CHAPTER VII. IRRIGATION-BASED AGRICULTURAL DEVELOPMENT PLAN ON THE PRIORITY SCHEMES

7.1 Development Target of the Project

7.1.1 Potential of Irrigation-based Agriculture Development

(1) Land Resources

The land suitability classification for assessment and demarcation of irrigable area in each scheme was made according to the specific criteria which have been prepared during the master planning stage in 1996 with reference to the "Guidelines: Land Evaluation for Irrigated Agriculture" published by FAO (1985) and the Tanzanian system for paddy irrigation, as well as taking into account the land, soil and agricultural conditions in the Central Wami River Basin. After examination of all the elemental factors, the following land suitability classes and/or sub-classes are applied to the final judgment of land suitability for irrigation development both for paddy and upland crop production:

Land Suitability Classes and Sub-classes

Order	Class	Sub-class
Suitable (SR, SU)	Higher Suitable (SR1, SU1)	SR1, SU1
	Moderately Suitable (SR2, SU2)	SR2nw, SU2f, etc.
	Marginally Suitable (SR3, SU3)	SR3tw, SU3f, etc.
Not Suitable (NR, NU)	Not Suitable (NR, NU)	NRm, NUr, etc.

Note: 1) R and U land class indicate paddy rice and upland crops respectively.
2) Subscripts in subclass indicate the nature of a requirement of limitation:
e.g. /nt and /wt for nutrients and on-farm

According to the above land suitability assessment, the arable land suitable for the irrigated farming in each scheme is demarcated as summarized below:

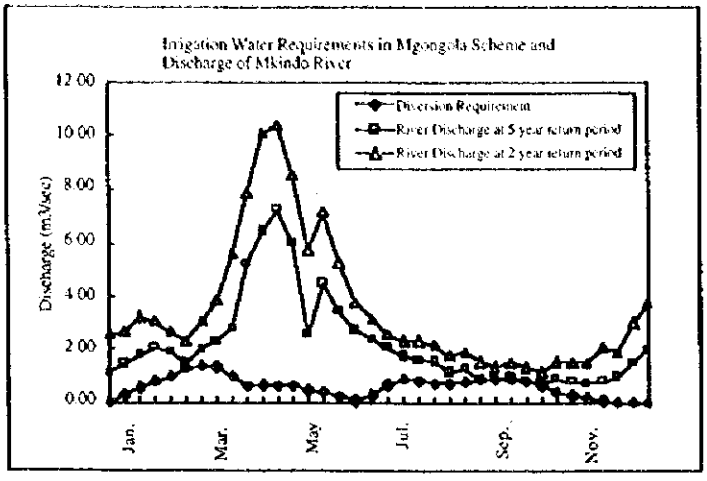
Areas by Land Suitability Classes

(Unit: ha)

Name of Scheme	Total Area	For Paddy Cultivation				For Upland Crop Cultivation			
		SR1	SR2	SR3	NR	SU1	SU2	SU3	NU
Mgeta	220	0	0	0	220	0	0	180	40
Mgongola	730	0	730	0	0	0	0	25	705
Mkula	175	0	145	27	3	70	75	30	0
Mwega	740	0	310	160	270	25	425	235	55

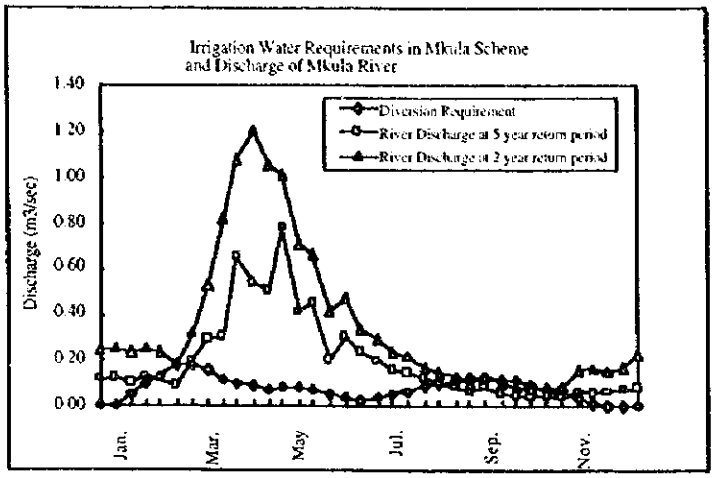
(2) Water Resources

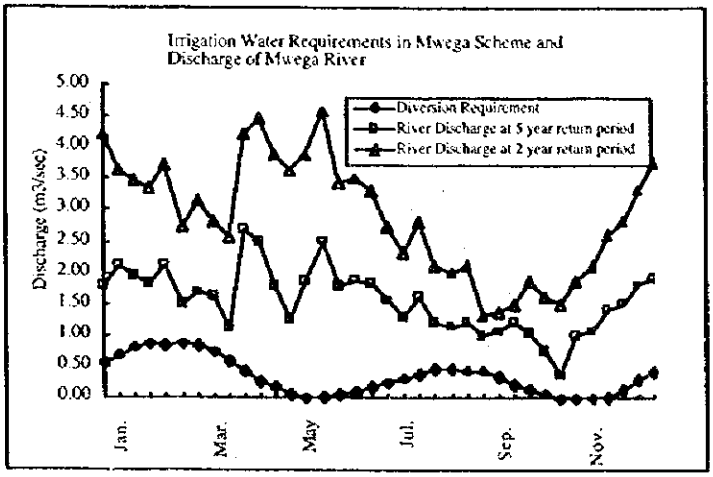
The Mgeta scheme depends on numerous small tributaries of the Mgeta river for irrigation water. As a whole, the water resources are judged to be sufficient, since the Mgeta river has plenty of water throughout the year but its water is not utilized.



The water source of the Mgongola scheme is the Mkindo river, while those of the Mkula and Mwega schemes are the Mkula river and the Mwega river, respectively. These rivers have no water users other than their respective schemes in their reaches.

In all the cases, the rivers have plenty of water in March and April, but the river discharge gradually decreases from May and reaches its lowest level in September/ October. Meanwhile, the irrigation water requirements in each scheme have two peaks in both February and September. September is the most critical season in the relation between water supply and demand.





As seen in the figure, the river water resources in the case of the Mgongola scheme are enough to meet the irrigation water demands under the conditions with the Project in the normal hydrological year and even during a drought with a 5-year return period. In the case of the Mkula scheme, the river flow satisfies the project irrigation water requirements in the average hydrological year but is clearly short against the requirement during a drought with a 5-year return period. Such a situation in the dry season requires an efficient and selective use of the limited water resources. In the case of the Mwega scheme, the river has plenty of water throughout the year.

(3) Human Resources

Farming activities of a household in the Study Area are carried out by the husband and wife and supported by all young members above 15 years old. The available family force carries out most of the farm work. As for the works requiring peak labor the most busy crop season, farmers help each other. If there is shortage of labor force, they might adjust the work duration to a certain extent. In the case of Malolo and Mgogozi villages, where farmers have developed the traditional irrigation furrow system and intensified the crop operation for production of onions, beans, tomatoes, etc., farmers employ seasonal labor from out-side the village to cover labor requirements.

The table below gives information on total population, number of households, average household size, average holding size, and working population for each scheme in the Study Area.

Demographic Data of Selected Schemes in the Study Area

Scheme	Total Population	No. of Households	Average Family Size	Working Population	Average Holding Size (ha)
Mgeta	8,500	1,700	5	3,910	0.80
Mgongola	8,470	1,694	5	4,225	1.62
Mkula	2,940	490	6	1,234	1.29
Mwega	5,265	741	7	2,862	1.28

Based on the figures shown above it would be possible to say that for the Mgongola and Mkula Schemes, the present holding size per household might be rather large compared with the family labor force. Thus, labor force availability may not be a problem when implementing the irrigation project. However, it will be necessary that in order to promote farming and/or crop diversification under the conditions with the Project, the youth must be organized into working groups either in-household or in-community in each village. To organize and use the expected large young population over 15 years old which will increase the labor force will be an important activity when implementing the Project.

It is also essential to upgrade the quality and/or skills of the labor force to accomplish the sustainable irrigation-based agricultural production. Thus, the Government should make efforts to provide facilities for basic technical education for the youth and improve the technical level of the extension officers.

7.1.2 Development Target of the Project

Considering the potential of irrigation-based agriculture development in each scheme, the development targets of the Project are set up as summarized below:

Scheme	Useful Water Resources (m^3/s by 1/5)	Suitable Land for Development (ha in gross)	Existing Irrigated Land (ha in net)	Targeted Irrigable Area	
				Rainy Season	Dry Season
Mgeta	0.01	69	18	30	30
Mgongola	0.75	730	60	620	
Mkula	0.04	175	1	149	149
Mwega	0.70	740	447	580	580
Total		1,714	526	1,379	759

7.2 Agricultural Development Plan

7.2.1 Proposed Land Use

The proposed land use in each scheme area is prepared according to the following basic concept:

- To utilize the land resources at maximum extent possible;
- To optimize the present land use for staple food as well as economic crop production as much as irrigation water resource is available in the scheme area;
- To give due consideration to the present land use; and
- To protect/conserve the natural environment and hence to maintain sustainable agricultural production activities.

