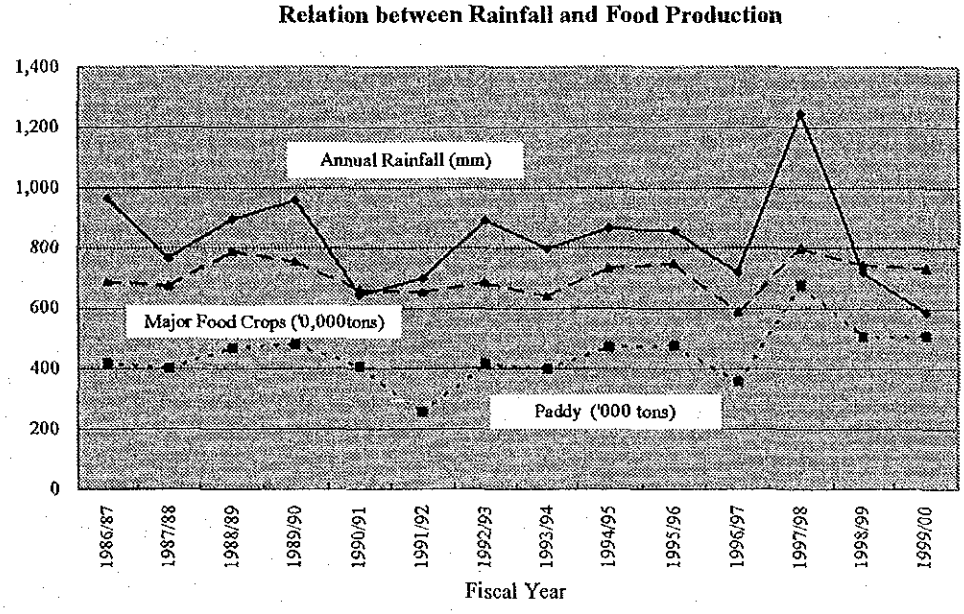
CHAPTER 7 FRAMEWORK FOR IRRIGATION DEVELOPMENT

7.1 Need of Irrigation Development

(1) Stabilization of Food Crops Production

At present, the cultivated area is estimated at approximately 10 million ha, and rainfed cultivation is dominant. As a result, food crops production has largely fluctuated year by year due to erratic and unreliable rainfall. This is easily identified from the past data on annual rainfall and food production as shown below:



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)

When rainfall decreases, food production also decreases. This figure would also indicate that timely water supply to crops, namely irrigation would bring about not only stability in crop production, but also an increase in crop production. Irrigation development is therefore a key activity to improve the productivity and also an important factor to improve the profitability in agriculture of the Mainland.

(2) Poverty Alleviation of Smallholders due to Improvement of Farm Income

In addition to unstable food production, the Mainland has another crucial issue that is a poverty problem. It is reported that more than 80 % of inhabitants in rural areas, who are almost all smallholders, are categorized as living in poverty.

Poverty levels may have increased to over 50% in 2000, and poverty is more widespread in rural area where rainfed agriculture by smallholders is prevailing. An improvement in farm income for them is urgently required . Irrigation development is able to produce the stable and higher production as mentioned above and in this sense, irrigation development could be regarded as one of effective approaches to poverty alleviation in rural area.

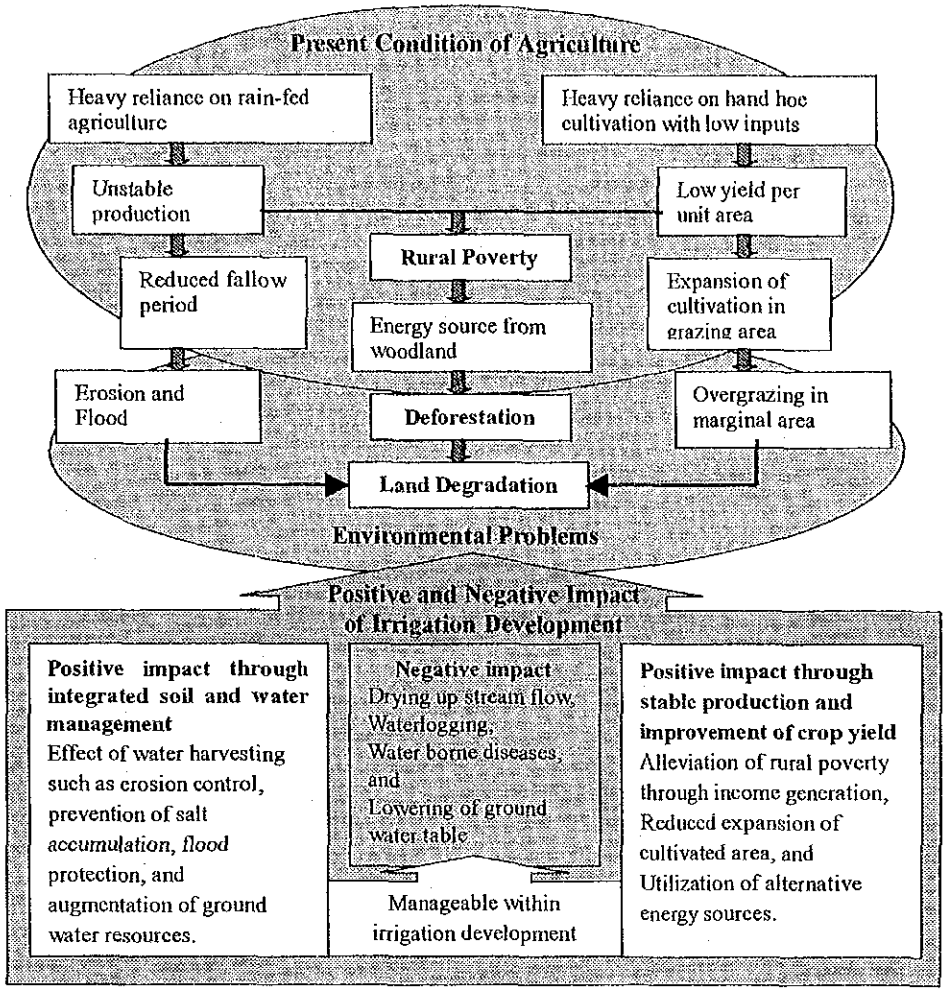
(3) Environmental Conservation Effects of Irrigation Development

Agriculture in Tanzania is heavily depending on hand hoes as the main cultivating tools with minimum inputs and rainfed conditions. These are the major causes of unstable production and low yield per unit area. Inappropriate land husbandry practices also accelerate the soil erosion and the consequent flood hazard. Expansion of cultivation into grazing area results in the overgrazing shifting into marginal areas. This can be a possible reason for land degradation along with the deforestation through fuelwood collection from woodland.

Under these circumstances, it can be expected that irrigation development can greatly contribute to the environmental conservation. Stable production and improvement of yield per unit area that will be attained through irrigation development can contribute to (i) the reduced expansion of cultivated area, (ii) the access to alternative energy sources and (iii) creation of job opportunity. Increased byproducts such as straw and bran can effectively be incorporated into organic agriculture combined with livestock activities. Furthermore, the integrated soil and water management can be undertaken under a properly designed irrigation scheme. The effect of water harvesting technologies such as erosion control, prevention of salt accumulation, flood protection and the augmentation of underground water resources will be of great importance specially in semi-arid regions.

Although the negative impacts of irrigation development on the environment such as drying-up of stream flow, water-logging, water borne diseases and lowering of ground water level are often pointed out, such problems can be controlled through appropriate management of irrigation scheme. The interrelation between environmental problems and irrigation development is summarized in the figure shown below.

Interrelation between Environmental Problems and Irrigation Development



Source: JICA Study Team

(4) Effect of Irrigation Development

According to the past increasing trend of cropped area and production of paddy, the future production can be estimated at most 950,000 ton in the year 2017 even under maximum efforts in input supply and extension services for yield increase. On the other hand, the production under the irrigation development could be estimated at around 1,250,000 ton in the year 2017, which would attain the self-sufficiency of rice as mentioned in Sub-clause 7.10. It is thus obvious that the self-sufficiency of rice will not be attained without irrigation development even with maximum effort for yield increase such as extension services and input supply improvement. Irrigation development can therefore be regarded as one of the effective approaches to the self-sufficiency of rice in the Mainland.

7.2 Objective and Strategies of National Irrigation Master Plan

7.2.1 Primary Objective of ASDS

The Tanzania Development Vision 2025 predicts that Tanzania will graduate from a least developed country to the middle-income country by the year 2025. This means that the GDP per capita shall reach US$ 755 at 2002 current cost by the year 2025 with the high average annual growth rate of 8 %. The Vision 2025 also envisages an agricultural sector that by the year 2025 is modernized, commercial, highly productive and profitable, utilizes natural resources in an overall sustainable manner and acts as an effective basis for inter-sectoral linkages. Taking into consideration these long-term goals, the ASDS, although taking a short-term view of the next five years (2002/07), 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.

The ASDS identifies agriculture's weakness and threats such as (i) low productivity, (ii) poor coordination and limited capacity, (iii) underdeveloped supporting facilities, (iv) other weakness and threats such as erosion of natural resource base, inappropriate technology, and dependency on rainfed agriculture. To settle these weakness' and threats, the ASDS proposes five strategic areas of action and thirty-seven broad activities/interventions. In these activities/interventions, the major issues related to irrigation development are to apply the principles of integrated soil and water management emphasizing the use of low-cost approaches by smallholder and to promote and support small-scale irrigation. The NIMP shall include these issues. Figure 7.2.1 shows the linkage of the NIMP with the ASDS.

7.2.2 Purpose of NIMP

In consideration of the strategic activities/interventions stipulated in the ASDS, the 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, which will undertaken in line with the following conditions and targets:

Targets of Sustainable Irrigation Development

Required Conditions	Targets
Technical Self-reliance	- Capacity building of Irrigation Section staff, Local Government Authority Staff and Extension Workers - Raising of technical knowledge of farmers on O & M and water management - Application of appropriate irrigation development level - Execution of environmental conservation
Financial Self-reliance	- Improvement of government financial situation by reform of taxation system - Strengthening and support of micro-finance to farmers - Enlargement of opportunity on private sector investment in irrigation development
Institutional/Organizational Strengthening	- Definition on roles and responsibility of Irrigation Section, Local Government Authority, and WUAs under decentralization - Strengthening/reform of Irrigation Section, Zonal Irrigation Offices and Local Government Authority - Legal framework strengthening for WUAs (legal status, land tenure, water right, ownership and responsibility of irrigation infrastructure) - Institutional strengthening for raising technical ability (extension services and training) - Institutional strengthening for raising financial capability (collection of water fee and O & M cost, micro-finance) - Promotion and support programme of private sector (creation of attractive climate for investment, Incentive of tax for BOT introduction, long and stable security of tenure)

7.2.3 Strategy of NIMP

(1) Lessons Learnt from NIDP Implementation

There are three major constraints which caused the unsatisfactory implementation of the NIDP. These are lack of appropriate technical approach to scheme implementation, inadequate institutional building and lack of financial resource as discussed in Sub-clause 4.2.3. There still remain the same and similar constraints in the current Irrigation Section of MAFS and other irrigation development activities, which were identified through the PCM workshops and problem analysis mentioned in Chapter 5. The NIMP shall be therefore formulated taking into due consideration these constraints.

