lit/ha	10,000	15	150,000
Agro-chemical (Pestc, Fungc)				
Pesticide (wiltigo, profecron, Ninja)	lit/ha	20,000	10	200,000
Herbicide	lit/ha	0	0	-
Fungicide defender, mupafidan)	lit/ha	50,000	1	50,000
Packing Material (Wdn Crt)	nos/ha	1,000	1000	1,000,000
Sub-total				**3,085,000**
2. Labour Requirement				
Land prep., Puddle and Bund	man/day	10,000	15	150,000
Nursery	man/day	5,000	40	200,000
Plant/Transplanting	man/day	10,000	20	200,000
Weeding and Fertilizer	man/day	10,000	20	200,000
Bird Scaring & plant upkeeping	man/day	13,000	30	390,000
Harvesting	man/day	5,000	180	900,000
Transport Marketing	man/day	12,500	30	375,000
Irrigation, etc	man/day	10,000	20	200,000
Threshing/Winnowing	man/day	4,412	35	154,420
Sub-total				**2,769,420**
3. Machinery and Draught Animal				
Tractor	LS	150,000	1	150,000
Hand Tractor	LS			-
Draught Animal	LS			-
Sub-total				**150,000**
4. Miscellaneous Cost (5% of Cost)				**300,221**
Total				**3,880,989**
III Net Return				
				30,479,011

Attachment-9.9.5 (6/6) Crop Budget (Economic Price)

Dry Season **Higher Price**

Onion

Conditions: Unit price: average price from 2007 to 2016
[Mark-up:1.7]
[Farmgate price: In assumption of efficient market, market price is used as it is. Production costs are converted by SW and SCF]
Note) Mark up: the ratio of total distribution expenses (transport costs, expenses for participating markets, storage expenses etc.)

(1) [Present: Rainfed → Future: Rainfed]

	Items	Unit	Unit Price (TZS)	Q'ty	Value (TZS)
I	Gross Return				
	Yield	kg/ha		2,000	
	Farmgate Price	TZS/kg	785		
	Gross Return	TZS/ha			**1,570,000**
II	Production Cost				
1. Farm Inputs					
	Seed	kg/ha	40,000	3	120,000
	Fertilizer (Urea, DAP, CAN)				
	Urea (46% N)	kg/ha	1,200	200	240,000
	CAN	kg/ha	1,000	200	200,000
	DAP	kg/ha	0	0	-
	NPK	kg/ha	0	0	-
	Manure	ton/ha		0	-
	Agro-chemical (Pestc, Herbc, Fungc)				
	Pesticide (Ninja)	lit/ha	20,000	3	60,000
	Herbicide	lit/ha	39,000	1	39,000
	Fungicide (Ivory 72)	lit/ha	50,000	1	50,000
	Packing Material (Bag 100kg)	nos/ha	1,000	100	100,000
	Sub-total				**809,000**
2. Labour Requirement					
	Land prep., Puddle and Bund	man/day	15,000	5	75,000
	Nursery	man/day	3,300	15	49,500
	Plant/Transplanting	man/day	6,600	25	165,000
	Weeding and Fertilizer	man/day	25,000	4	100,000
	Animals Scaring	man/day	0	0	-
	Harvesting	man/day	13,300	15	199,500
	Transport Marketing	man/day	10,500	10	105,000
	Irrigation, etc	man/day	0	0	-
	Threshing/Winnowing	man/day	7,000	5	35,000
	Sub-total				**729,000**
3. Machinery and Draught Animal					
	Tractor	LS	125,000	1	125,000
	Hand Tractor	LS			-
	Draught Animal	LS			-
	Sub-total				**125,000**
4. Miscellaneous Cost (5% of Cost)					**83,150**
	Total				**1,531,843**
III	Net Return				
					38,157

Sources: JICA Project Team

(2) [Present: Irrigation → Future: Irrigation (w/o Project)]

The case that there are exiting irrigation schemes. It is assumed that the yeild shall increase by the improvement of these exiting schemes (7.0 ton/ha → 10.0 ton/ ha (refer to (3))).
Corresponding to "Improvement of exiting" among Irrigation types.

	Items	Unit	Unit Price (TZS)	Q'ty	Value (TZS)
I	Gross Return				
	Yield	kg/ha		7,000	
	Farmgate Price	TZS/kg	785		
	Gross Return	TZS/ha			**5,495,000**
II	Production Cost				
1. Farm Inputs					
	Seed	kg/ha	40,000	10	400,000
	Fertilizer (Urea, DAP, V Max, Bstr)				-
	Urea (46% N)	kg/ha	1,000	150	150,000
	DAP	kg/ha	1,300	150	195,000
	Vig Max	kg/ha	8,000	20	160,000
	Booster	kg/ha	5,000	10	50,000
					-
	Agro-chemical (Pestc, Fungc)				-
	Pesticide (Ninja)	lit/ha	20,000	10	200,000
	Herbicide	lit/ha	39,000	5	195,000
	Fungicide (Ivory 72)	lit/ha	50,000	1	50,000
	Packing Material (Bag 100kg)	nos/ha	1,000	150	150,000
	Sub-total				**1,550,000**
2. Labour Requirement					
	Land prep., Puddle and Bund	man/day	12,000	30	360,000
	Nursery	man/day	3,000	40	120,000
	Plant/Transplanting	man/day	12,000	20	240,000
	Weeding and Fertilizer	man/day	10,000	40	400,000
	Animals Scaring	man/day	0	0	-
	Harvesting	man/day	10,000	20	200,000
	Transport Marketing	man/day	16,000	10	160,000
	Irrigation, etc	man/day	10,000	20	200,000
	Threshing/Winnowing	man/day	7,000	10	70,000
	Sub-total				**1,750,000**
3. Machinery and Draught Animal					
	Tractor	LS	125,000	1	125,000
	Hand Tractor	LS			-
	Draught Animal	LS			-
	Sub-total				**125,000**
4. Miscellaneous Cost (5% of Cost)					**171,250**
	Total				**3,049,534**
III	Net Return				
					2,445,466

(3) [Present: Irrigation → Future: Irrigation or Present: Irrigation → Future: Irrigation (with Project)]

At present, the areas which have no irrigation scheme or traditional irrigation is being done in. By implemention of NIMP2018, the yeild shall increase (2.0 ton/ ha (refer to (1)) → 10.0 ton/ ha).
Corresponding to "New full Development" or New canal extension".

	Items	Unit	Unit Price (TZS)	Q'ty	Value (TZS)
I	Gross Return				
	Yield	kg/ha		10,000	
	Farmgate Price	TZS/kg	785		
	Gross Return	TZS/ha			**7,850,000**
II	Production Cost				
1. Farm Inputs					
	Seed	kg/ha	40,000	10	400,000
	Fertilizer (Urea, DAP, V Max, Bstr)				-
	Urea (46% N)	kg/ha	1,000	150	150,000
	DAP	kg/ha	1,300	150	195,000
	Vig Max	kg/ha	8,000	20	160,000
	Booster	kg/ha	5,000	10	50,000
					-
	Agro-chemical (Pestc, Fungc)				-
	Pesticide (Ninja)	lit/ha	20,000	10	200,000
	Herbicide	lit/ha	39,000	5	195,000
	Fungicide (Ivory 72)	lit/ha	50,000	1	50,000
	Packing Material (Bag 100kg)	nos/ha	1,000	150	150,000
	Sub-total				**1,550,000**
2. Labour Requirement					
	Land prep., Puddle and Bund	man/day	12,000	30	360,000
	Nursery	man/day	3,000	40	120,000
	Plant/Transplanting	man/day	12,000	20	240,000
	Weeding and Fertilizer	man/day	10,000	40	400,000
	Animals Scaring	man/day	0	0	0
	Harvesting	man/day	10,000	20	200,000
	Transport Marketing	man/day	16,000	10	160,000
	Irrigation, etc	man/day	10,000	20	200,000
	Threshing/Winnowing	man/day	7,000	10	70,000
	Sub-total				**1,750,000**
3. Machinery and Draught Animal					
	Tractor	LS	125,000	1	125,000
	Hand Tractor	LS			-
	Draught Animal	LS			-
	Sub-total				**125,000**
4. Miscellaneous Cost (5% of Cost)					**171,250**
	Total				**3,049,534**
III	Net Return				
					4,800,466

Attachment-9.9.6 Farm Budget (Economic Price)

Economic Benefit

1. Economic Net Benefit per ha (Farm Benefit)

In TZS

Total Project Financial Net Benefit (Unit: million TZS) 【TZS 2,240/ USD】

	Net Benefit (Financial)	Phase 1 (2018 - 2025)	Phase 2 (2026 - 2035)	Total (Phase 1+2) (2018 - 2035)
1	**Net Benefit**	**916,476**	**1,100,850**	**2,017,326**

In UDS

Exch. Rate 2,240 TZS/ USD

Total Project Financial Net Benefit (Unit: million USD)

	Net Benefit (Financial)	Phase 1 (2018 - 2025)	Phase 2 (2026 - 2035)	Total (Phase 1+2) (2018 - 2035)
1	**Net Benefit**	**409**	**491**	**901**

//

★ Crops: Rice (i.e. Paddy) and Vegetable (Tomato and Onion)

★ Croping pattern

	Rice/ Paddy	Tomato	Onion
Share	0.60	0.05	0.35

Assumed constant over the country

★ Cropping intensity

Because the master plan estimates irrigated land are for both wet and dry seasons, this study adopted the area directly instead of assuming cropping intensity as a general mode across the country.

★ Net return of crop production and Incremental Return by improvement of irrigation

Rice/ Paddy

Net Return (TZS/ ha) **Economic farmgate price** is assumed constant across the seasons.

	Rf→Rf(w/o Project)	Ir→Ir (w/o Project)	Rf→Ir or Ir→Ir (with Project)
Yield (kg/ ha)	1,850	2,500	5,000
Farmgate Price (Wet) (Paddy: TZS/ kg)	422	422	422
Farmgate Price (Dry) (Paddy: TZS/ kg)	422	422	422
Net Return (Wet) (TZS)	-299,582	-332,832	722,130
Net Return (Dry) (TZS)	-299,582	-332,832	722,130
Net increase of net return (Rf → Ir)	**Wet**		1,021,712
	Dry		1,021,712
Net increase of net return (Ir → Ir)	**Wet**		1,054,961
	Dry		1,054,961

Note: Rf: Rainfed, Ir: Irrigation

Tomato

Net Return (TZS/ ha) **Economic farmgate price** is assumed the same as the market price

	Rf→Rf(w/o Project)	Ir→Ir (w/o Project)	Rf→Ir or Ir→Ir (with Project)
Yield (kg/ ha)	5,000	20,000	40,000
Farmgate Price (Wet) (TZS/ kg)	624	624	624
Farmgate Price (Dry) (TZS/ kg)	859	859	859
Net Return (Wet) (TZS)	735,379	8,599,011	21,079,011
Net Return (Dry) (TZS)	1,910,379	13,299,011	30,479,011
Net increase of net return (Rf → Ir)	**Wet**		20,343,632
	Dry		28,568,632
Net increase of net return (Ir → Ir)	**Wet**		12,480,000
	Dry		17,180,000

Note: Rf: Rainfed, Ir: Irrigation

Onion

Net Return (TZS/ ha) **Economic farmgate price** is assumed the same as the market price

	Rf→Rf(w/o Project)	Ir→Ir (w/o Project)	Rf→Ir or Ir→Ir (with Project)
Yield (kg/ ha)	2,000	7,000	10,000
Farmgate Price (Wet) (TZS/ kg)	571	571	571
Farmgate Price (Dry) (TZS/ kg)	785	785	785
Net Return (Wet) (TZS)	-389,843	947,466	2,660,466
Net Return (Dry) (TZS)	38,157	2,445,466	4,800,466
Net increase of net return (Rf → Ir)	**Wet**		3,050,309
	Dry		4,762,309
Net increase of net return (Ir → Ir)	**Wet**		1,713,000
	Dry		2,355,000

Note: Rf: Rainfed, Ir: Irrigation

★ Combined Incremental Net Return by Irrigation Development

Note: Rice/Paddy : Tomato : Onion = 60 : 20 : 20

		Combined Incremental Economic Net Return
Net increase of net return (Rf → Ir)	**Wet**	2,697,817
	Dry	3,708,267
Net increase of net return (Ir → Ir)	**Wet**	1,856,527
	Dry	2,316,227

Note) Each crop's net increase of net return is multipled by each crop intensity. Total of net increase of net returns shown as abov table.

2. Economic Benefit according to the irrigation development mode

Development mode	Yield change (kg/ ha)	Crop season	Net return increment (TZS / ha)	Phase 1 (2018 - 2025) Area to be developed (ha)	Phase 1 (2018 - 2025) Benefit of Irrigation Development (million TZS)	Phase 2 (2026 - 2035) Area to be developed (ha)	Phase 2 (2026 - 2035) Benefit of Irrigation Development (million TZS)	Total (Phase 1+2: 2018 - 2035) Area to be developed (ha)	Total (Phase 1+2: 2018 - 2035) Benefit of Irrigation Development (million TZS)
1) New [Full Development] <Surface>	1,850 → 5,000	Wet	2,697,817	102,795	277,323	126,731	341,898	229,527	619,221
	Tomato/ Onion (see below)	Dry	3,708,267	31,003	114,966	39,502	146,483	70,504	261,449
2) New [Full Develoopment] <Pressure>	1,850 → 5,000	Wet	2,697,817	2,405	6,488	3,175	8,566	5,580	15,054
	Tomato/ Onion (see below)	Dry	3,708,267	725	2,689	990	3,670	1,715	6,360
3) New [Canal Extension]	1,850 → 5,000	Wet	2,697,817	85,428	230,470	108,036	291,462	193,465	521,932
	Tomato/ Onion (see below)	Dry	3,708,267	25,765	95,542	33,675	124,875	59,439	220,417
4) Improvement	2,500 → 5,000	Wet	1,856,527	73,969	137,326	71,319	132,406	145,288	269,732
	Tomato/ Onion (see below)	Dry	2,316,227	22,309	51,672	22,230	51,490	44,539	103,162
				344,399	**916,476**	**405,658**	**1,100,850**	**750,057**	**2,017,326**

	Tomato Yield change	Onion Yiled change
1)	5,000 → 40,000	2,000 → 15,000
2)	5,000 → 40,000	2,000 → 15,000
3)	5,000 → 40,000	2,000 → 15,000
4)	20,000 → 40,000	7,000 → 15,000

★ Combined (Rice/Tomato/Onion) Net Benefir per ha (Economic Pri

Combined Net Benefit (TZS/ ha)

	Rf→Rf(w/o Project)	Ir→Ir (w/o Project)	Rf→Ir or Ir→Ir (with Project)
Wet : Dry =	***1.000***	***0.302***	
Rice : Tomato : Onion =	***0.600***	***0.050***	***0.350***
Combined Benefit per ha in A Year	-300,801	960,321	3,515,410

3,816,212 ←Net Benefit (Rf→Ir)/ ha
2,555,089 ←Net Benefit (Ir→Ir)/ ha

Natioan Average Farm Area per Farmer= 1.6 ha

6,105,938 ←Net Benefit (Rf→Ir)/ farmer
4,088,142 ←Net Benefit (Ir→Ir)/ farmer

	Rf→Rf(w/o Project)	Ir→Ir (w/o Project)	Rf→Ir or Ir→Ir (with Project)
Combined Benefit per farmer in A Year (per ha x 1.6 ha)	-481,282	1,536,514	5,624,656

Sources: JICA Project Team

Attachment-9.9.7 Cash Flow of NIMP2018 (2018-2035) (Economic Price)

(Unit: million TZS)