With reference to the results of land suitability classification, the present land use has been reviewed precisely, and then, the proposed land use under the conditions with irrigation development is prepared as follows:

Proposed Land Use in Each Scheme Area

(Unit: ha)

Scheme	Land Use Type	Present	Proposed	Remarks
Mgeta	Upland field	140	140	
	Grassland	45	45	the land should be subject to afforestation
	Forest/Woodlands	30	30	
	Settlement/Right-of-ways	5	5	canals, roads/footpaths, residential yards
	Total	220	220	
Mgongola	Paddy field	580	620	including existing pilot farm; drainage, flood protection and ridge
	Grass/Bush lands	130	0	construction will be developed into
	Settlement/Right-of-ways	20	110	paddy land canals, roads and flood
	Total	730	730	protection dike
Mkula	Paddy field	108	100	upland crops in the dry season
	Upland field	42	39	
	Sugarcane	11	10	
	Forest/Woodlands	10	10	
	Settlement/Right-of-ways	4	16	canal, roads, drain, etc.
	Total	175	175	
Mwega	Paddy field	210	240	upland crops in the dry season
	Upland field	340	340	
	Pasture land	35	0	will be developed to paddy land
	Forest/Woodlands	35	35	
	Swamp/River	65	65	unarable land
	Settlement/Right-of-ways	55	60	canals, roads, drains, etc.
	Total	740	740	

Note: Forest/Wood lands included lands planted with mango, coconuts or banana.

7.2.2 Approach for Improvement of Current Agricultural Situation

In principle, the Project will aim at implementation of sustainable agricultural development and increase of farm income, resulting in improvement of farmers' living standard. In order to attain this goal, the current agricultural activities should be improved successfully, considering the following farmers' intentions and limiting factors in agricultural activities:

(1) Farmers' Intentions on Agricultural Development

The Study Team arranged several group discussions with various types of villagers concerned such as female farmers, male farmers, and key persons in the village community. Through the group discussions, it was clarified what farmers really desire to do for the future development and how they achieve the improvement of agricultural situation. Moreover, the Team tried to reach a consensus with farmers concerning major features of agricultural development, and encourage them to participate in the implementation of the Project.

Major topics in group discussions concerning agricultural development in each scheme are summarized as follows:

1) Mgeta scheme

- Water volume in the rainy season is sufficient, but water shortage occurs in the dry season.
- Club root disease of cabbage is an important disease.
- Quality of commercial seeds is not acceptable.
- Price of commercial seeds is expensive.
- Price of farm products fluctuates season by season and is low.

2) Mgongola scheme

- Advanced farming practices of Special Programme - FAO should be disseminated to the whole project area.
- Transplanting method is more preferable than broadcasting method.
- Quality of Line 88 is not stable.
- Quality seeds should be supplied.
- Miscommunication between farmers and tractor owners exists.
- Farm inputs are not available in time and are expensive.
- Price of farm products fluctuates season by season and is low.

3) Mkula scheme

- A high yielding variety of paddy should be cultivated instead of the local one.
- Pulse cultivation is desired, but difficult due to attack of insects and/or diseases.
- Miscommunication between farmers and tractor owners exists.
- Fertilizer is available, but expensive.
- Price of farm products fluctuates season by season and is low.

4) Mwega scheme

- Cultivated area of onion and paddy should be expanded.
- Quality of seeds is not acceptable in general.
- Fertilizer is available, but expensive.
- Price of farm products fluctuates season by season and is low.
- Agro-chemicals are not available in time.

(2) Improvement of the Current Agricultural Situation

Considering farmers' intentions and conceptions obtained through the group discussions and field investigation, it is proposed that the following approach be applied in order to improve the current agricultural situation:

1) Practice of rotational cropping

In the case of paddy fields in the Mgongola, Mkula, and Mwega schemes, it is recommended to follow the cropping system of "paddy - upland crops rotation." When the field is used as paddy field under submerged condition after upland crops cultivation, air-drying effect will be expected. As a result, present soil fertility will be improved by change of the present situation of mineralization of soil organic substance, promoting decomposition of organic matters. Furthermore, suppression of insects and diseases, and further decrease of weeds are secondarily expected.

In the Mgeta scheme, club root disease (Plasmodiophora Brassicae) has been caused by continuous cropping of Brassica crops such as cabbage, Chinese cabbage, etc. It is necessary to undertake rotational cropping of Brassica crops with crops of other families such as lettuce, potato, etc., in order to reduce the occurrence of club root disease.

2) Promotion of utilization of organic matters

It is important to introduce compost in order to improve soil fertility. Especially, exhaustion of organic matters in upland fields is more active than in paddy fields. In the Mgeta scheme, farmers are suggested to apply a handful of compost per hill for vegetable cultivation.

It is known well that activities of green algae, blue-green algae, etc. are vigorous in submerged water of paddy fields. As a result, nitrogen fixation by those organisms are active in paddy fields. Ability of nitrogen fixation of "*Azolla*" is exceeded, so that it is possible to expect nitrogen fixation of 200 kg/ha per year. Application of "*Azolla*" has been introduced in the Mkindo pilot scheme of Mgongola scheme through the Special Programme - FAO, therefore mitigation of exceeding consumption of chemical fertilizer will be expected in the future.

In the Mwega scheme, there are no activities to use cow dung for improvement of soil fertility, although a number of cattle are kept by farmers. It is proposed to effectively use this cow dung for preparation of compost. Further, as they have no means for ferrying cow dung, it is also necessary to promote the introduction of carrying carts.

3) Promotion of group contact for hiring farm tractors

Farmers concerned in the Mgongola and Mkula schemes hire farm tractors for land preparation. Currently, they individually contact with tractor owners whenever they need tractors for land preparation. It is reported that tractor owners are suspicious of farmers' words and deeds due to miscommunication, and further work efficiency of tractors must be low because the target area designated by farmers for land preparation is not clustered, but scattered.
In the future, tractor operation will be further required for plowing and transport of products in the Mgongola and Mkula schemes. As a result, demand of tractors would be highly concentrated in each season. That is, tractors for land preparation will be required during the period from December to February for the 1st cropping (rainy season) and from May to July for the 2nd cropping (dry season). Besides a certain number of tractors might be necessary for transport of products during the period from May to July for the 1st cropping and from October to December for the 2nd cropping. It is recommended that group contact is a better alternative to avoid miscommunication and arrange a proper schedule for tractor operation.

4) Promotion of on-farm seed production

Farmers have emphasized constraints and importance on supply of quality seeds. Namely, it is urged that supply of quality seeds is the most important factor to ensure success of the project implementation and further promote sustainable supply of foodstuffs to consumers.

It is reported that supply of quality seeds for major food crops is very limited in Tanzania. Ability of the seed industry in the formal sector such as government seed farms and seed companies is presently very low and can meet less than 10% of seed demand in the whole country. This means that more than 90% of local seeds required are produced by small scale farmers themselves without seed quality control.

Morogoro, Dodoma, and Iringa Regions were selected as pilot regions for the implementation of the programme. Therefore, a on-farm seed production programme will be commenced in those regions for production of seeds for such food crops as maize, sorghum, etc.

It is expected that technical support for seed production will be provided under the on-farm seed production programme mentioned above, in order to improve quality and secure sustainable supply of crop seeds for the four schemes.

5) Popularization of draught cattle

Popularization of animal power is not a fresh approach. Previously, trial operation of draught animals had been demonstrated in villages related with Mgongola, Mkula, and Mwega schemes, as a part of a mechanization programme under technical assistance of the Sokoine University of Agriculture (SUA). Those trials, however, were suspended due to the following constraints:

a) The structure of some instruments was weak compared with the soil condition, while some instruments were too heavy for handling.

b) Farmers in Mgongola and Mkula have no experience in keeping cattle.
c) A part of farmers were not so interested in the oxenization programme. Oxenization approach was tried on a top-down basis, not bottom-up basis.

On the other hand, under the Special Programme - FAO the similar approach has been promoted in the target villages and farmers have been trained on the use of draught animals and various implements for various farming practices, i.e. plowing, harrowing, weeding, ridging, etc.

In a village near the Mwega scheme, farmers carry out land preparation entirely by draught cattle for cultivation of onion and maize. The unit charge for land preparation by draught animals is roughly estimated at Tsh. 6,000 per acre which is extremely low compared with hiring charge of manpower in the Mwega scheme, which is Tsh. 15,000 per acre. This means that cost performance of draught cattle is quite better than manpower.

Utilization of farm tractors is essential for land preparation in the schemes, and furthermore, draught cattle will be used as a supplemental means in order to eliminate labour requirement for land preparation. Utilization of draught cattle is also important and efficient for promotion of organic agriculture. Popularization of draught cattle is required to be promoted based on the long-term strategy. Accordingly, a concrete programme for promotion of popularization of draught cattle will not be included in the development plan for the four schemes, but it is proposed that popularization of draught cattle be considered step by step after the project implementation.

7.2.3 Selection of Major Crops

Based on the results of group discussions with farmers and information obtained from the field investigation, farmers' intentions concerning prospective crops are summarized as follows;

	Mgeta	Mgongola	Mkula	Mwega
Prospective crops Rain season	Maize, pulse	Paddy	Maize, paddy	Maize, paddy
Dry season	Cabbage, potato, pulse	Paddy, maize, Pulse, vegetables	Maize, pulse, vegetables	Onion, maize, Pulse, vegetables
Remarks (Farmers' Intentions)	- In the future, promising market should be checked before starting the cultivation of new crops	- Inter-cropping is preferable - Demonstration is required for promising crops and farming practices - Shortage of vegetables - Upland crops as income source	- Sugarcane should be changed to another crop. - It is difficult to take out sugarcane completely because of its marketability. - Farmers lack knowledge on vegetable cultivation. - Beans should be included as a promising crop.	- Shortage of vegetables is to be solved. - Farmers lack knowledge on vegetable cultivation. - Farmers desire to expand the area of onion and paddy cultivation.