(2) Irrigation Development with close association between Subject-wise Improvement and Scheme-wise Development

The NIMP proposes the two ideologies of Subject-wise Improvement and Scheme-wise Development, 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 area 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".

(a) Economically Sound

The NIMP is concerned with the economic soundness on use of limited capital. The government and farmers face difficult situations in terms of capital holding. It should thus seek the most appropriate use of limited capital in irrigation development so as to provide the most effective economic solution.

(b) Technically Appropriate

The NIMP emphasizes the importance of appropriate technologies for irrigation development. In the selection of appropriate technologies, consideration shall be given to simple and low-cost technology solutions, focusing on technical soundness for easy O & M by farmers. Dissemination of information shall be through the enhancement of extension services as a key to sustainable irrigation development.

(c) Socio-logically Sustainable

The NIMP puts farmers first. The NIMP is worked out considering farmers as not only the beneficiaries, but also the major driving force for irrigation development. Active participation and empowerment of farmers are indispensable for the sustainable irrigation development as farmers can help themselves in a bottom-up manner.

(d) Institutionally Reliable

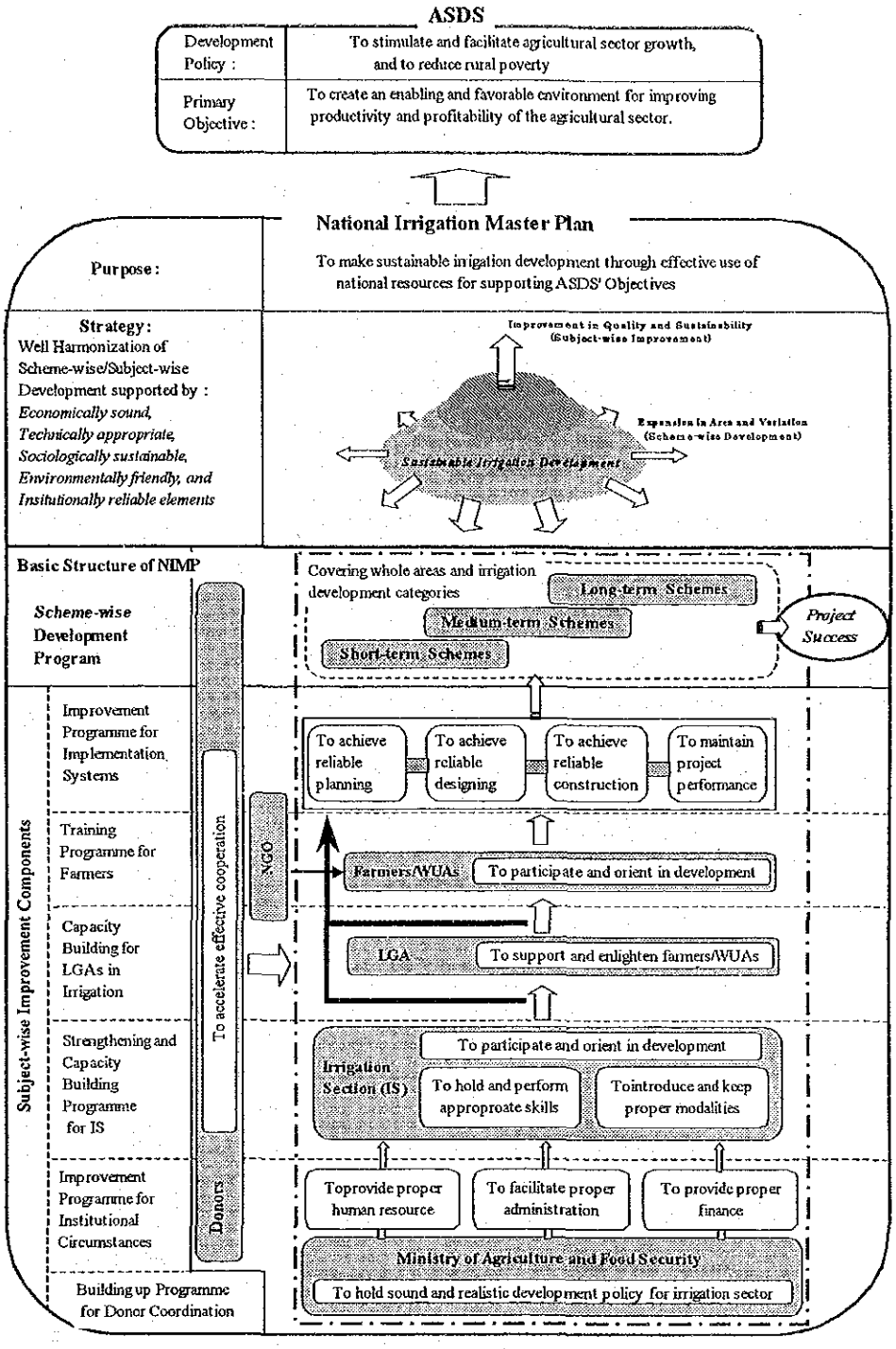
The NIMP emphasizes the importance of institutional reliability for irrigation development. The government/farmers partnership is essential for sustainable irrigation development, which would require the capacity to fulfill the respective duties. The NIMP will be formulated paying attention to institutional reliability to heighten the capacity of the partnership and also the ownership.

(e) Environmentally Friendly

The NIMP actualizes environmentally sustainable management of water and land use. A well-managed water and land use philosophy guarantees good circumstance for agricultural production, and a sustainable ecological system. It brings about environmentally appropriate conditions for farmers' living.

The concept of the NIMP which is discussed in the above, is delineated in the following figure.

Concept of NIMP



7.3 Framework for National Irrigation Master Plan

7.3.1 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.

(1) Legal Access to Land

The land tenure system plays an important role of establishment of self-reliant irrigation development. Presently, most of cultivated area is used for small-scale farming under customary tenure, not officially registered tenure. The majority of land holding falls within a land class referred to as "Village Land". This situation generally leads to security of tenure, which is critical for investment, but also hinders entry of medium and large-scale farmers into irrigation development and agriculture. The legal and physical access to land should be established.

(2) Dissemination of Water Right Registration

Water right is indispensable for irrigation development. Customary water use for traditional irrigation schemes is currently easily granted if proper application is made. However, most of farmers do not understand the water right, therefore do not submit a water right application. An education campaign is required to make them to understand the water rights issue, which would improve sustainable development and management of water resources.

(3) Act for Farmers Organization

In many irrigation projects, beneficial farmers register their organizations in conformity with the Cooperative Societies Act No.51 of 1991, which applies to associations of persons that have voluntarily joined together for the purpose of achieving common needs. The Water Users Association which carries out the operation and maintenance of the project facilities requires the membership of all beneficial farmers and compulsory payment of water charge from them. There is often conflict between the member farmers and non-member farmers in the same project because of lack of consistency in registration of membership under the Cooperative Societies Act. This issue also closely related to the ownership of transferred irrigation facilities. Improvements to the legislation of the Water Users Association are thus required for good management of irrigation projects.

(4) Favorable Taxes and Tariff for Irrigation Development

The high rates of interest for lending, taxes and energy tariffs are not presently

attractive for the agriculture sector including irrigation sub-sector. These are critical issues for the private investment to the agriculture sector including the irrigation sub-sector. The relevant agencies should review them and set rates which will result in profitable and increasing agriculture, which lead to promotion of irrigation development.

(5) Policy on Food Security

At present, the Government does not issue a clear policy on food security. In particular, a policy on staple food such as rice and maize is urgently required. Population in the Mainland is expected to increase with a high growth rate of about 3 %, which would result in serious food shortage in the near future. A policy to focus on effective use of national resources is required.

(6) Donor Coordination

Many donors have provided their assistance for irrigation sub-sector in their own policies. In order to enhance the effect of assistance, it is desirable to coordinate the donor-assisted projects/programme based on the development direction for irrigation.

7.3.2 Macro-economic Framework

(1) Macroeconomic Framework for the Projection of the Financial Resources Envelope

Pillars of the framework and specific targets adopted for the projection of the financial resources envelope for the NIMP are summarized below:

Pillars	Specific Measures/Targets
Stable and sustainable overall economic development	Assumed GDP growth rates for the implementation of the NIMP have been decided by referring to the rates provided in the PRSP and the Completion Point Document of IMF/IDA November 8, 2001. 2003/04 – 2007/08: 5.8%p.a.; 2008/09 – 2012/13: 5.9%p.a.; 2013/14 – 2017/18: 6.0%p.a.
Accelerated and sustainable irrigation development	Allocation of Development Budget (Local and Foreign Funds) to Irrigation Development
Stable and increased donor assistance	Financial assistance of foreign donors, both multi-lateral and bi-lateral, distributed through on-budget and out-of-budget system to irrigation development

(2) Indices Used for Financial Resources Envelope for NIMP

The past development expenditures, and operation and maintenance costs for irrigation development were analyzed using data from 1997/98 to 2002/03 since further past data could not be employed due to lack of figures and their reliability.

The obtained indices to be used for financial resources envelope for base case are summarized below:

Summary of Assumptions in Base Case

Items of Budget	Results of Analysis	Indices Obtained
(Development Budget)		
Local Fund of GOT Development Expenditure	Average share of local fund portion to GOT Development Expenditure for 5 years (1998/99 - 2002/03) is 12.48%.	12.5%
Local Fund of the MAFS Development Budget	Average MAFS's share to GOT Development Budget (local fund) for 5 years (1998/99 - 2002/03) is 5.48%.	5.5%
Local Fund of Development Budget for Irrigation Development	Average share of irrigation development for 5 years (1997/98 - 2001/02) is 1.46% of GOT Development Budget.	1.5%
Foreign Fund of Development Budget for Irrigation Development	Average multiple of foreign fund to local fund of irrigation development is during 1998/99 – 2002/03 is 9.4.	9.4 times
Out-of-Budget Foreign Fund for Irrigation Development	UNDP Tanzania Development Co-operation Report 1999 indicates that approximately half of donor money is reflected in the government budget, and the remaining will go directly to projects/programs as out-of-budget funds.	100% of Foreign Fund of Develop. Expenditure allocated to Irrigation Develop.
(Operation and Maintenance Budget)		
Personnel	37% of personnel of Crop Development Department are engaged in irrigation development. 50% of personnel expenditure of those personnel is the responsibility of NIMP.	Tsh.317,922 thousand/ year, and increase in proportion with annual GDP growth rate.
Maintenance of Irrigation Facilities	15% of Maintenance of Physical Infrastructure within Recurrent Expenditure.	Tsh.4,500 thousand/ year, and increase in proportion with annual GDP growth rate.