	Year	Cost			Total Cost	Agriculture Benefit	Other Benefit	Total Benefit	Net Benefit	Present Value Total Cost	Present Value Total Benefit	Present Value Net Benefit
		Construction	Soft Component	O&M								
1	2018	107,870	6,761		114,631	0	0	0	**-114,631**	102,349	0	-102,349
2	2019	288,708	6,640		295,348	0	0	0	**-295,348**	235,449	0	-235,449
3	2020	493,910	7,124	8,905	509,939	0	0	0	**-509,939**	362,964	0	-362,964
4	2021	744,910	8,939	16,354	770,203	27,505	0	27,505	**-742,698**	489,478	17,480	-471,998
5	2022	852,420	5,192	24,878	882,489	101,120	0	101,120	**-781,369**	500,748	57,378	-443,370
6	2023	625,601	2,841	31,134	659,576	227,058	0	227,058	**-432,518**	334,162	115,035	-219,127
7	2024	294,060	3,961	34,075	332,096	422,377	0	422,377	**90,281**	150,223	191,062	40,839
8	2025	186,803	3,525	35,943	226,271	634,348	0	634,348	**408,077**	91,387	256,203	164,816
9	2026	44,677	1,975	36,390	83,041	793,865	0	793,865	**710,824**	29,945	286,276	256,330
10	2027	284,519	3,530	431,582	719,631	868,845	0	868,845	**149,214**	231,702	279,745	48,043
11	2028	339,767	2,243	42,632	384,642	916,476	0	916,476	**531,835**	110,575	263,465	152,890
12	2029	562,738	3,125	48,260	614,123	927,874	0	927,874	**313,751**	157,630	238,162	80,532
13	2030	757,049	3,291	55,830	816,171	1,000,457	0	1,000,457	**184,287**	187,045	229,279	42,234
14	2031	808,712	2,365	63,917	874,994	1,087,135	0	1,087,135	**212,141**	179,041	222,449	43,408
15	2032	686,137	1,287	70,779	758,203	1,230,695	0	1,230,695	**472,492**	138,521	224,843	86,323
16	2033	440,131	1,117	75,180	516,427	1,423,826	0	1,423,826	**907,398**	84,240	232,257	148,016
17	2034	203,896	1,840	77,219	282,955	1,630,136	0	1,630,136	**1,347,181**	41,211	237,420	196,209
18	2035	187,578	1,203	79,095	267,876	1,805,176	0	1,805,176	**1,537,300**	34,834	234,744	199,910
19	2036	0	0	79,095	79,095	1,917,457	0	1,917,457	**1,838,363**	9,183	222,630	213,446
20	2037	0	0	870,043	870,043	1,969,473	0	1,969,473	**1,099,430**	90,195	204,169	113,974
21	2038	0	0	79,095	79,095	2,017,326	0	2,017,326	**1,938,231**	7,321	186,723	179,402
22	2039	0	0	79,095	79,095	2,017,326	0	2,017,326	**1,938,231**	6,537	166,717	160,180
23	2040	0	0	79,095	79,095	2,017,326	0	2,017,326	**1,938,231**	5,836	148,854	143,018
24	2041	0	0	79,095	79,095	2,017,326	0	2,017,326	**1,938,231**	5,211	132,906	127,695
25	2042	0	0	79,095	79,095	2,017,326	0	2,017,326	**1,938,231**	4,653	118,666	114,013
26	2043	0	0	79,095	79,095	2,017,326	0	2,017,326	**1,938,231**	4,154	105,952	101,797
27	2044	0	0	79,095	79,095	2,017,326	0	2,017,326	**1,938,231**	3,709	94,600	90,891
28	2045	0	0	79,095	79,095	2,017,326	0	2,017,326	**1,938,231**	3,312	84,464	81,152
29	2046	0	0	79,095	79,095	2,017,326	0	2,017,326	**1,938,231**	2,957	75,414	72,457
30	2047	0	0	2,451,940	2,451,940	2,017,326	0	2,017,326	**-434,614**	81,841	67,334	-14,507
31	2048	0	0	79,095	79,095	2,017,326	0	2,017,326	**1,938,231**	2,357	60,120	57,763
32	2049	0	0	79,095	79,095	2,017,326	0	2,017,326	**1,938,231**	2,105	53,678	51,574
33	2050	0	0	79,095	79,095	2,017,326	0	2,017,326	**1,938,231**	1,879	47,927	46,048
34	2051	0	0	79,095	79,095	2,017,326	0	2,017,326	**1,938,231**	1,678	42,792	41,114
35	2052	0	0	79,095	79,095	2,017,326	0	2,017,326	**1,938,231**	1,498	38,207	36,709
36	2053	0	0	79,095	79,095	2,017,326	0	2,017,326	**1,938,231**	1,338	34,114	32,776
37	2054	0	0	79,095	79,095	2,017,326	0	2,017,326	**1,938,231**	1,194	30,459	29,264
38	2055	0	0	79,095	79,095	2,017,326	0	2,017,326	**1,938,231**	1,066	27,195	26,129
39	2056	0	0	79,095	79,095	2,017,326	0	2,017,326	**1,938,231**	952	24,281	23,329
40	2057	0	0	870,043	870,043	2,017,326	0	2,017,326	**1,147,283**	9,350	21,680	12,330
41	2058	0	0	79,095	79,095	2,017,326	0	2,017,326	**1,938,231**	759	19,357	18,598
42	2059	0	0	79,095	79,095	2,017,326	0	2,017,326	**1,938,231**	678	17,283	16,605
43	2060	0	0	79,095	79,095	2,017,326	0	2,017,326	**1,938,231**	605	15,431	14,826
44	2061	0	0	79,095	79,095	2,017,326	0	2,017,326	**1,938,231**	540	13,778	13,238
45	2062	0	0	79,095	79,095	2,017,326	0	2,017,326	**1,938,231**	482	12,302	11,819
46	2063	0	0	79,095	79,095	2,017,326	0	2,017,326	**1,938,231**	431	10,984	10,553
47	2064	0	0	79,095	79,095	2,017,326	0	2,017,326	**1,938,231**	385	9,807	9,422
48	2065	0	0	79,095	79,095	2,017,326	0	2,017,326	**1,938,231**	343	8,756	8,413
										3,714,054	**5,182,377**	**1,468,323**

Present Value (Unit: million TZS)

Sources: JICA Project Team

Economic Value Indicator

(Unit: million TZS)

Net Present Value (NPV)	**1,468,323**
Benefit / Cost Ratio (B/C)	**1.40**
Economic Internal Rate of Return (EIRR)	**16.4%**

Sensitivity Analysis (EIRR)

Benefit	Cost: Base	Cost: +5%	Cost: +10%
Base	**16.4%**	**15.7%**	**15.1%**
-5%	**15.7%**	**15.0%**	**14.4%**
-10%	**14.9%**	**14.3%**	**13.7%**

Attachment-9.10.1 Tentative Program Design Matrix (PDM) for NIMP2018

Project Title: The Project on the National Irrigation Master Plan
Project Duration: 18 years from 2018/19 to 2035/36
Project Site: The Mainland of Tanzania

Executive Agency: National Irrigation Commission (NIRC)
Target Group: Irrigators' Organizations (IOs) in the priority irrigation schemes for the development

Project Summary	Indicators	Means of Verification	Important Assumptions
[Overall Goal] The annual rate of agricultural GDP growth (%), the reduction of rural poverty rate (%) and the reduction of food poverty rate (%) are achieved as the ASDP2 key performance indicator (KPI).	a. Agricultural GDP growth rate of 6% will be achieved. b. Rural poverty rate of 24% will be achieved. c. Food poverty rate of 5% will be achieved.	a. Government statistical data (NBS) b. Government statistical data (NBS) c. Government statistical data (NBS)	
[Project Purpose] Irrigation area (ha), number of beneficiary farms, crop yield (ton/ha), annual incremental farm income (TZS/ha /year) are achieved in the target irrigation areas.	a. Irrigation developed area will increase to 1,000,000 ha. b. Number of irrigation beneficiaries will increase to 600,000. c. Unit yield of target crops for irrigation will increase to 5 ton/ha for paddy, 40 ton/ha for tomato and 10 ton/ha for onion. d. Annual incremental net return will increase to TZS 3 to 4 million/ha on average	a. Agricultural statistics（ARDS, AASS, NSCA） b. Agricultural statistics（ARDS, AASS, NSCA） c. Agricultural statistics（ARDS, AASS, NSCA） d. Agricultural statistics（ARDS, AASS, NSCA） e. Agricultural statistics（ARDS, AASS, NSCA）	- There is no significant change in development policy of central government and LGAs.
[Outputs] 1. Irrigation schemes will be developed.	a. Dodoma zonal irrigation development plan (57,361 ha) b. Kilimanjaro zonal irrigation development plan (36,376 ha) c. Mbeya zonal irrigation development plan (89,095 ha) d. Morogoro zonal irrigation development plan (120,674 ha) e. Mtwara zonal irrigation development plan (54,682 ha) f. Mwanza zonal irrigation development plan (68,320 ha) g. Tabora zonal irrigation development plan (52,390 ha) h. Katavi zonal irrigation development plan (81,333 ha) i. Large-scale coomercial Irrigation development plan (220,000 ha)	In addition to NIRC's annual activity report, a. Progress Report / Completion Report (Individual Project) b. Progress Report / Completion Report (Individual Project) c. Progress Report / Completion Report (Individual Project) d. Progress Report / Completion Report (Individual Project) e. Progress Report / Completion Report (Individual Project)	- Prices of agricultural input materials and agricultural products do not change significantly. - There is no unusual weather which will have an extremely adverse effect on agricultural production.
2. Administrative organization and it functions will be strengthened.	a. RIOs are newly established (total 18 RIOs) b. Irrigation staff will be increased (total 218 staffs) c. IOs are registered (total 1,112 IOs) d. Annual activity report is prepared (total 18 times) e. NIRC's homepage is updated (total 17 times) f. Research and development survey on the theme of irrigation is carried out (total 10)	a. NIRC's Annual Activity Report (Plan and Actual) b. NIRC's Annual Activity Report (Plan and Actual) c. NIRC's Annual Activity Report (Plan and Actual) c. NIRC's Annual Activity Report (Plan and Actual) d. NIRC's Annual Activity Report (Plan and Actual) e. ditto / Research Report	
3. Capacity of irrigation staff and IOs (including its member farmers) will be build up.	a. Irrigation design manual and checklist will be maintained (Total 1 LS) b. Module for irrigation training will be maintained (total 1 LS) c. Capacity building training for irrigation staff of ZIOs / RIOs will be carried out (total 9 times) d. Capacity building training for irrigation staff of LGAs will be implemented (total 182 times) e. Capacity building training for IOs will be implemented (total 182 times) f. Technical training for strengthening private contractors and consultants will be implemented (total 9 times)	a. NIRC's Annual Activity Report (Plan and Actual) b. NIRC's Annual Activity Report (Plan and Actual) c. NIRC's Annual Activity Report (Plan and Actual) d. NIRC's Annual Activity Report (Plan and Actual) e. NIRC's Annual Activity Report (Plan and Actual) NIRC's Annual Activity Report (Plan and Actual) g. NIRC's Annual Activity Report (Plan and Actual)	
4. Coordination among the relevant government organization and private	a. Coodination meeting for private-sector investment for irrigation will be carried out (total 9 times) b. Coordination meeting for cross-cutting issues will be executed (total 9 times)	a. Training activity support (consultant, NGO etc.) b. NIRC's Annual Activity Report (Plan and Actual)	
Activities	**Inputs**		
	[Tanzania Side]	**[Development Partners Side]**	
＜Activity-1＞ 1-1 Development of irrigation schemes in Dodoma Zone 1-2 Development of irrigation schemes in Kilimanjaro Zone 1-3 Development of irrigation schemes in Mbeya Zone 1-4 Development of irrigation schemes in Morogoro Zone 1-5 Development of irrigation schemes in Mtwara Zone 1-6 Development of irrigation schemes in Mwanza Zone 1-7 Development of irrigation schemes in Tabora Zone 1-8 Development of irrigation schemes in Katavi Zone 1-9 Development of commercial irrigation schemes **＜Activiy-2＞** 2-1 Establishment of RIOs and strengthening of DIDTs/DIDs 2-2 Improvement of NIRC function (HR, equipment, facilities) 2-3 Registration of IOS 2-4 Establishment of project performance M&E system 2-5 Establishment of public relations system 2-6 Research and development for irrigation **＜Activity-3＞** 3-1 Capacity development training to irrigation staff in ZIOs/RIOs (Level 1) 3-2 Capacity development training to irrigation staff in LGAs (Level 2) 3-3 Capacity development training of IOs (Level 3) 3-4 Establishment of irrigation technical manuals and checklists 3-5 Establishment of training modules for irrigation development 3-6 Promotion of private contractors and enhancement of their engineering ability **＜Activity-4＞** 4-1 Coordination with private sector for irrigation investment 4-2 Coordination with relevant institutions for crosscutting issues	**1 Funding from central government/NIRC** a. Recurrent expenditures (personnel, general administrative expenses, etc.) b. Funding for irrigation development c. Survey/design/bidding d. Procurement of equipment and materials e. Securing of irrigation staff (NIRC/ZIO, District) f. Training activities (NIR /ZIO, District) g. Technical guidance on O&M of irrigation facilities h. Monitoring of work progress i. Collaboration with relevant sectors at the national level **2 LGAs** a. Project formulation based on CGL b. Technical guidance for IOs c. Monitoring of operation and effect indicators (primary data) d. Collaboration with relevant sectors at LGA level **3 IOs and its members** a. Participation in project formulation b. Contribution to irrigation infrastructure development cost c. Monitoring of contractor's work performance d. Collection and maintenance of O&M expenses of irrigation facilities e. O&M of irrigation facilities	**4 Financial & technical cooperation for irrigation development** a. Assist in survey, design and bidding b. Assist in irrigation infrastructure development c. Assist in organization and institutional development d. Assist in procurement of equipment and materials e. Assist in procurement of consulting and NGO services f. Assist in training activities	- The exchange rate of foreign currency is stable. - The staff who received the training will continue to engage in the works. - IWRMDP will be implemented as plannned. - ASDP2 will be implemented as planned. **[Pre-conditions]** - NIMP2018 approved by the government and implemented as planned. - The security of the target area is stable. - The farmers in the target area are motivated to irrigate agriculture.

Source: JICA Project Team

Attachment-11.4.1 (1/9) Development Program Summary
00 NIRC Development Program (Phase-1)

THE UNITED REPUBLIV OF TANZANIA
MINISTRY OF WATER AND IRRIGATION
NATIONAL IRRIGATION COMMISSION

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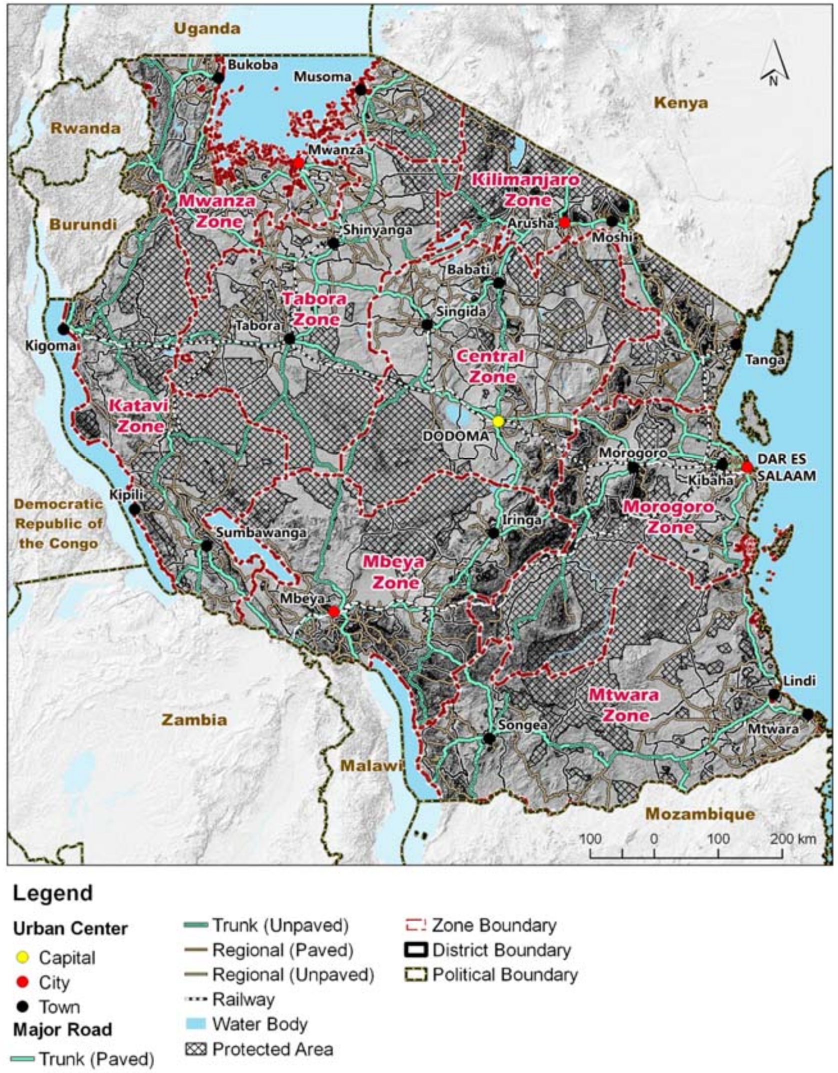
******* DEVELOPMENT PROGRAM SUMMARY ************

Program Name	00 NIRC Development Program (Phase-1)
Location	Mainland of Tanzania Number of Region: 26 Number of District: 185
Objective	Institutional Development and Capacity Building of NIRC Headquarter
Organizational and Functional Strengthening (SC2)	(1) Establishment of RIOs and strengthening of DIDTs/DIDs (2) Improvement of NIRC function (HR, equipment, facilities) (3) IO registration (4) Establishment of project performance monitoring and evaluation system (5) Establishment of public relations system (6) Research and development for irrigation
Capacity Building (SC3)	(1) Capacity development training to irrigation staff in ZIOs/RIOs (2) Establishment of design standards for irrigation in Tanzania (3) Establishment of training modules for irrigation development (4) Promotion of private contractors and enhancement of their engineering ability
Strengthening of Coordination (SC4)	(1) Coordination with private sector for irrigation investment (2) Coordination with relevant institutions for crosscutting issues (water and land conflict, etc.)
Program Period	2018 to 2025
Investment Cost	USD 5.5 million (with VAT18%)
Office Address: NIRC Headquarter Kilimo House, Kilimo Road, P.O. Box 6668, 14473 Dar es Salaam, Tanzania	
Contact Persons: DG/NIRC	

