THE STUDY
ON
THE NATIONAL IRRIGATION MASTER PLAN
IN
THE UNITED REPUBLIC OF TANZANIA

MASTER PLAN

EXECUTIVE SUMMARY

1 INTRODUCTION

(1) Authority

This Master Plan Report was prepared in accordance with the Scope of Work for the Study agreed between the Ministry of Agriculture and Food Security, the United Republic of Tanzania (MAFS) and the Japan International Cooperation Agency (JICA) on April 10, 2001.

(2) Background of the Study

The National Irrigation Development Plan (NIDP) prepared in 1994 requires revision due to its unsatisfactory implementation and the need for consistency with the new government policies such as the "Agriculture and Livestock Policy, 1997", "Tanzania Development Vision 2025, 2000", and the "Agricultural Sector Development Strategy, 2001". The Government of Tanzania (GOT) therefore requested the Government of Japan (GOJ) to extend its technical assistance and undertake the Study on the National Irrigation Master Plan (NIMP). The GOJ agreed to this request, and a Scope of Work was signed by both parties on April 10, 2001.

(3) Objectives of the Study

- Phase 1: Formulate the Master Plan for irrigation development at a national level with a target year of 2017
- Phase 2: Formulate the Action Plan for the candidate irrigation schemes and subjects selected through the Master Plan
- Phase 3: Conduct the Verification Study for the bottleneck items for successful implementation of the schemes
- Phase 1 to 3: Carry out technology transfer to the counterpart personnel through on-the-job training in the course of the Study

The Report presents the results of Phase 1 works.

(4) Study Area

The Study Area for Phase 1 is the Mainland of Tanzania.

(5) Steering Committee Meetings

Steering Committee meetings were held for the Inception Report on November 6, 2001, the Progress Report 1 on January 26, 2002, and the Draft Master Plan Report on August 29, 2002. These meetings were attended by staff of the Prime Minister's Office, MWLD, MOF, RUBADA, Presidents' Office, MLHS, SOFRAIP, MAFS, among others. The Embassy of Japan, the JICA Tanzania Office and DANIDA also sent staff to the meetings. The contents of these Reports were thoroughly discussed and agreement in principle was finally achieved.

2 NATIONAL SOCIO-ECONOMIC CONDITIONS AND DEVELOPMENT POLICIES

(6) Overview of Macro-economic Performance

The GDP growth rate jumped from 1.4 % in 1994 to 3.6 % the following year. It remained above 3 % up to 2000 except for a sharp decline to 0.9% in 1997 mainly due to severe weather conditions. The GDP growth rate is expected to rise to 5.9 % in 2002, 6.3 % in 2003 and 7 % in 2004.

(7) National Development Policies

After preparation of the NIDP in 1994, the government issued the following six major policies:

Relevant National Development Policies

Policies	Major Objectives Related to Agriculture/Irrigation Development
Tanzania Development Vision 2025 in 2000	Food self-sufficiency and food security are articulated as top goal of the first attribute, high quality livelihood.
Tanzania Assistant Strategy (TAS) in 2000	Management of external resources to achieve the development strategies.
National Poverty Eradication Strategy (NPES) in 1998	Encouragement of increased investment in smallholder irrigation systems.
Poverty Reduction Strategy Paper (PRSP) in 2000	Development of irrigated farming by communities under support of the government.
Decentralization Policy	Completion of decentralization by 2011.
Rural Development Strategy (RDS) in 2001	Promotion of profitable irrigation infrastructure.

(8) Current Economic Situations and Socio-economic Setting

The government has targeted several key areas in which strategic actions will be required to create conditions favorable for higher economic growth, focusing on poverty reduction. Agriculture sector reform and private sector development have

been identified as key areas for an increase of agricultural production. Agriculture is the largest employer, mostly through self-employment on smallholdings with women between 15 and 59 years old contributing to 63% of agricultural labor supply. Thus the agricultural development including irrigation must include the involvement of women. Tanzania faces a chronic food deficit and a food self-sufficiency rate subject to frequent fluctuations. These are more pronounced in the drought years when many regions experience food deficit. Imported amounts of maize and rice average 7 % and 15 % of the production amount, respectively. Poverty is pervasive throughout the Mainland with about 36 % of total population falling below the basic needs poverty line and 19 % below the food poverty line in 2000/01. Rural areas have the highest population and greater poverty: 20 % in food poverty and 39 % in basic needs poverty, reflecting a wide gap of poverty incidence between urban and rural.

3 SECTORAL DEVELOPMENT POLICIES AND ECONOMIC CONDITIONS

(9) Sectoral Development Policies

The "Agricultural Sector Development Strategy", and the "Agricultural Sector Development Programme" are super-ordinate plans to irrigation development. Their major points related to irrigation development are as follows:

Sectoral Development Policies

Policies	Major Points Related to Irrigation Development
Agricultural Sector Development Strategy (ASDS)	Encouragement of farmers towards integrated soil and water management by sub-soiling water harvesting, and use of appropriate husbandry practices to promote optimum use of water resources. Formulation of National Irrigation Master Plan.
Agricultural Sector Development Programme (ASDP : under preparation)	Reduction of over-dependence on rainfed agriculture through rehabilitation and management of low-cost smallholder irrigation schemes including rainwater harvesting, to reduce fluctuation in production..

(10) Sectoral Economic Analysis

Tanzania's economy is heavily dependent on agriculture, which accounts for 48 % of its GDP, and provides 65 % of its foreign exchange earnings. In spite of such large contribution to the country's economy, the share of expenditure to the agricultural sector was only 2.6 % of the total government one in 2000/01. The average share of irrigation development for five years of 1998/99 to 2002/03, is only 1.46 % of GOT Development Expenditure.

4 BACKGROUND AND CONSTRAINTS IN IRRIGATION DEVELOPMENT

(11) Natural Conditions

Tanzania has a territorial area of approximate 94.8 million ha and a cultivated area in the Mainland estimated at 10 million ha. Tanzania mostly lies on the Great Africa Plateau with altitudes ranging between 1,000 m and 2,000 m above mean sea level. Most regions receive rain from December to April referred to as the "wet season". The "dry season" is generally during the months of June to October. Annual rainfall varies from 500 mm to 1,000 mm over most of the country with highest rainfall of 1,000 mm to 3,000 mm in the north-east of Lake Tanganyika basin and in the Southern Highlands. Mean temperatures range from 26 ℃ on the coast to 17 ℃ on the Southern Highlands.

(12) National Irrigation Development Plan (NIDP)

(a) Philosophy and Composition of NIDP

The NIDP was prepared in 1994 to contribute toward the attaining of food security at all levels. The NIDP proposed five components under the sub-objectives of "Removal of the Sectoral Constraints" and "Implementation of Irrigation Infrastructure", which would be completed by 2014.

(b) Progress of Implementation of NIDP

The NIDP has not made adequately progress since 1995. About 70 % of the components for the "Removal of the Sectoral Constraints" have not yet been set up so far, and the 30% which have commenced are far from the expected target. In regard to the "Implementation of Irrigation Infrastructure", only about 30 % of the prioritized schemes have been completed or committed so far. The main reasons for the unexpected progress of the NIDP are inadequate institutional building, lack of human resources and financial resources.

(c) Review on NIDP by Irrigation Section

The Irrigation Section of MAFS has also reviewed the progress of irrigation development executed in the seven years since the NIDP was implemented in 1995. It found problems and constraints such as (i) low autonomy of Irrigation Section as the executing agency, (ii) limited coordination capacity of Irrigation Section, (iii) unclear relationships and responsibilities for extension services among government agencies, and (iv) lack of human and financial resources.

(13) New Water Policy

The National Water Policy which is due to be authorized shortly, states that "water uses will be subject to social, economic and environmental criteria", and "every

water use permit shall be issued for a specific duration". These two requirements bring great threats for irrigation water supply. One is that new irrigation water resources development will compete with industrial sectors and will be restrained from the viewpoint of economic superiority. The other threat is that continuous irrigation water supply will be hindered due to conditions imposed on the right holder or the needs of new water users.

(14) Land Use

(a) Present Land Use

The present land use is categorized into eight land types; forests, woodland, bushland, grassland, cultivated land, open land, water body and others. The cultivated land occupies about 10% of the total land area (about 10 million ha). The main food crops grown in the country are maize, sorghum, millet, paddy, wheat, sweet potato, cassava, pulses and bananas. Of these, maize is the dominant crop with a planted area of over 1.5 million ha during recent years, and the planted area of paddy increasing from less than 400,000 ha to more than 500,000 ha over the past few years. Maize is a dominant crop in the most of the regions, accounting for more than 50% of the food crop area in Iringa. Considerable parts of the land area are allocated for paddy in Morogoro, Tabora, Mwanza and Mbeya. The average planted area per holding is 1.76 ha ranging from 0.94 ha in Kigoma to 3.00 ha in Shinyanga.

(b) Land Tenure

Uncertainty and insecurity of land tenure for many rural households are causes of their reluctance to invest in land improvements. The reform of the land tenure system and land use legislation is needed in order to minimize the land use conflict and the degradation of land resources.

(c) Land Resources for Irrigation Development

About 33 % of cultivated land is actually utilized for crop production as planted land. Only 6 % of the planted land which is equivalent to about 200,000 ha is being irrigated. The total irrigation potential is so far estimated as 1 million ha. This estimate was also confirmed by the results of the inventory survey and of the preliminary estimate on potential area for large-scale irrigation schemes in this Study.

(15) Farming System

Small-scale subsistence farming is dominant in the Mainland. The majority of farmers rely on hand hoes as main cultivating tools, though a small percentage use tractors and draft animals. The main weakness in present cropping is the heavy

reliance on rainfed agriculture and the major constraints related to farm management are late transplanting, low plant density, poor weeding and low inputs. The traditional irrigation crops are rice, maize, beans, onions, horticulture, bananas, sugarcane, coffee, tea and cotton. Of these irrigated crops, rice is by far the most important crop.