(3) Financial Resources Envelope

(a) Development Budget

Using indices mentioned above, the analysis is carried out and the result is Tsh 342,179 million in Base Case, which is US$ 360.2 million converted at Tsh. 950/US$, over 15 years of the NIMP implementing period.

(b) Operation and Maintenance Budget

The analysis is carried out and the result is Tsh 7,863 million, which is US$ 8.3 million equivalent, for over 15 years of the NIMP implementing period.

(4) Sensitivity Analysis

Three scenarios, Base Case, High Case, and Low Case, are analyzed. Each scenario has the following indices:

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)
Out-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*

From the results of sensitivity analysis, the annual development budget, and operation and maintenance budget are projected as follows:

Annual Projected Development Budget

Case	'03	'04	'05	'06	'07	'08	'09	'10	'11	'12	'13	'14	'15	'16	'17
High[1]	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
US$[2]	18.7	20.0	21.4	22.8	24.4	26.0	27.8	29.8	31.8	34.0	36.4	38.9	41.7	44.6	47.7
Base[1]	14.8	15.7	16.6	17.6	18.6	19.7	20.9	22.1	23.4	24.8	26.3	27.8	29.5	31.3	33.2
US$[2]	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
Low[1]	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
US$[2]	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

1 : Billion Tsh, 2 : Million US$

Annual Operation and Maintenance Budget

Case	'03	'04	'05	'06	'07	'08	'09	'10	'11	'12	'13	'14	'15	'16	'17
High[1]	0.34	0.37	0.39	0.42	0.45	0.48	0.51	0.55	0.59	0.63	0.67	0.72	0.77	0.82	0.88
US$[2]	0.36	0.39	0.41	0.44	0.47	0.50	0.54	0.58	0.62	0.66	0.70	0.75	0.81	0.86	0.92
Base[1]	0.34	0.36	0.38	0.40	0.43	0.45	0.48	0.51	0.54	0.57	0.60	0.64	0.68	0.72	0.76
US$[2]	0.36	0.38	0.40	0.43	0.45	0.48	0.50	0.53	0.57	0.60	0.63	0.67	0.71	0.76	0.80
Low[1]	0.34	0.36	0.37	0.39	0.41	0.43	0.46	0.48	0.50	0.53	0.56	0.59	0.62	0.65	0.68
US$[2]	0.36	0.37	0.39	0.41	0.44	0.46	0.48	0.51	0.53	0.56	0.59	0.62	0.65	0.68	0.72

1 : Billion Tsh., 2 : Million US$

7.3.3 Demand Projection of Staple Foods

(1) Food Policy for Irrigation Sector

It is obvious that alleviation of poverty and agricultural activities are closely related where the agriculture creates employment and it is the main activity to secure not only food but also income. In rural areas where it is difficult to find major industries other than agriculture, the majority of the poor is engaged in agriculture, which suggests that the promotion of agriculture through the

agricultural development that is capable of providing food and income to the poor will surely play an important and straightforward role for the alleviation of poverty in rural villages.

In the poor villages of the Mainland the only way of achieving the improvement of food conditions (the achievement of self-sufficiency) and the securing of income (sales of surplus agricultural products and promotion of the sales of cash crop), which are the two main challenges of the country, is the vitalization and continuous improvement of agriculture by making effective use of existing resources. The development of irrigation, in particular, is expected to be effective as a measure for stable food supply as well as stable source of income, capable of realizing much-desired alleviation of poverty.

It is necessary in the Mainland to attempt to secure a stable supply of staple food with the improvement of nutritional state of the people in mind. It is not sufficient to try and secure the stable supply only through the enhancement of domestic production. Food import should naturally be taken into consideration from the point of adequacy of food variation as well as from the point of economy. Increase in production of food, however, should be the objective target because domestic production is found to be more economical than import, as shown in the table below which indicates that domestic agricultural products are competitive internationally.

Tanzanian Agricultural Sector Comparative Advantage Indicators
(Domestic Resource Coefficients)

Crops	Average	Improved	Potential
Maize (Iringa)	0.93	0.72	0.61
Maize (Dodoma)	0.66	0.71	0.96
Rice (rainfed, upland)	0.82	-	-
Rice (rainfed, lowland)	0.60	0.78	-
Rice (irrigated, Morogoro)	0.63	0.72	0.66

Note: The DRC measures the opportunity cost of the domestic resources required to save (or earn) US$ foreign exchange. A coefficient of 0.61 indicates that there is a potential for only spending US 61 cents to US$ 1.0 in maize imports. Any coefficient less than 1 implies that it is competitive at world prices.

Source Table 7.28, Tanzania, Agriculture: Performance and Strategies for Sustainable Growth, February 2000

As the buying ability of food of the poor people living in rural areas is exceptionally low, security of self-sufficiency through the increased production of staple food in rural areas and the enhancement of buying ability through the expansion of the cultivation of cash crop are both essential objectives and should be promoted as much as possible.

(2) Basic Assumption for Staple Food Demand Forecast

The Crop Monitoring and Early Warning Unit, Food Security Department, Ministry of Agriculture and Food Security in the Mainland, with the collaboration of FAO and others, has determined the annual per capita intake of staple food product, the outline of which is shown right.

Per Capita Consumption for Mailand

Commodity	Kg/Year/Person*
Maize	74.5
Rice	14.1
Wheat	4.3
Sorgum	15.5
Millet	15.5
Puses	11.4
Cassaba	38.2
Bananas	15.3
Potatoes	16.3

** Dry, edible*

An estimate of expected demand for staple food products was made in order to clarify the positioning of the irrigation sector in the overall agricultural development, and also to examine the relevance of the reinforcement and promotion of irrigation sector from the point of view of food supply.

The following conditions have been set up in making the demand forecast:

The calculation has been made based on the assumption that the current pattern of food intake will not change in the future. Accordingly, the current calorie intake of 2,300 kcal stays the same with demand increasing in proportion to the increase in population.

(3) Staple Foods Demand Forecast

In accordance with the scenario set in the above, the future demand of staple food products has been assessed for 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 Table 7.3.1, the summary of which is shown right:

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

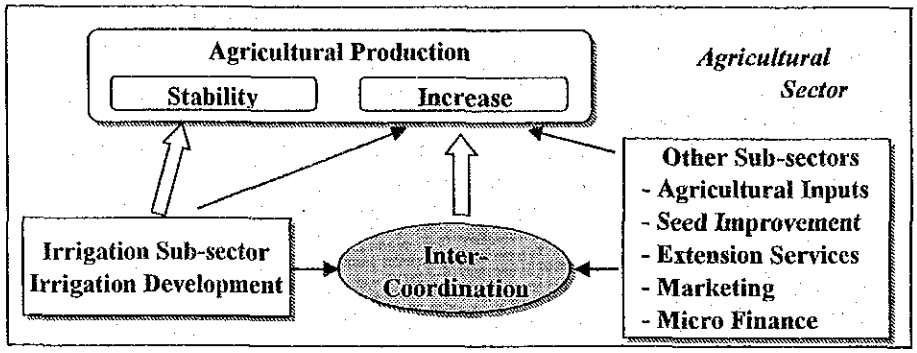
Even in a rather pessimistic assumption in which the Mainland is supposed to enjoy little economical development with calorie intake kept at the current level, the pressure from the increased population will require a demand for rice 1.6 times bigger than the current amount as well as that for maize 2.6 times more in the year 2017.

7.3.4 Need of Inter-coordination in Agricultural Sector

Irrigation is an essential tool for stabilization and increase of agricultural production. As discussed in Clause 7.1, there is no doubt that irrigation itself contributes to the stabilization of agricultural production. However, in relation to improvement of agricultural production, irrigation can function as a catalyst to

bring out the physiologically suitable environment for enhancing the agricultural production. Irrigation itself could not realize the remarkable increase of agricultural production without interventions from other sub-sectors such as agricultural inputs, extension services, marketing and micro finance. The other sub-sectors therefore require to be developed under close inter-coordination with the irrigation sub-sector, to achieve a significant increase of agricultural production.

Need of Inter-coordination in Agricultural Sector



7.4 Basic Plan for Irrigation Development Level

7.4.1 Concept of Guideline of Irrigation Development Level

The function of a guideline for irrigation development level is to provide an indication of principles on technical decision making for irrigation scheme implementation. It is not a formal document which must be followed absolutely. Often, it will indicate areas of flexibility, which may be applied to a particular scheme. Additionally, it should not be a criterion for scheme selection or prioritization. The criteria for scheme selection has been prepared in several irrigation development projects/programmes and is generally based on an intention that schemes identified as being below a standard shall not be developed. However, the guideline for irrigation development level should be essentially different from a document outlining the criteria for scheme selection. The guideline for irrigation development level is based on a concept that farmers in every area may develop irrigation to an extent which suits their own requirements. Farmers will develop their irrigation practice within allowable range of irrigation development corresponding to the development potential of their own areas. The guideline for irrigation development level should show the possible and most suitable modalities of irrigation development by irrigation development pattern recognizing the potential and limitation of irrigation development of the relevant area.

7.4.2 Classification of Irrigation Development Patterns

In the NIDP, all of potential irrigation schemes were divided into the following three kinds of intervention, having a sense of prioritization for scheme implementation.

- Rehabilitation or Upgrading of Traditional Irrigation Schemes
- Schemes based on Water Harvesting Technology
- New Smallholder Schemes

Within the new schemes mentioned above, traditional irrigation schemes are also included if a significant improvement results in classification in a completely different class. These classifications of irrigation development pattern, however, do not cover all possibilities, and are not sufficient for the purpose of defining the irrigation development level.

Through reviewing other classification of irrigation type in the Mainland proposed previously, in this Study irrigation development patterns is classified into the following types from three different angles, namely, scheme style, type of water source, and scale of scheme.

Classification of Irrigation Development Pattern

Scheme Type	Rehabilitation of ex scheme.*			New irrigation scheme **			Water harvesting scheme		
Water sources	Surface water	Ground water	Others (lake etc.)	Surface water	Ground water	Others (lake etc.)	Stream flood	Current water	Rain water
Village scheme	R-V-S	R-V-G	R-V-O	N-V-S	N-V-G	N-V-O		W-V-C	W-V-R
Small-scale	R-S-S	R-S-G	R-S-O	N-S-S	N-S-G	N-S-O	W-S-F	W-S-C	
Medium-scale	R-M-S	R-M-G	R-M-O	N-M-S	N-M-G	N-M-O	W-M-F		
Large-scale	R-L-S			N-L-S					

Note: above irrigation development pattern is shown in (Scheme type) – (Scale of scheme) – (Water source), where,
(Scheme type), R: Rehabilitation of existing scheme, N: New irrigation scheme, W: Water harvesting scheme
(Scale of scheme), V: Village scheme, S: Small-scale. M: Medium-scale, L: Large-scale
(Water source), S: Surface water, G: Groundwater, O: Others
**: Irrigation schemes grouped into "Traditional" and "Improved Traditional" are classified in this pattern.*
***: Irrigation schemes grouped into "Modern" are classified in this pattern, and irrigation schemes newly developing without existing irrigation systems are also included.*

Within the above classification, the village scheme has a special characteristic. Its size is generally less than 30 ha and is smaller than the so-called small-scale scheme. It would be implemented on the basis of farmers' initiative without public intervention. Moreover, this classification may be further subdivided by water abstraction. For the irrigation patterns categorized into "for surface water", those could be subdivided into "by intake weir", "by dam reservoir" and "by under-drain" etc. These schemes may be the subject of specialized study but might not be considered as general examples.