Sources: JICA Project Team



NATIONAL IRRIGATION MASTER PLAN (2018-2035)
Zonal Irrigation Map

Attachment-11.4.1 (2/9) Development Program Summary
01 Dodoma Zonal Irrigation Development Program (Phase-1)

THE UNITED REPUBLIV OF TANZANIA
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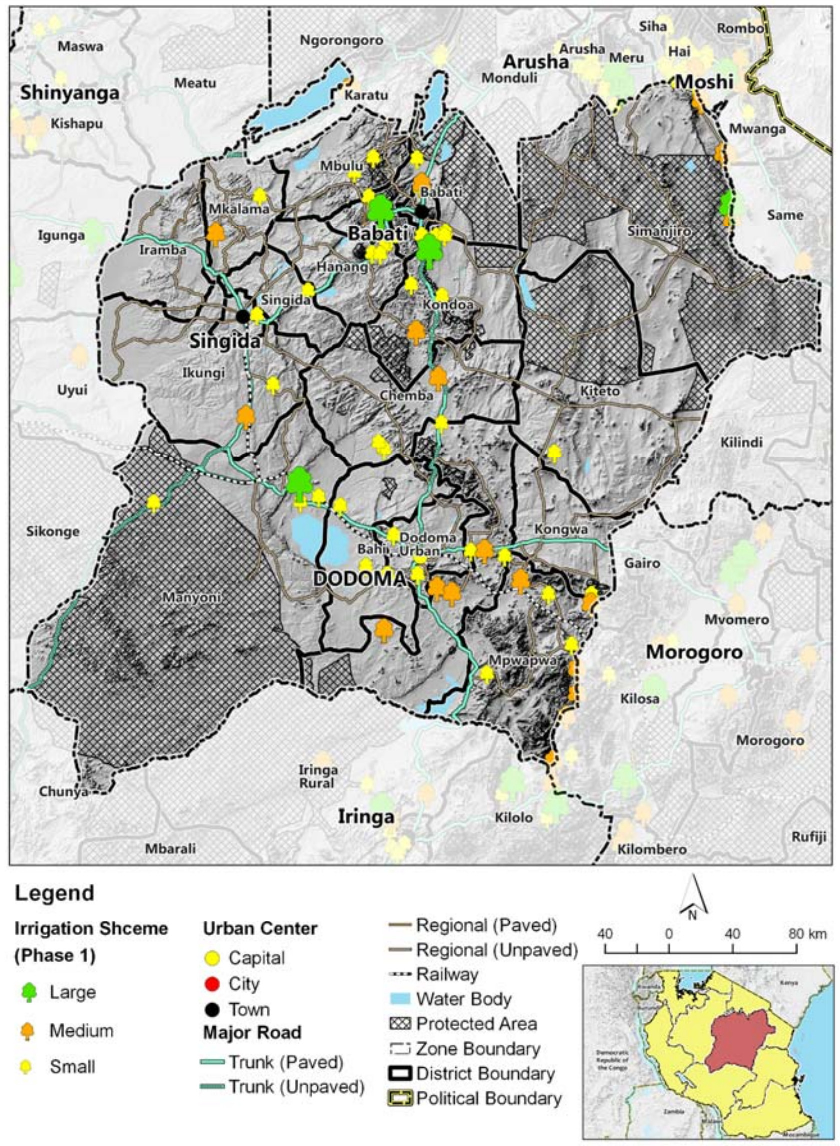
***** DEVELOPMENT PROGRAM SUMMARY **********

Program Name	01 Dodoma Zonal Irrigation Development Program (Phase-1)
Location	Dodoma Irrigation Zone Region Name: Dodoma (8), Singida (7), Manyara (7) Note: No. of District in parenthesis
Hard Component	To develop 37,395 ha of irrigation area by 2025
Target Development Area by Size of Irrigation Scheme	● Small Scale: 10,267 ha (42 schemes) ● Medium Scale: 13,128 ha (17 schemes) ● Large Scale: 14,000 ha (4 schemes) ● Total: 37,395 (63 schemes)
Target Development Area by Type of Works	● Improvement: 17,583 ha ● Expansion: 13,875 ha ● New Development: 5,937 ha
Target Development Area by Type of Irrigation Scheme	● Weir Irrigation: 17,503 ha ● Pump Irrigation: 600 ha ● Dam and Pond Irrigation: 15,142 ha ● Groundwater Irrigation: 4,150 ha
Soft Component	● Institutional and Functional Strengthening ● Capacity Building ● Strengthening of Coordination
Program Period	2018 to 2025
Investment Cost	USD 209.3 million (with VAT18%)
Target Crops and Yield	● Paddy: 5.0 ton/ha ● Tomato: 40 ton/ha, Onion: 10 ton/ha
Financial and Economic Performance Indicators	Net return per ha: TZS 3.2 million/year EIRR: 16.7%
Office Address: Dodoma Zonal Irrigation Office	
Contact Persons: ZIE	

Sources: JICA Project Team



* Refer to NIRC website or Data Book for individual project information.

NATIONAL IRRIGATION MASTER PLAN (2018-2035)
Dodoma Zonal Irrigation Development Program (Phase-1)

Attachment-11.4.1 (3/9) Development Program Summary
02 Kilimanjaro Zonal Irrigation Development Program (Phase-1)

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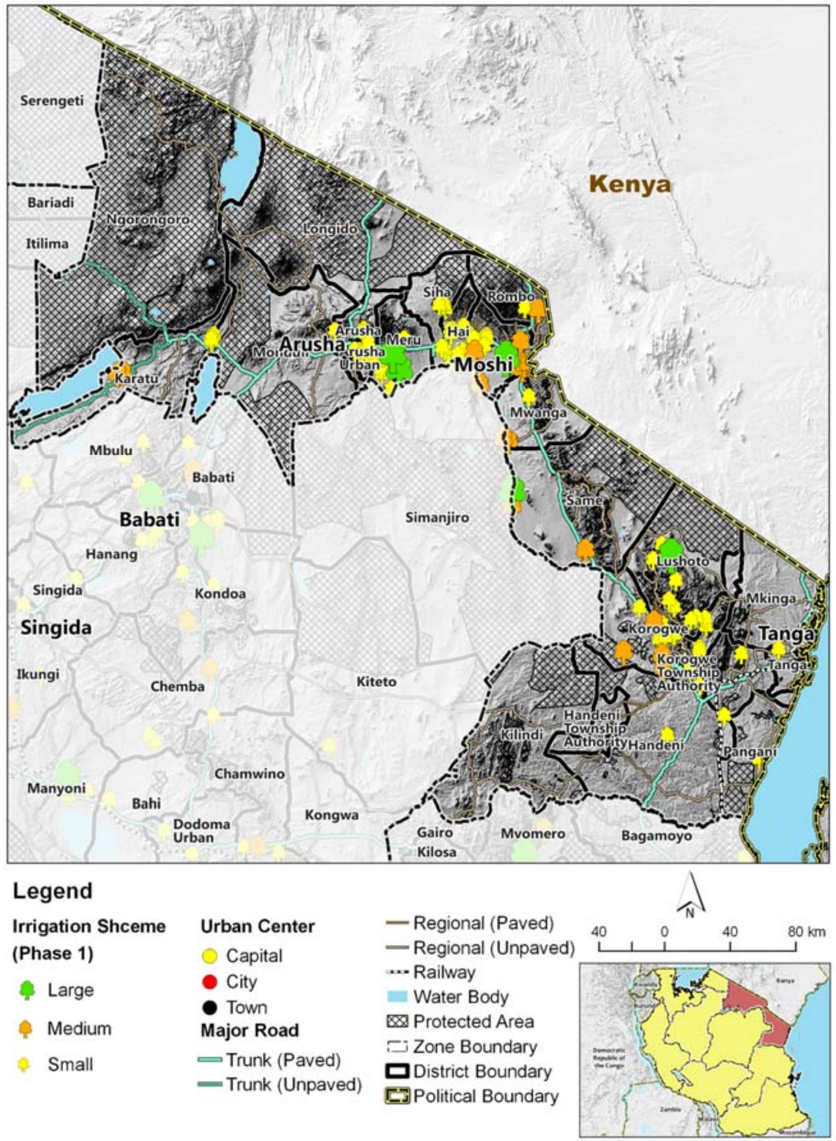
******* DEVELOPMENT PROGRAM SUMMARY ************

Program Name	02 Kilimanjaro Zonal Irrigation Development Program (Phase-1)
Location	Kilimanjaro Irrigation Zone Region Name: Arusha (7), Kilimanjaro (7), Tanga (11) Note: No. of District in parenthesis
Hard Component	To develop 39,567 ha of irrigation area by 2025
Target Development Area by Size of Irrigation Scheme	• Small Scale: 13,409 ha (72 schemes) • Medium Scale: 15,228 ha (16 schemes) • Large Scale: 10,930 ha (4 schemes) • Total: 39,567 ha (92 schemes)
Target Development Area by Type of Works	• Improvement: 17,293 ha • Expansion: 6,132 ha • New Development: 16,142 ha
Target Development Area by Type of Irrigation Scheme	• Weir Irrigation: 36,504 ha • Pump Irrigation: 1,633 ha • Dam and Pond Irrigation: 450 ha • Unknown: 980 ha
Soft Component	• Institutional and Functional Strengthening • Capacity Building • Strengthening of Coordination
Program Period	2018 to 2025
Investment Cost	USD 229.5 million (with VAT18%)
Target Crops and Yield	• Paddy: 5.0 ton/ha • Tomato: 40 ton/ha, Onion: 10 ton/ha
Financial and Economic Performance Indicators	Net return per ha: TZS 4.0 million/year EIRR: 15.4%
Office Address: Kilimanjaro Zonal Irrigation Office	
Contact Persons: ZIE	

Sources: JICA Project Team



* Refer to NIRC website or Data Book for individual project information.

NATIONAL IRRIGATION MASTER PLAN (2018-2035)
Kilimanjaro Zonal Irrigation Development Program (Phase-1)

Attachment-11.4.1 (4/9) Development Program Summary
03 Mbeya Zonal Irrigation Development Program (Phase-1)

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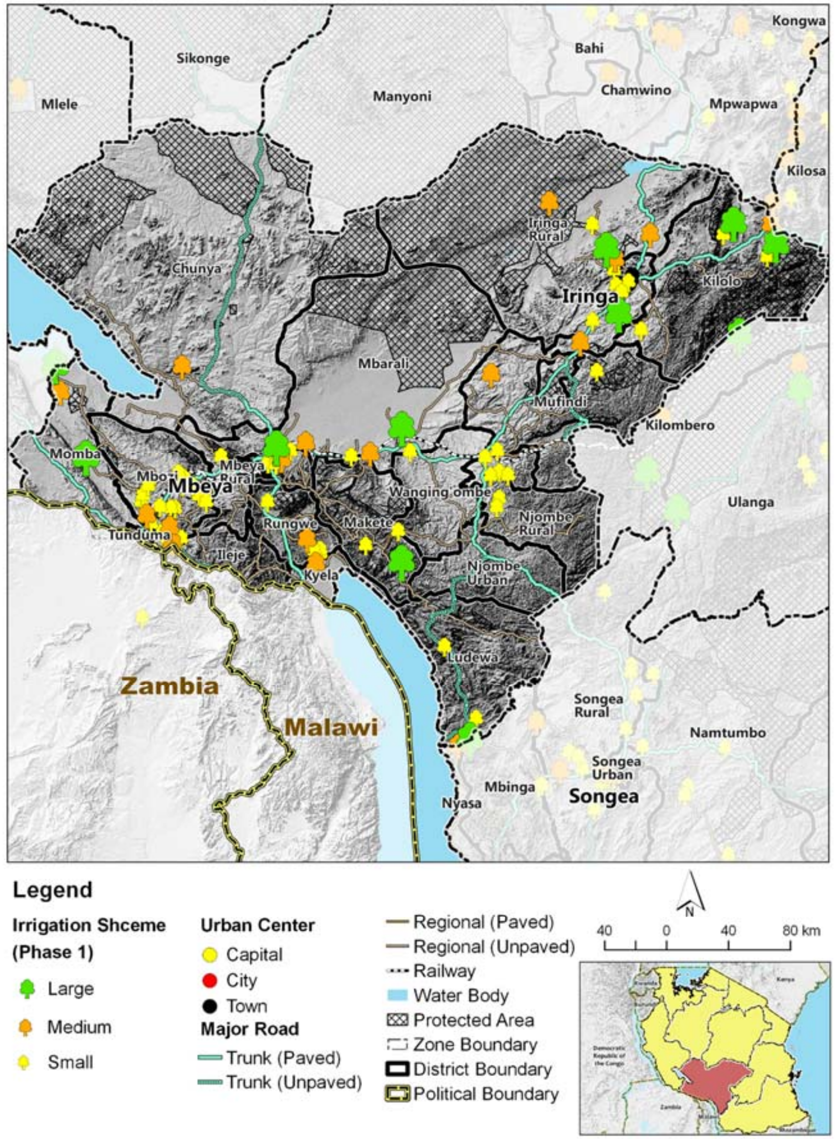
***** DEVELOPMENT PROGRAM SUMMARY **********

Program Name	03 Mbeya Zonal Irrigation Development Program (Phase-1)
Location	Mbeya Irrigation Zone Region Name: Iringa (5), Mbeya (7), Songwe (5), Njombe (6) Note: No. of District in parenthesis
Hard Component	To develop 62,779 ha of irrigation area by 2025
Target Development Area by Type of Works	• Improvement: 19,450 ha • Expansion: 29,948 ha • New Development: 13,381 ha • Total: 62,779 ha
Target Development Area by Size of Irrigation Scheme	• Small Scale: 10,484 ha • Medium Scale: 14,262 ha • Large Scale: 38,033 ha
Target Development Area by Type of Irrigation Scheme	• Weir Irrigation: 45,761 ha • Pump Irrigation: 118 ha • Dam and Pond Irrigation: 6,340 ha • Groundwater Irrigation: 220 ha • Unknown: 10,340 ha
Soft Component	• Institutional and Functional Strengthening • Capacity Building • Strengthening of Coordination
Program Period	2018 to 2025
Investment Cost	USD 320.4 million (with VAT18%)
Target Crops and Yield	• Paddy: 5.0 ton/ha • Tomato: 40 ton/ha, Onion: 10 ton/ha
Financial and Economic Performance Indicators	Net return per ha: TZS 2.9 million/year EIRR: 16.0%
Office Address: Mbeya Zonal Irrigation Office	
Contact Persons: ZIE	

Sources: JICA Project Team



* Refer to NIRC website or Data Book for individual project information.