Concerning the selection of prospective crops, the farmers' intentions should be considered enough, and further the following conditions are also paid due attention:

a) To be major crops which are proposed in the National Agricultural Development Plan
b) To be relatively familiar to the farmers as well as extension officers concerned
c) To be acceptable to the farmers in view of farming practices
d) To use water resources effectively
e) To contribute maximum benefit to the farmers in the Project area

As described above, it is proposed that prevailing crops should be cultivated, and further a double cropping system should be adopted for the Project, as mentioned in the following sub-sections.

7.2.4 Proposed Cropping Pattern and Farming Practices

(1) Proposed Cropping Pattern

In preparing the proposed cropping pattern for the Project area, the following points were confirmed in the course of various group discussions and field investigation.

a) To minimize the crop water requirement

The periods of peak water requirement for paddy and upland crops should not overlap each other.

b) To consider the existing cropping pattern

The proposed cropping pattern should be acceptable to farmers, considering the familiarity of the farmers and extension officers concerned. Accordingly, it is not recommendable to introduce new crops to a large extent and drastically change the system of crop rotation.

c) To maximize utilization of irrigation water and cropping intensity

Effective use of irrigation water is strongly required in order to utilize the limited water resources and extend the irrigation area to the maximum. Furthermore, cropping intensity is proposed to be raised up to 200%, aiming at future sustainable prosecution of the proposed farming practices. High cropping intensity of over 200% is not practicable in the Project area, from the viewpoint of growth period of promising crops, occurrence of insects and diseases, farmers' familiarity, labour productivity, and water management, etc.

The proposed cropping patterns illustrated in Figure 7.2.1 satisfactorily meet all the requirements and conditions mentioned above.

(2) Cultivated Area and Cropping Intensity

In the Mgeta scheme, supplemental irrigation in the rainy season will be ensured, while irrigation efficiency in the dry season will be improved. In such other schemes as Mgongola, Mkula, and Mwega schemes, supplemental irrigation in the rainy season will be ensured fully, while sufficient irrigation water is available during the dry season. The

cultivated area by crop and cropping intensity under without and with project conditions are shown in Tables 5.3.1 and 7.2.1 respectively and summarized below.

Cultivated Area and Cropping Intensity

	Without Project Condition				With Project Condition			
	Project area (ha)	Cultivated Area (ha) RS	DS	Cropping Intensity (%)	Project area (ha)	Cultivated Area (ha) RS	DS	Cropping Intensity (%)
Mgeta Scheme								
Maize/Pulse*1		30	0			30	0	
Cabbage		0	6			0	6	
Potato		0	3			0	3	
Pulse		0	9			0	21	
Total	30	30	18	159	30	30	30	200
Mgongola Scheme								
Paddy		580	40			620	310	
Upland crops		0	0			0	310	
Total	580	580	40	107	620	620	620	200
Mkula Scheme								
Paddy		108	0			108	0	
Maize/Others*1		42	40			0	0	
Maize/Pulse*1		0	0			41	108	
Pulse/ Vegetables*2		0	0			0	41	
Sugarcane		11	11			0	0	
Total	161	161	51	132	149	149	149	200
Mwega Scheme								
Paddy		210	0			240	0	
Maize/Pulse *1		266	114			340	136	
Pulse		0	70			0	0	
Onion		0	182			0	444	
Total	550	476	366	153	580	580	580	200

Remarks : RS: Rainy Season, DS: Dry Season
*1: Maize is a predominant crop.
*2: Pulse is a predominant crop.
Without-project condition is the same condition as the present one.

(3) Proposed Farming Practices

The present farming practices applied out in the Project area are likely to be of extensive cultivation, namely no application of fertilizer and agro-chemicals as well as low input of labour force are common. Proper farming practices are adopted to take effect of irrigated agriculture and promote increase of crop production, based on the proper application of farm inputs. That is, it is indispensable to apply quality seeds of high yielding varieties or improved varieties with proper dosage of fertilizer and agro-chemicals under such sufficient supporting services as extension, credit, research, etc., in order to expect highly effective impacts from the Project.

It is not practical to recommend ideal farming practices which are entirely different from the current farming practices. Each component of the proposed farming practices should be formulated considering the present situation of availability of machinery and animal power, labour requirement, etc., based on the guideline on farming practices which are proposed by the agricultural extension office.

Fertilizer and organic materials should be applied more effectively than in the current situation, from the viewpoint of sustainability of soil fertility and increase of crop

production under irrigated condition. Dissemination of application of agro-chemicals to the farmers should be paid careful attention. It is noted that farmers are aware of the effect of agro-chemicals, however most of them have no sufficient knowledge on identification of pests and diseases and proper application of agro-chemicals.

Extension officers are required to give guidance on proper farming practices to farmers and to manifest the effect of proper application of farm inputs under irrigated condition. As one of extension tools, it is strongly recommended that a demonstration plot be created to demonstrate effectiveness of proper farming practices to farmers concerned.

The proposed farming practices for major crops are elaborated in Section 3.3.4 of Divisions 2 to 5 and summarized as follows:

Summary of Proposed Farming Practices

	Paddy	Maize	Onion
Variety	HYV (Line 88, etc.)	STAHA, TMV 1	Red Creole
Seed amount	40 to 50 kg/ha	20 to 25 kg/ha	5 to 6 kg/ha
Fertilizer			
N	80	30	60
P	25	20	40
K	0	0	0
Planting density	10 cm x 10 cm ~ 10 cm x 20 cm	70 cm x 90 cm ~ 70 cm x 100 cm	10 cm x 10 cm ~ 20 cm x 20 cm

	Cabbage	Potato	Pulse
Variety	Copenhagen	Cherokes, Chipewa	Cow pea, Garden pea, soybean
Seed amount	200 g/ha	800 kg/ha	20 kg/ha
Fertilizer			
N	40	30	40
P	30	30	0
K	0	0	0
Planting density	50 cmx 70 cm ~ 70 cm x 90 cm	50 cm x 70 cm ~ 70 cm x 100 cm	70 x 90 cm ~ 70 cm x 100 cm

7.2.5 Anticipated Crop Yield and Production

When the Project is implemented, it is expected that the yield of crops will be sustained at a certain higher level under proper management of irrigation water, application of proposed farming practices, and enhancement of agricultural support services. On the contrary, in the case the Project is not implemented, it is conceived that the present yield would almost not be improved, considering the past trend of crop production in Morogoro Region.

The crop yields under the conditions without and with project were estimated as follows:

Unit Yield of Major Crops by Scheme

(Unit: ton/ha)

Scheme/Crops	Without	With
(1) Mgeta scheme		
Maize	1	3
Pulse	0.7	1.5
Cabbage	10	15
Potato	3	6
(2) Mgongola scheme		
Paddy (Mkindo pilot scheme)	3.8	5
Paddy (Mgongola area)	1.6	5
Maize	-	3
(3) Mkula scheme		
Paddy	2	5
Maize	1.5	3
Pulse	-	1.5
(4) Mwega scheme		
Paddy	2	5
Maize	1.5	3
Pulse	0.8	1.5
Onion	10	15

The target yields of the prospective crops described above were estimated based on the available information obtained from regional offices and research stations.

Production in each irrigation scheme under without and with project conditions is shown in Tables 5.3.1 and 7.2.1, respectively, and is summarized as follows.

Incremental Crop Production of Major Crops by Scheme

(Unit: ton)

Scheme/Crops	Present/ Without Project	With Project	Increment
(1) Mgeta scheme			
Maize / pulse *1	30	90	60
Cabbage	60	90	30
Potato	9	18	9
Pulse	7	32	24
(2) Mgongola scheme			
Paddy (Mkindo pilot scheme)	456	4,650 *3	3,362 *3
Paddy (Mgongola area)	832	-	-
Cereal crops / vegetables *1	-	930	930
(3) Mkula scheme			
Paddy	216	540	324
Maize	123	447	324
Pulse / vegetables *2	-	62	62
(4) Mwega scheme			
Paddy	420	1,200	780
Maize / pulse *1	570	1,428	858
Pulse	56	-	-56
Onion	1,820	3,390	1,570

Note)
*1: Maize is applied as representative crop.
*2: Pulse crop is applied as representative crop.
*3: Including Mkindo pilot scheme and Mgongola area.

7.2.6 Marketing Plan for Agricultural Commodities

At present farmers cannot negotiate prices with traders. The trader fix a price and it is up to the farmer to accept or reject it. Most of the time, due to the fact that the trader could always find a farmer who will accept his price, the farmer is forced to accept it.

This problem arises because the farmers do not present a united front to the traders at the moment of negotiating the price; individual farmers are powerless to negotiate under the present condition.

Therefore, in order for the farmers to have a market power when negotiating prices with the dealers, they need to get together and organize themselves under one union. WUG could play that role.

It is important that WUG provides storage facilities both for inputs to be purchased and for products of its members to be sold to traders. If products are not kept under a same place, there is always the risk that a member could unilaterally negotiate with a trader breaking the unified stance on price negotiation. Sub-section 7.3.3 gives a general layout of the proposed marketing system to be used for the implementation of the marketing plan.

Another aspect to be considered and which would give a leverage power to the farmers is the upgrade of quality of products. WUG should encourage farmers by providing them with technical assistance of VEOs. By upgrading the quality of the products of its members, WUG could negotiate better prices with the traders.

7.2.7 Optimal Land Holding Size

In the Mkula and Mgongola schemes, land reclamation (transforming some extensions of rainfed areas will be transformed into irrigable area) and the construction of new irrigation facilities will be carried out through the implementation of the Project; land allocation has been done on a traditional basis and titling is not a clearly settled matter. For the Mwega and Mgeta schemes, neither land reclamation nor new irrigation development will be carried out; only rehabilitation works will be implemented; land titling had also already been settled. Reallocation of new irrigable land in Mkula and Mgongola coming from the land reclamation is possible and recommended.