7.4.3 Guideline of Irrigation Development Level

The guideline of irrigation development level shall consider a number of

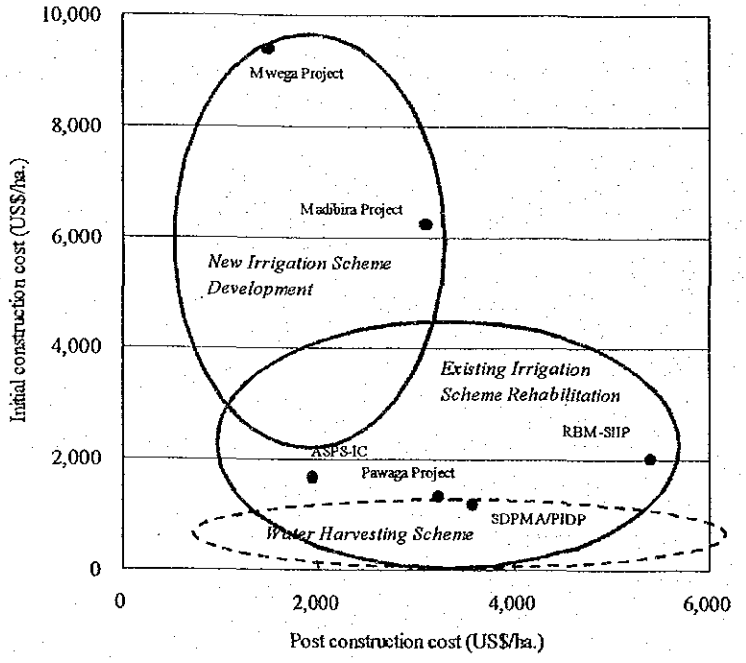
indicators for each irrigation development pattern. The indicators on irrigation development level are extracted from many prospective ones, taking views in Sustainability, Adaptability and Feasibility into consideration, namely, (i) Position of a balance in hardware and software, (ii) Project Scale, (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. Applicable indications in these indicators are summarized in Table 7.4.1. Outlines for the indications are given below:

(1) Position of a balance in hardware and software

A balance in hardware and software is the most important aspect for irrigation development. Hardware in irrigation development might indicate physical facilities for irrigation practice whereas software in irrigation development might specify those activities during post-project implementation including project O & M and additional care efforts of all those associated with the Project.

The ranges of project costs for the selected on-going projects show a close relationship between "hardware (like an initial construction cost) "and "software (like a post construction cost)" which are described in more detail in Appendix D. The positions of irrigation schemes on the two-axis graph of the initial construction cost and the post-project cost are distributed with a certain tendency and can be grouped into several classifications of irrigation development as shown in the following figure:

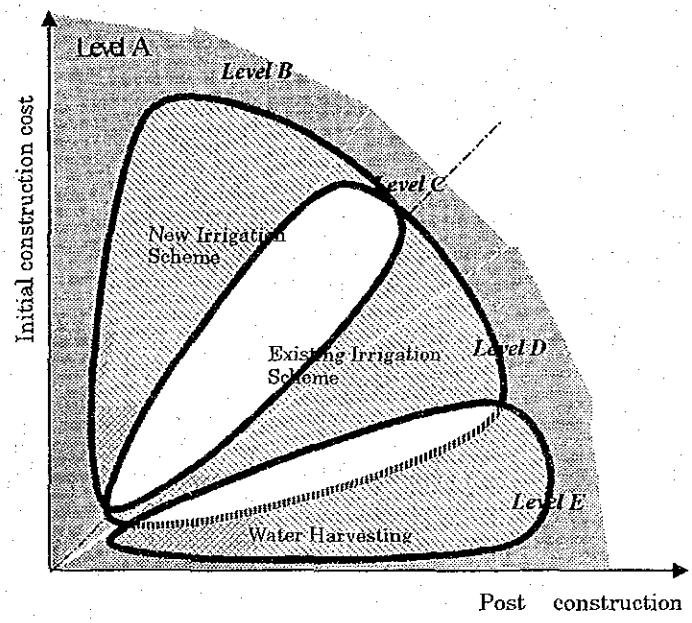
Provisional Classification of Irrigation Development



For new irrigation development schemes, rather higher-cost facilities are required to compensate for the farmers' shortcoming of experiences and knowledge in water management, which have arisen from poor irrigation practices. This viewpoint was also recognized in previous studies. Conversely, for the rehabilitation scheme, the post construction cost exceeds the initial construction owing to the advantages of farmers' experiences in irrigation practice. For water harvesting adopted in marginal areas, low-cost technology is essentially recommended for constructing simple facilities with shorter project life, due not only to economic feasibility, but also the characteristic of natural condition. For example, ephemeral rivers for water harvesting generally change watercourse regularly resulting in investments of long life solid facilities being inappropriate.

Relationships between hardware and software aspects could be grouped into five levels from A to E as shown in the figure to the right:

Groups of Balancing Position of Hardware and Software



When planning irrigation schemes, the method and modality of the irrigation system should be outlined taking these guidelines regarding balancing position of hardware and software into consideration.

(2) Project Scale

"Project scale" is the covering area of irrigation service provided by the relevant irrigation project. Although it is difficult to develop strict rules for categorizing the irrigation into classes, the following three classes of irrigation scheme will be adopted:

Indications in Project Scale

Irrigation class	Covered area (ha.)	Remarks
Small-scale	~500	Generally lower limit (about 20ha) exists.
Medium-scale	500~2,000	
Large-scale	2,000~	

Designated values of irrigation area in the above table are generally assumed to be

applied primarily for the rice cultivation. Therefore, it may give a broad interpretation of application of the designated values of irrigation area.

(3) Applicable Crop for Irrigation

Applicable crop for irrigation is selected as that which features highest, in terms of economical and practical analysis, on the basis of beneficiaries' requirement.

(4) Target Yield of Irrigated Crop

The target yields of irrigated crops were proposed in various figures in all previous irrigation development schemes. In the case of rice production, it ranges from 1.5 ton/ha to 5.0 ton/ha. Various target yields of irrigated crops are being proposed under the previous irrigation schemes.

Target Yield of Irrigated Crop

Crop	Scheme Style	Target Yield	Remarks
Paddy	New scheme	3.0~6.0ton/ha	
	Rehabilitation	3.0~5.0ton/ha	
	Water harvesting	1.0~1.5ton/ha	Considering yearly fluctuation
Maize	New scheme	3.0~5.0ton/ha	
	Rehabilitation	3.0~5.0ton/ha	
	Water harvesting	1.0~1.5ton/ha	Considering yearly fluctuation
Beans	New scheme	1.0~2.0ton/ha	
	Rehabilitation	1.0~2.0ton/ha	

(5) Irrigation Method and Modality of Irrigation System

In consideration of the Distribution of Flow Duration Curves ($Q_1(75)$), Figure 6.2.2, the river regimes in the Mainland can be identified.

Broadly Applicable Irrigation Methods

River Regime Type	Indicator	With Reservoir		Without Reservoir	
		Higher Altitude	Lower Altitude	Higher Altitude	Lower Altitude
Perennial rivers	$20<Q_1(75)$	C	A	C	A
Intermittent rivers	$0<Q_1(75)\leq 20$	C	A	B	B
Ephemeral rivers	$Q_1(75)=0$	-	B	B, C	B, C

"Higher altitude" means higher elevation position of irrigation area in compare with the height of water source, "Lower altitude" is in opposite condition.
A: Perennial Irrigation, B: Flood Irrigation, C: Lift Irrigation, -: Not applicable

(6) Expected Project Life

Generally, the project life is selected to be the optimized point of the relation between inputs and outputs of the project, in viewpoint of economy. However, in some cases, optimality hides other factors, including capability of implementation, possibility of acquisition of required inputs, stability of project conditions etc. It should be at least 50 years. If some conditions surrounded projects are variable and remodeling of the project is envisaged when the conditions alter, project life should be restrained reduced to the predictable duration.

(7) Reliability of Project

Reliability of irrigation project means a dependability of project against certain targeted drought occurrences to secure and maintain irrigation needs by means of construction of irrigation system. Adopting lower reliability of irrigation with simpler and cheaper facilities lowers security of irrigation water supply against drought occurrence. Conversely, accepting irrigation development with higher reliability against harder drought occurrence becomes much more expensive. For the investment level of project implementation, affordable limits and manageable scale of project are very crucial. Therefore, the final project formulation is not to be an optimum choice in economy, but to be an optimum selection in good balance of the input and output. The indication of drought occurrences for irrigation water supply is proposed from 20 to 50 %. In the case of water harvesting, no significant improvement against drought occurrences is expected.

(8) Affordable Range of Project Cost

Approximate unit project cost of US$ 2,000/ha is used as as initial figure and had gradually become a standard. However, adequate project cost varies corresponding to the own circumstances of the project. Some projects may be optimal at a lower standard than the unit project cost, alternatively, some can be constructed taking a much higher cost than the unit cost.

Affordable range of irrigation project cost is subject to affordability and admissibility of a party of project concerned, and project economy. It would be decided at the minimum among the values. It is surveyed as follows:

Affordable Limit of Project Cost by Expected Production Yield **(unit: US$/ha)**

Project life	~10 years			10~20years			20~30years			~50years		
Profit/ha	N	E	W	N	E	W	N	E	W	N	E	W
~$100/ha	500	400	300	650	500	400	750	600	500	800	650	-
$100~$200/ha	1,000	800	600	1,250	1,000	800	1,500	1,200	1,000	1,650	1,300	-
$200~$400/ha	2,000	1,600	1,200	2,500	2,000	1,600	3,000	2,400	2,000	3,300	2,600	-
$400~$600/ha	3,000	2,400	-	3,750	3,000	-	4,500	3,600	-	5,000	3,900	-
$600~$800/ha	4,000	3,200	-	5,000	4,000	-	6,000	4,800	-	6,600	5,200	-
$800~$1000/ha	5,000	4,000	-	6,250	5,000	-	7,500	6,000	-	8,250	6,500	-
$1000~	6,000	4,800	-	8,000	6,000	-	9,000	7,200	-	10,000	7,800	-

N.: New irrigation scheme, E.: Existing irrigation scheme, W: Water harvesting scheme
Above indicated unit irrigation project cost is major part of initial investment cost. New irrigation scheme cost much initial cost with small O&M cost. Instead of the situation of new irrigation scheme, existing and water harvesting scheme require much O&M cost in spite of lower initial cost.