NATIONAL IRRIGATION MASTER PLAN (2018-2035)

Mbeya Zonal Irrigation Development Program (Phase-1)

Attachment-11.4.1 (5/9) Development Program Summary
04 Morogoro Zonal Irrigation Development Program (Phase-1)

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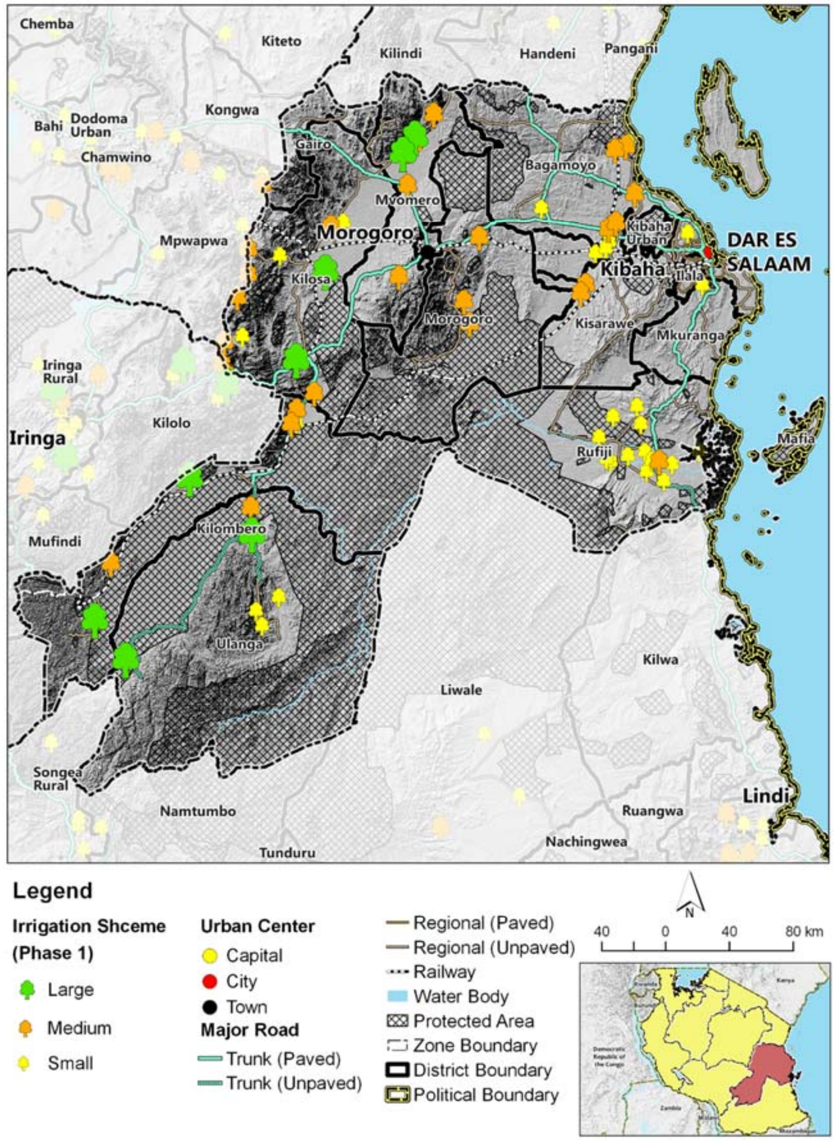
***** DEVELOPMENT PROGRAM SUMMARY **********

Program Name	04 Morogoro Zonal Irrigation Development Program (Phase-1)
Location	Morogoro Irrigation Zone Region Name: Morogoro (9), Pwani (9), DSM (6) Note: No. of District in parenthesis
Hard Component	To develop 62,109 ha of irrigation area by 2025
Target Development Area by Size of Irrigation Scheme	• Small Scale: 7,440 ha (33 schemes) • Medium Scale: 20,604 ha (24 schemes) • Large Scale: 34,065 ha (8 schemes) • Total: 62,109 (65 schemes)
Target Development Area by Type of Works	• Improvement: 8,504 ha • Expansion: 17,231 ha • New Development: 36,374 ha
Target Development Area by Type of Irrigation Scheme	• Weir Irrigation: 4,089 ha • Pump Irrigation: 5,260 ha • Dam and Pond Irrigation: 5,760 ha • Lake Water Irrigation: 620 ha • Groundwater Irrigation: 100 ha • Unknown: 3,980 ha
Soft Component	• Institutional and Functional Strengthening • Capacity Building • Strengthening of Coordination
Program Period	2018 to 2025
Investment Cost	USD 406.2 million (with VAT18%)
Target Crops and Yield	• Paddy: 5.0 ton/ha • Tomato: 40 ton/ha, Onion: 10 ton/ha
Financial and Economic Performance Indicators	Net return per ha: TZS 3.6 million/year EIRR: 18.3%
Office Address: Morogoro Zonal Irrigation Office	
Contact Persons: ZIE	

Sources: JICA Project Team



* Refer to NIRC website or Data Book for individual project information.

NATIONAL IRRIGATION MASTER PLAN (2018-2035)
Morogoro Zonal Irrigation Development Program (Phase-1)

Attachment-11.4.1 (6/9) Development Program Summary
05 Mtwara Zonal Irrigation Development Program (Phase-1)

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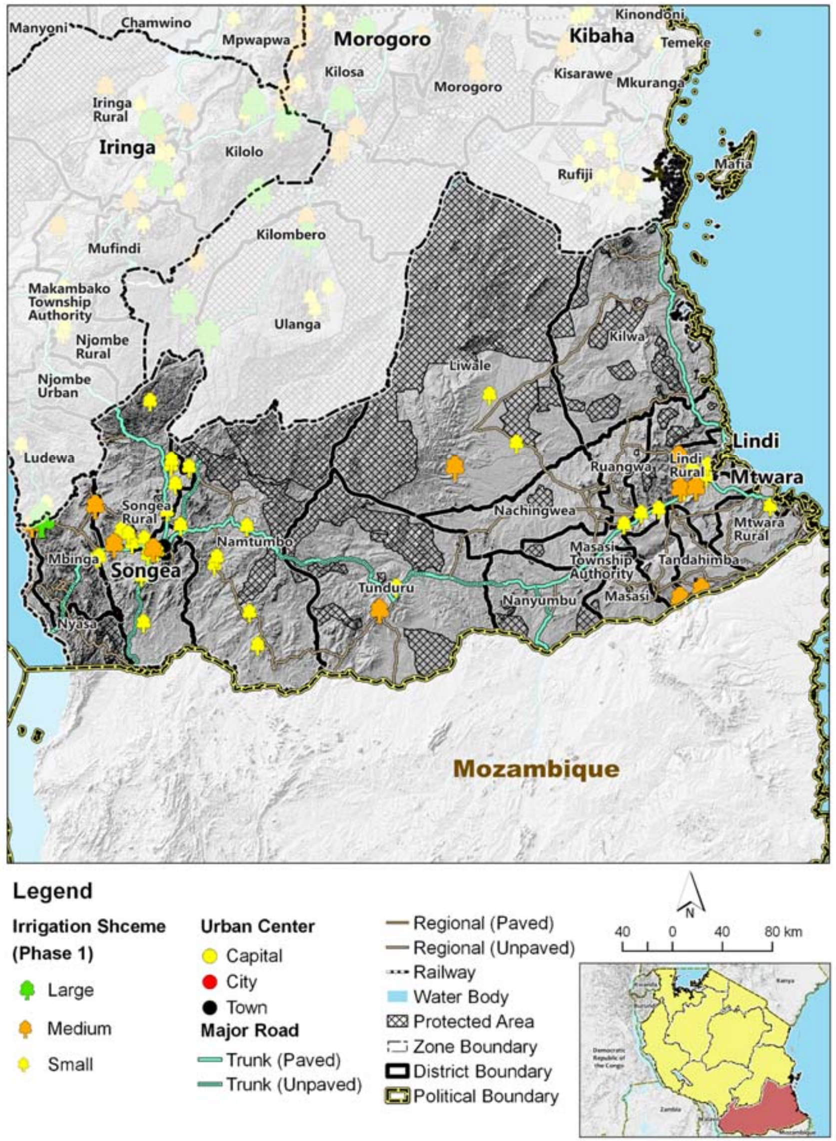
***** DEVELOPMENT PROGRAM SUMMARY **********

Program Name	05 Mtwara Zonal Irrigation Development Program (Phase-1)
Location	Mtwara Irrigation Zone Region Name: Lindi (6), Mtwara (9), Ruvuma (8) Note: No. of District in parenthesis
Hard Component	To develop 19,107 ha of irrigation area by 2025
Target Development Area by Size of Irrigation Scheme	• Small Scale: 4,401 ha (37 schemes) • Medium Scale: 7,339 ha (11 schemes) • Large Scale: 2,710 ha (1 scheme) • Total: 19,107 ha (49 schemes)
Target Development Area by Type of Works	• Improvement: 4,657 ha • Expansion: 7,650 ha • New Development: 6,800 ha
Target Development Area by Type of Irrigation Scheme	• Weir Irrigation: 13,257 ha • Dam and Pond Irrigation: 3,740 ha • Lake Water Irrigation: 200 ha • Groundwater Irrigation: 100 ha • Unknown: 1,800 ha
Soft Component	• Institutional and Functional Strengthening • Capacity Building • Strengthening of Coordination
Program Period	2018 to 2025
Investment Cost	USD 110.7 million (with VAT18%)
Target Crops and Yield	• Paddy: 5.0 ton/ha • Tomato: 40 ton/ha, Onion: 10 ton/ha
Financial and Economic Performance Indicators	Net return per ha: TZS 5.4 million/year EIRR: 18.3%
Office Address: Mtwara Zonal Irrigation Office	
Contact Persons: ZIE	

Sources: JICA Project Team



* Refer to NIRC website or Data Book for individual project information.

NATIONAL IRRIGATION MASTER PLAN (2018-2035)
Mtwara Zonal Irrigation Development Program (Phase-1)

Attachment-11.4.1 (7/9) Development Program Summary
06 Mwanza Zonal Irrigation Development Program (Phase-1)

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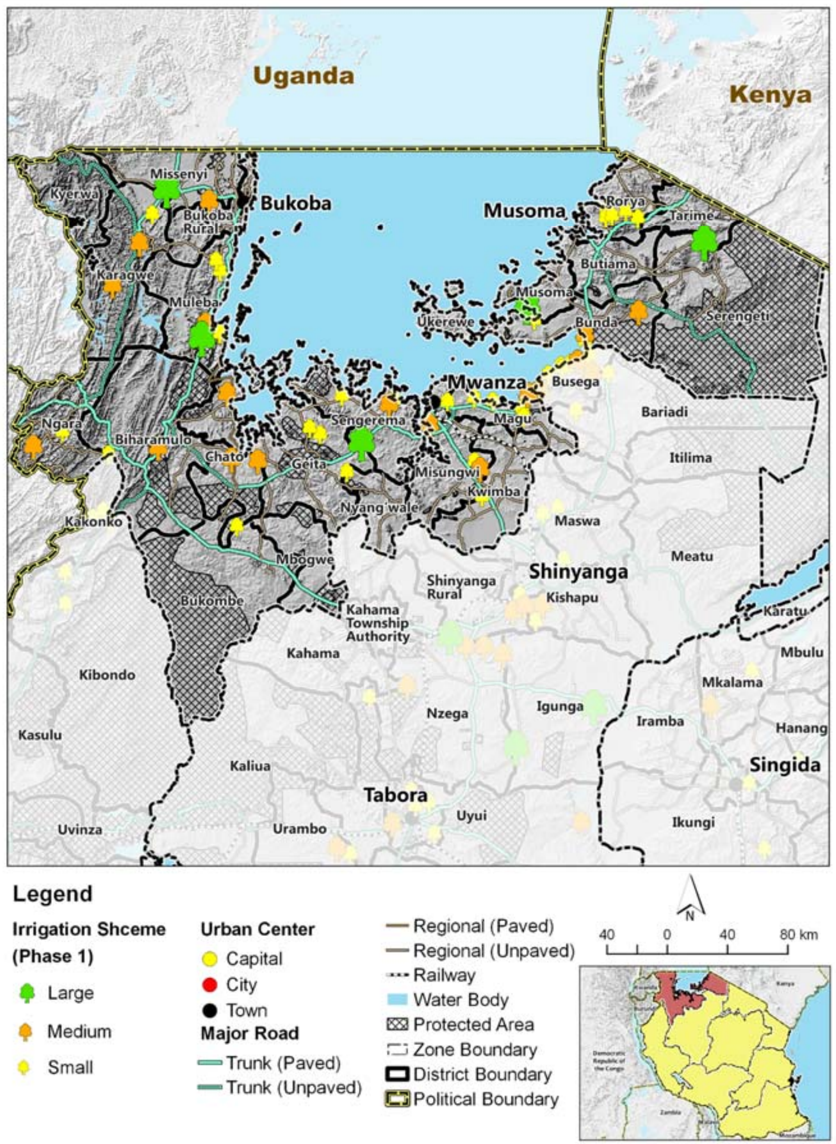
***** DEVELOPMENT PROGRAM SUMMARY **********

Program Name	06 Mwanza Zonal Irrigation Development Program (Phase-1)
Location	Mwanza Irrigation Zone Region Name: Kagera (8), Geita (6), Mwanza (8), Mara (9) Note: No. of District in parenthesis
Hard Component	To develop 44,144 ha of irrigation area by 2025
Target Development Area by Size of Irrigation Scheme	● Small Scale: 6,339 ha (27 schemes) ● Medium Scale: 13,265 ha (14 schemes) ● Large Scale: 24,540 ha (5 schemes) ● Total: 44,144 ha (46 schemes)
Target Development Area by Type of Works	● Improvement: 5,955 ha ● Expansion: 9,522 ha ● New Development: 28,667 ha
Target Development Area by Type of Irrigation Scheme	● Weir Irrigation: 9,015 ha ● Pump Irrigation: 1,395 ha ● Dam and Pond Irrigation: 26,930 ha ● Lake Water Irrigation: 5,864 ha ● Groundwater Irrigation: 140 ha ● Unknown: 44,141 ha
Soft Component	● Institutional and Functional Strengthening ● Capacity Building ● Strengthening of Coordination
Program Period	2018 to 2025
Investment Cost	USD 302.3 million (with VAT18%)
Target Crops and Yield	● Paddy: 5.0 ton/ha ● Tomato: 40 ton/ha, Onion: 10 ton/ha
Financial and Economic Performance Indicators	Net return per ha: TZS 2.9 million/year EIRR: 18.0%
Office Address: Mwanza Zonal Irrigation Office	
Contact Persons: ZIE	

Sources: JICA Project Team



* Refer to NIRC website or Data Book for individual project information.

NATIONAL IRRIGATION MASTER PLAN (2018-2035)
Mwanza Zonal Irrigation Development Program (Phase-1)

Attachment-11.4.1 (8/9) Development Program Summary
07 Tabora Zonal Irrigation Development Program (Phase-1)

THE UNITED REPUBLIV OF TANZANIA
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NATIONAL IRRIGATION COMMISSION

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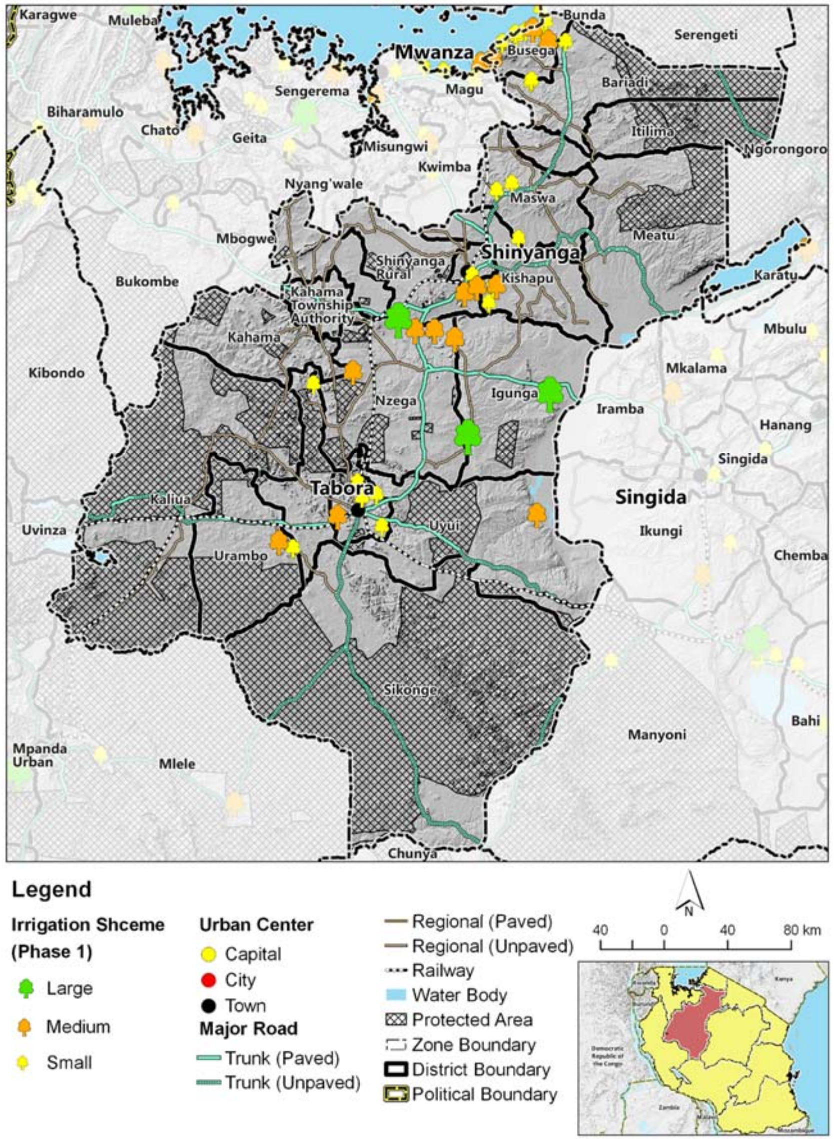
National Irrigation Commission
Kilimo House, Kilimo Road
P.O. Box 6668, 14473 Dar es Salaam

***** DEVELOPMENT PROGRAM SUMMARY **********

Program Name	07 Tabora Zonal Irrigation Development Program (Phase-1)
Location	Tabora Irrigation Zone Region Name: Tabora (8), Shinyanga (6), Simiyu (6) Note: No. of District in parenthesis
Hard Component	To develop 26,236 ha of irrigation area by 2025
Target Development Area by Size of Irrigation Scheme	● Small Scale: 5,128 ha (20 schemes) ● Medium Scale: 12,608 ha (15 schemes) ● Large Scale: 8,500 ha (3 schemes) ● Total: 26,236 ha (38 schemes)
Target Development Area by Type of Works	● Improvement: 5,995 ha ● Expansion: 9,754 ha ● New Development: 10,487 ha
Target Development Area by Type of Irrigation Scheme	● Weir Irrigation: 7,607 ha ● Pump Irrigation: 450 ha ● Dam and Pond Irrigation: 14,850 ha ● Lake Water Irrigation: 3,079 ha ● Groundwater Irrigation: 250 ha
Soft Component	● Institutional and Functional Strengthening ● Capacity Building ● Strengthening of Coordination
Program Period	2018 to 2025
Investment Cost	USD 169.0 million (with VAT18%)
Target Crops and Yield	● Paddy: 5.0 ton/ha ● Tomato: 40 ton/ha, Onion: 10 ton/ha
Financial and Economic Performance Indicators	Net return per ha: TZS 2.2 million/year EIRR: 15.0%
Office Address: Tabora Zonal Irrigation Office	
Contact Persons: ZIE	

Sources: JICA Project Team



* Refer to NIRC website or Data Book for individual project information.