The next step is to determine which would be the optimal land holding size to be reallocated. For the determination of the optimal land holding size, two factors must be taken into consideration: one, the Government policy concerning irrigation development states that the benefits accrued from the development must reach all the members of the related community; two, the reallocated land holding size must be adequate enough to satisfy the "payability" requirement that the reallocated plot must be capable to cover the production cost, taxes and duties, operation and maintenance cost, and amortization cost of a hypothetical loan incurred to cover investment costs in the scheme.

The optimization process for the determination of the land holding size from the financial point of view has been made through the "capacity-to-pay" analysis as elaborated in sub-section 8.2.2 of Chapter 8.

On the other hand, taking into consideration the government's policy of sharing the irrigation benefits among all the members of the related community, the principle of even distribution has been applied; this mean to equally distribute all reallocable land among the all the households representing the whole community. As a result of the optimization process analysis results and the application of the even distribution principle, it is recommended that 0.30 ha per household should be distributed in Mkula scheme and 0.36 ha per household in Mgongola scheme. Even though the sizes are small, they are financially feasible as shown by the "capacity-to-pay" analysis.

7.3 Irrigation Development Plan

7.3.1 Development Concept

As stated in Chapter VI, "Farmer's participatory approach to the Project" is a key subject for irrigation development. It requires both GOT and beneficiaries to collaborate with each other to establish self-sustainable projects. Under this approach, the beneficiaries were involved in this Study, and will be principally involved in design, construction activities and full responsibility of operation and management matters. Also, "environment-friendly development" is a key subject to maintain the development schemes.

Based on the above approach to the Project, the following concepts are especially taken into account in the irrigation development plan:

1) Irrigation and drainage facilities shall be easily maintained and operated by beneficiaries themselves.
2) Materials locally available in and around the project areas shall be used as much as possible for construction of facilities.
3) Irrigation and drainage facilities shall be so designed, operated and maintained as to get rid of or not to cause water-borne diseases as much as possible.
4) Simple design shall be applied as much as possible for easy rehabilitation.
5) Small facilities shall be constructed by beneficiaries using locally available materials as much as possible.

Based on the above basic concept and also reflecting the beneficiaries wishes, irrigation development plans for the priority development schemes are formulated. Major criteria concretely applied in the formulation of development plans are as follows:

As for the headworks, most important points are the control of diversion discharge and the flood release through the weir. Thus, the headworks should be designed so as to divert the required amount of water within the allowable limit without adjusting the inlet opening, even if the river water level fluctuates or is raised by flood. Also a fixed overflow type weir which can release flood without any operations should be adopted in principle.

As for the irrigation system, it should be connected to the drainage system so that excess water in the irrigation canal can be drained automatically to the drainage system. By applying this system, the major irrigation canal system can convey water at a constant discharge level without frequent operations.

Canals should be primarily of trapezoidal cross-sectional type, which is basically earth-oriented. Major irrigation and drainage canals should be designed so as to maintain a flow velocity of more than 0.6 m/s for preventing the breeding of parasites causing water-borne diseases. Also, from the maintenance point of view, the major irrigation canals should be lined with concrete.

Small canal-related structures should be designed uniformly as much as possible. Offtakes and checks provided on irrigation canals will be equipped with stoplog guides only since steel gates are easily ruined and have actually deteriorated in most of the schemes. Livestock water basins and washing steps should be provided as required and at convenient points.

From the irrigation operation point of view, a non-water supply period should be set up in October and/or November, when the irrigation water requirements are the least. During this period, all water in the irrigation canal systems should be completely drained and the canals dried up, and damaged portions of canals should be repaired. Once irrigation water supply is started, water is conveyed at a constant discharge level on the conveyance system without frequent operations of the intake, checks, and offtakes. However, when water resources are insufficient to cover irrigation water demands, careful water management including rotational irrigation water supply and/or selective use of limited water must be made. These operation and maintenance works including technical and financial matters shall be managed by beneficiaries themselves under technical assistance from government agencies.

Also from the viewpoint of beneficiaries' participatory approach, small facilities such as field ditches and paddy ridges are expected to be constructed by beneficiaries under technical assistance from the government agencies. Beneficiaries are also expected to participate in the construction of irrigation and drainage facilities as a work force and in the arrangement of the rights-of-way for the construction of project facilities.

7.3.2 Layout of Project Facilities

(1) Mgeta Scheme

Two typical existing irrigation systems were selected for the model development in the Mgeta scheme. One is a canal (herein referred to as " Mzinga canal") diverting from the Mzinga river and running on the ridge feeding the area between the Mzinga river and the Lukundi river (herein referred to as "Mzinga area"), about 22 ha in gross. The other is the canal (herein referred to as "Mindu canal") diverting water from the Mindu river to the left just at the confluence point with the tributary and running along contour lines supplying water to the area of around 25 ha in gross (herein referred to as "Mindu area"). Figure 7.3.1 indicates the route of these canals and commanding areas.

There are about 60 households on the ridges of the Mzinga area. A pipeline system conveying water by gravity is proposed for the Mzinga canal system for drinking as well as irrigation and domestic water supply. The length of the canal is about 1.3 km and the difference of head between the intake point and the canal end point is about 300 m. The longitudinal gradient is about 25% on an average. The Mindu canal is proposed to be improved with using cement concrete lining in most reaches. The length of the canal to be improved is about 1 km consisting of an upper portion of 0.75 km and a lower portion of 0.25 km.

(2) Mgongola Scheme

The proposed canal system layout is shown in Figure 7.3.2. The existing Mkindo intake will be utilize for the Mgongola area as well. In order to accommodate enough water for the Mgongola scheme and to meet the requirement to cope with the flood with a 50-year return period, the inlet portion of the existing intake and the main canal will be replaced with new facilities. The main canal will be extended straightly south-eastwards across the Dizingwi river and the local trunk road B127 and then will turn left to the east and run in parallel to the Dizingwi-Mkindo river. At the end point, water will be diverted to secondary canals and then to tertiary canals. Finally, water will be distributed to fields through field ditches.

Major drains, which collect excess water directly from fields or from field drains, will be provided alternatively in parallel between secondary canals. These drains will join each other and flow into the Mgongola river. A flood protection dike will be provided along the Mgongola river and the Dizingwi - Mkindo river so as to protect the scheme area from creeping floods from these rivers.

Roads will be provided along the main and secondary canals for transportation of agricultural inputs and products, inspection and operation and maintenance of irrigation and drainage facilities.

Irrigation Canals	
Main canal	3.8 km
Secondary canals	6.8 km
Tertiary canals	12.3 km
Total	22.9 km
Drainage Canals	13.1 km
Flood protection dike	10.2 km
Road	9.5 km

(3) Mkula Scheme

In the Master Plan stage, land resources of 320 ha were identified as prospective areas for agriculture, however, the soil investigation carried out in this Stage found that sandy soils are largely distributed in the lower part of the identified area along the Mkula river. The area covered with sandy soils is not suitable for applying traditional surface irrigation methods, since such methods incur large amount of irrigation water losses due to seepage. Also, the water resources of the Mkula river are limited in the dry season. Considering both factors, the objective development area was selected in the upper part between the Mkula river and Nyamigoli river. The irrigation area is 149 ha in net.

The proposed canal system layout is shown in Figure 7.3.3. The existing headworks and the canal are proposed to be used with improvement works. The existing canal will be extended straightly by about 1 km and will divert water to both sides through the proposed tertiary canals. The canal is called Main Canal just before it crosses the trunk road B127 and Secondary Canal-1 just after that point. Also a new major canal, called Secondary Canal-2, having both irrigation and drainage functions is proposed to be provided from the Main Canal end for supplying irrigation water to the lowlying area extending on the left side of the existing canal.

Main Canal		0.2 km
Secondary Canal-1		1.1 km
Secondary Canal-2	(Irrigation cum drainage	3.0 km
Tertiary Canals		10.1 km
Total		14.3 km

(4) Mwega Scheme

The proposed canal system layout is shown in Figure 7.3.4. The Mwega river was carefully inspected in order to find a suitable site for diversion of the river water and it is concluded that a point about 500 m upstream of the existing upper Nyinga intake is suitable as a intake structure site. At the proposed intake site, outcrop of rock can be seen at the foot of the hill on the left bank, about 15 m from the river edge. Boring investigation found rock formation at about 4 m below the riverbed on the left side and 5.5 m on the right side.

A main canal is proposed to be provided for conveying irrigation water for all the irrigation area of 580 ha in net. It will run from the intake site along the Mwega river on the left bank side. It will diverge from the Secondary Canals 1 and 2, which convey water to the left bank area of the Mwega river across it. Further the Main Canal will run on the right side and join the Irrigation Canal-A. The Irrigation Canal-A will be completely improved as a part of the Main Canal. From the improved Irrigation Canal-A, branch canals, so-called connecting canals, will be provided at intervals of about 1.5 km to the existing Irrigation Canal-B. Total length of canals is as follows:

Main canal	13.4 km
Secondary canal-1	1.6 km
Secondary canal-2	4.6 km
Connecting canals	0.8 km
Total	20.5 km

The Mwega river cross-section is proposed to be enlarged in the portion of about 1.9 km long from 400 m downstream to 1.5 km upstream of the current lower Nyinga intake. A drainage canal will be provided along the upstream side of the existing Malolo-Chabi road to drain floodwater to the Mwega river. The Malolo-Chabi road is proposed to be improved in the section where the road crosses the Malolo basin and Mwega river. Also the access road from the highway A-7 will be improved at the crossing points with seasonal streams.

7.3.3 Preliminary Design

(1) Irrigation Water Requirements

Irrigation water requirements are calculated in accordance with the proposed cropping pattern. The peak irrigation water requirement for each of the schemes is estimated as follows.