(16) Marketing

The distribution of the selected food crops from producers to final consumers follow a multi-channel structure ranging from direct marketing to intensive distribution involving several intermediaries. Domestic trade is mostly undertaken directly between traders and producers. The physical exchange process in the marketing of the major cereals in rural areas takes place mainly through periodic food market fares. Transportation of the major cereals and non-cereals in the country is made by various means such as human couriers, bicycles, pickup trucks, buses, and heavy-duty lorries. Prices of all food crops depend on the supply-demand situation and for many of the foodstuffs they fluctuate considerably according to seasons of the year. High and sometimes exorbitant prices are common during seasons of high demand for food crops and low prices during the high supply season. Major constraints in marketing are the unregulated market, the underdeveloped transportation infrastructure, poor storage facilities, and absence of market information and promotion.

(17) Institution

The role of the government in agricultural policy has been changing from being an active participant to being a facilitator, playing a regulatory role and providing support services and technical backup. Instead of the governments' strong intervention, the participatory approach of all stakeholders in the agricultural development has been emphasized. Consequently, farmers and other private sectors are now expected and encouraged to play a much greater part in all stages of agricultural development including irrigation development. A number of institutional constraints facing irrigation development were identified in the NIDP. They essentially stemmed from various factors and their complex interactions. However, the overall institutional setting for irrigation development has been unfortunately considered as one of major causes for the poor performance of irrigation in the past,

(18) Organization

Organizations related to irrigation development are the central government, the local government, the private sectors, NGOs, and local villages. In the central governmental body, there is no one organization holding all necessary mandates

for irrigation development. The major participants at the central level include PO-PC, PO-RALG, MOF, MAFS, MWLD, MLHS, and MCM. Coordination mechanisms for the relevant organizations are necessary, but no comprehensive system has yet been established. The Irrigation Section is at present one of five sections belonging to the Crop Development Division in the MAFS. Considering the importance of irrigation development for economic development and poverty alleviation in the rural areas, the present institutional position in irrigation development unfortunately seems inappropriate to coordinate and harmonize the different organizations involved in irrigation development, and furthermore, unable to make prompt decisions.

(c) Local Government Authorities

The LGRP will bring about the dramatic change of the roles and functions of the local governments through a decentralization policy. These reforms will be particularly critical to the delivery of support services to smallholders, rural infrastructure development, and farmer's access to financial services. However, local governments presently face a lot of constraints that limit their capacity building. The LGRP is still under way. Its efficient and smooth implementation may be crucial to reform the institutional and organizational setting of irrigation development.

(d) Present Performance of Governmental Organization

The demarcation of roles and functions of irrigation farming among the relating governmental organizations were clearly defined in the LGRP in June 2001. For the MAFS, the high priority of institutional and/or organizational strengthening is to formulate and review policy, laws, procedures, regulations and guidelines on irrigation farming. It indicates that the formation of an effective institutional framework including securing the stronger institutional and organizational position of the Irrigation Section is urgently required for efficient irrigation development.

(e) Private Sector Organizations

The private sector, in particular the farmers themselves, is expected to become a main player in irrigation development. However, at present farmers face a lot of constraints to perform their roles to a large extent. The ASDS identified institutional and governmental constraints, financial constraints, natural environment constraints, human resource constraints, and infrastructure constraints. These constraints should be carefully studied further to identify some key factors for practical and efficient countermeasures, and gradual stage-wise support programme should be formulated to overcome the persistent constraints

one by one. The investment by the private companies in irrigated farming will be one of important alternatives in the future and play an important role for the irrigation development. The relevant governmental agencies need to prepare favorable and attractive legal and institutional frameworks for the private investors.

(19) Problems on Selected Existing Irrigation Schemes

A problem analysis was undertaken on a selection of six existing irrigation schemes, to identify the failures due to changed circumstances related to irrigation development and other issues overlooked when the NIDP was prepared. Important conclusions from the problem analysis are summarized as follows:

Important Points identified by Problem Analysis

Important Points	Main Cause
Lack of appropriate participatory approaches like PRA and RRA	Lack of sociological consideration
Unsound logical structure of project and weak linkage between purpose and output in project	Lack of technical consideration
Misunderstanding of the concept of "by simple and low-cost technology", taken to mean "easy and no without technical know-how"	Lack of technical and economical consideration
Lack of feedback system on the lessons learn through actual experience in implementation of the irrigation projects	Lack of technical and institutional consideration
Inadequate guidelines and manuals in planning, design and construction supervision, and lack of proper application of them	lack of technical, economical and institutional consideration
Need of effective support system to WUAs' activities	Lack of sociological and institutional consideration
Lack of human resources and active participation of LGA in irrigation development	Lack of sociological and institutional consideration

(20) Study on Irrigation Development Level

Discrepancies in irrigation development level may bring about; (i) ineffective utilization of limited resources available for irrigation development, (ii) complaints from farmers concerned about the irrigation schemes being in depleted level, (iii) confusion in expansion of model effects to other areas, and (iv) complexity in supervising and monitoring irrigation schemes together with others which are under different development levels. Existing technical references hardly mention the different irrigation development levels. In Tanzania, irrigation development should be promoted in various manners corresponding to the requirements of each site. Pursuing optimum irrigation development for each target area according to its constraints and locality requires different irrigation development levels.

(21) Privatization of NAFCO

After the Arusha Declaration of 1967, the government constructed a number of large-scale mechanized irrigated rice projects, to be run by a parastatal, the National Agriculture and Food Corporation (NAFCO), in order to substitute growing imports of rice. Presently NAFCO has 22 farms including 4 rice farms. These farms, in particular the rice farms, are today facing severe financial and managerial difficulties because of policy changes towards a market oriented economy since the mid '80s and poor management. In order to revive the farms through privatization, the MAFS established a sub-committee of experts to prepare the privatization strategy of the agricultural farms, particularly the NAFCO. The strategy has not yet been completed.

(22) Existing Construction and O & M Equipment of MAFS

The MAFS possesses construction and O & M equipment comprising 347 items as at the end of July 2002. Most are out of order and require repairing, for which the necessary cost has been estimated at Tsh.976 million in total, a large financial load on the MAFS. Prior to repairing, it is necessary to urgently make a study on the most effective use of these resources.

(23) Environment

The Mainland faces serious environmental problems in the existing schemes. The identified environmental problems are as follows:

Negative and Positive Impacts

Negative Impacts	Positive Impacts
Overuse of water by upstream beneficiaries to detriment of downstream beneficiaries, leading to loss of income and quality of life for downstream beneficiaries and finally accelerating over grazing and wide spread land degradation.	Creation of cattle' grazing during periods when there are not many alternatives using end points of drains.
Overuse of water leading to falling replenishment of groundwater reserves.	Creation of an incentive for highly beneficial soil and water conservation practices through irrigation.
Local flooding due to poor water control /management.	Reduction of damage to downstream and upstream cultivation areas, health risks associated with flooding and soil erosion by flood alleviation.
Soil erosion leading to loss of soil cover.	
Water logging and salinity in vulnerable soils leading to poor agricultural production.	
Water-born diseases such as Bilharzia and Malaria.	
Increased use of fertilizer and pesticides resulting in negative impact to environment.	
Deforestation for reclamation of new farming land.	

Source: JICA Study Team

5 INVENTORY SURVEY AND PCM WORKSHOP

(24) Existing Irrigation Facilities

(a) Dams

In 1970s, 21 small-scale dams were constructed mainly on seasonal rivers for irrigation and domestic use purposes, centering on the Tabora region. These are of earthfill type and currently, all except seven small-scale dams suffer from serious sedimentation. In addition, a large number of small dams over the whole land, called Charco dams, are used for irrigation, domestic and livestock purpose.

(b) Diversion Structures

There are several types of diversion structures such as gunny bags piling type, wooden piling type, bamboo piling type, gabion type, stone masonry type, and concrete type. The former three types are simple and easily constructed by farmers themselves but need the frequent repairs as they are often washed out by floods. The gabion type is stronger against floods. Frequent repairs place a large load on farmers. The stone masonry and concrete type weirs are the most stable and firm types but generally are in poor condition due to unsuitable planning, design and construction.

(c) Canals and Related Structures

Canal lining is observed in both improved traditional and modern irrigation schemes. The applied linings are of stone masonry, concrete panel and cast-in-situ concrete types. Canal linings bring about some benefits such as less maintenance, low conveyance loss, less land acquisition area, and protection against water-borne disease. Traditional irrigation schemes are generally provided with very few structures such as concrete pipes for crossing purpose compared with the improved traditional and modern irrigation schemes. These structures are mostly made of concrete or stone masonry. Generally, these structures are not properly designed and constructed from hydraulic and structure viewpoints.

(25) Inventory Survey for Irrigation Schemes

(a) Objective and Scope

The inventory survey of the irrigation schemes was carried out to grasp the present situation and proposed plan of irrigation schemes including location, history, irrigation and drainage, agriculture and land use, farmers' supporting system, farmers' organization, operation and maintenance, and environment. The inventoried schemes are 1,428 in total, covering 854,300 ha as follows:

Inventorized Schemes

Data Source	Nos. of Schemes	Estimated Irrigation Area (ha)
Inventory Survey by the NIMP	689	616,700
Inventory Survey by the RBMSIIP	739	237,600
Total	**1,428**	**854,300**

Source: Inventory survey conducted by the NIMP and RBMSIIP

(b) Classification of Inventorized Schemes

The inventorized irrigation schemes are classified into the following irrigation types defined in the study on Regional Irrigation Development Strategy:

Inventorized Schemes by Type of Irrigation

Type of Irrigation	Nos. of Schemes	Existing Area (ha)	Estimated Irrigation Area (ha)
Existing Schemes	1,189	191,900	670,400
Traditional Irrigation	982	122,600	518,700
Water Harvesting	42	7,900	27,600
Modern Irrigation	52	35,900	73,800
Improved Traditional Irrigation	113	25,500	50,300
Newly Proposed Schemes	239	-	183,900
Water Harvesting	163	-	123,100
Modern Irrigation	76	-	60,800
Total	**1,428**	**191,900**	**854,300**

Source: Inventory survey conducted by NIMP and RBMSIIP

Out of 1,428 schemes, 1,111 schemes have an irrigation area of less than 500 ha. The irrigation schemes are categorized by size of irrigation area as shown below.