NATIONAL IRRIGATION MASTER PLAN (2018-2035)

Tabora Zonal Irrigation Development Program (Phase-1)

Attachment-11.4.1 (9/9) Development Program Summary
08 Katavi Zonal Irrigation Development Program (Phase-1)

THE UNITED REPUBLIV OF TANZANIA
MINISTRY OF WATER AND IRRIGATION
NATIONAL IRRIGATION COMMISSION

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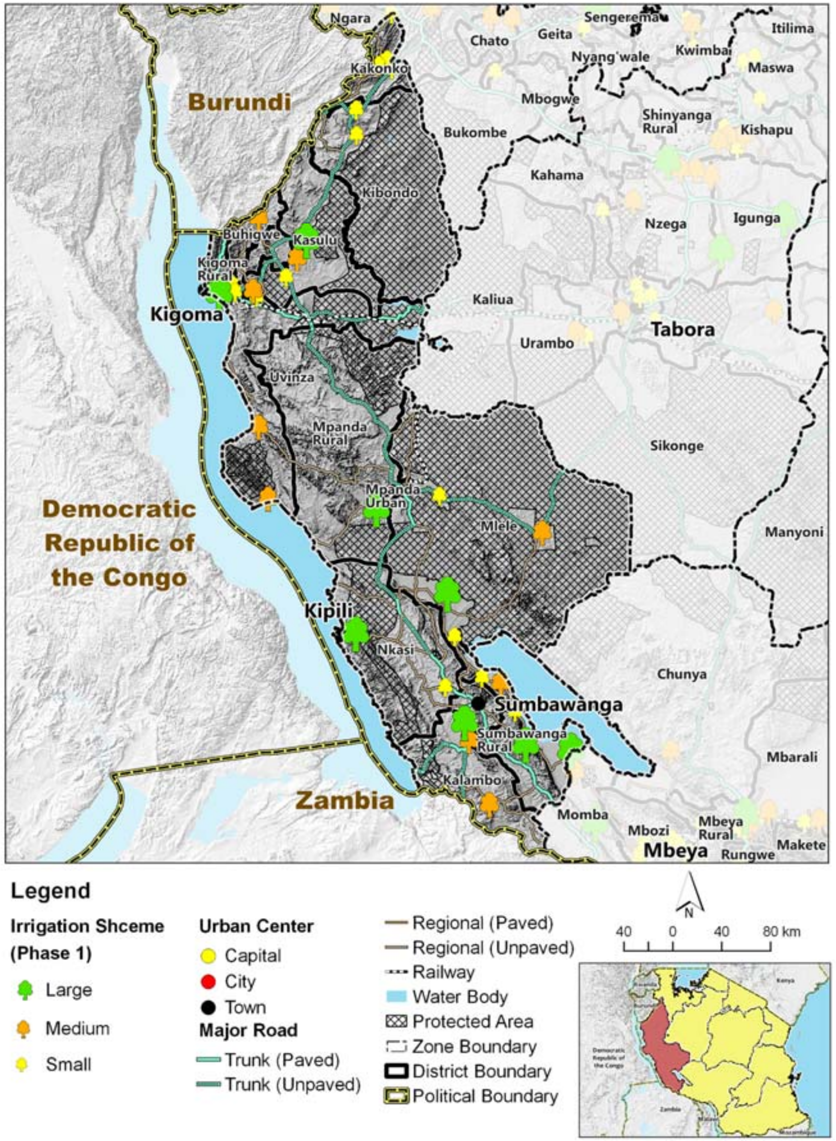
***** DEVELOPMENT PROGRAM SUMMARY **********

Program Name	08 Katavi Zonal Irrigation Development Program (Phase-1)
Location	Katavi Irrigation Zone Region Name: Katavi (5), Kigoma (8), Rukwa (4) Note: No. of District in parenthesis
Hard Component	To develop 53,062 ha of irrigation area by 2025
Target Development Area by Size of Irrigation Scheme	● Small Scale: 4,100 ha (16 schemes) ● Medium Scale: 9,998 ha (10 schemes) ● Large Scale: 38,964 ha (8 Schemes) ● Total: 53,062 (34 schemes)
Target Development Area by Type of Works	● Improvement: 16,811 ha ● Expansion: 17,081 ha ● New Development: 19,140 ha
Target Development Area by Type of Irrigation Scheme	● Weir Irrigation: 30,877 ha ● Dam and Pond Irrigation: 20,085 ha ● Groundwater Irrigation: 1,100 ha ● Unknown: 1,000 ha
Soft Component	● Institutional and Functional Strengthening ● Capacity Building ● Strengthening of Coordination
Program Period	2018 to 2025
Investment Cost	USD 300.0 million (with VAT18%)
Target Crops and Yield	● Paddy: 5.0 ton/ha ● Tomato: 40 ton/ha, Onion: 10 ton/ha
Financial and Economic Performance Indicators	Net return per ha: TZS 2.5 million/year EIRR: 15.2%
Office Address: Katavi Zonal Irrigation Office	
Contact Persons: ZIE	

Sources: JICA Project Team



* Refer to NIRC website or Data Book for individual project information.

NATIONAL IRRIGATION MASTER PLAN (2018-2035)
Katavi Zonal Irrigation Development Program (Phase-1)

Attachment-11.5.1 (1/2) **Irrigation Infrastructure Development Cost (Construction and Engineering Services) for Phase 1 by Irrigation Zon**

Dodoma

Type of Works	Unit Cost (USD)	Development Area (ha)	Construction Cost (USD)	F/S (USD)	D/D (USD)	SV (USD)	Engineering Services (USD)	Development Cost (USD)	Development Cost (TZS mil)
New Gravity-Type (All)	6,608	3,897	25,751,376	1,030,055	1,545,083	3,090,165	5,665,303	31,416,679	70,373
New Presure-Type (All)	17,700	2,040	36,108,000	1,444,320	2,166,480	4,332,960	7,943,760	44,051,760	98,676
Expansion	3,540	13,875	49,117,500	1,964,700	2,947,050	5,894,100	10,805,850	59,923,350	134,228
Improvement	3,540	17,583	62,243,820	1,867,315	2,489,753	4,979,506	9,336,573	71,580,393	160,340
Total		37,395	173,220,696	6,306,390	9,148,365	18,296,731	33,751,486	206,972,182	463,618

Kilimanjaro

Type of Works	Unit Cost (USD)	Development Area (ha)	Construction Cost (USD)	F/S (USD)	D/D (USD)	SV (USD)	Engineering Services (USD)	Development Cost (USD)	Development Cost (TZS mil)
New Gravity-Type (All)	6,608	16,142	106,666,336	4,266,653	6,399,980	12,799,960	23,466,594	130,132,930	291,498
New Presure-Type (All)	17,700	0	0	0	0	0	0	0	0
Expansion	3,540	6,132	21,707,280	868,291	1,302,437	2,604,874	4,775,602	26,482,882	59,322
Improvement	3,540	17,293	61,217,220	1,836,517	2,448,689	4,897,378	9,182,583	70,399,803	157,696
Total		39,567	189,590,836	6,971,461	10,151,106	20,302,212	37,424,779	227,015,615	508,515

Mbeya

Type of Works	Unit Cost (USD)	Development Area (ha)	Construction Cost (USD)	F/S (USD)	D/D (USD)	SV (USD)	Engineering Services (USD)	Development Cost (USD)	Development Cost (TZS mil)
New Gravity-Type (All)	6,608	13,381	88,421,648	3,536,866	5,305,299	10,610,598	19,452,763	107,874,411	241,639
New Presure-Type (All)	17,700	0	0	0	0	0	0	0	0
Expansion	3,540	29,948	106,015,920	4,240,637	6,360,955	12,721,910	23,323,502	129,339,422	289,720
Improvement	3,540	19,450	68,853,000	2,065,590	2,754,120	5,508,240	10,327,950	79,180,950	177,365
Total		62,779	263,290,568	9,843,093	14,420,374	28,840,748	53,104,215	316,394,783	708,724

Morogoro

Type of Works	Unit Cost (USD)	Development Area (ha)	Construction Cost (USD)	F/S (USD)	D/D (USD)	SV (USD)	Engineering Services (USD)	Development Cost (USD)	Development Cost (TZS mil)
New Gravity-Type (All)	6,608	36,374	240,359,392	9,614,376	14,421,564	28,843,127	52,879,066	293,238,458	656,854
New Presure-Type (All)	17,700	0	0	0	0	0	0	0	0
Expansion	3,540	17,231	60,997,740	2,439,910	3,659,864	7,319,729	13,419,503	74,417,243	166,695
Improvement	3,540	8,504	30,104,160	903,125	1,204,166	2,408,333	4,515,624	34,619,784	77,548
Total		62,109	331,461,292	12,957,410	19,285,594	38,571,189	70,814,193	402,275,485	901,097

Mtwara

Type of Works	Unit Cost (USD)	Development Area (ha)	Construction Cost (USD)	F/S (USD)	D/D (USD)	SV (USD)	Engineering Services (USD)	Development Cost (USD)	Development Cost (TZS mil)
New Gravity-Type (All)	6,608	6,600	43,612,800	1,744,512	2,616,768	5,233,536	9,594,816	53,207,616	119,185
New Presure-Type (All)	17,700	200	3,540,000	141,600	212,400	424,800	778,800	4,318,800	9,674
Expansion	3,540	7,650	27,081,000	1,083,240	1,624,860	3,249,720	5,957,820	33,038,820	74,007
Improvement	3,540	4,657	16,485,780	494,573	659,431	1,318,862	2,472,867	18,958,647	42,467
Total		19,107	90,719,580	3,463,925	5,113,459	10,226,918	18,804,303	109,523,883	245,333

Mwanza

Type of Works	Unit Cost (USD)	Development Area (ha)	Construction Cost (USD)	F/S (USD)	D/D (USD)	SV (USD)	Engineering Services (USD)	Development Cost (USD)	Development Cost (TZS mil)
New Gravity-Type (All)	6,608	28,442	187,944,736	7,517,789	11,276,684	22,553,368	41,347,842	229,292,578	513,615
New Presure-Type (All)	17,700	225	3,982,500	159,300	238,950	477,900	876,150	4,858,650	10,883
Expansion	3,540	9,522	33,707,880	1,348,315	2,022,473	4,044,946	7,415,734	41,123,614	92,117
Improvement	3,540	5,955	21,080,700	632,421	843,228	1,686,456	3,162,105	24,242,805	54,304
Total		44,144	246,715,816	9,657,826	14,381,335	28,762,670	52,801,831	299,517,647	670,920

Tabora

Type of Works	Unit Cost (USD)	Development Area (ha)	Construction Cost (USD)	F/S (USD)	D/D (USD)	SV (USD)	Engineering Services (USD)	Development Cost (USD)	Development Cost (TZS mil)
New Gravity-Type (All)	6,608	9,282	61,335,456	2,453,418	3,680,127	7,360,255	13,493,800	74,829,256	167,618
New Presure-Type (All)	17,700	1,205	21,328,500	853,140	1,279,710	2,559,420	4,692,270	26,020,770	58,287
Expansion	3,540	9,754	34,529,160	1,381,166	2,071,750	4,143,499	7,596,415	42,125,575	94,361
Improvement	3,540	5,995	21,222,300	636,669	848,892	1,697,784	3,183,345	24,405,645	54,669
Total		26,236	138,415,416	5,324,394	7,880,479	15,760,958	28,965,831	167,381,247	374,934

Katavi

Type of Works	Unit Cost (USD)	Development Area (ha)	Construction Cost (USD)	F/S (USD)	D/D (USD)	SV (USD)	Engineering Services (USD)	Development Cost (USD)	Development Cost (TZS mil)
New Gravity-Type (All)	6,608	19,140	126,477,120	5,059,085	7,588,627	15,177,254	27,824,966	154,302,086	345,637
New Presure-Type (All)	17,700	0	0	0	0	0	0	0	0
Expansion	3,540	17,081	60,466,740	2,418,670	3,628,004	7,256,009	13,302,683	73,769,423	165,244
Improvement	3,540	16,841	59,617,140	1,788,514	2,384,686	4,769,371	8,942,571	68,559,711	153,574
Total		53,062	246,561,000	9,266,269	13,601,317	27,202,634	50,070,220	296,631,220	664,454

Total

Type of Works	Unit Cost (USD)	Development Area (ha)	Construction Cost (USD)	F/S (USD)	D/D (USD)	SV (USD)	Engineering Services (USD)	Development Cost (USD)	Development Cost (TZS mil)
New Gravity-Type (All)	6,608	133,258	880,568,864	35,222,755	52,834,132	105,668,264	193,725,150	1,074,294,014	2,406,419
New Presure-Type (All)	17,700	3,670	64,959,000	2,598,360	3,897,540	7,795,080	14,290,980	79,249,980	177,520
Expansion	3,540	111,193	393,623,220	15,744,929	23,617,393	47,234,786	86,597,108	480,220,328	1,075,694
Improvement	3,540	96,278	340,824,120	10,224,724	13,632,965	27,265,930	51,123,618	391,947,738	877,963
Total		344,399	1,679,975,204	63,790,767	93,982,030	187,964,060	345,736,856	2,025,712,060	4,537,595

注：表中の費用にはVAT（18%）を含む。
出典：JICA調査団

Attachment-11.5.1 (2/2) **Irrigation Infrastructure Development Cost (Construction and Engineering Services) for Phase 2 by Irrigation Zon**

Dodoma

Type of Works	Unit Cost (USD)	Development Area (ha)	Construction Cost (USD)	F/S (USD)	D/D (USD)	SV (USD)	Engineering Services (USD)	Development Cost (USD)	Development Cost (TZS mil)
New Gravity-Type (All)	6,608	25,649	169,488,592	6,779,544	10,169,316	20,338,631	37,287,490	206,776,082	463,178
New Presure-Type (All)	17,700	420	7,434,000	297,360	446,040	892,080	1,635,480	9,069,480	20,316
Expansion	3,540	11,480	40,639,200	1,625,568	2,438,352	4,876,704	8,940,624	49,579,824	111,059
Improvement	3,540	19,609	69,415,860	2,082,476	2,776,634	5,553,269	10,412,379	79,828,239	178,815
Total		57,158	286,977,652	10,784,947	15,830,342	31,660,684	58,275,973	345,253,625	773,368

Kilimanjaro

Type of Works	Unit Cost (USD)	Development Area (ha)	Construction Cost (USD)	F/S (USD)	D/D (USD)	SV (USD)	Engineering Services (USD)	Development Cost (USD)	Development Cost (TZS mil)
New Gravity-Type (All)	6,608	5,427	35,861,616	1,434,465	2,151,697	4,303,394	7,889,556	43,751,172	98,003
New Presure-Type (All)	17,700	176	3,115,200	124,608	186,912	373,824	685,344	3,800,544	8,513
Expansion	3,540	8,499	30,086,460	1,203,458	1,805,188	3,610,375	6,619,021	36,705,481	82,220
Improvement	3,540	15,689	55,539,060	1,666,172	2,221,562	4,443,125	8,330,859	63,869,919	143,069
Total		29,791	124,602,336	4,428,703	6,365,359	12,730,718	23,524,780	148,127,116	331,805

Mbeya

Type of Works	Unit Cost (USD)	Development Area (ha)	Construction Cost (USD)	F/S (USD)	D/D (USD)	SV (USD)	Engineering Services (USD)	Development Cost (USD)	Development Cost (TZS mil)
New Gravity-Type (All)	6,608	16,508	109,084,864	4,363,395	6,545,092	13,090,184	23,998,670	133,083,534	298,107
New Presure-Type (All)	17,700	285	5,044,500	201,780	302,670	605,340	1,109,790	6,154,290	13,786
Expansion	3,540	28,973	102,564,420	4,102,577	6,153,865	12,307,730	22,564,172	125,128,592	280,288
Improvement	3,540	30,074	106,461,960	3,193,859	4,258,478	8,516,957	15,969,294	122,431,254	274,246
Total		75,840	323,155,744	11,861,610	17,260,105	34,520,211	63,641,926	386,797,670	866,427

Morogoro

Type of Works	Unit Cost (USD)	Development Area (ha)	Construction Cost (USD)	F/S (USD)	D/D (USD)	SV (USD)	Engineering Services (USD)	Development Cost (USD)	Development Cost (TZS mil)
New Gravity-Type (All)	6,608	27,883	184,250,864	7,370,035	11,055,052	22,110,104	40,535,190	224,786,054	503,521
New Presure-Type (All)	17,700	40	708,000	28,320	42,480	84,960	155,760	863,760	1,935
Expansion	3,540	39,146	138,576,840	5,543,074	8,314,610	16,629,221	30,486,905	169,063,745	378,703
Improvement	3,540	7,297	25,831,380	774,941	1,033,255	2,066,510	3,874,707	29,706,087	66,542
Total		74,366	349,367,084	13,716,370	20,445,397	40,890,795	75,052,562	424,419,646	950,700