Peak Irrigation Water Requirement

Name of Scheme	Unit Diversion Requirement (l/sec/ha)	Irrigation Area in net (ha)	Project Diversion Requirement (m3/sec)
Mgeta, Mzinga system	0.8	14	0.011
Mindu system	0.8	16	0.013
Mgongola	2.2	620	1.36
Mkula	1.2	149	0.18
Mwega	1.5	580	0.88

(2) Irrigation and Drainage Works

1) Headworks

The existing headworks of the Mgongola and Mkula schemes will be improved. The existing free intakes of the Mgeta schemes will be reinforced with wet stone masonry and concrete works. In the Mwega scheme, the headworks will be newly constructed in the uppermost part of the Mwega area and all existing intakes will be removed from the river.

Headworks

Name of Scheme		Features of Headworks
Mgeta,	Mzinga system	Reinforcing with wet masonry and concrete at the weir portion and constructing the inlet.
	Mindu system	- do -
Mgongola		Flood discharge: 114 m^3/s with a 50-year return period. Design intake discharge: 1.4 m^3/s Heightening the existing wall in front of the inlet by 40 cm to 70 cm against the flood and reconstructing the intake portion.
Mkula		Flood discharge: 59 m^3/s with a 50-year return period. Design intake discharge: 0.18 m^3/s. Providing concrete membrane to cover water leaking points and reconstructing the intake structure because the present intake is insufficient in height against flood and in inflow capacity.
Mwega		Flood discharge: 99 m^3/s with a 50-year return period. Design intake discharge: 0.9 m^3/s. Building new headworks consisting of an overflow weir, a sand scouring sluice with a gate, an inlet equipped with a gate, an approaching channel, the sand trap pond and a sand flushing sluice from the pond. Removing all existing intakes from the Mwega river in order to increase the flood carrying capacity and to mitigate flooding

2) Canals

Canals will be of trapezoidal cross-section type in principle. Main and secondary canals will be lined with concrete. Others will be of earth type. Design water depth and canal bottom width are so determined that the ratio of the design water depth (h) / the design canal bottom width (b) is 0.7 to 1.0. Canal side slope will be 1 : 1 in concrete lined portions and 1.5 : 1 in earth portions, except for small earth canals having a height of 0.5 m, in which the side slope will be 1 : 1.

In the case of lined canals, the design canal velocity should be as faster as possible provided that the canal velocity be less than 70% of the critical velocity. In the case of earthen canals, the design permissible canal velocity is set at 0.9 m/s, and in the case of drainage canals, at 1.2 m/s, since the design flood discharge has only a 10-year return period.

Features of Canal Works

Scheme		Features of Canals
Mgeta	Mzinga canal	pipeline, PVC pipe, diameter 100 mm.
	Mindu canal	concrete lining planting cobble stones, bottom width 0.2m, canal height 0.2m
Mgongola	Main canal :	concrete flume in first reaches, 280 m, width 1.3 m, height 1.1 m
		concrete lining in other reaches, bottom width 0.8~0.9 m, height 1.0~1.1 m
	Secondary canals:	concrete lining, bottom width 0.4 m~0.8 m wide, canal height 0.6~0.8 m
	Tertiary canals	earthen canal, bottom width 0.4~0.5 m, canal height 0.5~0.6 m
	Drainage canals	earthen canal, bottom width 0.7~3.5 m, canal height 0.4~1.1 m
Mkula	Main canal	Reconstruct the existing canal in first reaches, 0.2 km as a main canal and
	Secondary canal-1	rehabilitate in the other reaches 0.5 km as a secondary canal-1 and extended by 0.5 km, bottom width 0.3 m, height 0.6 m
	Secondary canal-2	earthen canal, bottom width 0.8 m, height 1.1 m
	Tertiary canals	earthen canal, bottom width 0.3~0.4 m, height 0.5~0.6 m, Tertiary canals to be provided on the right side area, where sandy soil layer prevails under the top soil layer is built with borrowed impervious materials so as to be covered with the impervious materials in all the wetted perimeter.
Mwega	Main canal	concrete lining, bottom width 0.3~0.8 m, canal height 0.6~1.0 m
	Secondary canals	concrete lining, bottom width 0.3~0.4 m, canal height 0.6 m
		partly chute in S.canal-2 bottom width 0.6m height 0.5 m in rectangular
	Connection canals	concrete flume, width 0.3~0.4m, height 0.4~0.5m
	Drainage canal	alongside the Malolo-chabi road : earthen canal type protected by rock riprap in the road side slope, bottom width 4.0 m, depth 1.0 m

3) Canal-related structures

Various kinds of structures such as turnouts, checks, drops, culverts, cross drains, and side spillways will generally be provided on the main and secondary irrigation canals. Drop structures and road-crossing culverts will be provided on drainage canals.

The Mzinga pipeline will be provided with float valves and outlet valves. The Mindu canal will have many drops to dissipate hydraulic energy brought by a very steep slope.

On the secondary canal-2 of the Mkula scheme, which functions as an irrigation cum drainage canal, check cum drop structures having a function of spillway in addition to their primary functions will be provided in order to convey excess water downstream of the secondary canal even when the check is completely closed with logs.

In the Mwega scheme, aqueducts will be provided at the points where the secondary canals cross the Mwega river and the Kikalo river. Also, cross drain structures or siphons will be provided on the canals in order to safely release floodwater coming from the hilly area across the main canal or secondary canals.

(3) Other Major Works

1) Roads

Farm roads to be provided in the Mgongola scheme are planned to be of earthen type having 4.0 m in width and 0.3 m to 0.5 m in thickness. Also, the existing road to the Mkindo intake will be improved with laterite pavement in the lower sections and smoothing of the rough surface in the uppermost sections near the intake. In the Mwega scheme, the existing Malolo-Chabi

road will be improved in the 1 km section in the Mwega river basin. It will be 6 m in width and heightened by 0.5 to 1.0 m above the ground surface. Also an existing bridge on the Malolo-Chabi road will be replaced with a new one. The new bridge will be of concrete T-shape beam type supported by concrete abutments. The span will be 12 m in net and the width 4 m. The access road from the highway A7 to Malolo village will be improved with submergible concrete slabs at the five crossing points over seasonal streams.

2) Flood protection dike

Flood protection dikes to be provided along the Dizingwi-Mkindo river and along the Mgongola river will have a height of 0.3 m - 1.2 m and 1.0 m - 1.5 m, respectively in due consideration of a freeboard of 0.6 m from the flood water level. The crest width will be 3 m and the side slope will be 2 : 1.

3) River improvement

As for the Mgongola scheme, in order to protect the phase-I paddy fields of the Mkindo scheme from inundation, the Dizingwi river will be deepened by 1 m with a bottom width of 7 m in the section from the bridge on the road B127 to the point of 1 km downstream of the bridge.

The Mwega river is proposed to be widened from present 4 m to 10 m so as to convey flood flow of 10-year probability in the section of about 1.9 km long from 400 m downstream to 1.5 km upstream of the current lower Nyinga intake. A section of about 300 m within the above reaches in and around the lower Nyinga intake will be deepened by about 1 m by excavation of rock which is exposed in the river bed.

(4) On-farm Works

As for the Mgongola scheme, present rainfed paddy fields of about 510 ha in net will be reshaped by leveling so as to remove the micro relief. The leveling volume is estimated at 260 m^3/ha in case that the leveling works are executed only in area where earth cutting or earth filling is required to be more than 10 cm. Field ditches and paddy plot ridges have to be also constructed. These minor works including final leveling are expected to be carried out by beneficiaries. In the other schemes, small field ditches and ridges should be properly provided in the area where they do not exist or are insufficient.

7.3.4 Operation and Maintenance

(1) Operation

1) Operation of the conveyance system

The main and secondary canals generally convey water on a 24-hour basis. It is recommended to change the diversion discharge at only a few stages, for example, four stages such as puddling and transplanting stage, the following stage, non water supply period (maintenance period of facilities), and the former stage of puddling and transplanting. During each stage, river water

will be constantly diverted through the intake except in emergency cases such as flooding of the irrigation canal system or breaking of the canal bank.

From the main and secondary canals to tertiary canals, water will be diverted continuously without rotation in principle, however if tertiary canals have small commanding area and thus the irrigation water demands are small, rotational water supply from a parent canal to such small tertiary canals should be applied among small tertiary blocks. When river water is insufficient against the above scheduled discharge and further against the irrigation water demands, rotational irrigation water supply should be carried out among all the tertiary blocks.

2) Operation at on-farm level

All the tertiary canals will divert irrigation water to field ditches on a rotational basis (ON-OFF basis) in accordance with a pre-determined schedule except in the period of puddling and transplanting stage, in which the tertiary canals will continuously distribute water to field ditches in principle.

Paddy

The irrigation water supply method should be changed according to the situation of water availability and the irrigation water demands. Rotational irrigation water supply should be applied during the puddling and transplanting period among paddy plots. From the viewpoint of water saving, the puddling works should be carried out right after the paddy plot is filled with water. In the normal time after transplanting, continuous water supply from a field ditch is usually adopted whenever the field ditch conveys water. However, when the water resources are tight against the irrigation water demands or in case the percolation rate is higher than expected, water should be supplied all at once by applying the rotational irrigation method among paddy plots in each tertiary block.

Upland crops

Rotational irrigation water supply will be adopted in upland crop fields. When water is abundant against irrigation water demands, water can be diverted from tertiary canals to fields at any water-serving time, because the tertiary canals usually convey water more than irrigation water demands. In this time, farmers can almost freely take water on a date allocated for irrigation. When irrigation water is insufficient, rotational irrigation water supply should be strictly applied at on-farm level in accordance with a predetermined irrigation schedule.