Inventorized Schemes by Size of Potential Area Unit : Nos.

Type of Irrigation	Less than 500 ha	500 – 2,000 ha	More than 2,000 ha	Total
Traditional Irrigation	810	136	36	982
Water Harvesting	133	54	18	205
Modern Irrigation	86	25	17	128
Improved Traditional Irrigation	82	30	1	113
Total	**1,111**	**245**	**72**	**1,428**

Source: Inventory survey conducted by NIMP and RBMSIIP

Of the total schemes, 1,328 schemes are smallholder irrigation schemes while 85 are private schemes and 15 government-managed schemes, such as NAFCO, and SUDECO.

Inventorized Schemes by Management Type Unit : Nos.

Type of Irrigation	Smallholder	Private	Others	Total
Traditional Irrigation	924	52	6	982
Water Harvesting	204	1	0	205
Modern Irrigation	95	25	8	128
Improved Traditional Irrigation	105	7	1	113
Total	**1,328**	**85**	**15**	**1,428**

Source: Inventory survey conducted by NIMP and RBMSIIP

Some 1,300 schemes depend on water source from rivers and streams. Pump irrigation schemes being mainly located in such regions as Kagera, Mara, and

Mwanza, depends on water sources from groundwater and lakes.

Inventorized Schemes by Type of Water Abstraction Unit : Nos.

Type of Irrigation	Gravity	Pump	Total
Traditional Irrigation	962	20	982
Water Harvesting	204	1	205
Modern Irrigation	74	54	128
Improved Traditional Irrigation	106	7	113
Total	1,346	82	1,428

Source: Inventory survey conducted by NIMP and RBMSIIP

(c) Needs of rehabilitation

The needs of construction, improvement and rehabilitation of irrigation facilities are described below.

Required Work Type Unit : Nos.

Type of Irrigation	Construction/Improvement	Rehabilitation	Total Scheme
Dam	5	3	1,346
Diversion Weir	478	395	
Pump	78	2	82
Irrigation Canals	340	895	1,428

Source: Inventory survey conducted by NIMP and RBMSIIP

(26) Problem Analysis on Specific Fields

Problems found in the fields of agriculture, irrigation schemes and institution and organization are as follows:

Agriculture	Irrigation Schemes	Institution and Organization
- Low crop yield and unstable production due to over-dependence of rainfed agriculture - Insufficient investment in land improvement due to uncertainly and insecurity of land tenure - Rudimentary farming system mostly depending on hand hoes - High rates of soil degradation due to reduced fallow period	- Inadequate farmers' participation - Poor logical structure for project planning - Insufficient capability of Irrigation Section on appropriate project planning - No feedback system - No practical guidelines and manuals on implementation - Poor capability of local consultant and contractors - Poor supporting system to WUAs - Low capability of local government staff in irrigation development	- Low autonomy and inadequate coordination of Irrigation Section - Unclear demarcation of responsibilities for extension services between Irrigation Section and Local Governments - Lack of institutional guarantee tenure and institutional mechanism to mediate water conflicts - No comprehensive mechanism among major participants - Lack of a legal mandate, technical skills and facilitate to enforce some roles - Lack of expertise for strategic and financial planning & management - Very limited resources for local level institutional building for community participation in development process - A shortage of competent personnel and technical equipment to manage and control development process

(27) PCM Workshops

Through the five PCM (Project Cycle Management) workshops involving different participant groups, the core problems identified were (i) ineffective performance of the Irrigation Section, (ii) poor support to irrigation farming by the LGAs, (iii) water scarcity on farm plots, and (iv) poor development of irrigation farming. At least two hidden core problems can be extracted from these separately identified problems which relate to insufficient ownership and insufficient capability in institution, technology and finance. These problems have been analyzed, and the obtained secondary causes have been classified into five categories: financial, technical, social, organizational/institutional, and environmental issues, to aid the identification of appropriate countermeasures.

6 POTENTIAL AREA OF IRRIGSATION DEVELOPMENT

(28) Water Resources Potential

(a) Hydrological Environment

Tanzania is hydrologically divided into nine drainage river basins. These are (i) Pangani River Basin, (ii) Ruvu/Wami River Basin, (iii) Rufiji River Basin, (iv) Ruvuma River and the Southern Coast Basin, (v) Lake Nyasa Basin, (vi) Internal Drainage Basin, (vii) Lake Rukwa Basin, (viii) Lake Tanganyika Basin, and (ix) Lake Victoria Basin. The surface river regime corresponds to the rainfall pattern. The hydrological year starts in October/November and ends in September/October.

(b) Macroscopic Water Balance in the Country

The result of extensive water balance study showed sufficient water resource for present water use. In the hydrological cycle in the Mainland, about 9.7 % of rainfall makes up a run-off component, which is a major water source for the most part of water users. Current water use shares less than 1 % of annual rainfall. Seasonal fluctuation of water availability is a crucial factor in the Mainland.

(c) Method of Assessment of Water Resources Potential

Assessment of water resources potential is based on both surface water and groundwater. For the availability of surface water, consideration was given to two characteristics: quantitative availability and flow regime. Quantitative availability is determined by preparing a distribution map of specific run-off for the entire country. Characteristics of flow regime can be determined by means of flow duration curves, and also an indicator of Base Flow Index.

(d) Specific Run-off

Specific run-off at hydro-meteorological stations was calculated at annual mean level. The result identified a trend lower in central areas and southern part. This tendency is not contradicted with the general shape of rainfall distribution.

(e) Flow Regime

The flow duration curves are classified into three groups in the Study; Group A ($Q_1(95)>0$), Group B($Q_1(65)>0$, $Q_1(95)=0$) and Group C($Q_1(65)=0$). Each group has different characteristics in flow regime and in method of water use. The Group A($Q_1(95)>0$) is a perennial river for which stable and constant water abstraction is possible. The Group C ($Q_1(65)=0$) is an ephemeral river for which water use is short-lived within a year. The Group B($Q_1(65)>0$, $Q_1(95)=0$) is intermittent and has an intermediate characteristic between the both. The rivers classified in Groups A($Q_1(95)>0$), B($Q_1(65)>0$, $Q_1(95)=0$) and C($Q_1(65)=0$) makeup 68.5 %, 17.5 % and 14.0 % of the total river numbers, respectively. The regional distribution was formed with attention to the value of $Q_1(75)$.

(f) Groundwater

The groundwater potential could be related to the general hydro-geological structure. Generally, high potential areas surround Lake Victoria, Lake Tanganyika, Lake Rukwa and Mt. Kilimanjaro. The riparian area of Rufiji river also has a groundwater potential.

(g) Identification of Water Resources Potential

In the assessment of water resources potential, three points of view, namely, "Quantitative potential of water in natural condition", "Allowable water quantity under the artificial control" and "Seasonal steadiness of water availability" were taken into consideration. The assessment results are summarized below:

Summary of Water Potentials in Major Viewpoints

Viewpoints	Available data	Identification of water potential	Status
Quantitative potential of water in natural condition	"Map of Specific Run-off"	Areas having the annual averaged specific discharge more than or equal 1.0 m^3/sec./500km^2 could be identified as higher potential area.	To be considered largely
Allowable water under the artificial control	No information is available at the moment at the whole country basis.	It should be considered separately for scheme by scheme, by means of confirming individual water right.	To be referred if possible
Seasonal steadiness of water availability	"Map of Distribution of $Q_1(75)$ in Flow Duration Curves"	Areas having the value of $Q_1(75)$ more than or equal 10 % could be identified as higher potential area for perennial irrigation.	To be considered supplementary

Source: JICA Study Team

Quantitative shear of groundwater within the whole hydrological cycle in the Mainland was identified at 0.4 % only. Therefore, for the purpose of

determining the general water potential over the whole country, focus should be given to surface water.

(29) Land Resources Potential

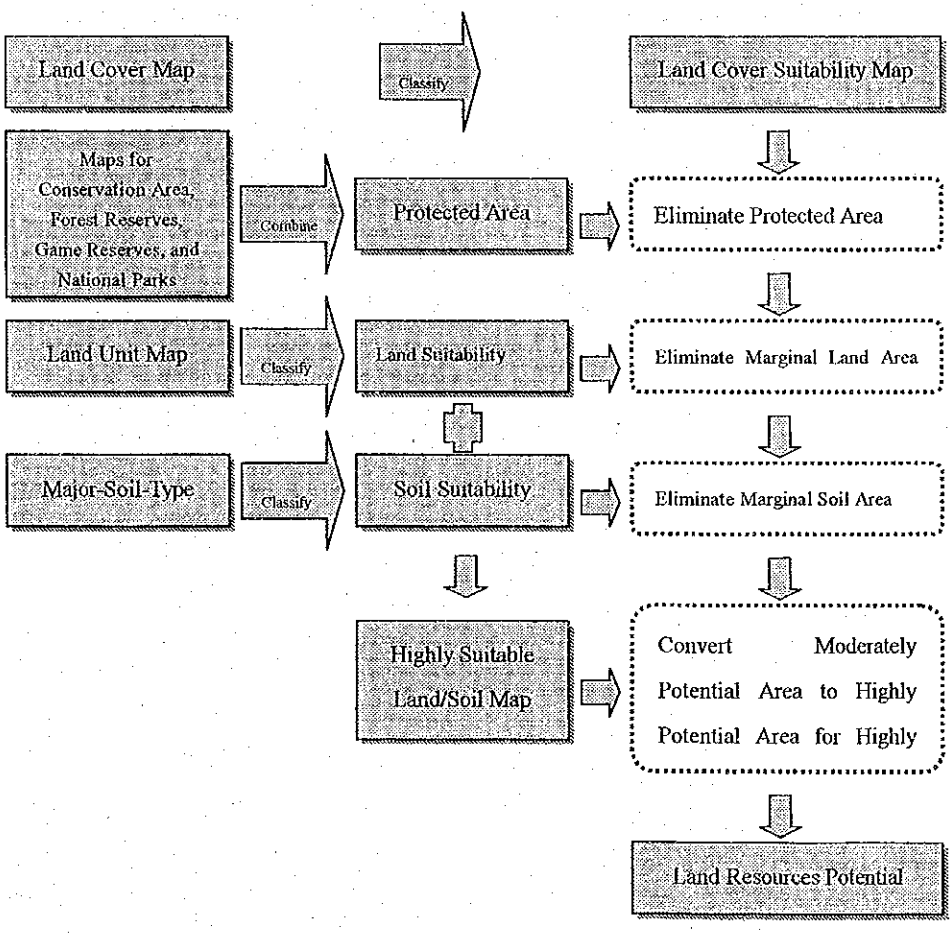
(a) Land Unit, Soil Type and Land Cover Classifications

Land units were classified into three major classes with the criteria based on slope, physical condition of the land and susceptibility to soil erosion. Soil types were classified into three major classes with the criteria based on natural soil fertility levels, soil profile characteristics, salinity levels and drainage characteristics. Land Cover classifications included Cultivated land as highly suitable, bushland and grassland as moderately suitable and all the other areas were classified as marginal area.