Mtwara

Type of Works	Unit Cost (USD)	Development Area (ha)	Construction Cost (USD)	F/S (USD)	D/D (USD)	SV (USD)	Engineering Services (USD)	Development Cost (USD)	Development Cost (TZS mil)
New Gravity-Type (All)	6,608	29,573	195,418,384	7,816,735	11,725,103	23,450,206	42,992,044	238,410,428	534,039
New Presure-Type (All)	17,700	2,844	50,338,800	2,013,552	3,020,328	6,040,656	11,074,536	61,413,336	137,566
Expansion	3,540	7,815	27,665,100	1,106,604	1,659,906	3,319,812	6,086,322	33,751,422	75,603
Improvement	3,540	6,982	24,716,280	741,488	988,651	1,977,302	3,707,442	28,423,722	63,669
Total		47,214	298,138,564	11,678,380	17,393,988	34,787,976	63,860,344	361,998,908	810,878

Mwanza

Type of Works	Unit Cost (USD)	Development Area (ha)	Construction Cost (USD)	F/S (USD)	D/D (USD)	SV (USD)	Engineering Services (USD)	Development Cost (USD)	Development Cost (TZS mil)
New Gravity-Type (All)	6,608	19,163	126,629,104	5,065,164	7,597,746	15,195,492	27,858,403	154,487,507	346,052
New Presure-Type (All)	17,700	400	7,080,000	283,200	424,800	849,600	1,557,600	8,637,600	19,348
Expansion	3,540	10,568	37,410,720	1,496,429	2,244,643	4,489,286	8,230,358	45,641,078	102,236
Improvement	3,540	4,858	17,197,320	515,920	687,893	1,375,786	2,579,598	19,776,918	44,300
Total		34,989	188,317,144	7,360,713	10,955,082	21,910,164	40,225,959	228,543,103	511,937

Tabora

Type of Works	Unit Cost (USD)	Development Area (ha)	Construction Cost (USD)	F/S (USD)	D/D (USD)	SV (USD)	Engineering Services (USD)	Development Cost (USD)	Development Cost (TZS mil)
New Gravity-Type (All)	6,608	20,954	138,464,032	5,538,561	8,307,842	16,615,684	30,462,087	168,926,119	378,395
New Presure-Type (All)	17,700	0	0	0	0	0	0	0	0
Expansion	3,540	11,194	39,626,760	1,585,070	2,377,606	4,755,211	8,717,887	48,344,647	108,292
Improvement	3,540	4,587	16,237,980	487,139	649,519	1,299,038	2,435,697	18,673,677	41,829
Total		36,735	194,328,772	7,610,771	11,334,967	22,669,933	41,615,671	235,944,443	528,516

Katavi

Type of Works	Unit Cost (USD)	Development Area (ha)	Construction Cost (USD)	F/S (USD)	D/D (USD)	SV (USD)	Engineering Services (USD)	Development Cost (USD)	Development Cost (TZS mil)
New Gravity-Type (All)	6,608	21,076	139,270,208	5,570,808	8,356,212	16,712,425	30,639,446	169,909,654	380,598
New Presure-Type (All)	17,700	0	0	0	0	0	0	0	0
Expansion	3,540	24,036	85,087,440	3,403,498	5,105,246	10,210,493	18,719,237	103,806,677	232,527
Improvement	3,540	4,453	15,763,620	472,909	630,545	1,261,090	2,364,543	18,128,163	40,607
Total		49,565	240,121,268	9,447,215	14,092,004	28,184,007	51,723,226	291,844,494	653,732

Total

Type of Works	Unit Cost (USD)	Development Area (ha)	Construction Cost (USD)	F/S (USD)	D/D (USD)	SV (USD)	Engineering Services (USD)	Development Cost (USD)	Development Cost (TZS mil)
New Gravity-Type (All)	6,608	166,233	1,098,467,664	43,938,707	65,908,060	131,816,120	241,662,886	1,340,130,550	3,001,892
New Presure-Type (All)	17,700	4,165	73,720,500	2,948,820	4,423,230	8,846,460	16,218,510	89,939,010	201,463
Expansion	3,540	141,711	501,656,940	20,066,278	30,099,416	60,198,833	110,364,527	612,021,467	1,370,928
Improvement	3,540	93,549	331,163,460	9,934,904	13,246,538	26,493,077	49,674,519	380,837,979	853,077
Total		405,658	2,005,008,564	76,888,708	113,677,245	227,354,489	417,920,442	2,422,929,006	5,427,361

Note: Cost includes VAT (18%).
Source: JICA Project Team

Attachment-11.6.1(1/9) Cash Flow of NIMP2018 (2018-2025) (Economic Price) (All Zones, Phase 1)

(Unit: million TZS)

	Year	Cost			Total Cost	Agriculture Benefit	Other Benefit	Total Benefit	Net Benefit	Present Value: Total Cost	Present Value: Total Benefit	Present Value: Net Benefit
		Construction	Soft Component	O&M								
1	2018	107,870	6,761		114,631	0	0	0	**-114,631**	102,349	0	-102,349
2	2019	288,708	6,640		295,348	0	0	0	**-295,348**	235,449	0	-235,449
3	2020	493,910	7,124	8,905	509,939	0	0	0	**-509,939**	362,964	0	-362,964
4	2021	744,910	8,939	16,354	770,203	27,505	0	27,505	**-742,698**	489,478	17,480	-471,998
5	2022	852,420	5,192	24,878	882,489	101,120	0	101,120	**-781,369**	500,748	57,378	-443,370
6	2023	625,601	2,841	31,134	659,576	227,058	0	227,058	**-432,518**	334,162	115,035	-219,127
7	2024	294,060	3,961	34,075	332,096	422,377	0	422,377	**90,281**	150,223	191,062	40,839
8	2025	186,803	3,525	35,943	226,271	634,348	0	634,348	**408,077**	91,387	256,203	164,816
9	2026	0	0	35,943	35,943	793,865	0	793,865	**757,923**	12,961	286,276	273,314
10	2027	0	0	395,371	395,371	868,845	0	868,845	**473,474**	127,299	279,745	152,446
11	2028	0	0	35,943	35,943	916,476	0	916,476	**880,534**	10,333	263,465	253,132
12	2029	0	0	35,943	35,943	916,476	0	916,476	**880,534**	9,226	235,237	226,011
13	2030	0	0	35,943	35,943	916,476	0	916,476	**880,534**	8,237	210,033	201,796
14	2031	0	0	35,943	35,943	916,476	0	916,476	**880,534**	7,355	187,529	180,175
15	2032	0	0	35,943	35,943	916,476	0	916,476	**880,534**	6,567	167,437	160,870
16	2033	0	0	35,943	35,943	916,476	0	916,476	**880,534**	5,863	149,497	143,634
17	2034	0	0	35,943	35,943	916,476	0	916,476	**880,534**	5,235	133,480	128,245
18	2035	0	0	35,943	35,943	916,476	0	916,476	**880,534**	4,674	119,178	114,504
19	2036	0	0	35,943	35,943	916,476	0	916,476	**880,534**	4,173	106,409	102,236
20	2037	0	0	395,371	395,371	916,476	0	916,476	**521,106**	40,987	95,008	54,021
21	2038	0	0	35,943	35,943	916,476	0	916,476	**880,534**	3,327	84,829	81,502
22	2039	0	0	35,943	35,943	916,476	0	916,476	**880,534**	2,970	75,740	72,770
23	2040	0	0	35,943	35,943	916,476	0	916,476	**880,534**	2,652	67,625	64,973
24	2041	0	0	35,943	35,943	916,476	0	916,476	**880,534**	2,368	60,379	58,011
25	2042	0	0	35,943	35,943	916,476	0	916,476	**880,534**	2,114	53,910	51,796
26	2043	0	0	35,943	35,943	916,476	0	916,476	**880,534**	1,888	48,134	46,246
27	2044	0	0	35,943	35,943	916,476	0	916,476	**880,534**	1,685	42,977	41,291
28	2045	0	0	35,943	35,943	916,476	0	916,476	**880,534**	1,505	38,372	36,867
29	2046	0	0	35,943	35,943	916,476	0	916,476	**880,534**	1,344	34,261	32,917
30	2047	0	0	1,114,227	1,114,227	916,476	0	916,476	**-197,751**	37,191	30,590	-6,601
31	2048	0	0	35,943	35,943	916,476	0	916,476	**880,534**	1,071	27,313	26,241
32	2049	0	0	35,943	35,943	916,476	0	916,476	**880,534**	956	24,386	23,430
33	2050	0	0	35,943	35,943	916,476	0	916,476	**880,534**	854	21,773	20,919
34	2051	0	0	35,943	35,943	916,476	0	916,476	**880,534**	762	19,441	18,678
35	2052	0	0	35,943	35,943	916,476	0	916,476	**880,534**	681	17,358	16,677
36	2053	0	0	35,943	35,943	916,476	0	916,476	**880,534**	608	15,498	14,890
37	2054	0	0	35,943	35,943	916,476	0	916,476	**880,534**	543	13,837	13,295
38	2055	0	0	35,943	35,943	916,476	0	916,476	**880,534**	485	12,355	11,870
										2,572,674	**3,559,229**	**986,555**

Sources: JICA Project Team

Present Value

(Unit: million TZS)

Economic Value Indicator

(Unit: million TZS)

Net Present Value (NPV)	**986,555**
Benefit / Cost Ratio (B/C)	**1.38**
Economic Internal Rate of Return (EIRR)	**16.4%**

Sensitivity Analysis (EIRR)

Benefit	Cost: Base	Cost: +5%	Cost: +10%
Base	**16.4%**	**15.7%**	**15.0%**
-5%	**15.6%**	**14.9%**	**14.3%**
-10%	**14.9%**	**14.2%**	**13.6%**

Attachment-11.6.1(2/9) Cash Flow of NIMP2018 (2018-2025) (Economic Price) (Dodoma Zone, Phase 1)

(Unit: million TZS)

	Year	Cost: Construction	Cost: Soft Component	Cost: O&M	Total Cost	Agriculture Benefit	Other Benefit	Total Benefit	Net Benefit
1	2018	11,046	587		11,632	0	0	0	**-11,632**
2	2019	29,564	576		30,140	0	0	0	**-30,140**
3	2020	50,577	618	912	52,106	0	0	0	**-52,106**
4	2021	76,279	775	1,675	78,729	2,877	0	2,877	**-75,852**
5	2022	87,288	450	2,548	90,286	10,576	0	10,576	**-79,710**
6	2023	64,062	246	3,188	67,496	23,749	0	23,749	**-43,748**
7	2024	30,112	344	3,489	33,945	44,178	0	44,178	**10,233**
8	2025	19,129	306	3,681	23,115	66,348	0	66,348	**43,233**
9	2026	0	0	3,681	3,681	83,033	0	83,033	**79,352**
10	2027	0	0	40,486	40,486	90,875	0	90,875	**50,389**
11	2028	0	0	3,681	3,681	95,857	0	95,857	**92,177**
12	2029	0	0	3,681	3,681	95,857	0	95,857	**92,177**
13	2030	0	0	3,681	3,681	95,857	0	95,857	**92,177**
14	2031	0	0	3,681	3,681	95,857	0	95,857	**92,177**
15	2032	0	0	3,681	3,681	95,857	0	95,857	**92,177**
16	2033	0	0	3,681	3,681	95,857	0	95,857	**92,177**
17	2034	0	0	3,681	3,681	95,857	0	95,857	**92,177**
18	2035	0	0	3,681	3,681	95,857	0	95,857	**92,177**
19	2036	0	0	3,681	3,681	95,857	0	95,857	**92,177**
20	2037	0	0	40,486	40,486	95,857	0	95,857	**55,371**
21	2038	0	0	3,681	3,681	95,857	0	95,857	**92,177**
22	2039	0	0	3,681	3,681	95,857	0	95,857	**92,177**
23	2040	0	0	3,681	3,681	95,857	0	95,857	**92,177**
24	2041	0	0	3,681	3,681	95,857	0	95,857	**92,177**
25	2042	0	0	3,681	3,681	95,857	0	95,857	**92,177**
26	2043	0	0	3,681	3,681	95,857	0	95,857	**92,177**
27	2044	0	0	3,681	3,681	95,857	0	95,857	**92,177**
28	2045	0	0	3,681	3,681	95,857	0	95,857	**92,177**
29	2046	0	0	3,681	3,681	95,857	0	95,857	**92,177**
30	2047	0	0	114,097	114,097	95,857	0	95,857	**-18,240**
31	2048	0	0	3,681	3,681	95,857	0	95,857	**92,177**
32	2049	0	0	3,681	3,681	95,857	0	95,857	**92,177**
33	2050	0	0	3,681	3,681	95,857	0	95,857	**92,177**
34	2051	0	0	3,681	3,681	95,857	0	95,857	**92,177**
35	2052	0	0	3,681	3,681	95,857	0	95,857	**92,177**
36	2053	0	0	3,681	3,681	95,857	0	95,857	**92,177**
37	2054	0	0	3,681	3,681	95,857	0	95,857	**92,177**
38	2055	0	0	3,681	3,681	95,857	0	95,857	**92,177**

Sources: JICA Project Team

Present Value

(Unit: million TZS)

Total Cost	Total Benefit	Net Benefit
10,386	0	-10,386
24,027	0	-24,027
37,088	0	-37,088
50,034	1,828	-48,206
51,231	6,001	-45,229
34,196	12,032	-22,164
15,355	19,984	4,629
9,336	26,797	17,461
1,327	29,942	28,615
13,035	29,259	16,224
1,058	27,557	26,499
945	24,604	23,659
843	21,968	21,124
753	19,614	18,861
672	17,513	16,840
600	15,636	15,036
536	13,961	13,425
479	12,465	11,987
427	11,130	10,702
4,197	9,937	5,740
341	8,872	8,532
304	7,922	7,618
272	7,073	6,802
242	6,315	6,073
217	5,639	5,422
193	5,034	4,841
173	4,495	4,322
154	4,013	3,859
138	3,583	3,446
3,808	3,200	-609
110	2,857	2,747
98	2,551	2,453
87	2,277	2,190
78	2,033	1,955
70	1,815	1,746
62	1,621	1,559
56	1,447	1,392
50	1,292	1,243
262,978	**372,271**	**109,292**

Economic Value Indicator

(Unit: million TZS)

Net Present Value (NPV)	**109,292**
Benefit / Cost Ratio (B/C)	**1.42**
Economic Internal Rate of Return (EIRR)	**16.7%**

Sensitivity Analysis (EIRR)

Benefit	Cost: Base	Cost: +5%	Cost: +10%
Base	**16.7%**	**16.0%**	**15.3%**
-5%	**16.0%**	**15.3%**	**14.6%**
-10%	**15.2%**	**14.5%**	**13.9%**

Attachment-11.6.1(3/9) Cash Flow of NIMP2018 (2018-2025) (Economic Price) (Kilimanjaro Zone, Phase 1)

(Unit: million TZS)