(9) Allowable Limit in Economic Indicator

Economic indicator of EIRR or B/C etc. can be adopted for irrigation projects as well as other sectoral development projects in order to specify a relative position

in economic worth. A figure around 10-12 % or more is usually required as the project allowable limit along with a reasonable rate of interest when loan is adopted. The economic indicator is not only useful to identify absolute status of the project in economic feasibility but also to enable a comparison with other similar candidate projects. A basin-wise approach has been recently highlighted in the sector of water-resources development and management in the Mainland, in which good consent and objective prioritization corresponding to the economic superiority among concerned water users are highly attached importance.

7.5 Basic Plan for Institutional Development

The 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 setting can be compared to a kind of engine to smoothly operate the irrigation development procedure and the mechanism composed of the various participants, that is, the Central Government, the Local Government Authorities, the Irrigators' Organizations, Private Companies, NGOs, Donors and etc.

Without the engine, i.e. the practical and reliable institutional setting, the irrigation development projects/programmes will lose their momentum and control. Consequently they must encounter the persistent constraints discussed previously. Whether the institutional development is achieved smoothly and harmoniously among the various players or not will definitely become a crucial prerequisite for the sustainable and self-reliant irrigation development, i.e. the NIMP.

7.5.1 Roles of Central Government, Local Government Authorities and Farmers' Organizations

The main objective of institutional development in the NIMP is to provide a more effective and more fitting institutional framework for the various participants of irrigation development and to support them for achieving good performances of their demarcated roles and functions.

The Central Government, including the MAFS, will be basically responsible for determining the national minimum standards (NMS) of service, safeguarding professionalism, and determining the qualifications and numbers of staff required to meet the NMS. In that sense, among the demarcated roles, a top priority for the Irrigation Section is given to the role of formulating and reviewing policy, laws, procedures, regulations and guidelines on irrigation farming. This role is quite essential and requires the Irrigation Section to provide firm policy and technical guidance to the Local Government Authorities (LGAs).

The Zonal Irrigation Office and the Regional Secretariat have basically inter- and

intra-regional coordination and supervision functions through different channels. The main task of the Zonal Irrigation Office is technical supervision while the Regional Secretariat is to coordinate irrigation development with other development activities.

The LGAs' role is quite critical under the decentralization policy. A number of constraints discussed in Sub-clause 4.3.7 must be resolved one by one for them to perform their roles satisfactorily. One of their main roles is based on the guidance from the Central Government to provide technically and financially appropriate and feasible replicable models and/or methods of irrigation development to the irrigators' organizations (farmers) and, in addition, to assist and encourage them to operate and maintain the irrigation scheme by themselves.

The role of irrigators' organizations will become very important for the farmers-oriented irrigation development. They will play a main role in operating and maintaining the irrigation scheme and achieving self-reliance. However, they surely need back-up support from the LGAs and the Zonal Irrigation Offices during the short and medium terms.

7.5.2 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. The details were discussed in Clause 8.2.

(1) *Institutional Strengthening of the Irrigation Section*

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

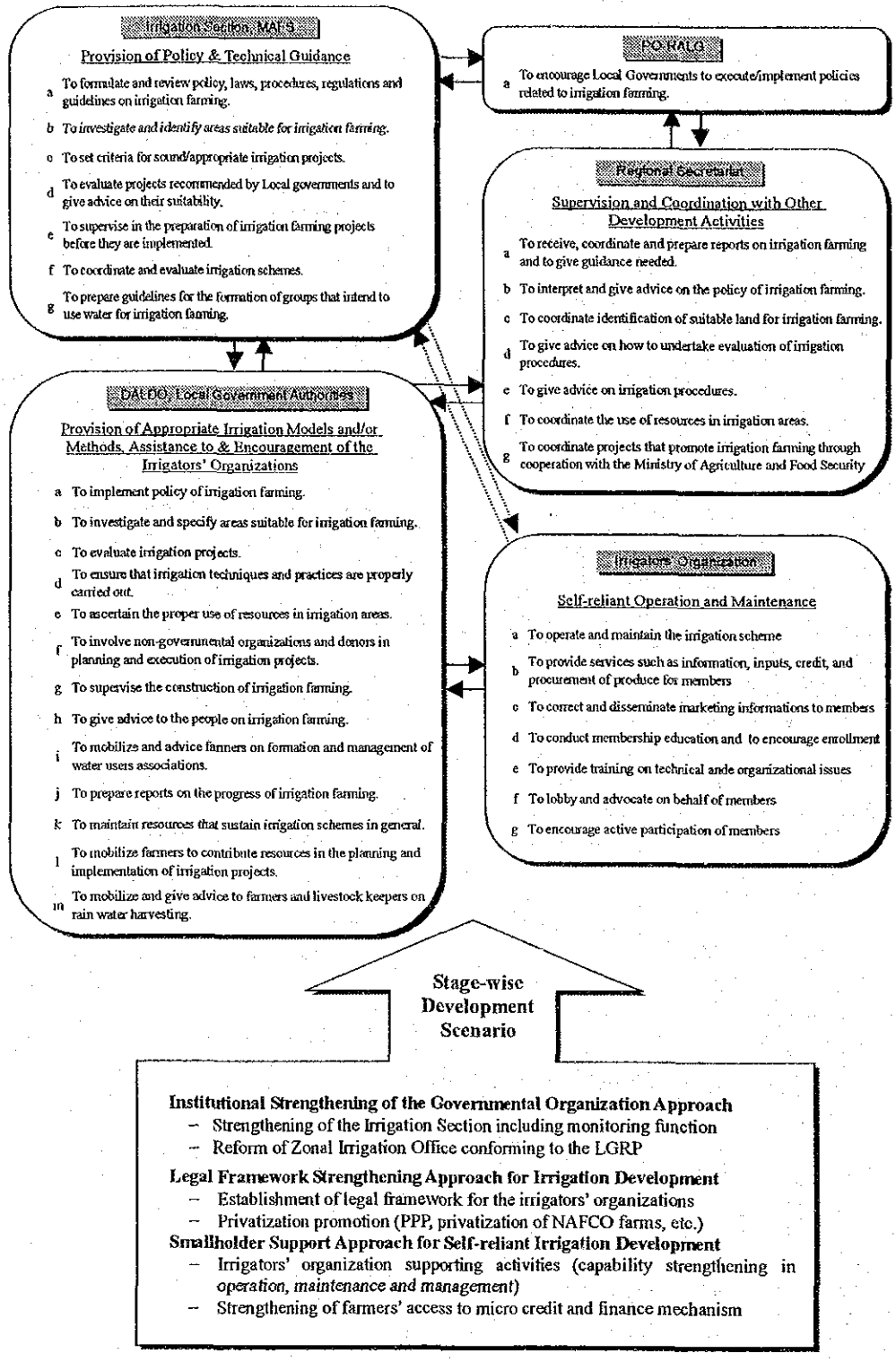
(2) Legal Framework Strengthening for Irrigation Development Program

- Establishment of Legal Framework for the Irrigators' Organization
- PPP (Public Private Partnership): Privatization Promotion

(3) 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

Institutional Development Components and Demarcated Roles of the Central Government, Regional Secretariat, the Local Government Authorities, and Irrigators' Groups



Source: JICA Study Team

7.6 Basic Plan for Agricultural Development

7.6.1 Target Crops for Irrigation

The most important food crop in the Mainland is maize and accounts for about 40% of per capita calorific consumption. The country became self sufficient in maize production in 1985/86 but since then the production has fallen as it depends on the rainfall availability. There is therefore a need to invest in irrigation as a mean of increasing the nation's self-sufficiency or security in maize again, especially in areas where there is erratic rainfall or maize is cultivated as a second crop after paddy. In addition, the importance of rice in the national diet in urban areas is increasing with per capita consumption rising during the past decade. The yield of rice has increased at a greater rate due mainly to an improvement in the irrigation systems. It was concluded in the NIDP that irrigation had a role in contributing towards food security and self-sufficiency in rice production at national level and this principle is maintained under the NIMP.

The importance of rice production was further reinforced through the forecasted demand for rice production mentioned in Clause 7.1. Currently, the total production and demand for paddy are both slightly less than 800,000 ton per year at national level. But the estimated demand at the year 2017 will exceed 1,200,000 ton due mainly to the population increase. In order to satisfy such an increasing demand, 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 at the same time as cash crop.

The demand for maize will similarly increase based on the future population increase. The demand projection discussed in Sub-clause 7.3.3 shows that the total demand of maize will reach above 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. Even in the drier part of the country, there is potential for increased maize production under rainfed conditions through the introduction of drought resistant varieties and the improved rainfed farming practices.

The importance of sugarcane and perishable commodities such as vegetables and other high valued crops was also emphasized as target crops for irrigation development in the NIDP. The production of industrial crops including sugarcane should be considered in the course of privatization of the large-scale

irrigation schemes. According to the results of the inventory survey, major irrigated crops under smallholdings other than paddy and maize are beans and vegetables including onion, tomato and leaf vegetables. Such crops can be produced in the areas with good access to the markets or with strong and durable local demand. Special attention should be paid for leguminous crops such as beans and chick peas not only from the production viewpoint but also from the soil management viewpoint.

7.6.2 Land Use Plan

(1) Agro-ecological Zone

In order to select the most suitable crops for different areas, the information obtained through the agro-ecological zone map can effectively be utilized. Agro-ecological zones map provides data on climate, physiography, soils and vegetation/land use and tsetse occurrence. These are the main physical factors that influence potential and constraints for crop and livestock production.

According to the data on major farming systems for each agro-ecological zone, a map of the area suitable for paddy and maize was produced as shown in Figures 7.6.1 and 7.6.2. Furthermore, the data on temperature regime and moisture zones were also expressed on maps as shown in Figures 7.6.3 and 7.6.4. This information is useful for the selection of suitable crops and also for the decision of cropping intensity. Agro-ecological zone maps thus provides valuable information for the selection of suitable crops under rainfed condition, for the evaluation of the area to be proposed for irrigation scheme and also for the investigation of the suitable crop and cropping intensity in each scheme.

(2) Present Cropping Pattern

Since the major irrigated crops cultivated in the smallholders' field are paddy and maize and to a lesser extent, beans and vegetables, the analysis of the present cropping pattern was carried out by focusing on paddy, maize and others. 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 by allocating the planted area, production and yield into rainfed and irrigated, for paddy and maize. The result is shown in Table 7.6.1. It is clear from the result that the irrigated area for paddy occupies less than 20% of rainfed area but the production under irrigated area reaches more than 50% of rainfed production. On the other hand, irrigated maize is negligible both in area and production.

(3) Future Cropping Pattern

Based on the present cropping pattern as shown in Table 7.6.2, the future cropping

pattern was planned according to the following criteria including the development direction and cropping intensity potential estimated from the agro-ecological zone map as shown in Table 7.6.3.