(b) Identification of Land Resources Potential

The land resource potential map was created in the following manner.

Preparation Process of Land Resource Potential Map



(30) Socio-economic Potential

(a) Assessment Methodology for Socio-economic Potential

Socio-economic potential for irrigation development was examined using population density, road density and food deficit on a district basis, since these are considered as indicators showing marketing conditions. Paved roading gave positive effects to the socio-economic potential according to the inventory survey results, so an area 50 km either side of roads was allocated an additional indicator.

(b) Identification of Socio-economic Potential

Assessment was made by overlapping three indicators: population density, road density, and food deficit. For population and road densities, all districts were classified into two areas, namely higher and lower density districts as compared with the average density in population and road (respectively) of the whole country excluding Zanzibar. Food deficit was evaluated from the results of questionnaire survey and inspection by Food Security Department, MAFS. Out of 99 districts, 25 districts are categorized as a high potential area, 58 districts as a medium potential area and 16 districts as a low potential area. Finally, the potential for the area within 50 km from the paved roads was identified.

(31) Identification of Irrigation Development Potential Area

The demarcation of irrigation development potential area was made by overlaying three assessment maps: water resource, land resource and socio-economic potential maps, to identify High, Medium and Low Potential Areas. According to the results, the High Potential Area extends over Mara, Mwanza, Arusha Kilimanjaro, Morogoro, Mbeya and Iringa regions. The Medium Potential Area is mostly located around the high potential areas. The Low Potential Area is scattered over the whole country except Kigoma, Tabora, Rukwa and Lindi regions. The study results show the division of the total area of 94.8 million ha, consisting of 2.1 million ha for the "High Potential Area", 4.8 million ha for the "Medium Potential Area", 22.3 million ha of the "Low Potential Area", 35.9 million ha for the "Forest/Marginal Area", 7.3 million ha for the "Water Body", and 27.1 million ha for the "Protected Area".

(32) Confirmation of Irrigation Schemes Inventorized by Identified Irrigation Development Potential Area

Irrigation schemes identified through the inventory survey, of which the coordinates are available, are plotted on the irrigation development potential map and show the general tendency that most of irrigation schemes are located around the irrigation potential areas. The inventory survey results also show the estimated

irrigation area of 854,300 ha in total, while the high potential area would be estimated at 2.1 million ha although it is a gross area. Since there would still be plenty of room for further irrigation development, new irrigation schemes should be selected from such potential areas.

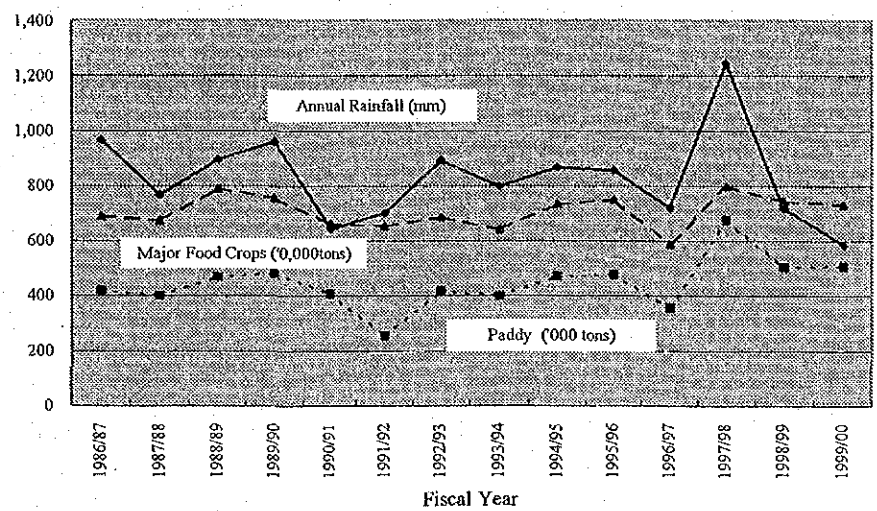
7 FRAMEWORK FOR IRRIGATION DEVELOPMENT

(33) Need of Irrigation Development

(a) *Stabilization of Food Crops Production*

Rainfed cultivation which is prevailing in the Mainland, brings about the unstable and low production due to erratic and unreliable rainfall. To improve this undesirable situation, irrigation is essential. The figure below shows the relation between annual rainfall and food production.

Relation between Rainfall and Food Production



Source: Annual Rainfall (Tanzania Meteorological Agency, Ministry of Communication and Transport Major Food Crops (Maize, Rice, Wheat, Sorghum, Pulses, Cassava, Potatoes, Bananas: A Statistical Analysis of the 2000/01,Food Security Department, MAFS)

The figure shows that rainfall brings about stability and increases in crop production. From this, it can be said that irrigation development is a key activity to improve the productivity and also an important factor to improve the profitability in agriculture.

(b) Poverty Alleviation

The Mainland faces a poverty problem. More than 80 % of inhabitants in rural area, who are almost all smallholders, are categorized as living in poverty, and mostly are engaged in rainfed agriculture. Irrigation development is known to produce a more stable and higher production, therefore irrigation development could be regarded as one of effective approaches to poverty alleviation in rural

area.

(c) Environmental Conservation Effects of Irrigation Development

Inappropriate land husbandry practices might accelerate the soil erosion and the consequent flood hazard. Irrigation development could greatly contribute to the environmental conservation. Stable production and improvement of yield per unit area through irrigation development, could contribute to (i) the reduced expansion of cultivated area, (ii) the access to alternative energy sources and (iii) the creation of job opportunity. Furthermore, integrated soil and water management could be undertaken under a properly designed irrigation scheme, with erosion control, prevention of salt accumulation, flood protection and augmentation of underground water resources all achievable.

(34) Objective and Strategies of National Irrigation Master Plan

(a) Primary Objective of ASDS

The ASDS defines that its primary objective is to create an enabling and conducive environment for improving the productivity and profitability of the agricultural sector as the basis for improved farm incomes and rural poverty reduction in the medium and long term.

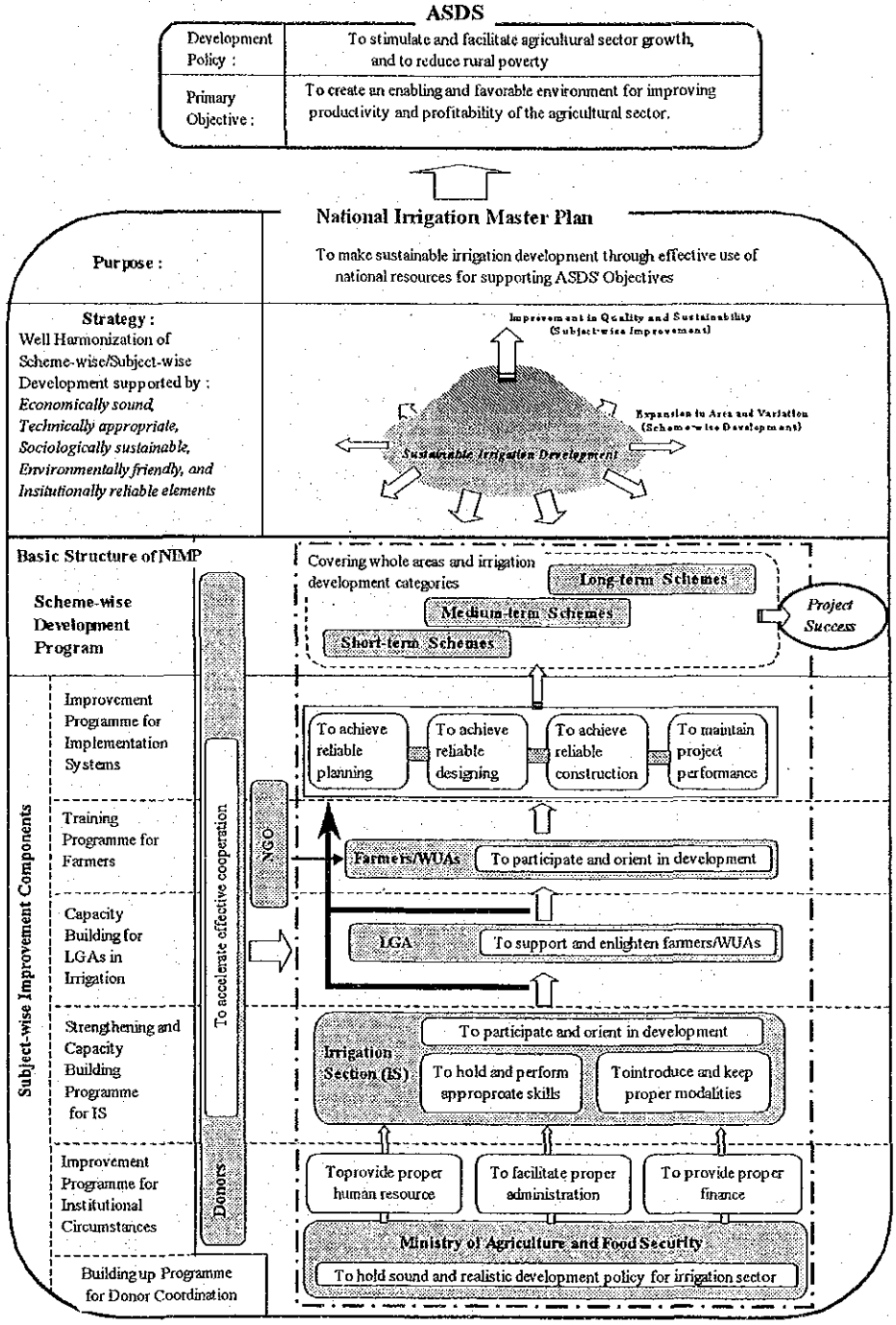
(b) Purpose of NIMP

In consideration of the strategic activities/interventions stipulated in the ASDS and philosophy employed in the NIDP and also the study results, the "*Sustainable Irrigation Development*" was selected as a purpose of the NIMP with emphasis on comprehensive measures through "*Effective Use of National Resources*", to largely contribute to attainment of the primary objective of ASDS. The "*Sustainable Irrigation Development*" means the establishment of technically and financially self-reliant irrigation schemes through institutional and organizational strengthening/reform.