	Year	Cost: Construction	Cost: Soft Component	Cost: O&M	Total Cost	Agriculture Benefit	Other Benefit	Total Benefit	Net Benefit	Present Value: Total Cost	Present Value: Total Benefit	Present Value: Net Benefit
1	2018	12,129	621		12,749	0	0	0	**-12,749**	11,383	0	-11,383
2	2019	32,462	609		33,071	0	0	0	**-33,071**	26,364	0	-26,364
3	2020	55,534	654	1,001	57,189	0	0	0	**-57,189**	40,706	0	-40,706
4	2021	83,756	821	1,839	86,415	2,877	0	2,877	**-83,538**	54,918	1,828	-53,090
5	2022	95,844	477	2,797	99,118	10,576	0	10,576	**-88,541**	56,242	6,001	-50,241
6	2023	70,341	261	3,501	74,102	23,749	0	23,749	**-50,354**	37,543	12,032	-25,511
7	2024	33,063	364	3,831	37,258	44,178	0	44,178	**6,919**	16,854	19,984	3,130
8	2025	21,004	324	4,041	25,369	66,348	0	66,348	**40,980**	10,246	26,797	16,551
9	2026	0	0	4,041	4,041	83,033	0	83,033	**78,991**	1,457	29,942	28,485
10	2027	0	0	44,455	44,455	90,875	0	90,875	**46,421**	14,313	29,259	14,946
11	2028	0	0	4,041	4,041	95,857	0	95,857	**91,816**	1,162	27,557	26,395
12	2029	0	0	4,041	4,041	95,857	0	95,857	**91,816**	1,037	24,604	23,567
13	2030	0	0	4,041	4,041	95,857	0	95,857	**91,816**	926	21,968	21,042
14	2031	0	0	4,041	4,041	95,857	0	95,857	**91,816**	827	19,614	18,787
15	2032	0	0	4,041	4,041	95,857	0	95,857	**91,816**	738	17,513	16,774
16	2033	0	0	4,041	4,041	95,857	0	95,857	**91,816**	659	15,636	14,977
17	2034	0	0	4,041	4,041	95,857	0	95,857	**91,816**	589	13,961	13,372
18	2035	0	0	4,041	4,041	95,857	0	95,857	**91,816**	526	12,465	11,940
19	2036	0	0	4,041	4,041	95,857	0	95,857	**91,816**	469	11,130	10,660
20	2037	0	0	44,455	44,455	95,857	0	95,857	**51,403**	4,608	9,937	5,329
21	2038	0	0	4,041	4,041	95,857	0	95,857	**91,816**	374	8,872	8,498
22	2039	0	0	4,041	4,041	95,857	0	95,857	**91,816**	334	7,922	7,588
23	2040	0	0	4,041	4,041	95,857	0	95,857	**91,816**	298	7,073	6,775
24	2041	0	0	4,041	4,041	95,857	0	95,857	**91,816**	266	6,315	6,049
25	2042	0	0	4,041	4,041	95,857	0	95,857	**91,816**	238	5,639	5,401
26	2043	0	0	4,041	4,041	95,857	0	95,857	**91,816**	212	5,034	4,822
27	2044	0	0	4,041	4,041	95,857	0	95,857	**91,816**	190	4,495	4,306
28	2045	0	0	4,041	4,041	95,857	0	95,857	**91,816**	169	4,013	3,844
29	2046	0	0	4,041	4,041	95,857	0	95,857	**91,816**	151	3,583	3,432
30	2047	0	0	125,281	125,281	95,857	0	95,857	**-29,424**	4,182	3,200	-982
31	2048	0	0	4,041	4,041	95,857	0	95,857	**91,816**	120	2,857	2,736
32	2049	0	0	4,041	4,041	95,857	0	95,857	**91,816**	108	2,551	2,443
33	2050	0	0	4,041	4,041	95,857	0	95,857	**91,816**	96	2,277	2,181
34	2051	0	0	4,041	4,041	95,857	0	95,857	**91,816**	86	2,033	1,948
35	2052	0	0	4,041	4,041	95,857	0	95,857	**91,816**	77	1,815	1,739
36	2053	0	0	4,041	4,041	95,857	0	95,857	**91,816**	68	1,621	1,553
37	2054	0	0	4,041	4,041	95,857	0	95,857	**91,816**	61	1,447	1,386
38	2055	0	0	4,041	4,041	95,857	0	95,857	**91,816**	54	1,292	1,238
										288,652	**372,271**	**83,618**

Sources: JICA Project Team

Present Value

(Unit: million TZS)

Economic Value Indicator

(Unit: million TZS)

Net Present Value (NPV)	**83,618**
Benefit / Cost Ratio (B/C)	**1.29**
Economic Internal Rate of Return (EIRR)	**15.4%**

Sensitivity Analysis (EIRR)

Benefit	Cost: Base	Cost: +5%	Cost: +10%
Base	**15.4%**	**14.7%**	**14.1%**
-5%	**14.7%**	**14.0%**	**13.4%**
-10%	**13.9%**	**13.3%**	**12.7%**

Attachment-11.6.1(4/9) Cash Flow of NIMP2018 (2018-2025) (Economic Price) (Mbeya Zone, Phase 1)

(Unit: million TZS)

	Year	Cost: Construction	Cost: Soft Component	Cost: O&M	Total Cost	Agriculture Benefit	Other Benefit	Total Benefit	Net Benefit	Present Value: Total Cost	Present Value: Total Benefit	Present Value: Net Benefit
1	2018	16,908	8,245		25,153	0	0	0	**-25,153**	22,458	0	-22,458
2	2019	45,253	8,098		53,351	0	0	0	**-53,351**	42,531	0	-42,531
3	2020	77,417	8,687	1,396	87,500	0	0	0	**-87,500**	62,281	0	-62,281
4	2021	116,759	10,902	2,563	130,224	4,546	0	4,546	**-125,678**	82,760	2,889	-79,871
5	2022	133,611	6,331	3,899	143,841	16,715	0	16,715	**-127,127**	81,620	9,484	-72,135
6	2023	98,059	3,465	4,880	106,403	37,532	0	37,532	**-68,872**	53,907	19,015	-34,892
7	2024	46,092	4,831	5,341	56,264	69,817	0	69,817	**13,553**	25,451	31,582	6,131
8	2025	29,280	4,299	5,634	39,213	104,855	0	104,855	**65,642**	15,838	42,349	26,512
9	2026	0	0	5,634	5,634	131,222	0	131,222	**125,589**	2,032	47,320	45,288
10	2027	0	0	61,972	61,972	143,616	0	143,616	**81,645**	19,953	46,241	26,287
11	2028	0	0	5,634	5,634	151,489	0	151,489	**145,856**	1,620	43,550	41,930
12	2029	0	0	5,634	5,634	151,489	0	151,489	**145,856**	1,446	38,884	37,438
13	2030	0	0	5,634	5,634	151,489	0	151,489	**145,856**	1,291	34,717	33,426
14	2031	0	0	5,634	5,634	151,489	0	151,489	**145,856**	1,153	30,998	29,845
15	2032	0	0	5,634	5,634	151,489	0	151,489	**145,856**	1,029	27,677	26,647
16	2033	0	0	5,634	5,634	151,489	0	151,489	**145,856**	919	24,711	23,792
17	2034	0	0	5,634	5,634	151,489	0	151,489	**145,856**	821	22,064	21,243
18	2035	0	0	5,634	5,634	151,489	0	151,489	**145,856**	733	19,700	18,967
19	2036	0	0	5,634	5,634	151,489	0	151,489	**145,856**	654	17,589	16,935
20	2037	0	0	61,972	61,972	151,489	0	151,489	**89,518**	6,424	15,704	9,280
21	2038	0	0	5,634	5,634	151,489	0	151,489	**145,856**	521	14,022	13,500
22	2039	0	0	5,634	5,634	151,489	0	151,489	**145,856**	466	12,519	12,054
23	2040	0	0	5,634	5,634	151,489	0	151,489	**145,856**	416	11,178	10,762
24	2041	0	0	5,634	5,634	151,489	0	151,489	**145,856**	371	9,980	9,609
25	2042	0	0	5,634	5,634	151,489	0	151,489	**145,856**	331	8,911	8,580
26	2043	0	0	5,634	5,634	151,489	0	151,489	**145,856**	296	7,956	7,660
27	2044	0	0	5,634	5,634	151,489	0	151,489	**145,856**	264	7,104	6,840
28	2045	0	0	5,634	5,634	151,489	0	151,489	**145,856**	236	6,343	6,107
29	2046	0	0	5,634	5,634	151,489	0	151,489	**145,856**	211	5,663	5,453
30	2047	0	0	174,647	174,647	151,489	0	151,489	**-23,158**	5,829	5,056	-773
31	2048	0	0	5,634	5,634	151,489	0	151,489	**145,856**	168	4,515	4,347
32	2049	0	0	5,634	5,634	151,489	0	151,489	**145,856**	150	4,031	3,881
33	2050	0	0	5,634	5,634	151,489	0	151,489	**145,856**	134	3,599	3,465
34	2051	0	0	5,634	5,634	151,489	0	151,489	**145,856**	120	3,213	3,094
35	2052	0	0	5,634	5,634	151,489	0	151,489	**145,856**	107	2,869	2,762
36	2053	0	0	5,634	5,634	151,489	0	151,489	**145,856**	95	2,562	2,466
37	2054	0	0	5,634	5,634	151,489	0	151,489	**145,856**	85	2,287	2,202
38	2055	0	0	5,634	5,634	151,489	0	151,489	**145,856**	76	2,042	1,966
										434,794	**588,324**	**153,530**

Sources: JICA Project Team

Present Value

(Unit: million TZS)

Economic Value Indicator

(Unit: million TZS)

Net Present Value (NPV)	**153,530**
Benefit / Cost Ratio (B/C)	**1.35**
Economic Internal Rate of Return (EIRR)	**16.0%**

Sensitivity Analysis (EIRR)

Benefit	Cost: Base	Cost: +5%	Cost: +10%
Base	**16.0%**	**15.3%**	**14.7%**
-5%	**15.3%**	**14.6%**	**14.0%**
-10%	**14.5%**	**13.9%**	**13.3%**

Attachment-11.6.1(5/9) Cash Flow of NIMP2018 (2018-2025) (Economic Price) (Morogoro Zone, Phase 1)

(Unit: million TZS)

	Year	Cost: Construction	Cost: Soft Component	Cost: O&M	Total Cost	Agriculture Benefit	Other Benefit	Total Benefit	Net Benefit	Present Value: Total Cost	Present Value: Total Benefit	Present Value: Net Benefit
1	2018	20,409	974		21,383	0	0	0	**-21,383**	19,092	0	-19,092
2	2019	54,624	957		55,580	0	0	0	**-55,580**	44,308	0	-44,308
3	2020	93,448	1,026	1,685	96,159	0	0	0	**-96,159**	68,444	0	-68,444
4	2021	140,937	1,288	3,094	145,320	5,881	0	5,881	**-139,439**	92,353	3,737	-88,616
5	2022	161,278	748	4,707	166,733	21,620	0	21,620	**-145,113**	94,609	12,268	-82,341
6	2023	118,364	409	5,891	124,664	48,546	0	48,546	**-76,118**	63,159	24,595	-38,564
7	2024	55,636	571	6,447	62,654	90,307	0	90,307	**27,653**	28,341	40,850	12,509
8	2025	35,343	508	6,800	42,652	135,627	0	135,627	**92,976**	17,226	54,778	37,551
9	2026	0	0	6,800	6,800	169,733	0	169,733	**162,933**	2,452	61,207	58,755
10	2027	0	0	74,804	74,804	185,764	0	185,764	**110,960**	24,085	59,811	35,726
11	2028	0	0	6,800	6,800	195,948	0	195,948	**189,148**	1,955	56,330	54,375
12	2029	0	0	6,800	6,800	195,948	0	195,948	**189,148**	1,745	50,295	48,549
13	2030	0	0	6,800	6,800	195,948	0	195,948	**189,148**	1,558	44,906	43,348
14	2031	0	0	6,800	6,800	195,948	0	195,948	**189,148**	1,391	40,095	38,703
15	2032	0	0	6,800	6,800	195,948	0	195,948	**189,148**	1,242	35,799	34,557
16	2033	0	0	6,800	6,800	195,948	0	195,948	**189,148**	1,109	31,963	30,854
17	2034	0	0	6,800	6,800	195,948	0	195,948	**189,148**	990	28,539	27,548
18	2035	0	0	6,800	6,800	195,948	0	195,948	**189,148**	884	25,481	24,597
19	2036	0	0	6,800	6,800	195,948	0	195,948	**189,148**	790	22,751	21,961
20	2037	0	0	74,804	74,804	195,948	0	195,948	**121,144**	7,755	20,313	12,559
21	2038	0	0	6,800	6,800	195,948	0	195,948	**189,148**	629	18,137	17,507
22	2039	0	0	6,800	6,800	195,948	0	195,948	**189,148**	562	16,194	15,632
23	2040	0	0	6,800	6,800	195,948	0	195,948	**189,148**	502	14,459	13,957
24	2041	0	0	6,800	6,800	195,948	0	195,948	**189,148**	448	12,909	12,461
25	2042	0	0	6,800	6,800	195,948	0	195,948	**189,148**	400	11,526	11,126
26	2043	0	0	6,800	6,800	195,948	0	195,948	**189,148**	357	10,291	9,934
27	2044	0	0	6,800	6,800	195,948	0	195,948	**189,148**	319	9,189	8,870
28	2045	0	0	6,800	6,800	195,948	0	195,948	**189,148**	285	8,204	7,919
29	2046	0	0	6,800	6,800	195,948	0	195,948	**189,148**	254	7,325	7,071
30	2047	0	0	210,812	210,812	195,948	0	195,948	**-14,865**	7,036	6,540	-496
31	2048	0	0	6,800	6,800	195,948	0	195,948	**189,148**	203	5,840	5,637
32	2049	0	0	6,800	6,800	195,948	0	195,948	**189,148**	181	5,214	5,033
33	2050	0	0	6,800	6,800	195,948	0	195,948	**189,148**	162	4,655	4,494
34	2051	0	0	6,800	6,800	195,948	0	195,948	**189,148**	144	4,157	4,012
35	2052	0	0	6,800	6,800	195,948	0	195,948	**189,148**	129	3,711	3,582
36	2053	0	0	6,800	6,800	195,948	0	195,948	**189,148**	115	3,314	3,199
37	2054	0	0	6,800	6,800	195,948	0	195,948	**189,148**	103	2,959	2,856
38	2055	0	0	6,800	6,800	195,948	0	195,948	**189,148**	92	2,642	2,550
										485,412	**760,984**	**275,571**

Sources: JICA Project Team

Economic Value Indicator

(Unit: million TZS)

Net Present Value (NPV)	**275,571**
Benefit / Cost Ratio (B/C)	**1.57**
Economic Internal Rate of Return (EIRR)	**18.3%**

Sensitivity Analysis (EIRR)

Benefit	Cost: Base	Cost: +5%	Cost: +10%
Base	**18.3%**	**17.5%**	**16.8%**
-5%	**17.5%**	**16.7%**	**16.1%**
-10%	**16.7%**	**16.0%**	**15.3%**

Attachment-11.6.1(6/9) Cash Flow of NIMP2018 (2018-2025) (Economic Price) (Mtwara Zone, Phase 1)

(Unit: million TZS)

	Year	Cost			Total Cost	Agriculture Benefit	Other Benefit	Total Benefit	Net Benefit
		Construction	Soft Component	O&M					
1	2018	5,854	300		6,153	0	0	0	**-6,153**
2	2019	15,667	294		15,961	0	0	0	**-15,961**
3	2020	26,802	316	483	27,601	0	0	0	**-27,601**
4	2021	40,423	396	887	41,707	1,692	0	1,692	**-40,014**
5	2022	46,257	230	1,350	47,837	6,222	0	6,222	**-41,615**
6	2023	33,949	126	1,690	35,764	13,971	0	13,971	**-21,793**
7	2024	15,957	176	1,849	17,982	25,990	0	25,990	**8,007**
8	2025	10,137	156	1,950	12,244	39,032	0	39,032	**26,789**
9	2026	0	0	1,950	1,950	48,848	0	48,848	**46,897**
10	2027	0	0	21,455	21,455	53,461	0	53,461	**32,006**
11	2028	0	0	1,950	1,950	56,392	0	56,392	**54,442**
12	2029	0	0	1,950	1,950	56,392	0	56,392	**54,442**
13	2030	0	0	1,950	1,950	56,392	0	56,392	**54,442**
14	2031	0	0	1,950	1,950	56,392	0	56,392	**54,442**
15	2032	0	0	1,950	1,950	56,392	0	56,392	**54,442**
16	2033	0	0	1,950	1,950	56,392	0	56,392	**54,442**
17	2034	0	0	1,950	1,950	56,392	0	56,392	**54,442**
18	2035	0	0	1,950	1,950	56,392	0	56,392	**54,442**
19	2036	0	0	1,950	1,950	56,392	0	56,392	**54,442**
20	2037	0	0	21,455	21,455	56,392	0	56,392	**34,937**
21	2038	0	0	1,950	1,950	56,392	0	56,392	**54,442**
22	2039	0	0	1,950	1,950	56,392	0	56,392	**54,442**
23	2040	0	0	1,950	1,950	56,392	0	56,392	**54,442**
24	2041	0	0	1,950	1,950	56,392	0	56,392	**54,442**
25	2042	0	0	1,950	1,950	56,392	0	56,392	**54,442**
26	2043	0	0	1,950	1,950	56,392	0	56,392	**54,442**
27	2044	0	0	1,950	1,950	56,392	0	56,392	**54,442**
28	2045	0	0	1,950	1,950	56,392	0	56,392	**54,442**
29	2046	0	0	1,950	1,950	56,392	0	56,392	**54,442**
30	2047	0	0	60,464	60,464	56,392	0	56,392	**-4,072**
31	2048	0	0	1,950	1,950	56,392	0	56,392	**54,442**
32	2049	0	0	1,950	1,950	56,392	0	56,392	**54,442**
33	2050	0	0	1,950	1,950	56,392	0	56,392	**54,442**
34	2051	0	0	1,950	1,950	56,392	0	56,392	**54,442**
35	2052	0	0	1,950	1,950	56,392	0	56,392	**54,442**
36	2053	0	0	1,950	1,950	56,392	0	56,392	**54,442**
37	2054	0	0	1,950	1,950	56,392	0	56,392	**54,442**
38	2055	0	0	1,950	1,950	56,392	0	56,392	**54,442**

Sources: JICA Project Team

Present Value

(Unit: million TZS)