(2) Maintenance of Facilities

Major regular maintenance works are as follows:

- To periodically lubricate the spindles of all the steel gates and to paint the gates' frame and leaves.
- To periodically remove floating debris from the front of the inlet of headworks and the front of inlets of culvert, checks, and siphons.

- To weed and root trees up from the right-of-way of canals especially from lined portions at least twice a year.
- To confirm stoplogs and to supplement them before irrigation water supply starts.
- To heighten depressing portions of canal embankment with earth materials.

In the maintenance period, all water in the irrigation canal systems should be completely drained, the canals dried up and damaged portions of canals repaired. Major maintenance works during the maintenance period are as follows:

- To remove deposits from canals.
- To repair eroded and damaged portions of canals.
- To get rid of snails transmitting schistosomiasis.

7.4 Institutional Reinforcement Plan

7.4.1 Water Users' Groups

All of the irrigation facilities rehabilitated and newly constructed under the Project will be operated and maintained by the farmers themselves. For the operation and maintenance of the irrigation facilities, the farmers in each scheme should organize a water users' groups. The proposed WUG in each scheme is described below.

(1) Objectives of WUG

The main objective of WUGs to be established in the schemes is to operate and maintain the irrigation facilities. In addition, marketing and credit services are also included in the WUG's objectives. The farmers in the schemes are confronted with various problems such as difficulties in marketing and high prices of farm inputs. In order to increase their agricultural productivity, it is a crucial factor to improve the agricultural support services such as marketing and credits, as well as the rehabilitation of irrigation facilities. For the improvement of such supporting services, it is proposed to establish an organization having such functions like those of an agricultural cooperative in each scheme. As for implementing a reinforcement and/or establishment programme for the farmers organizations, there are the following two alternative approaches:

(a) Two cooperative societies are organized separately, i.e. agricultural cooperative and water users' cooperative societies. In this case, each scheme has two organizations: WUG which is responsible for O&M of irrigation facilities, and the agricultural cooperative handling the agricultural supporting services.

(b) WUG should be organized as the multi-function for covering not only O&M of irrigation facilities but also the agricultural supporting services.

It is proposed to take up the second alternative for the following reasons: The farmers will cultivate crops according to an irrigation schedule decided by WUG, accordingly in its function, WUG is the best position to provide such supporting services as credits and farm inputs on time in accordance with the irrigation-based crop cultivation schedule. Besides, the number of capable persons to take leadership in the cooperative societies is so far limited in each scheme area.

The members of WUG should be the beneficiaries of the irrigation schemes, and its membership should consist of beneficiaries, irrespective of their gender.

(2) Proposed Organization and Activities

The proposed organization consists of Type-A and -B, as shown in Figure 7.4.1. Both types have almost the same structure. The only difference between the two types is as follows:

1) Type-A is for small projects having less than 100 farmers, and the farmers are linked directly with the executive committee.

2) Type-B is for larger projects with over 100 farmers. In this type, the farmers are divided into several sub-groups by each irrigation block covered by a secondary canal or by a village, and each sub-group is linked separately with the executive committee. The members of the executive committee of WUG are elected by the beneficiary farmers.

Although the adoption of these types is to be decided by the farmers, it is recommended that the size of a farmers' group should be less than 100 farmers, so that one of the prime requirements to activate WUG is "face to face" communication among the executive committee and the farmers. Taking smooth communication into account, the proposed type to be adopted for each scheme is as follows.

Mgeta Scheme	Type-A
Mgongola Scheme	Type-B
Mkula Scheme	Type-B
Mwega Scheme	Type-B

The proposed WUG consists of the following four components: (i) general meeting, (ii) executive committee, (iii) auditing, and (iv) service sections including O&M, marketing of agricultural commodities and credit, and women's group. Each sub-group has also the same functions. The main functions and activities are as follows:

1) General Meeting

The general meeting is held at least annually, and has the following main activities:

- Election of the of executive committee members and the auditor,
- Approval of the result of auditing,
- Approval of the annual management plan and budget,
- Determination of the amount of irrigation service charge,
- Revision of the irrigation service charge,
- Revision and enactment of articles and by-laws,
- Specific items requested by the members and committees, etc.

2) Executive Committee

The committee is composed of the following members; Chairman, Vice Chairman, General Secretary, Treasurer, Auditor, and several members who are representatives of the service sections. In the case of Type-B, the representatives of the sub-groups are included as committee members. All

these posts should be opened to both genders. In addition, one or several volunteer porters are appointed in the committee in order to ensure close communication among the members and between the committee and the farmers. The regular meeting is held monthly.

Main tasks of the committee are (i) to prepare annual management plans and budget, (ii) to instruct and supervise activities implemented by the service sections, (iii) to manage complaints and grievance from the farmers, (iv) to arrange and appoint volunteers to work in service sections, (v) to manage accounting and general affairs, and (vi) to coordinate with other agencies and associations, and so on.

3) Service Sections

Under the instruction and supervision of the executive committee, the route service works are implemented by the following four sections; (i) O&M, (ii) agriculture, (iii) marketing and credit, and (iv) women's group. These sections employ several volunteers, and their main activities are as follows:

(a) O&M Section

- Preparation of annual irrigation schedule,
- Estimate of irrigation service charge,
- Management of communal works such as canal clearing and maintenance of farm roads,
- Security service for irrigation facilities, etc.

(b) Agricultural Section

- Transmission and notification of information for extension implemented by VEO and officers in the DALDO's offices,
- Information services for new farming practices and varieties,
- Arrangement of farmers' meetings on agricultural extension,
- Providing machinery services,
- Promotion, arrangement and guidance for group farming such as communal control of pests and diseases, transplanting and harvesting, etc.

(c) Marketing and Credit Section

- Implementation of cooperative purchasing and shipping,
- Arrangement of storage facilities for farm inputs and products,
- Agricultural credit services,
- Exploitation of new marketing channels, etc.

(d) Women's Group

- Promotion for women's agri-business and cottage industry,
- Promotion for homestead development,
- Improvement of social welfare and health care,
- Educating activities on home economy and management, etc.

4) Auditing Section

Although the registered farmers' cooperatives should be subject to auditing by authorized organizations like COASCO, it is proposed that each WUG has an auditing system in addition to the above official auditing. Namely, an auditing section or committee, which consists of several volunteers (beneficiaries), is established apart from the executive committee. This section always checks the WUG' accounting including collection of ISC, and reports those results at the general meeting.

(3) Irrigation Service Charge and Annual Membership Fee

Irrigation Service Charge

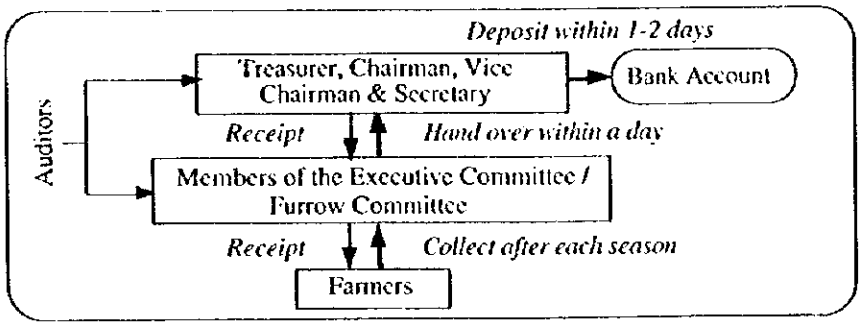
All O&M costs of irrigation facilities are covered by the irrigation service charges (ISC) collected from the farmers. The amount of ISC is estimated by each WUG, and includes the following items:

(a) Operation cost
(b) Maintenance cost
(c) Replacement cost of facilities and equipment
(d) Collecting cost (transportation cost for collectors and treasurers)

In order to minimize the labour cost, it is proposed that maintenance works should be carried by farmers as communal work which is widely adopted among the existing WUGs.

The proposed collecting procedure of ISC is as follows: ISC is collected after each cropping season. All members of the executive committee and furrow committee collect ISC directly from the farmers, and the collected amount is deposited immediately in WUG's bank account. For collecting ISC, the members organize groups consisting of 2-3 members each, and they do not collect it alone. The treasurer manages all these transactions, and auditors should check their collection. The collectors (members) should issue receipt to the farmers, and the treasurer collects those copies.

Proposed Collecting System of Irrigation Service Charge



To achieve smooth collection of ISC, it is recommended to include the following punishment rule and incentive in the articles and by-laws.

1) If a farmer fails to pay on time, WUG imposes on him a fine equivalent to some percentage of total ISC per month during the non-payment period.

2) When a farmer pays the full amount of ISC and on time, some percentage of the full amount is reimbursed to him as an incentive.

The executive committee is responsible for management and use of ISC. For the payment of O&M, there are two types. One is the recurrent costs such as operation and management costs, and the other is for the costs of emergency and specific O&M works. The former is paid by the treasurer after approval of the chairman, vice chairman and general secretary, as a routine of the WUG's works. For the latter, a committee meeting is held to assess its necessity and release fund for such works.

Annual Membership Fees

With the exception of O&M costs for irrigation facilities, costs necessary for WUG's supporting activities such as marketing and credit services are covered by annual membership fees collected from the farmers. These costs include personnel cost for leaders of WUG, transportation cost, and expenses for stationery such as pencil and notebook. It is recommended that WUG's leaders work as volunteers with no wage or salary, though this matter should be decided by the farmers at the WUG's general meeting. The leaders of existing WUGs are also volunteers. Thus, the costs for management of WUG excluding O&M of facilities are only transportation and stationery costs mentioned above, and there will be no need to collect a high membership fee from the farmers. The annual membership fees are collected by the same system as the irrigation service charge.