- Emphasis is given to the promotion of rice production according to the principle of development concept,
- Emphasis is also given to the full utilization of remaining potential of maize production under rain-fed conditions,
- Production of other crops such as beans and vegetables will be adjusted by the climate and market conditions of each year,
- Information on crop suitability obtained from agro-ecological zone map is taken into account for the decision of development direction in each region, and
- Information on temperature regime and moisture zones obtained from agro-ecological zone map is taken into account for the decision of cropping intensity potential in each region.

The future cropping pattern thus planned is shown in Table 7.6.4 and the overall alteration of cropping pattern at national level is shown below. These results on cropping pattern were used for the estimation of economic feasibility of each scheme.

Present and Future Cropping Patterns under Irrigation

Present Cropping Pattern (123.3%)				
Paddy (48.5%)		Maize (31.2%)	Others (44.0%)	
Wet (39.5%)	Dry (9.0%)	Wet (31.2%)	Wet (29.3%)	Dry (14.7%)

Developing Direction and Cropping Intensity Potential

Future Cropping Pattern (133.5%)				
Paddy (82.3%)		Maize (18.0%)	Others (33.2%)	
Wet (63.5%)	Dry (18.8%)	Wet (18.0%)	Wet (18.5%)	Dry (14.7%)

Source: JICA Study Team

7.6.3 Farming System Improvement Plan

(1) Farming System

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.

(2) Input Supply

(a) Fertilizer and Agro-chemicals

Since the main reason restricting fertilizer use appears to be the absence of access to credit for its purchase, the government has tried to alleviate this problem through the establishment of Agricultural Input Trust Fund (AGITF). The AGITF provides soft loans to traders with low repayment rates for the local distribution of inputs. So far, the AGITF deals with only about 10% of all inputs supplied in the country and this should be strengthened. The government's strategy on input supply should continue with support for private channels focusing more on the creation of an enabling environment for the efficient operation of the private sector in input supply.

As for agro-chemicals, the government policy is to improve and strengthen the services in plant protection especially for the control of migratory pests and epidemic diseases. The supply of agro-chemicals has, however, suffered from the shortage in credit and distribution system. Furthermore, the enforcement of regulations of agro-chemicals under the Plant Protection Act of 1997 is inadequate. The establishment of proper distribution systems, the provision of extension messages on the safe handling and use of agro-chemicals together with the promotion of integrated pest management measures are the key issues for the future improvement and for irrigation development.

(b) Improved Seeds

Breeder seeds are mainly produced by the Department of Research and Development, more specifically in research stations such as Dakawa Research Center and the KATRIN (Kilombero Agricultural Training and Research Institute at Ifakara) where breeders are stationed. Foundation seeds were formerly produced in Kilosa Farm and certified seeds were supplied through the TANSEED. Since Kilosa Farm is not functioning and the TANSEED was privatized, there is no clear system of improved seed production and distribution. Tanzania Official Seed Certification Agency (TOSCA) is responsible for quality control from the foundation seed farm stage up to the sale of certified seed to the farmer. The TOSCA is also

supervising the selection of farmer inspectors to produce certified seeds by distributing breeder or foundation seeds obtained from Research Centers.

Improved seed production and distribution in the Mainland is thus in a vulnerable position. The most promising approach to improve seed production now is to develop community based seed production. This approach builds upon pilot projects funded by bilateral donors and NGOs. These projects are all based upon continued government responsibility for the production of breeder and foundation seed and for inspection. Under such projects, selected farmers who have received specific training in seed production are supplied with foundation seed for multiplication. If this approach proves to be viable, it can be scaled up as a major seed production system.

(3) Farmers Supporting Systems

(a) Agricultural Research

The current research programmes are classified into crop research, livestock research, special programmes and socio-economics. There is no specialized research on irrigation. The crop research on developing appropriate agronomic recommendations along with the development of high yielding varieties, and special programmes on soil fertility and water conservation are comparatively relevant to the development of irrigated agriculture and such research should be promoted. Special emphasis should be given to the research on new varieties of irrigated rice including Nerica Rice.

A system for allocating funds to the district for contracting research activities has been pioneered in the lake zone. Under this approach, the district is empowered to award contracts for research and it is free to award such contracts to government research stations, universities or NGOs. Reaction to the farmers' needs would be served by strengthening the links between the research agencies and the districts within their respective area, ensuring that research topics are demand-driven with priority to solve local problems. This approach should also be applied for the research activities on irrigation development.

The department of research and development made substantial progress in privatizing research activities connected with the main export and cash crops such as tea, coffee and tobacco. A joint venture arrangement is being negotiated for the research on cotton, cashew and sugarcane. This is another direction of research for the future. Research in the field of irrigation should be incorporated into crop research activities as crop productivity will be greatly increased through irrigation.

(b) Extension System

Strengthening of extension services is considered essential for the successful development of irrigated agriculture. Extension officers are required to give guidance concerning the proper farming practices to farmers and to show the effect of proper application of farm inputs under irrigated condition.

The most dramatic change to affect extension services has been the decision to decentralize all extension services to the district level. The district councils are responsible for the provision of extension services to farmers together with other services such as education, health etc. Priority should therefore be given to the empowerment of extensions staff in the field of irrigation development, and the supporting system for such staff should also be established.

There has been a long tradition of NGOs operating in the agricultural sector in the Mainland. These NGOs offer an excellent opportunity to assess alternative approaches to extension work. Privatization of extension and mechanisms for cost sharing with beneficiaries are being tried under National Agricultural Extension Project II (NAEP II) with the specific objective of bringing the private sector and NGOs into the provision of extension services. This is another direction of agricultural extension in future and the activities of such private sector and NGOs should be promoted.

7.6.4 Crop Budget

In order to preliminarily evaluate the economic feasibility of each proposed irrigation scheme, crop budgets of 'with' and 'without' project were prepared for rice, maize and beans. Beans were selected as typical irrigated crop other than rice and maize. "With-project" reflects the condition under which proper irrigation facilities with appropriate input supply and farmers' support services are provided. "Without-project", on the other hand, relates to the prevailing rainfed condition without any input supply and support services. Information collected in the field and from relevant agencies along with the data obtained from past similar studies was utilized for the preparation of the crop budget. The draft proposal was also carefully examined by the economist of the Department of Research and Development. The crop budget thus finalized is shown in Table 7.6.5 and the results were used for the evaluation of the economic feasibility of each proposed irrigation scheme.

7.7 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 consider 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 food so as to optimize the overall effect within the confinement of limited budget.

In a social environment in which decentralization is promoted, it is not an intention to deny the efforts made by respective regions to draw up and implement individual development plans. However, strengthening of ties between regions in an effort to complement each is an essential part of decentralization. Concerning food security in particular, it is very important for adjacent regions plagued by food scarcity or over-production to cooperate with each other and to complement each other. The mechanism is important from the point of view of mutual development as well. The decentralization can be promoted only with the mutual complement as a prerequisite. The enhancement of cooperation among sectors as well as regions is essential to enable the agricultural (irrigation) development to proceed

The irrigation development potential map indicates the High, Medium and Low Potential areas. The High Potential areas are located at Mbeya, Iringa, Morogoro, Kilimanjaro, Arusha and Mwanza.. Further selection of irrigation schemes shall be made in these High Potential areas locations.

7.8 Basic Plan for Scheme Implementation

Most of irrigation schemes in the Mainland have been implemented by the central government initiative, using the so-called "Top-Down System". However, this system is recently changed. In the government, the initiatives in irrigation development are gradually being transferred to the local governments. In irrigation schemes, the farmers' role is become more crucial as a leading player, and finally will be involved in the private sector which is expected to participate in and activate irrigation development.

In this process, however, the Central Government is still required to take an initiative for implementation of model type schemes, which will effect the direction in development of all irrigation schemes. These correspond to the pilot model scheme and river basin management scheme supported under ASPS-IC and RBMSIIP respectively. Such an approach will continue considering the importance of its role.

Possible implementation options for irrigation schemes are as follows:

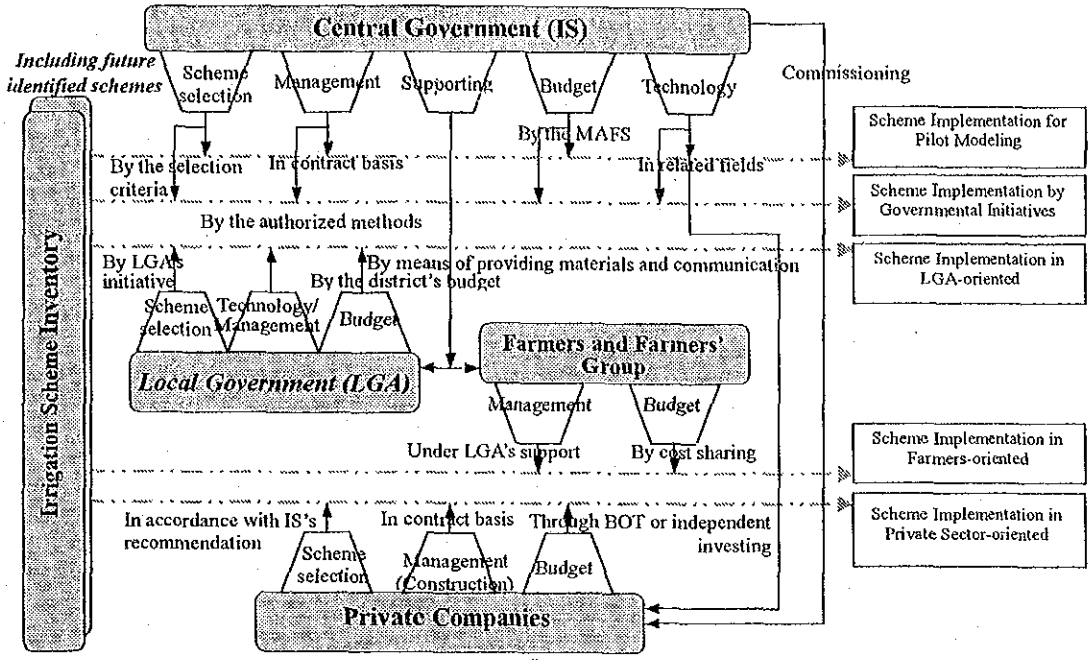
Implementation Options for Irrigation Scheme

Options	Characteristics	Examples
Scheme Implementation for Pilot Model Type	This option is to establish a replicable model of irrigation development scheme. In order to make the pilot model effective, extending efforts for the model effects is essentially required, after the establishment of the model. Prior to implementing the pilot model irrigation schemes within the NIMP, methodology on the pilot scheme establishment should be examined thoroughly	ASPS-IC, Mwega Irrigation Project etc.
Scheme Implementation by Central Governmental Initiatives Approach	This option is to implement the schemes which have a special objectives, or provide a significant benefit in magnitude and in quality.	Pawage Project, Madibila Project, RBMSIIP etc.
Scheme Implementation by LGA-oriented Approach	This option is to implement by LGAs' initiatives with few intervention of central government for the common schemes, which are controllable by the LGAs.	*No examples so far*
Scheme Implementation by Farmers-oriented Approach	This option is individual irrigation practice of farmers on a small scale. Required involvement from the public organizations is not direct intervention but technical assistance.	Widely seeable in local
Scheme Implementation by Private Sector-oriented Approach	This option is, for instance, to implement irrigation scheme by BOT basis. The schemes are required to gain certain profit for worth business.	Kilombero Irrigation Project (planning)

As mentioned above, 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.