	Year	Total Cost	Total Benefit	Net Benefit
1	2018	5,494	0	-5,494
2	2019	12,724	0	-12,724
3	2020	19,646	0	-19,646
4	2021	26,505	1,076	-25,430
5	2022	27,144	3,531	-23,614
6	2023	18,119	7,078	-11,041
7	2024	8,134	11,756	3,622
8	2025	4,945	15,765	10,820
9	2026	703	17,615	16,912
10	2027	6,908	17,213	10,305
11	2028	561	16,211	15,651
12	2029	501	14,474	13,974
13	2030	447	12,924	12,477
14	2031	399	11,539	11,140
15	2032	356	10,303	9,946
16	2033	318	9,199	8,881
17	2034	284	8,213	7,929
18	2035	254	7,333	7,080
19	2036	226	6,548	6,321
20	2037	2,224	5,846	3,622
21	2038	181	5,220	5,039
22	2039	161	4,660	4,499
23	2040	144	4,161	4,017
24	2041	129	3,715	3,587
25	2042	115	3,317	3,202
26	2043	102	2,962	2,859
27	2044	91	2,644	2,553
28	2045	82	2,361	2,279
29	2046	73	2,108	2,035
30	2047	2,018	1,882	-136
31	2048	58	1,681	1,622
32	2049	52	1,501	1,449
33	2050	46	1,340	1,293
34	2051	41	1,196	1,155
35	2052	37	1,068	1,031
36	2053	33	954	921
37	2054	29	851	822
38	2055	26	760	734
		139,313	**219,005**	**79,692**

Economic Value Indicator

(Unit: million TZS)

Net Present Value (NPV)	**79,692**
Benefit / Cost Ratio (B/C)	**1.57**
Economic Internal Rate of Return (EIRR)	**18.3%**

Sensitivity Analysis (EIRR)

Benefit	Cost		
	Base	+5%	+10%
Base	**18.3%**	**17.5%**	**16.9%**
-5%	**17.5%**	**16.8%**	**16.1%**
-10%	**16.7%**	**16.0%**	**15.3%**

Attachment-11.6.1(7/9) Cash Flow of NIMP2018 (2018-2025) (Economic Price) (Mwanza Zone, Phase 1)

(Unit: million TZS)

	Year	Cost: Construction	Cost: Soft Component	Cost: O&M	Total Cost	Agriculture Benefit	Other Benefit	Total Benefit	Net Benefit	PV Total Cost	PV Total Benefit	PV Net Benefit
1	2018	16,016	692		16,708	0	0	0	**-16,708**	14,918	0	-14,918
2	2019	42,865	680		43,545	0	0	0	**-43,545**	34,714	0	-34,714
3	2020	73,331	730	1,322	75,383	0	0	0	**-75,383**	53,656	0	-53,656
4	2021	110,598	915	2,428	113,941	4,534	0	4,534	**-109,407**	72,412	2,881	-69,530
5	2022	126,560	532	3,694	130,785	16,668	0	16,668	**-114,117**	74,211	9,458	-64,753
6	2023	92,884	291	4,623	97,797	37,427	0	37,427	**-60,370**	49,547	18,962	-30,586
7	2024	43,659	406	5,059	49,124	69,622	0	69,622	**20,498**	22,221	31,493	9,272
8	2025	27,735	361	5,336	33,432	104,562	0	104,562	**71,129**	13,503	42,231	28,728
9	2026	0	0	5,336	5,336	130,855	0	130,855	**125,519**	1,924	47,188	45,263
10	2027	0	0	58,701	58,701	143,214	0	143,214	**84,513**	18,900	46,111	27,211
11	2028	0	0	5,336	5,336	151,066	0	151,066	**145,729**	1,534	43,428	41,894
12	2029	0	0	5,336	5,336	151,066	0	151,066	**145,729**	1,370	38,775	37,405
13	2030	0	0	5,336	5,336	151,066	0	151,066	**145,729**	1,223	34,620	33,397
14	2031	0	0	5,336	5,336	151,066	0	151,066	**145,729**	1,092	30,911	29,819
15	2032	0	0	5,336	5,336	151,066	0	151,066	**145,729**	975	27,599	26,624
16	2033	0	0	5,336	5,336	151,066	0	151,066	**145,729**	870	24,642	23,772
17	2034	0	0	5,336	5,336	151,066	0	151,066	**145,729**	777	22,002	21,225
18	2035	0	0	5,336	5,336	151,066	0	151,066	**145,729**	694	19,645	18,951
19	2036	0	0	5,336	5,336	151,066	0	151,066	**145,729**	620	17,540	16,920
20	2037	0	0	58,701	58,701	151,066	0	151,066	**92,364**	6,085	15,660	9,575
21	2038	0	0	5,336	5,336	151,066	0	151,066	**145,729**	494	13,983	13,489
22	2039	0	0	5,336	5,336	151,066	0	151,066	**145,729**	441	12,484	12,043
23	2040	0	0	5,336	5,336	151,066	0	151,066	**145,729**	394	11,147	10,753
24	2041	0	0	5,336	5,336	151,066	0	151,066	**145,729**	352	9,953	9,601
25	2042	0	0	5,336	5,336	151,066	0	151,066	**145,729**	314	8,886	8,572
26	2043	0	0	5,336	5,336	151,066	0	151,066	**145,729**	280	7,934	7,654
27	2044	0	0	5,336	5,336	151,066	0	151,066	**145,729**	250	7,084	6,834
28	2045	0	0	5,336	5,336	151,066	0	151,066	**145,729**	223	6,325	6,102
29	2046	0	0	5,336	5,336	151,066	0	151,066	**145,729**	199	5,647	5,448
30	2047	0	0	165,430	165,430	151,066	0	151,066	**-14,365**	5,522	5,042	-479
31	2048	0	0	5,336	5,336	151,066	0	151,066	**145,729**	159	4,502	4,343
32	2049	0	0	5,336	5,336	151,066	0	151,066	**145,729**	142	4,020	3,878
33	2050	0	0	5,336	5,336	151,066	0	151,066	**145,729**	127	3,589	3,462
34	2051	0	0	5,336	5,336	151,066	0	151,066	**145,729**	113	3,204	3,091
35	2052	0	0	5,336	5,336	151,066	0	151,066	**145,729**	101	2,861	2,760
36	2053	0	0	5,336	5,336	151,066	0	151,066	**145,729**	90	2,555	2,464
37	2054	0	0	5,336	5,336	151,066	0	151,066	**145,729**	81	2,281	2,200
38	2055	0	0	5,336	5,336	151,066	0	151,066	**145,729**	72	2,036	1,965
										380,600	**586,678**	**206,078**

Sources: JICA Project Team

Present Value

(Unit: million TZS)

Economic Value Indicator

(Unit: million TZS)

Net Present Value (NPV)	**206,078**
Benefit / Cost Ratio (B/C)	**1.54**
Economic Internal Rate of Return (EIRR)	**18.0%**

Sensitivity Analysis (EIRR)

Benefit	Cost: Base	Cost: +5%	Cost: +10%
Base	**18.0%**	**17.3%**	**16.6%**
-5%	**17.2%**	**16.5%**	**15.8%**
-10%	**16.4%**	**15.7%**	**15.1%**

Attachment-11.6.1(8/9) Cash Flow of NIMP2018 (2018-2025) (Economic Price) (Tabora Zone, Phase 1)

(Unit: million TZS)

	Year	Cost: Construction	Cost: Soft Component	Cost: O&M	Total Cost	Agriculture Benefit	Other Benefit	Total Benefit	Net Benefit
1	2018	8,942	411		9,354	0	0	0	**-9,354**
2	2019	23,934	404		24,338	0	0	0	**-24,338**
3	2020	40,945	434	738	42,117	0	0	0	**-42,117**
4	2021	61,752	544	1,356	63,652	2,063	0	2,063	**-61,589**
5	2022	70,665	316	2,062	73,043	7,584	0	7,584	**-65,459**
6	2023	51,862	173	2,581	54,616	17,029	0	17,029	**-37,586**
7	2024	24,377	241	2,825	27,443	31,678	0	31,678	**4,235**
8	2025	15,486	215	2,980	18,680	47,576	0	47,576	**28,896**
9	2026	0	0	2,980	2,980	59,540	0	59,540	**56,560**
10	2027	0	0	32,776	32,776	65,163	0	65,163	**32,387**
11	2028	0	0	2,980	2,980	68,735	0	68,735	**65,756**
12	2029	0	0	2,980	2,980	68,735	0	68,735	**65,756**
13	2030	0	0	2,980	2,980	68,735	0	68,735	**65,756**
14	2031	0	0	2,980	2,980	68,735	0	68,735	**65,756**
15	2032	0	0	2,980	2,980	68,735	0	68,735	**65,756**
16	2033	0	0	2,980	2,980	68,735	0	68,735	**65,756**
17	2034	0	0	2,980	2,980	68,735	0	68,735	**65,756**
18	2035	0	0	2,980	2,980	68,735	0	68,735	**65,756**
19	2036	0	0	2,980	2,980	68,735	0	68,735	**65,756**
20	2037	0	0	32,776	32,776	68,735	0	68,735	**35,959**
21	2038	0	0	2,980	2,980	68,735	0	68,735	**65,756**
22	2039	0	0	2,980	2,980	68,735	0	68,735	**65,756**
23	2040	0	0	2,980	2,980	68,735	0	68,735	**65,756**
24	2041	0	0	2,980	2,980	68,735	0	68,735	**65,756**
25	2042	0	0	2,980	2,980	68,735	0	68,735	**65,756**
26	2043	0	0	2,980	2,980	68,735	0	68,735	**65,756**
27	2044	0	0	2,980	2,980	68,735	0	68,735	**65,756**
28	2045	0	0	2,980	2,980	68,735	0	68,735	**65,756**
29	2046	0	0	2,980	2,980	68,735	0	68,735	**65,756**
30	2047	0	0	92,369	92,369	68,735	0	68,735	**-23,633**
31	2048	0	0	2,980	2,980	68,735	0	68,735	**65,756**
32	2049	0	0	2,980	2,980	68,735	0	68,735	**65,756**
33	2050	0	0	2,980	2,980	68,735	0	68,735	**65,756**
34	2051	0	0	2,980	2,980	68,735	0	68,735	**65,756**
35	2052	0	0	2,980	2,980	68,735	0	68,735	**65,756**
36	2053	0	0	2,980	2,980	68,735	0	68,735	**65,756**
37	2054	0	0	2,980	2,980	68,735	0	68,735	**65,756**
38	2055	0	0	2,980	2,980	68,735	0	68,735	**65,756**

Sources: JICA Project Team

Present Value

(Unit: million TZS)

Year	Total Cost	Total Benefit	Net Benefit
2018	8,352	0	-8,352
2019	19,402	0	-19,402
2020	29,978	0	-29,978
2021	40,452	1,311	-39,141
2022	41,447	4,303	-37,143
2023	27,670	8,628	-19,042
2024	12,414	14,330	1,916
2025	7,545	19,215	11,671
2026	1,074	21,471	20,396
2027	10,553	20,981	10,428
2028	857	19,760	18,903
2029	765	17,643	16,878
2030	683	15,752	15,070
2031	610	14,065	13,455
2032	544	12,558	12,013
2033	486	11,212	10,726
2034	434	10,011	9,577
2035	387	8,938	8,551
2036	346	7,981	7,635
2037	3,398	7,126	3,728
2038	276	6,362	6,086
2039	246	5,680	5,434
2040	220	5,072	4,852
2041	196	4,528	4,332
2042	175	4,043	3,868
2043	156	3,610	3,454
2044	140	3,223	3,084
2045	125	2,878	2,753
2046	111	2,570	2,458
2047	3,083	2,294	-789
2048	89	2,048	1,960
2049	79	1,829	1,750
2050	71	1,633	1,562
2051	63	1,458	1,395
2052	56	1,302	1,245
2053	50	1,162	1,112
2054	45	1,038	993
2055	40	927	886
	212,618	**266,941**	**54,322**

Economic Value Indicator

(Unit: million TZS)

Net Present Value (NPV)	**54,322**
Benefit / Cost Ratio (B/C)	**1.26**
Economic Internal Rate of Return (EIRR)	**15.0%**

Sensitivity Analysis (EIRR)

Benefit	Cost: Base	Cost: +5%	Cost: +10%
Base	**15.0%**	**14.3%**	**13.7%**
-5%	**14.3%**	**13.6%**	**13.0%**
-10%	**13.6%**	**12.9%**	**12.3%**

Attachment-11.6.1(9/9) Cash Flow of NIMP2018 (2018-2025) (Economic Price) (Katavi Zone, Phase 1)

Present Value

(Unit: million TZS)

	Year	Cost: Construction	Cost: Soft Component	Cost: O&M	Total Cost	Agriculture Benefit	Other Benefit	Total Benefit	Net Benefit	Present Value: Total Cost	Present Value: Total Benefit	Present Value: Net Benefit
1	2018	15,853	832		16,685	0	0	0	**-16,685**	14,897	0	-14,897
2	2019	42,429	817		43,247	0	0	0	**-43,247**	34,476	0	-34,476
3	2020	72,587	877	1,309	74,772	0	0	0	**-74,772**	53,221	0	-53,221
4	2021	109,474	1,100	2,403	112,978	3,724	0	3,724	**-109,254**	71,800	2,367	-69,433
5	2022	125,274	639	3,656	129,570	13,692	0	13,692	**-115,878**	73,521	7,769	-65,752
6	2023	91,940	350	4,576	96,866	30,744	0	30,744	**-66,121**	49,075	15,576	-33,499
7	2024	43,216	488	5,008	48,711	57,191	0	57,191	**8,480**	22,035	25,870	3,836
8	2025	27,453	434	5,282	33,169	85,892	0	85,892	**52,723**	13,397	34,691	21,294
9	2026	0	0	5,282	5,282	107,491	0	107,491	**102,209**	1,905	38,762	36,858
10	2027	0	0	58,105	58,105	117,644	0	117,644	**59,539**	18,708	37,878	19,170
11	2028	0	0	5,282	5,282	124,093	0	124,093	**118,811**	1,519	35,674	34,155
12	2029	0	0	5,282	5,282	124,093	0	124,093	**118,811**	1,356	31,852	30,496
13	2030	0	0	5,282	5,282	124,093	0	124,093	**118,811**	1,211	28,439	27,228
14	2031	0	0	5,282	5,282	124,093	0	124,093	**118,811**	1,081	25,392	24,311
15	2032	0	0	5,282	5,282	124,093	0	124,093	**118,811**	965	22,671	21,706
16	2033	0	0	5,282	5,282	124,093	0	124,093	**118,811**	862	20,242	19,381
17	2034	0	0	5,282	5,282	124,093	0	124,093	**118,811**	769	18,073	17,304
18	2035	0	0	5,282	5,282	124,093	0	124,093	**118,811**	687	16,137	15,450
19	2036	0	0	5,282	5,282	124,093	0	124,093	**118,811**	613	14,408	13,795
20	2037	0	0	58,105	58,105	124,093	0	124,093	**65,988**	6,024	12,864	6,841
21	2038	0	0	5,282	5,282	124,093	0	124,093	**118,811**	489	11,486	10,997
22	2039	0	0	5,282	5,282	124,093	0	124,093	**118,811**	437	10,255	9,819
23	2040	0	0	5,282	5,282	124,093	0	124,093	**118,811**	390	9,157	8,767
24	2041	0	0	5,282	5,282	124,093	0	124,093	**118,811**	348	8,176	7,828
25	2042	0	0	5,282	5,282	124,093	0	124,093	**118,811**	311	7,300	6,989
26	2043	0	0	5,282	5,282	124,093	0	124,093	**118,811**	277	6,517	6,240
27	2044	0	0	5,282	5,282	124,093	0	124,093	**118,811**	248	5,819	5,571
28	2045	0	0	5,282	5,282	124,093	0	124,093	**118,811**	221	5,196	4,975
29	2046	0	0	5,282	5,282	124,093	0	124,093	**118,811**	197	4,639	4,442
30	2047	0	0	163,750	163,750	124,093	0	124,093	**-39,657**	5,466	4,142	-1,324
31	2048	0	0	5,282	5,282	124,093	0	124,093	**118,811**	157	3,698	3,541
32	2049	0	0	5,282	5,282	124,093	0	124,093	**118,811**	141	3,302	3,161
33	2050	0	0	5,282	5,282	124,093	0	124,093	**118,811**	125	2,948	2,823
34	2051	0	0	5,282	5,282	124,093	0	124,093	**118,811**	112	2,632	2,520
35	2052	0	0	5,282	5,282	124,093	0	124,093	**118,811**	100	2,350	2,250
36	2053	0	0	5,282	5,282	124,093	0	124,093	**118,811**	89	2,098	2,009
37	2054	0	0	5,282	5,282	124,093	0	124,093	**118,811**	80	1,874	1,794
38	2055	0	0	5,282	5,282	124,093	0	124,093	**118,811**	71	1,673	1,602
										377,380	**481,929**	**104,549**

Sources: JICA Project Team

Economic Value Indicator

(Unit: million TZS)

Net Present Value (NPV)	**104,549**
Benefit / Cost Ratio (B/C)	**1.28**
Economic Internal Rate of Return (EIRR)	**15.2%**

Sensitivity Analysis (EIRR)

Benefit	Cost: Base	Cost: +5%	Cost: +10%
Base	**15.2%**	**14.6%**	**13.9%**
-5%	**14.5%**	**13.9%**	**13.2%**
-10%	**13.8%**	**13.2%**	**12.6%**