(c) Strategy of NIMP

The NIMP proposes the two ideologies of Scheme-wise Development and Subject-wise Improvement, and a close linkage between them as a strategic approach to the sustainable irrigation development. The Subject-wise Improvement aims at creation of appropriate environment for sustainable irrigation development, mainly from a viewpoint of enhancing quality. The Scheme-wise Development aims at expansion of irrigation areas and variation using effective use of national resources including financial resource. The Subject-wise Improvement Programme and Scheme-wise Development Programme shall be prepared in consideration of five elements; "Economically

Sound", "Technically Appropriate", "Socio-logically Sustainable", "Institutionally Reliable" and "Environmentally Friendly", and also the major constraints causing the unsatisfactory implementation of the NIDP, such as lack of appropriate technical approach to scheme implementation, inadequate institutional building and lack of financial resource.



(35) Framework for National Irrigation Master Plan

(a) Policy Framework

The government has made some effort towards changing the government-oriented irrigation development into the farmers-oriented irrigation development, aiming at the final target of the self-reliant irrigation development. Some progress has been achieved, but should be further accelerated. The policy framework requires strengthening or modification to create the enabling environment toward the self-reliant irrigation development by the private sector as follows:

Recommended Issues on Policy Framework

Policy Framework	Recommended Issues
- Legal Access to Land	Establishment of legal and physical access to land for establishment of self-reliant irrigation development.
- Dissemination of Water Right Registration	Execution of educational campaign for easy understand of water right.
- Act for Farmers' Organization	Need of appropriate act for WUAs for well management of irrigation project.
- Favorable Taxes and Tariff for Irrigation Development	Set of sound taxes and energy tariff for growing and profitable agriculture
- Policy on Food Security	Issuance of clear picture for food security especially rice and maize
- Close Communication with International Community	Strengthening of close communication with multi- and bi-donors for enhancing the assistance effect from donors.

(b) Macro-economic Framework

Through the analysis on actual development and recurrent expenditures to irrigation development from 1998/99 to 2002/03, expected financial resource is projected for three cases: High Case, Base Case and Low Case.

Conditions of Sensitivity Analysis

Variable	Base Case	High Case	Low Case
GDP Growth Rate	5.8% p.a. for 2003/04 – 2007/08; 5.9% p.a. for 2008/09 – 2012/12; 6.0% p.a. for 2013/14 – 2017/18	1.0%p.a. above Base Case	5.1% p.a. for the entire NIMP period (Ave. of 1999 – 2001)
Budget allocation to Irrigation Development	1.5% (of local fund portion of GOT Development Budget)	1.7%	1.5% (No increase)
Our-of-Budget Donors Assistance	100% (Same amount of foreign fund portion of Development Budget)	110%	100% (No increase)

The results of the sensitivity analysis are given below:

Results of Sensitivity Analysis on Total Budget for 15Years

Scenario	Financial Resources Envelope (million Tsh)*	in million US$
Base Case	350,042	369
High Case	451,251	475
Low Case	327,967	345

** : Initial/Development Budget + Operation and Maintenance Budget*

(c) Demand Projection of Staple Foods

A demand projection for staple food products was made using the current pattern of 2,300 kcal and the population of 53,464,000 estimated by the President's Office with the average annual increase rate of 3.08 %. The result is shown in the table to the right. Even with a rather pessimistic assumption that there is little economical development and calorie intake kept at the current level, the pressure from the increased population will require a demand for rice 1.6 times bigger than the current amount as well as that for maize 2.6 times more in the year 2017.

Future Demand of Staple Food Products

Crop	Year 2017
Maize	5,151
Rice	1,239
Wheat	322
Sorghum	1,118
Millets	917
Pulses	655
Cassava	6,007
Bananas	4,070
Potatoes	3,418

Unit : 1,000 tons

(36) Need of Inter-sectoral Coordination in Agriculture Sector

Irrigation is an essential tool for stability and an increase of agricultural production. It is no doubt that irrigation itself contributes to the stabilization of agricultural production, and an improvement in this by irrigation becomes a major factor for creating the physiological suitable environment for enhancing the agricultural production. However, irrigation by itself could not realize the remarkable increase of agricultural production without interventions from other sub-sectors such as agricultural inputs and extension services. The other sub-sectors therefore require to be developed under close co-coordination with the irrigation sub-sector, to achieve a significant increase of agricultural production.

(37) Basic Plan for Irrigation Development Level

(a) Concept

The function of a guideline for irrigation development level is to provide an indication of principles and technical issues for irrigation scheme implementation, not all of which must be obeyed formally. Often, it may provide broad interpretation and allow for flexibility depending upon the peculiarity of scheme site. Thus, the required guideline for irrigation development level could show a possible and most suitable modality of irrigation development by irrigation development pattern on the basis of recognition of potentiality and limitation of irrigation development of the relevant area.

(b) Guideline of Irrigation Development Level

The guideline of irrigation development level shall provide information regarding selected indicators by irrigation development patterns. The indicators on

irrigation development level are extracted among many prospective ones, taking views in Sustainability, Adaptability and Feasibility into consideration, namely, (i) Position of a balance in hardware and software aspects, (ii) Project Scale, (iii) Applicable Crop for Irrigation, (iv) Target Yield of Irrigation Crop, (v) Irrigation Method, and Modality of Irrigation System, (vi) Expectable Project Life, (vii) Reliability of Project, (viii) Affordable Range of Project Cost, and (iv) Allowable Limit in Economic Indicator. Thus, appropriate irrigation development level can be selected using these indicators.

(38) Basic Plan for Institutional Development

(a) Basic Concept

A basic concept of the institutional development for the NIMP is to realize a practical and reliable institutional setting for the sustainable and self-reliant irrigation development. The institutional development will be implemented in a stage-wise programme. The conformity to the LGRP is also essential.

(b) Institutional Development Components

The following three groups of the institutional development components are identified for the NIMP and they will support the participants of irrigation development to achieve good performances of their demarcated roles and functions:

Institutional Development Components

Components	Sub-components
Institutional Strengthening of the Irrigation Section	- Promotion of the Irrigation Section to a Department - Strengthening of Monitoring Function - Reform of Zonal Irrigation Office conforming to the LGRP
Legal Framework Strengthening for Irrigation Development Program	- Establishment of Legal Framework for the Irrigators' Organization - PPP (Public Private Partnership): Privatization Promotion
Smallholder Supporting Program for Self-reliance	- Strengthening of Operation and Maintenance Skill - Strengthening of Management Skill - Strengthening of Farmers' Access to Micro Credit and Finance Mechanism

Source: JICA Study Team

(39) Basic Plan for Agricultural Development

(a) Target Crops for Irrigation Development

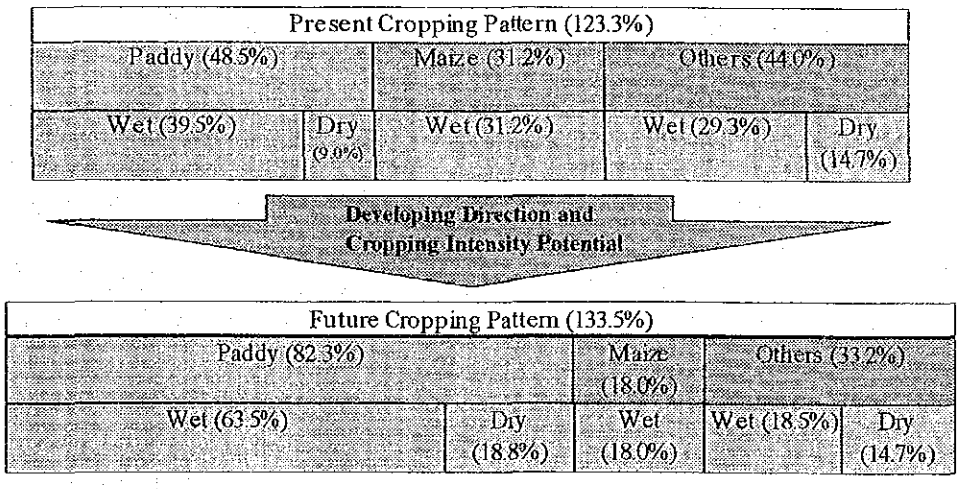
It was concluded in the NIDP that irrigation has a role in contributing towards food security and self-sufficiency in rice production at national level. This principle is maintained under the NIMP, too. In order to satisfy an increasing demand in excess of 1,200,000 ton at the year 2017, the future production of paddy should be increased. One big advantage of paddy production for farmers is that paddy can be used as subsistence food crop to supplement maize and at the

same time as a cash crop. The demand on maize will similarly increase based on the future population increase. The demand projection shows that the total demand of maize will exceed 5 million ton per year by the year 2017. The major development on the future maize production should be carried out through full utilization of the remaining potentials under rainfed conditions. This can be achieved in the regions having a strong expectation of adequate rainfall such as Iringa, Mbeya, Rukwa and Ruvuma by expanding the cultivation area and also by increasing the yield per unit area through improvement in management for the supply of hybrid seed and necessary farm input.