To start with, "Scheme Implementation by Governmental Initiatives" will be carried on at the same pace as usual in view of the national development policy. "Scheme Implementation for Pilot Modeling" should precede the remaining sorts of scheme implementation so as to lead success of irrigation development by means of giving a replicable model. As the decentralization progresses, the "Scheme Implementation in LGA-oriented Approach" should spread in parallel with capacity building of LGAs and improvement of institutional circumstances. Concurrently, the "Scheme Implementation in Farmers-oriented Approach" should be executed. Finally, "Scheme Implementation in Private Sector-oriented" is expected to be gradually introduced in the possible sites and be established by the target year of the NIMP.

IS, LGAs, farmers and their groups, and private companies will participate in all irrigation scheme implementation as players. Relationships among them in irrigation development by implementation type are schematically shown as follows:



7.9 Priority Grouping of Inventorized Irrigation Schemes

7.9.1 Preparation of Criteria of Priority Ranking

(1) General

Several criteria/guidelines for scheme prioritization have been developed for such irrigation development programs as RBMSIIP, ASPS-IC, and PIDP so as to select suitable schemes to meet objective of the programme. Those criteria are facilitated so that the schemes can be evaluated by various aspects, such as technical factors, economical factors, environmental aspects, and social aspects. The criteria have been reviewed and two, criteria for screening schemes, and criteria for scheme prioritization, are proposed.

(2) *Criteria for screening of inventorized schemes*

Criteria for screening of the inventorized schemes are set up to examine the minimum qualification of the proposed irrigation schemes for implementation. The proposed schemes should have the following conditions:

Screening Criteria for Inventorized Schemes

	Item	Description
(a)	Needs of rehabilitation	The schemes requiring rehabilitation shall be selected.
(b)	Type of scheme	The smallholder irrigation schemes shall be selected.
(c)	*History of rehabilitation*	*No rehabilitation/improvement works has been conducted for* last 5 years shall be selected.
(d)	Availability of basic data	Basic data for scheme prioritization shall be available for prioritization.

(3) Criteria for prioritization of inventorized schemes

(a) Factors for Prioritization

In due consideration of five elements for sustainability of the irrigation development as mentioned in Sub-clause 7.2.3, prioritization of the inventorized irrigation schemes are carried out from the following viewpoints:

- Technical Factors
- Economic Factors
- Environmental Factors
- Ease of Implementation
- Social Factors
- Regional Condition

(b) Technical Factors

The schemes shall be evaluated in technical viewpoints, such as slope, possibility of salinity and alkalinity problem in soil, occurrence of flood, and drainage problem.

(c) Economic Factors

The level of economic viability can be represented by EIRR. EIRR may be supplemented by size of potential area and water abstraction method. In addition, financial viability of farmers can be considered based on incremental benefits with irrigation.

(d) Environmental Factors

The schemes shall be prioritized according to possibility of environmental status, such as sedimentation, water-borne diseases, and water quality.

(e) Factors for Ease of Implementation

The ease of implementation for each scheme shall be evaluated based on accessibility to the site, including distance from main road and road condition in wet season.

(f) Social Factors

The readiness for implementation shall be directly related to the social aspects such as formation of farmers' organization for irrigation, farmers' abilities for operation and maintenance of the schemes, existence of water right, because these factors are fundamental requirement for commencement of the rehabilitation / construction works.

(g) Regional Conditions

The objective of NIMP in line with that of ASDS is to realize the

sustainability of irrigation development through effective use of national resources, and it consequently contributes to regional food security and poverty reduction. Regional condition of those factors, such as development potential, regional self-sufficiency ratio of food crop, and poverty index, shall be assessed for prioritization of schemes.

Considering the above, the criteria for prioritization are prepared, as shown in the following page:

Criteria for Scheme Prioritization

Factors for Evaluation			Points
A	Technical Factors (15 points)	1. Slope (4 points)	
		(a) Flat (less than 0.5%)	4
		(b) Mild (0.5 - 2.0%)	3
		(c) Moderate (2.0 - 4.0%)	2
		(d) Steep (more than 4.0%)	1
		2. Salinity / Alkalinity of Soil (7 points)	
		(a) Observed	0
		(b) Not observed	7
		3. Damage by flood (2 points)	
		(a) Observed	0
		(b) Not observed	2
		4. Drainage Problem (2 points)	
		(a) Observed	0
		(b) Not observed	2
2	Economic Factors (30 points)	1 Size of potential area (7 points)	
		(a) Less than 500 ha	2
		(b) 500 - 1000 ha	4
		(c) 1000 - 2000 ha	5
		(d) More than 2000 ha	7
		2. Water abstraction method (8 points)	
		(a) Gravity	8
		(b) Pump	2
		3. EIRR (10 points)	10
		(a) Less than 8.0%	1
		(b) 8.0 - 12.0 %	3
		(c) 12.0 - 16.0 %	5
		(d) 16.0 - 20.0 %	7
		(e) More than 20.0 %	10
		4. Financial Viability (5 points)	5
3	Possibility of Environmental Status Factor (10 points)	1. Sedimentation (5 points)	
		(a) Serious	0
		(b) Fair	1
		(c) Little	4
		(d) None	5
		2. Water-borne Diseases (2 points)	
		(a) Serious	0
		(b) Fair	1
		(c) None	2
		3. Water quality (3 points)	
		(a) Serious	0
		(b) Fair	1
		(c) Little	2
		(d) None	3

4	Ease of implementation (5 points)	1 Accessibility to site	
		(a) Serious	5
		(b) Fair	3
		(c) Little	1
5	Social Factors (20 points)	1. Organization set-up (2 points)	
		(a) Established	2
		(b) Not yet established	1
		2. Establishment of O&M committee (2 points)	
		(a) Organization set-up	2
		(b) Not yet established	0
		3. Linkage with village (1 point)	
		(a) Good	1
		(b) Poor	0
		4. Operation body of schemes (3 points)	
		(a) Farmers' organization	3
		(b) Other bodies	1
		5. Training for O&M (2 points)	
		(a) Satisfactory	2
		(b) Not satisfactory	1
		6. Maintenance of scheme (1 point)	
		(a) By Farmers' organization	1
		(b) By Other bodies	0
		7. Existence of water right (8 points)	
		(a) Existence	8
		(b) Non-existence	0
		8. Average farm size (1 point)	
		(a) 0 – 1.0 ha per household	1
		(b) Others	0
6	Regional condition (20 points)	1. Development ratio (3 points) (existing irrigated area / potential area)	
		(a) Less than 30%	3
		(b) 30 – 60%	2
		(c) More than 60%	1
		2. Self-sufficiency ratio of food crop (10 points)	
		(a) Less than 20 %	10
		(b) 20 – 40 %	8
		(c) 40 – 60 %	6
		(d) 60 – 80 %	4
		(e) More than 80 %	2
		3. Poverty index (BHN) (7 points)	
		(a) More than 40	7
		(b) 30 - 40	5
		(c) 20 - 30	3
		(d) Less than 20	1

7.9.2 Analysis of Inventorized Schemes for Priority Grouping

(1) General

The answered questionnaires in the inventory survey involve a lot of questionable data or are completely lacking in such basic data as potential irrigable area, project costs, which are needed to estimate irrigation benefit as well as EIRR. In order to solve the problem, cross checking and supplementary data were required. In particular, development costs, irrigation benefits and Economic Internal Rate of Return (EIRR) were crosschecked and supplemented.

(2) Estimate of Rehabilitation / Construction Cost

Estimate of the project cost are assumed classifying the grades of rehabilitation or construction into four categories.

Classification of the Inventorized Scheme by Type of Construction / Improvement Works

Category	Diversion Weir	Irrigation Canal
Category 1	No need for rehabilitation	To be rehabilitated
Category 2	To be rehabilitated	To be rehabilitated or no need
Category 3	To be constructed / replaced	To be rehabilitated or no need
Category 4	To be constructed / replaced	To be constructed / extended

Source: JICA Study Team

The project costs for rehabilitation, improvement and construction for each category were assumed and supplemented based on the previous performance of irrigation development and the Guideline of Irrigation Development Level described in Clause 7.4.

Unit Project Costs by Type of Water Abstraction **Unit : US$/ha**

Type of Irrigation	Category 1	Category 2	Category 3	Category 4
Traditional Irrigation	1,500	2,000	2,500	3,000
Water Harvesting	500	1,000	1,200	1,500
Modern Irrigation	2,000	3,000	4,000	5,000
Improved Traditional Irrigation	2,000	3,000	4,000	5,000

Source: JICA Study Team

(3) Estimate of Irrigation Benefits

The irrigation benefits were defined as the difference of net crop production values between future with and without project conditions, and were calculated according to the flowing equations.

- Net crop production values =
  {(unit yield of paddy x economic farm gate prices) – production cost per ha}
  + {(unit yield of maize x economic farm gate prices) – production cost per ha }
  + {(unit yield of beans x economic farm gate prices) – production cost per ha }
- Irrigation benefits =
  net crop production value (under with-project conditions)
  - net crop production value (under without-project conditions)

The proposed cropping pattern and crop budget for each crop are based on the Basic Plan for Agricultural Development in Clause 7.6.

(4) Calculation of EIRR

EIRR for each scheme was calculated on the basis of supplemented costs and estimated benefits under the following basic assumptions:

- Conversion factor to economic construction cost is 0.8.

- Conversion factor of agricultural inputs and labour force are based on the report on "The Study on the Smallholder Irrigation Projects in Central Wami River Basin, Morogoro" in 1998.
- Economic annual O&M cost is 0.5 % of the economic construction cost,
- Constriction period is 3 years for small-scale schemes, 4 years for medium-scale schemes, and 5 years for large-scale schemes,
- Build-up period is 3 years after completion of construction works
- Project economic life is 50 years for the large-scale schemes, 15 years for the water harvesting schemes, and 30 years for the other categories of the schemes.
- Replacement cost is estimated at 1% of the economic construction cost in every 10 years after completion of the construction works.

The supplemented financial cost data were converted to economic costs by applying a conversion factor of 0.8.

7.9.3 Priority Grouping of Inventorized Schemes

(1) Objectives

Priority grouping of the inventorized schemes aims to facilitate the formulation of a 15-year scheme-wise development programme for the NIMP. In order to utilize the nation's endowed resources effectively for irrigation development, the proposed schemes should be investigated, planned, designed and implemented in a proper manner in accordance with the proposed criteria, and only those schemes that will pass the screening criteria should be allowed to proceed for implementation.

The implementation schedule of NIMP should therefore be based on the priority groupings which will classify the inventorized schemes into 5 groups ("A" group to "E" group.)