(4) By-laws of WUG

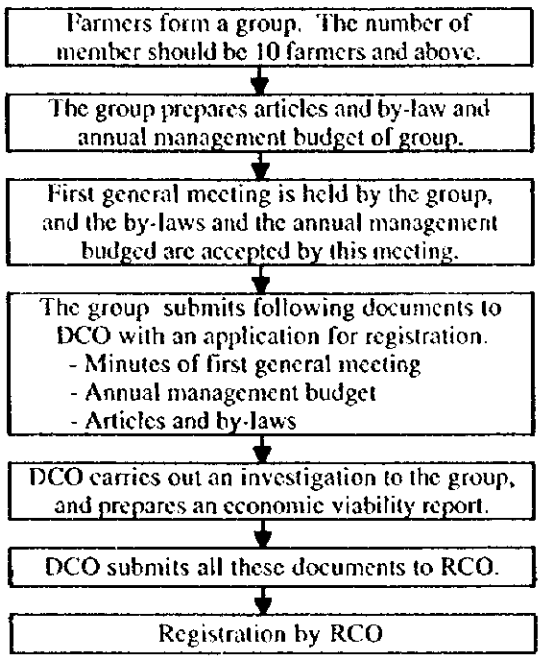
Standard articles and by-laws of WUG have been prepared by the Department of Cooperative. But this is for the general cooperatives, and articles necessary for WUGs which are responsible for the O&M of the Project are not included at all. Although these standard articles and by-laws apply basically to WUG, it is necessary to enact several new articles. These are listed below.

(a) Farmers who use irrigation water from the Project should be members of WUG.
(b) WUG has the right to collect ISC from the beneficiaries who receive irrigation services from WUG, and the beneficiaries have the duty to pay ISC to WUG.
(c) WUG inflicts a punishment on the beneficiaries who use irrigation water and facilities illegally and fail to pay ISC.
(d) The beneficiaries have the duty to participate in the communal works on O&M planned by WUG.
(e) The tenant beneficiaries have a right to join WUG and to be elected to the executive committee, and are bound to pay ISC and membership fees, instead of the owner beneficiaries.

The by-laws must be authorized legally by the government agencies. In the case of the Lower Moshi Project located in the Kilimanjaro Region, the Moshi District Council has authorized the by-laws concerned, after approval of the Minister responsible for Local Government. The district councils of Morogoro, Kilosa and Kilombero districts should also authorize the districts' by-laws.

(5) Registration and Water Right of WUG

For acquiring the official authorization, WUGs should be registered with government agencies. There are two ways for this registration. One is registration with the Ministry of Home Affairs and the other is with MAC. In Tanzania, the organizations are classified into two types: "Association" and "Cooperative." The former Ministry handles the registration of "Associations", and the latter that of "Cooperatives". It is proposed that WUGs established in the Schemes be registered with MAC which is responsible for supporting services to such organizations. The present process of registration is shown below.



WUGs should also take water right after registration. RCO handles the registration of WUG and the Regional Water Engineer the issuance of water right. The DALDO's offices should provide necessary guidance and supporting services to WUGs for these registration and obtaining of water right.

(6) Irrigation Meeting

The crop production activities are closely linked with various agricultural sup-port activities including extension services, machinery services, supply of farm inputs, credit services, etc., which are implemented by the Government and private sectors, and all these should be coordinated with the farming. In this context, it is proposed to hold irrigation meetings under the presidency of WUG. The meeting is held before each cropping season, and attended by the following people:

(a) All farmers (beneficiaries),
(b) Members of the executive committee of WUG,
(c) Officers of DALDO' offices (DCO, DEO and DIVEO),
(d) Officers attached to the scheme (VEO and Irrigation Technician),
(e) Members of the village government (Village Chairman and Village Executive Officer), and

(f) Banks, NGOs and private sectors such as owner of farm machinery and dealer of farm inputs.

VEO and Irrigation Technician make necessary support for the holding of this meeting by WUG. In this meeting, the following items are discussed among the attendance. Based on the result of these discussions, WUG requests the related agencies for the necessary support services.

1) Recommended crops to be cultivated in the season,
2) Cropping schedule including land preparation, seeding, harvesting, etc.,
3) Irrigation schedule, and
4) Required quantities of farm inputs such fertilizers and agricultural credits, and their supplying periods, etc.

All farmers confirm the irrigation schedule through this meeting, and WUG commence to manage irrigation facilities and agricultural support services after the meeting.

(7) Facilities of WUG

The facilities necessary for the activities of WUG are an office building (Mgeta - 50 m^2, Mgongola - 200 m^2, Mkula - 100 m^2, Mwega - 200 m^2), a storage house for fertilizers (Mgongola - 250 m^2, Mkula - 60 m^2, Mwega - 330 m^2), motorcycles (3-5 nos. for each scheme), and tools (shovels, hoes, etc.) for maintenance of the canals.

WUG shares a floor space of the office with VEO, Irrigation Technician and the village government. All necessary administrative works including typing, printing, communication, etc. should be supported by the offices of DALDO or Division Extension Officer (DIVEO).

7.4.2 Rural Credit Facilities

At the initial stage of the Project, the farmers need a considerable amount of loan for purchasing farm inputs. However, almost no agricultural credit is found in the project area at present. To overcome such situation, the following three credit systems are proposed to be provided for the schemes.

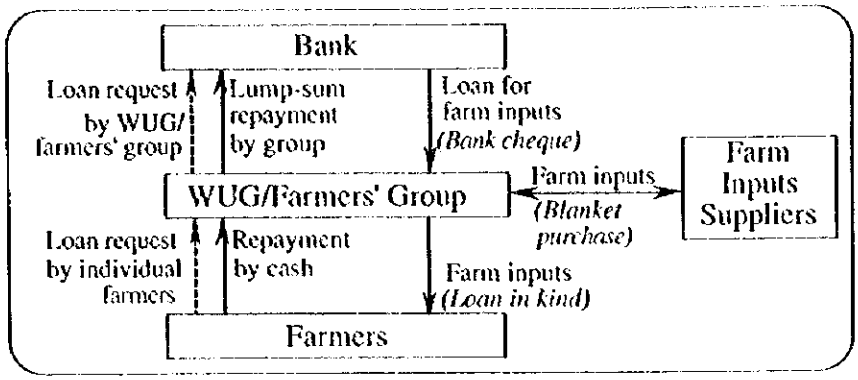
1) Group Loan System Administered by the Water Users' Group

Layout of the Group Loan System and Procedures

The proposed credit system is to provide loans to the farmers who will need them in order to purchase farm inputs required at the initial stage of the Project. The proposed system is based on group loans, which will be managed by WUG; this system covers agricultural production activities.

The following figure shows the outline of the proposed credit system:

Outline of the Group Loan System



The loan procedures to be followed under the system are as follows:

i) The loan is limited only to the purchase of farm inputs, and its ceiling amount is set depending on the type of crops.

ii) To receive a loan, the farmers have to form a group and select a representative. The members of such group are jointly and severally responsible for repayment of the loan for defaulters.

iii) Farm input requirements are estimated by the group together with the required loan amount. At this time, the extension officer gives technical guidance such as recommended fertilizers and agro-chemicals to be used.

iv) The bank provides a loan for the group on a lump sum basis or dividing it into two portions. Then the group purchases farm inputs in one lot. The bank provides the loan amount only to the suppliers of farm inputs, and the group receives farm inputs in kind from the suppliers. In this way, the group and its representative do not need to deal with cash money, except for the bank check to be issued to the suppliers.

v) The representative collects the loan payment amount for each farmer, and repays it to the bank in a lump sum. The bank does not collect the loan payment amount from individual farmers.

Requisites for the Group Loan Operation

i) One prerequisite for the functioning of the credit system is that the WUG and the farmers themselves must thoroughly understand the credit operations involved in the system. They must also be able to carry out the procedures for obtaining the loan and have managerial and accounting knowledge for administering and monitoring the received loan.

ii) By-laws concerning the operation of the loan groups must be formulated with the agreement of all members and they must be formalized by DALDO. The by-laws must specify the rights and duties of all members and the penalties in case of default.

iii) The bank must lecture WUG about the specific banking procedures to be followed for obtaining and repaying the loans. The training of WUG on administration of the loan could be done through VEO who must have been previously trained either by the bank providing the loans or by a hired specialist assigned for that purpose.

iv) The bank should grant a loan to WUG with an interest rate lower than the normal market rate; this is because WUG will take care of the administrative operations of the loan, i.e. distribution, follow-up, and collection of the funds, lowering the operational costs for the bank.

2) Revolving Loan System

WUG collects a considerable amount of share from the members, and lends its money to the farmers at an interest rate lower than the market rate. The repayment amounts from the farmers are deposited in WUG's account, and WUG finances the farmers again.

The Ndungu Irrigation Project in the Kilimanjaro region is being operated such revolving loan system. The cooperative of the Ndung project consists of 147 members, and has collected the share amounting to Tsh. 147 million (Tsh. 10,000/member). Based on these funds, the commercial committee organized within the cooperative is providing loan services to the farmers. It may be possible to introduce such loan system to WUGs to be established in each scheme. The merit of the revolving loan system is a lower interest rate than the market rate.

3) Mutual Aid Credit Associations

Although the above system is to be applied for duly organized groups registered with MAC, it is important and necessary that the farmers must have a simple credit organization like the one called "rotating-funds credit association." This type of credit organizations which is more modest in purpose than the system explained above, aims to provide the associates with funds to cover needs not necessarily for production purposes but also for emergencies or consumption purposes. The implementation of these associations will help to "educate" the farmers on using mutual aid mechanisms.

The rotating funds credit association could be formed by 20 members from which an association head is selected, who is in charge of the administration of the system.