(b) Cropping Pattern

The present cropping pattern is estimated based on the crop production data of the year 1999/2000 with the existing irrigated area obtained from the current inventory survey. Since the major irrigated crops cultivated in the smallholders' field are paddy, maize and other crops including beans and vegetables, the analysis of the present cropping pattern was carried out by focusing on paddy, maize and others. Based on the present cropping pattern, the future cropping pattern was planned according to the development direction and cropping intensity potential estimated from agro-ecological zone map. The overall alteration of cropping pattern at national level is shown as below.

Present and Future Cropping Patterns under Irrigation



Source: JICA Study Team

(c) Farming System Improvement Plan

Present farming practices prevailing in the majority of rainfed area are likely to be of extensive cultivation, namely no application of fertilizer and agro-chemicals as well as low input of labour force. Proper farming practices should be adopted to take full advantage of irrigated agriculture and promote the productivity of crops

cultivated based on the proper application of farm inputs. This would include the use of certified seeds of high yielding varieties or improved varieties with proper dosage of fertilizer and agro-chemicals under sufficient supporting services such as research and extension.

(40) Basic Plan for Spatial Development

From the viewpoint of agricultural development potential in the Mainland, the "suitable product in suitable land" policy should be promoted, as a prerequisite for an effective and feasible development. It is advisable to approach the required demand of food at the national level as much as possible by putting priority on projects with higher investment efficiency, which enables increased production of agricultural products and the subsequent efficient distribution of surplus agricultural products in regions that lack sufficient amount of food so as to optimize the overall effect within the confinement of limited budget.

(41) Basic Plan for Project Implementation

There are five options in scheme implementation. These are (i) Scheme Implementation for Pilot Model Type, (ii) Scheme Implementation by Central Government Initiative Approach, (iii) Scheme Implementation by LGA-oriented Approach, (iv) Scheme Implementation by Farmers-oriented Approach, and (v) Scheme Implementation by Private Sector-oriented Approach. Scheme implementation should be prepared considering the timely application of these options in light of the decentralization policy, and the increase of farmers' role and private sector in irrigation development.

(42) Priority Grouping of Inventorized Irrigation Schemes

(a) Prioritization Criteria of Inventorized Schemes

Prioritization of 1,428 Inventorized irrigation schemes is made based on following the criteria (Full score: 100 points):

Prioritization Criteria

Item	Score	Item	Score
Technical Factor	15 points	Ease of Implementation	5 points
Economic Factor	30 points	Social Factor	20 points
Environmental Factor	10 points	Regional Conditions	20 points

Source: JICA Study Team

(b) Results of Priority Grouping

The results of the priority grouping are summarized as follows:

Summary of Priority Groupings

No.	Group	Nos.	Estimated Irrigation Area (ha)
(1)	On-going Schemes Group	29	13,600
(2)	"A" Group (Score : over 70)	50	34,800
(3)	"B" Group (Score : 61 – 70)	411	199,000
(4)	"C" Group (Score : 51 – 60)	538	158,700
(5)	"D" Group (Score : below 50)	108	19,300
(6)	"E" Group	127	343,100
(7)	Excluded Group	165	85,800
Total		**1,428**	**854,300**

Source: JICA Study Team

The "E" group consists of 127 schemes, which has one or more of the following characteristics:

- No rehabilitation work is in progress.
- They are NAFCO schemes or private irrigation schemes.
- They are smallholder irrigation schemes, but rehabilitation works have been conducted for recent 5 years;

The "Excluded" group of 165 schemes is categorized as "no need for rehabilitation/improvement and/or no smallholder schemes".

(c) General Features of "A" Group Schemes

The general features of the "A" Group schemes are as follows:

Distribution of "A" Group Schemes by Region

Region	Nos.	Estimated Area (ha)*	Region	Nos.	Estimated Area (ha)*
Arusha	2	240	Mbeya	-	-
Coast	2	2,300	Morogoro	3	6,793
Dar es Salaam	-	-	Mtwara	-	-
Dodoma	-	-	Mwanza	14	8,610
Iringa	1	120	Rukwa	-	-
Kagera	-	-	Ruvuma	2	2,700
Kigoma	-	-	Shinyanga	6	3,700
Kilimanjaro	6	2,180	Singida	6	3,140
Lindi	4	3,200	Tabora	-	-
Mara	1	50	Tanga	3	1,750
Sub-total	16	8,090	Sub-total	34	26,693
Total				**50**	**34,783**

** : Estimated Irrigation Area*

(43) Alternative Study for Development Target

(a) Projected Budget for Development

The Projected budget for irrigation development is estimated for 3 cases, namely High Case, Base Case and Low Case using the past actual expenditures and assuming the increase in GDP growth rate. The projected budget for development for each case is tabulated below:

Projected Development Budget

Case	'03	'04	'05	'06	'07	'08	'09	'10	'11	'12	'13	'14	'15	'16	'17	Total
High	18.7	20.0	21.4	22.8	24.4	26.0	27.8	29.8	31.8	34.0	36.4	38.9	41.7	44.6	47.7	466.0
Base	15.6	16.5	17.5	18.5	19.6	20.7	22.0	23.3	24.6	26.1	27.6	29.3	31.1	32.9	34.9	360.2
Low	15.5	16.3	17.1	18.0	18.9	19.9	20.9	22.0	23.1	24.3	25.5	26.8	28.2	29.6	31.1	337.5

Unit : Million US$

(b) Possible Irrigation Development Areas by 2017

Taking into consideration the analysis results of inventory survey, the possible irrigation development areas by 2017 are calculated for 3 cases as follows:

Accumulated Irrigation Development Areas by 2017

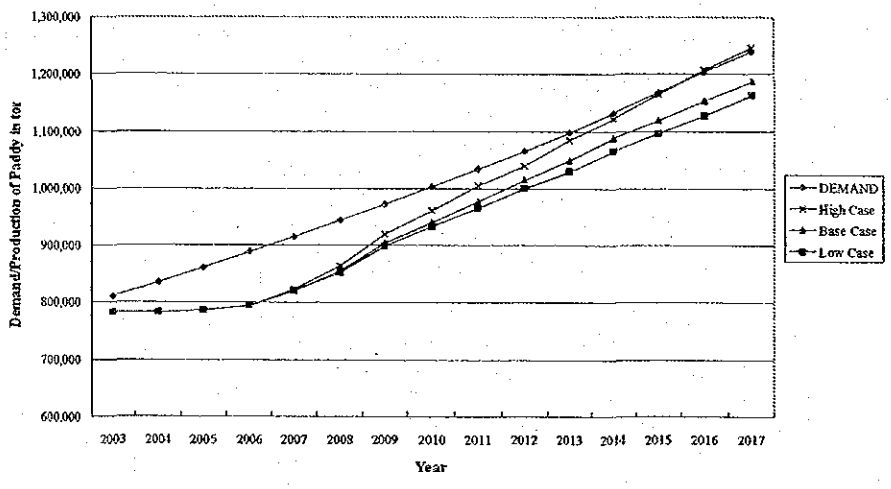
Case	'03	'04	'05	'06	'07	'08	'09	'10	'11	'12	'13	'14	'15	'16	'17
High	218	229	239	250	265	276	281	294	312	325	337	352	372	387	405
Base	218	228	236	243	254	264	271	278	290	304	316	325	335	351	362
Low	218	222	234	240	248	261	268	274	287	296	306	321	328	337	350

Unit: Thousand ha

(c) Comparison with Future Demand of Rice

The possible production of paddy was calculated for the above 3 cases in view of built-up period. The table below shows comparison of future demand of paddy with each case:

Projected Production of Paddy by Development Alternatives



As can be seen in this figure, the irrigation development areas under the High Case, say 405,400 ha will satisfy the paddy demand in 2017 subject to proper agricultural input supply. Since it is deemed that the projected budget for High Case would be within procurable extent, and also taking into consideration the High Case could bring about a high possibility to meet the projected demand of paddy by the target year 2017, it was regarded as an appropriate scenario for the study on development programme of the NIMP. If current budget to irrigation

development continues in the future, namely the Low Case, the country will face the severe deficit of paddy. It is therefore expected that the GOT will allocate the sufficient budget to irrigation development, at least that for the High Case.

8 IRRIGATION DEVELOPMENT PROGRAMME

(44) Development Scenario for the Year 2017

The NIMP aims to achieve sustainable irrigation development through effective use of national resources resulting in an increase of agricultural productivity. The development programme which implement the NIMP, targets the establishment of sustainable irrigation development system by 2017 in a stage-wise development: Short Term (2003 – 2007), Medium Term (2003 – 2012) and Long Term (2003 – 2017). In due consideration of needs of structural reform of the agricultural sector, further strengthening of local governments under decentralization policy, and self-reliant irrigation development, the JICA Study Team elaborates the stage-wise development scenario for Subject-wise Improvement and Scheme-wise Development focusing on improvement in quality and expansion in area respectively.

Stage-wise Irrigation Development Scenario

	Short Term (2003 -2007)	Medium Term (by 2012)	Long Term (by 2017)
Development Target	To Establish Sustainable Irrigation Development System by 2017		
Key Issue for each Term	Reform	Decentralization	Self-reliance
Subject-wise Improvement			
Strategic Approach	- Reform of environment for promotion of decentralization and involvement of private sector - Establishment of appropriate technologies on irrigation development in cost-effective concept - Dissemination of concept of river basin approach - Establishment of irrigation development system by participatory approach	- Actualization of irrigation development by LGA's initiatives under decetralization - Application of appropriate technologies on irrigation development in cost-effective concept - Establishment of environmental protection method on irrigation - Establishment of farmers-oriented irrigation development system	- Establishment of easy access system from farmers on technical support - Spred of environmental protection method established - Establishment of self-reliant irrigation development by private sector-oriented with public sector partnership
Activities	Prepare and apply tailor-made improvement programme for project sustainability		
Scheme-wise Development			
Strategic Approach	Expand the irrigated area through development of irrigation schemes in effective use of national resources		
Activities	Give priority to rehabilitation of small-scale irrigation and water harvesting schemes		
Expected Annual Growth Rate of GDP	5.8 % to 6.0 %		

(45) Institutional Supporting Programme

(a) Stage-wise Development

The programs basically have three steps for the short, medium and long terms based on the stage-wise development scenario. The basic objective of the institutional development for each term is as follows:

Basic Objective for Each Term

Term	Basic Objective for Each Term
Short Term (2003-2007)	To reform the existing institutional setting for better performance of participatory irrigation development responding to the decentralization policy.
Medium Term (by 2012)	To support actualizing farmers-oriented irrigation development through the Local Government Authorities' initiatives and assistance to the farmers.
Long Term (by 2017)	To support realizing self-reliant irrigation development through the PPP (Public Private Partnership).