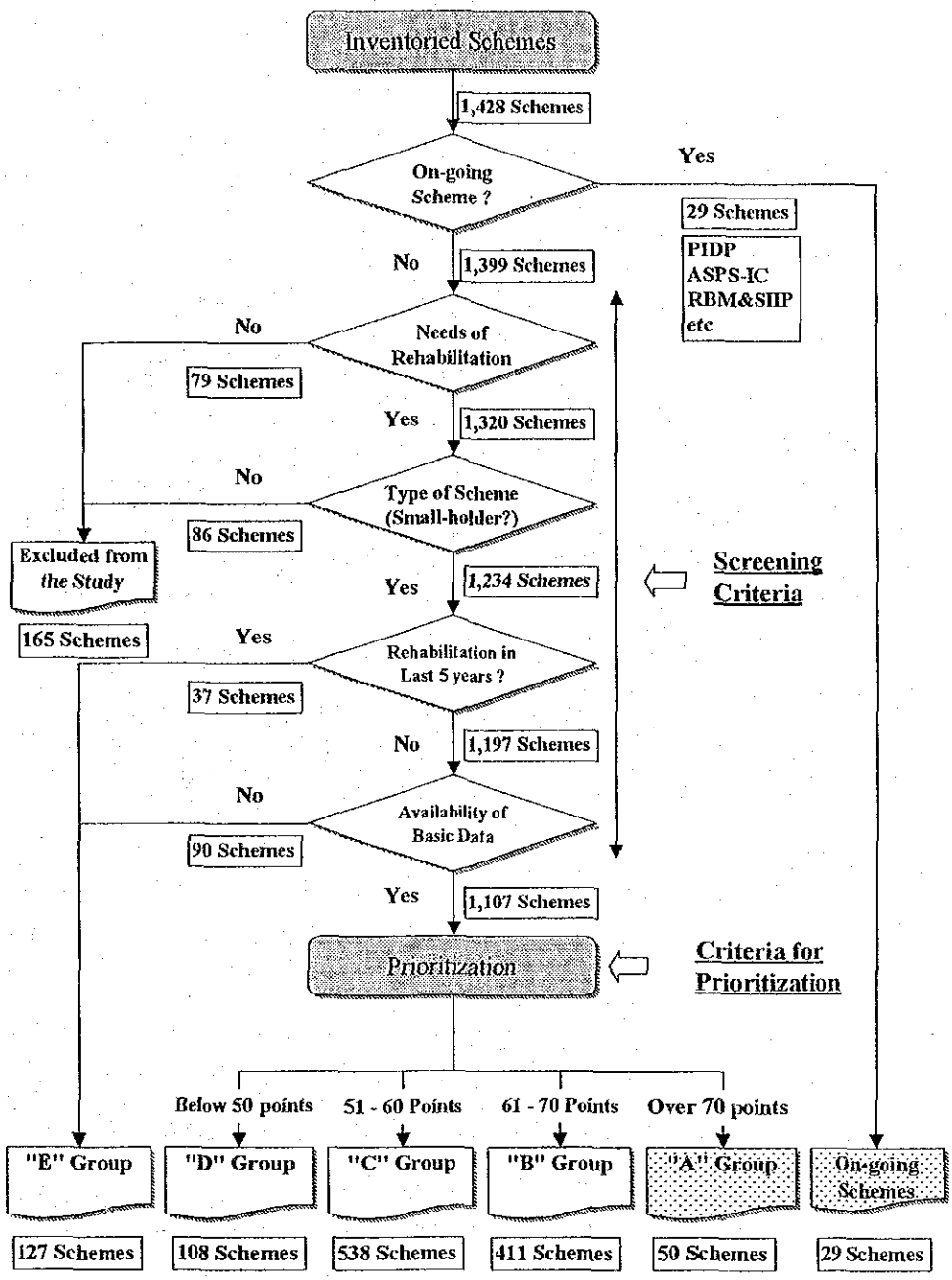
(2) Method and Process of Priority Grouping

The inventorized schemes are classified into three priority groups through the assessments of the following factors:

- Present status of schemes,
- Needs of rehabilitation,
- Management type of schemes,
- History of rehabilitation/improvement,
- Availability of basic data
- Prioritization of schemes

The workflow of the priority grouping is shown below.

Priority Grouping of Inventoried Schemes



Present status of schemes

Among the inventorized schemes, the schemes, which are under implementation or are committed to be implemented, are confirmed. The implementation schedule for those schemes shall be reflected in the NIMP.

- On-going or committed schemes : 29
- Other schemes : 1,399

Necessity of rehabilitation

Schemes which have been recently constructed or rehabilitated, or well functioning and do not require rehabilitation/improvement works, are to be excluded from the list of schemes for implementation under the NIMP. The schemes requiring rehabilitation works are further examined for the priority grouping.

- Schemes not requiring rehabilitation works : 79
- Schemes requiring rehabilitation works : 1,320

Management type of schemes

In line with the approach of the NIMP, aiming finally to improve productivity of smallholders through rehabilitation of irrigation infrastructure, the NAFCO and private schemes are to be excluded from the list of schemes for implementation under the NIMP. The 1,320 schemes requiring rehabilitation works are further examined for the priority grouping.

- NAFCO and private schemes : 86
- Smallholder irrigation schemes : 1.234

History of rehabilitation/improvement

The schemes, where rehabilitation/improvement works were carried out in last 5 years, are excluded:

- Rehabilitation in last 5 years : 37
- No rehabilitation in last 5 years : 1,197

Availability of basic data

Availability of the basic data should be checked before prioritization of the schemes is carried out in the light of the "criteria for prioritization". A check of data availability is made for the above 1,197 schemes. The data required are as follows:

- Name and location of scheme
- Present irrigated area and potential area
- Description of rehabilitation/improvement

The number of schemes to meet the above condition is 1,107

Prioritization according to the criteria

1,107 schemes are classified into four groups according to the criteria for prioritization as shown right:

Criteria for Prioritization

Points	Group
Over 70	" A" Group
61 - 70	" B" Group
51 – 60	" C" Group
Below 50	" D" Group

7.9.4 Results of Priority Grouping

(1) "A" to "D" Groups

Among the inventorized schemes, 50 schemes are finally as the "A" Group (schemes to be implemented) through the following steps:

	Nos. of Schemes
- No rehabilitation work is in progress	: 1,320
- They are smallholder irrigation schemes	: 1,235
- No rehabilitation work has been conducted for 5 years	: 1,198
- Basic data for prioritization are available	: 1,107
- "A" Group	(50)
- "B" Group	(411)
- "C "Group	(538)
- "D" Group	(108)

(2) "E" Group:

The "E" group (schemes to be investigated) consists of 127 schemes. These schemes have one or more of the following characteristics:

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

The results of the priority grouping are summarized as follows:

Summary of Priority Grouping

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

(3) 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.	Potential Area (ha)	Region	Nos.	Potential 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	34	1,750
Total	**50 nos. and 34,783 ha (34,800 ha)**				

7.10 Alternative Study for Development Target

(1) Available Budget for Development

In Sub-clause 7.3.2, the available budget for irrigation development is projected 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 available budget for initial/development fund is tabulated below:

Projected Initial/Development Budget

Case	'03	'04	'05	'06	'07	'08	'09	'10	'11	'12	'13	'14	'15	'16	'17
High[1]	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
US$[2]	18.7	20.0	21.4	22.8	24.4	26.0	27.8	29.8	31.8	34.0	36.4	38.9	41.7	44.6	47.7
Base[1]	14.8	15.7	16.6	17.6	18.6	19.7	20.9	22.1	23.4	24.8	26.3	27.8	29.5	31.3	33.2
US$[2]	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
Low[1]	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
US$[2]	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

1 : Billion Tsh., 2 : Million US$

(2) Possible Irrigation Development Areas by 2017

Taking into consideration the analysis results of inventory survey discussed in Clause 5.2, the possible irrigation development areas by 2017 are calculated for 3 cases as follows:

Irrigation Development Areas by 2017

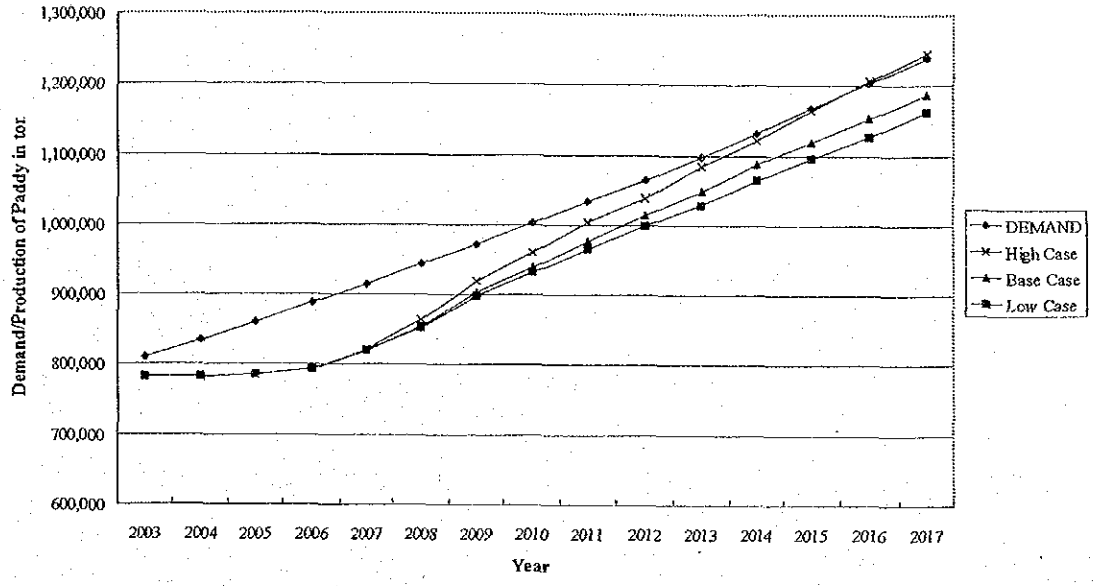
Case	'03	'04	'05	'06	'07	'08	'09	'10	'11	'12	'13	'14	'15	'16	'17
High[1]	218	229	239	250	265	276	281	294	312	325	337	352	372	387	405
Base[1]	218	228	236	243	254	264	271	278	290	304	316	325	335	351	362
Low[1]	218	222	234	240	248	261	268	274	287	296	306	321	328	337	350

1 : Thousand ha

(3) Comparison with Future Demand of Rice

The possible production of paddy was calculated for the above 3 cases in view of the built-up period. The table below shows comparison 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 by 2017 subject to proper agricultural input supply. Those areas under Base Case will fall short as will those under the Low Case. Since it is deemed that the High Case would be within procurable extent, and also taking into consideration that the High Case had a high probability of meeting 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.

As shown in the table of conditions of sensitivity analysis in Sub-clause 7.3.2, Low Case means the application of current financial situation to the irrigation development. If such financial situation continues in the future, the GOT would face the severe deficit of paddy. It is therefore expected that the GOT will arrange the budget for High Case.