(b) Strengthening of Irrigation Section

The present position of the Irrigation Section in MAFS unfortunately makes it unable to achieve the demarcated roles through coordinating and co-operating with the different organizations pertaining to irrigation development and, furthermore, unable to make prompt decisions. The Section also needs stronger mandates of the personnel administration and budget allocation. It consequently requires a stronger institutional and organizational position of the Irrigation Section in the MAFS. The Institutional Strengthening of the Irrigation Section has the following three sub-components:

- Promotion of the Irrigation Section to Department status
- Strengthening of Monitoring Function
- Reform of Zonal Irrigation Office conforming to the LGRP

A task force of the experts should be organized to prepare a reform plan of the Irrigation Section. The plan should be a stage-wise program responding to the Short Term (2003-2007), Medium Term (by 2012) and Long Term (by 2017). The promotion of the Section to the Department should be effected in the short term, because it must be the important first step toward sustainable and self-reliant irrigation development and a trigger of other institutional developments.

(c) Legal Framework Strengthening for Irrigation Development

A sound legal framework is a prerequisite for successful farmers-oriented irrigation development, empowering farmers and the other private sectors to enable them to secure their ownership, i.e. to take full responsibility for all decisions and matters involved in development, operation and maintenance of the irrigation schemes. Legal status of irrigators' group, land tenure and water right, as well as ownership of and responsibility for irrigation infrastructure should be

clearly defined for irrigation development. Presently these items are defined disconnectedly by a number of separate laws. In particular, a new legal framework exclusively for the irrigators' groups seems to be very important and necessary for securing their ownership and self-reliable irrigation development.

A consultancy work for establishment of the legal framework, possibly a new Act, Ordinance or Regulations, should be undertaken through the initiative of the Irrigation Section in cooperation with the relevant governmental agencies, lawyers and technical specialists. The consultancy work should be compatible with the amendments of the Water Act.

(d) Smallholder Supporting for Self-reliance

Extension services for the irrigators' groups through the DALDO should be continuously given a high priority for actualization of self-reliant irrigation development. The following sub-components should be emphasized in the training programs for them.

- Strengthening of Operation and Maintenance Skills
- Strengthening of Administrative, Financial and Technical Management Skills

(e) Monitoring and Evaluation of NIMP

The NIMP itself should be carefully monitored and evaluated by its performance at each development stage, just the same as an irrigation development scheme, which needs good operation and maintenance for satisfactory performance. Necessary feedback through a reliable monitoring and evaluation mechanism should be promptly provided to aid NIMP revision. The role of monitoring and evaluation of the NIMP should be assigned to the Irrigation Section.

(46) Subject-wise Improvement Programme

(a) Contents of Subject-wise Improvement Programme

The Subject-wise Improvement Programme consists of several components related to the important subjects, which closely affect irrigation development in the Mainland. The components in the Subject-wise Improvement Programme are categorized as follows;

- Support scheme implementation directly,
- Strengthen management system and management of scheme implementation,
- Enhance benefit of irrigation more,
- Sustain implemented irrigation, and
- Restore irrigation practice when hindered

The components of the Subject-wise Improvement Programme were each formulated systematically and comprehensively, in the light of significance of the programme in future irrigation development in the Mainland, and also taking into consideration the results of problem analysis, PCM workshops and inventory survey.

(b) Components of Subject-wise Improvement Programme

Twenty nine groups of components were identified as required for the improvement programme. However, some groups of components are not able to fulfill the objectives by themselves, and require an integrated approach with other similar components. Consequently, re-grouping of components was made, and finally 37 components were formed by the conceptualized aspects.

(c) Improvement Programme for the Year 2017

Thirty seven components will be stage-wise implemented by dividing them into the Short Term and Medium Term groups in view of the following aspects:

- Common components for all irrigation schemes,
- Fundamental issues for irrigation schemes,
- Co-ordination with the Stage-wise Development Scenario,
- Sound linkage with future transition of the scheme implementation types, and
- Orderly association of each component in consideration with the whole context of the Subject-wise Improvement Programme

As a result, 29 components will be executed or started in the Short Term, and the remaining 8 components in the Medium Term as shown below:

List of Subject-wise Improvement Programme in Short Term

No.	Ref.	Components
1	A1	IS Institutional Improvement Programme
2	B1	IS Working Mandate Formulation Programme
3	B2	Contract Management System Improvement programme
4	B5	Cooperation Channeling within Irrigation-Sector Establishment Programme
5	B6	Sub-sectors Coordination System Establishment
6	C1	Survey and Investigation Guideline Establishment Programme
7	C2.1	Planning Guideline Establishment Programme
8	C2.2	Designing Guideline Establishment Programme
9	C3.1	O&M Guideline Establishment Programme
10	C3.2	Monitoring & Evaluation Guideline Establishment Programme
11	C4	Farmers' Participation in Irrigation Development Programme
12	C6	Farmers' O&M Manual Establishment Programme
13	C7	Establishment of DADP Formulation Guideline for Irrigated Agriculture Development
14	D1	Web-site and Networking Establishment Programme
15	D2	Technical Manuals Handling Guideline Establishment Programme
16	D3	Information and Database Improvement Programme
17	D4	Irrigation Development Contractors and Consultants' Listing Programme

18	D7	Existing-scheme Monitoring System Establishment Programme
19	E1.1	Irrigation Technology Research Center Establishment Programme
20	E1.2	Perennial Irrigation Method Improvement Programme
21	E1.3	Flood Irrigation Development Programme
22	E1.4	Small Dam Technology for Irrigation Development Establishment Programme
23	E1.5	Environmental Assessment Study for Irrigation Practice in Tanzania
24	E1.6	Study of River-Basin Approach in Irrigation Development
25	E3	IS's Equipment Management Programme
26	E4	Irrigation Development Contractors and Contractors' Training Programme
27	E5	Farmers' Participation Training Programme
28	E6.1	Irrigated Agriculture Training Programme for Rice Production Increase
29	E6.2	Irrigated Agriculture Training Programme for Cash Crops Production Increase

List of Subject-wise Improvement Programme in Medium Term

No.	Ref.	Components
1	A2	LGA Institutional Strengthening Programme for Irrigation Development
2	B3	Regulatory Networking System Establishment between LGAs and IS
3	B4	NGOs' Intervention in Irrigation Development Encourage Programme
4	C5	Village Irrigation Development Guideline Establishment Programme
5	D5	LGAs' Data Organization Programme
6	D6	LGA Networking System Establishment Programme
7	E2	Hydraulic Experimental Center Establishment Programme
8	E7	Integrated Irrigation Development Model establishment Programme

Source: JICA Study Team

(47) Scheme-wise Development Programme

(a) Irrigation Development at National Level

The possible irrigation development areas by 2017 are estimated at 405,400 ha under the "High Case" of financial resources. This area is the result of developing 626 irrigation schemes which are selected from the "A" and "B" Groups and Part of "C" Group. The breakdown of 626 irrigation schemes is as follows:

Irrigation Development Areas by 2017

Type of Development	Nos.	Total Irrigation Area
Rehabilitation of Traditional Irrigation Schemes	462	274,600 ha
Rehabilitation/ New Construction of Water Harvesting Schemes	122	68,200 ha
New Construction of Smallholder Irrigation Schemes	42	62,600 ha
Total	**626**	**405,400 ha**

Source: JICA Study Team

(b) Irrigation Development at Regional Level

The irrigation development programmes by each development type and Region are shown in the following table:

Irrigation Development Areas by 2017

Unit: ha

Region	Rehabilitation of Traditional Irrigation Schemes	Rehabilitation/ New Construction of Water Harvesting Schemes	New Construction of Smallholder Irrigation Schemes	Total
Arusha	62,200	800	1,100	64,100
Coast	900	400	6,900	8,200
Dar es Salaam	0	0	0	0
Dodoma	1,800	11,400	200	13,400

Iringa	13,200	0	800	14,000
Kagera	600	0	0	600
Kigoma	11,000	1,600	0	12,600
Kilimanjaro	68,600	0	13,400	82,000
Lindi	6,200	1,200	1,900	9,300
Mara	0	2,800	100	2,900
Mbeya	52,100	0	7,100	59,200
Morogoro	25,800	3,800	24,500	54,100
Mtwara	2,100	2,700	0	4,800
Mwanza	400	12,900	2,300	15,600
Rukwa	7,000	400	1,200	8,600
Ruvuma	2,100	1,600	1,200	4,900
Shinyanga	900	10,900	100	11,900
Singida	0	8,500	0	8,500
Tabora	2,200	8,800	1,500	12,500
Tanga	17,500	400	300	18,200
Total	**274,600**	**68,200**	**62,600**	**405,400**

Source: JICA Study Team

(c) Development Programme for the Year 2017

Based on the prioritization results of irrigation schemes and projected development budget, the irrigation development areas are estimated as follows:

Accumulated Irrigation Development Area

Type of Irrigation Schemes to be Developed	Short Term 2003 - 2007	Medium Term by 2012	Long Term by 2017
(a) Rehabilitation of Traditional Irrigation Scheme	179,800 ha	216,100 ha	274,600 ha
(b) Development of Water Harvesting Schemes	41,600 ha	57,200 ha	68,200 ha
(c) New Smallholder Schemes	43,800 ha	51,600 ha	62,600 ha
Total	**265,200 ha**	**324,900 ha**	**405,400 ha**

Source: JICA Study Team

(48) Regional Development Programme

Irrigation development area of 405,000 ha would contribute to achievement of rice self-sufficiency by 2017 at national level. In addition, rice status at regional level should also be examined taking into consideration the policy of "suitable product in suitable land". A comparison of projected demand of rice and development of selected priority schemes was made and as a result, rice surplus in 2017 would occur at 7 regions out of 20 regions: Coast, Lindi, Mbeya, Morogoro, Mwanza, Rukwa, and Ruvuma. Judging from the surplus amount of rice and road condition, the following distribution plan is considerable:

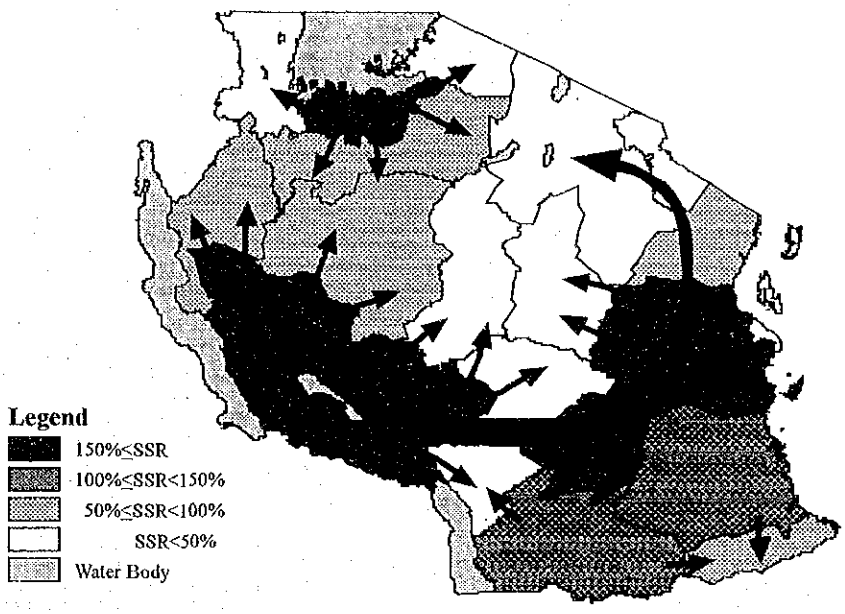
Flow of Surplus Rice

Region	Flow of Surplus Rice
Mwanza	Surrounding areas only because of poor road condition
Rukwa	Its northern and eastern areas and also for Dar es Salaam through national road
Mbeya	Its eastern areas and also for Dar es Salaam through national road.
Morogoro	Its northern areas and also for Dar es Salaam and Kilimanjaro and Arusha regions via national road.
Coast	Dar es Salaam and Kilimanjaro and Arusha regions through national road.
Lindi and Ruvuma	Iringa and Mtwara

Source: JICA Study Team

A following figure presents the flow of surplus rice :

Flow of Rice on Regional Basis



Note: SSR(Self-sufficient Ratio) is the ratio of "Rice Production" to "Rice Demand".

(49) Cost Estimate on NIMP Implementation

(a) Total Implementation Cost

The total implementation cost for the NIMP is estimated at US$ 593.9 million (including US$ 110.6 million of Farmers' contribution), and is broken down to US$ 23.0 million for the subject-wise improvement, US$ 553.1 million for the scheme-wise development and US$ 17.8 million for on-going irrigation projects. The comparison shows that the required cost would be slightly higher than projected development budget for some years. These deficits are still manageable and thus should be arranged by the GOT.

(b) Operation and Maintenance Cost

The operation and maintenance cost is assumed to be US$ 15/ha, consisting of US$ 5/ha for government and US$ 10/ha for farmers. From this, the government's shared cost would be estimated at US$ 20 million against US$ 9 million of projected budget under High Case. The projected government budget for operation and maintenance is nearly half of the total budget. These deficits should be arranged by the GOT. High involvement of private sector is one of effective ways to mitigate such deficits.

(50) Appropriateness of Investment to Irrigation Development

The implementation of the NIMP consisting of 37 components of Subject-wise Improvement Programme and 626 irrigation schemes of Scheme-wise Development Programme, and will require about US$ 503.8 million for 15 years (government portion only). This implementation would produce a possibility of self-sufficiency of rice by 2017. In addition, the NIMP implementation would also achieve (i) creation of job opportunity (38 million man-day at full development of 2017), (ii) poverty reduction of smallholder by increase of farm income (US$ 143/ha to US$ 450 per one crop season), and (iii) saving of foreign currency necessary for rice import (US$ 69 million for import of rice at 2002 current price). With the above study result, it is judged that investment of US$ 503.8 million to the NIMP implementation would be appropriate from a national viewpoint.

9 CONCLUSIONS AND RECOMMENDATIONS

(51) Conclusions

The Study presents the framework and strategies for sustainable irrigation development for the Mainland with the target year of 2017, aiming to contribute to creation of an enabling and conducive environment for improving productivity and profitability of agricultural sector.

In order to achieve this aim, the Study prepared the development programme toward the year 2017. As a result, the Study selected 37 components of Subject-wise Improvement Programme and 626 irrigation schemes of Scheme-wise Development Programme as follows:

Components and Schemes to be Developed by 2017

Components and Schemes Developed		Short Term 2003 - 2007	Medium Term by 2012	Long Term by 2017
(a) Subject-wise Improvement Programme				
- Components		29 nos.	8 nos.	-
(b) Scheme-wise Development Programme				
- Rehabilitation of traditional irrigation schemes	(nos)	72	197	462
	(ha)	179,800 ha	216,000 ha	274,600 ha
- Development water harvesting schemes	(nos)	64	92	122
	(ha)	41,600 ha	57,200 ha	68,200 ha
- Construction of smallholder schemes	(nos)	5	16	42
	(ha)	43,800 ha	51,600 ha	62,600 ha
Total of (b)	**(nos)**	**141**	**305**	**626**
	(ha)	**265,200 ha**	**324,900 ha**	**405,400 ha**

Source: JICA Study Team

In preparation of the development programme, the Study established a

prioritization system for implementation of the many irrigation schemes, and conducted a priority ranking of them for implementation using the data and information obtained through the inventory survey. The availability of data and information on the scheme largely effected the priority ranking and therefore the ranking should be updated whenever new data and information becomes available.

The Study concludes that implementation of these programmes would have a high probability of achieving the future demand of rice by 2017 with successful inter-sectoral coordination. In addition, it would produce (i) the cost saving of about US$ 69 million required for rice import at 2017, (ii) increase of farm income to US$ 450 per one crop season, (about 3 times of current rate), and (iii) creation of job opportunity of 38 million man-day.

(52) Recommendations

(a) Urgent Commencement of NIMP Implementation

The food deficit is a serious issue in Tanzania. The increasing population pressure will further aggravate the situation if appropriate countermeasures are not taken on time. It is therefore recommended that the NIMP be implemented as early as possible since irrigation development is a key factor to improve the productivity in agriculture.

(b) Urgent Need of Strengthening the Irrigation Section

The Study presents the implementation of 37 components as the Subject-wise Improvement Programme and 626 irrigation schemes as the Scheme-wise Development Programme by the year 2017. The Irrigation Section of MAFS shall be responsible for smooth implementation of the programme as a coordination agency with the different organizations involved. However, the present positioning of the Irrigation Section in MAFS unfortunately does not provide it with adequate capacity to achieve these targets and it consequently requires a stronger institutional and organizational position.

(c) Legal Framework Strengthening for Irrigation Development

A sound legal framework is a prerequisite for successful farmers-oriented irrigation development, empowering farmers and the other private sectors to enable them to secure ownership, i.e. to take full responsibility for all decisions and matters involved in development, operation and management of the irrigation schemes. Legal status of irrigators' groups, land tenure and water right, as well as ownership of and responsibility for irrigation infrastructure should be clearly defined for irrigation development. In particular, a new legal framework exclusively for the irrigators' groups is very important and necessary for securing

their ownership and self-reliable irrigation development.

(d) Arrangement of Financial Resource for NIMP Implementation

The inadequate financial resource is one of major constraints as can be understood from lessons learnt from unsatisfactory implementation of the NIDP. For smooth implementation of the NIMP, adequate budget allocation is essential. In this Study, the financial resource envelope for irrigation development, was assessed using the past actual development expenditures allocated to the irrigation development and assuming the increase of the government budget in proportion of that of GDP growth rate. The sensitivity analysis was also made for three cases (High Case, Base Case and Low Case). As a result, the High Case (for which a financial resource envelope is projected at US$ 454 million for 15 years from 2003 to 2017), would enable implementation of 37 components of Subject-wise Improvement Programme and 626 schemes of Scheme-wise Development Programme (including 29 on-going projects), which would bring about a possibility to meet the rice demand by 2017.

(e) Irrigation Development in River basin Management

Recently, a focus has been put on a river basin management approach from the viewpoint of effective use of water resources among many different stakeholders. This approach is considered quite reasonable and acceptable, but it is important to evaluate the effective use of water resources without a prejudice view such as consideration of economic terms only. Over 70% of the total labor population is engaged in agricultural activities, and water is required both for domestic and agricultural purposes. Over 87 % of all poor people live in rural areas where agriculture is a mainstay in livelihood. Under such situations, the effective use of water resources should be evaluated from an overall viewpoint, not only an economic viewpoint. Irrigation development also should be required to consider an appropriate water management with less water loss.

(f) Need of Inter-sectoral Coordination

Irrigation provides an effective environment for stability and increase of agricultural production. There is no doubt that while irrigation itself directly links with the stability of agricultural production, improvements to irrigation becomes a major factor for creating the physiological suitable environment for enhancing the agricultural production. Irrigation by itself could not realize the remarkable increase of agricultural production without assistance from other sub-sectors such as agricultural inputs and extension services. It is therefore recommended that other sub-sectors in agricultural sector be developed under close coordination with the irrigation sub-sector, to enhance respective effects toward increase of

agricultural production.

(g) Need of Updating of NIMP

The NIMP provides the overall framework and strategies for irrigation development toward the year 2017, and is based on the ASDP and the ASDS. The ASDP, which is defined as a 5-year rolling programme, will require updating every five years. The NIMP also requires to be updated at least every 5 years in conformity with the ASDP. If actual progress of scheme-wise development and subject-wise improvement are not satisfactory and/or additional data on the irrigation schemes become available, the NIMP should be updated without waiting for the five yearly review.

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