The members of a rotating funds credit association, by means of monthly fixed deposits decided by all members, make up a communal fund from which each in turn withdraws certain amounts at regular intervals. The assignment of these sums can be made through a "lottery" system or decided by mutual agreement among the members. The deposits and withdrawals continue until each member has received the agreed standard sum of money. The duration of the associations may be unlimited or pre-determined, further, the association can be open or closed, in the sense that it admits or does not admit the entrance of new members or the departure of existing ones.

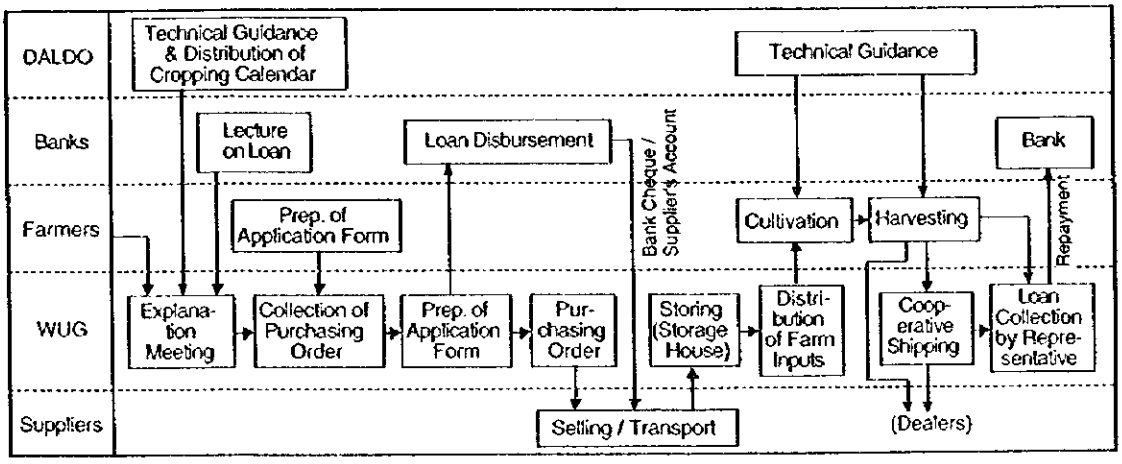
Penalties for defaulting must be established in the rules governing the association. These rules must be clearly defined and enforced. The peers' pressure plays an important role for the enforcement of the rules.

By implementing the credit systems explained above, the farmers would have the benefit of accessing credit in an organized way. At present, CRDB has stopped implementing a credit system with similar characteristics as the group loan system mentioned above. However, CRDB would be interested in supporting the above proposed system if the farmers involved in the system are those who are producing in irrigated lands. If no group loan service from CRDB is available, it is proposed to introduce the revolving loan system managed by WUG. In this case, it will be necessary to employ a permanent staff for handling revolving loans.

7.4.3 Marketing System for Agricultural Commodities

The figure below shows the layout of the proposed marketing system.

Cooperative Purchasing and Group Loan



The system requires an efficient coordination among DALDO office, the bank granting loans to WUG and the farm inputs' suppliers. The flow of activities for the proposed marketing cum credit system is as follows:

(a) DALDO office provides technical guidance on the inputs to be purchased and how to use them in a proper way. The office must also distribute the cropping calendar adequate for the farming area. Prior to reception of the farm inputs from the suppliers, DALDO office through VEO provides technical guidance on cultivation and harvesting.

(b) DALDO holds an explanation meeting with WUG with respect to the bank granting the loan as well as farm input supply system. WUG also receives a lecture on loan procedures by the bank's staff.

(c) After deciding to adopt the system, WUG members determine the loan amount to be requested to the bank based on their inputs' requirements. WUG then prepares the loan application and delivers it to the bank. At the same time,

WUG contacts the inputs' suppliers and presents its purchase list. The bank makes the disbursement directly to the inputs' supplier.

(d) The supplier prepares the inputs' order for a timely deliver. After the bank makes the loan's disbursement, the supplier transports the inputs to the storage facilities specified by WUG.

(e) After receiving the inputs, WUG should distribute immediately them to the farmers.

(f) WUG collects the money from its members after harvesting for repayment to the bank. WUG is in charge of delivering the repayment to the bank.

For the selling of products, it is recommended to introduce a cooperative shipping system. After harvesting, the products are collected at the storage facilities of WUG for waiting to be either delivered to the traders or to be picked up by them. The products' selling are negotiated between WUG and the traders. WUG takes the money from the total selling amount for repayment to the bank for repayment to the bank, then the members take the balance.

7.4.4 Women's Participation in Development

The Project will contribute to energize those activities related to crop production, marketing of farm inputs and products, post-harvest, transportation, community services, etc. With such economic and social development in the rural area, women will have the chance to join in these activities. On the other hand, it is expected that the economic and social development is activated and accelerated by the women's participation. The following points will be proposed for the women's participation in the development process.

1) Appointment of women's leaders in the executive committee of WUG in order to encourage greater participation of women in public affairs,

2) Establishment of women's groups and encouragement of value-added processing of crops by these women's groups in order to improve their employment opportunities, and

3) Encouragement of livestock farming including pigs, sheep, goats, etc. by the women's groups.

WUGs should play an important role in promoting these activities, and DALDO offices should provide necessary guidance to them. The establishment of women's groups is proposed in WUG as mentioned in Sub-section 7.4.1 (2). A representative of the women's group joins the executive committee as its member, and participates in all WUG's management. VEO conducts supporting services to activate them in cooperation with the village government.

7.4.5 Training Programme

(1) Training Programme for O&M and Management of WUG

All WUGs in the schemes should be strengthened through a forced training programme. In addition, officers and front-line staff below the district level should also be trained to get enough skills on O&M activities through provision of an intensive training programme, because they still have not enough experience and knowledge on the O&M of irrigation systems.

For the training, a wide scale programme will be introduced. Namely, the training programme is implemented not only for the farmers and staff below the district level, but also for the senior officers involved in O&M and the people in the village, including Village Chairmen, Village Executive Officers, elder people, informal rural leaders in villages, because O&M by WUG needs a lot of cooperation and supporting services from them.

DALDO offices are responsible for the implementation of the training programme. The training programme is divided into four courses depending on training contents and trainee's educational background; i.e. Course-A, -B, -C, and -D. The details are shown in Table 7.4.1, and summarized as follows:

Proposed Training Courses and Trainees

Training Courses	Period (day)	Frequency (time/year)	Trainees
Course-A	2	1	- RAS, Regional Planning Officer, District Commissioner, District Executive Director, District Administrative Officer. - Senior officials of the offices of RALDO, DALDO and the Zonal Irrigation Office. - Senior officials of the offices involved in WUG's activities (District Water Engineer, District Community Development Officer, District Cooperative Officer, etc.).
Course-B	7	1	- Officials involved in O&M (Zonal Irrigation Office, RALDO and DALDO's offices, Division Extension Officer, DCO). - Village extension officer and irrigation technician to be attached to the project.
Course-C	10	2	- Farmer's level training to leaders of WUG, gate keepers and key farmers.
Course-D	2	2	- Village chairman, village executive office, chairman of ward council, ward executive office, elder people, informal rural leaders in the village, leaders of women's groups, etc.

The Course-A is for senior officers involved in WUG's activities; the Course-B is for officers of ZIO, RALDO and DALDO offices, and DCO offices; and the Course-C is for farmer's level training including leaders of WUGs, gate operators, etc. The Course-D is conducted only to the people in the villages related to the projects. The training contents consist of O&M and WUG's management including agricultural support services, but some other contents such as new agricultural extension system and promotion of the women in development are also included in this training programme, because the officers and the people involved in strengthening of WUG should have those basic knowledge. The lecture is made visually by the use of overhead projector, etc., and the training should be implemented intensively during the implementation period of the Project.

In addition to the above training programme, the following training is proposed:

1) Special Training of VEOs and Irrigation Technicians: Before the implementation of the Project, VEOs and Irrigation Technicians to be attached to the Project are dispatched to KATC (Kilimanjaro Agricultural Training Center) for upgrading their basic technical knowledge.

2) Follow-up Training of WUGs: DALDO offices implement occasionally follow-up training of WUGs according to the necessity for improvement of their management. DALDO offices always monitor all WUG's activities through VEOs and Irrigation Technicians, and prepare necessary training programmes for them.

(2) Training Programme for Reinforcement of Agricultural Extension Services

Throughout and after the project implementation, agricultural extension services should be promoted for the improvement of the present agricultural productivity. Subjects to be reinforced are listed up considering the current situation, and further given the order of priority as follows;

First priority
- Dissemination of proposed farming practices (all schemes)
- Promotion of proper water management (all schemes)

Second priority
- Improvement of soil fertility (all schemes)
- Implementation of soil conservation (Mgeta scheme)
- Improvement of storage facilities (except Mgeta scheme)

Third priority
- Adoption of improved tools (all schemes)
- Promotion of pig rearing (Mgeta scheme)
- Popularization of draught animals (except Mgeta scheme)

The subjects in the group of first priority should be carried out to bring about rapid benefits from the Project. Currently, farmers in the scheme areas have been facing some constraints which decrease the agricultural productivity and further deteriorate the quality of farm products. Accordingly, the subjects in the second priority are expected for the improvement of the current situation, however a great deal of inputs and time might be required. Regarding the subjects in the third priority, it is necessary to arrange some additional inputs from the financial and technical points of view.

It is proposed therefore to concentrate on the implementation of the subjects in the first priority group in order to improve the current situation. Furthermore, it will be necessary to consider the second priority subject to further enhance the improved situation.

As for the target groups such as farmers concerned and frontline extension staffs (DIVEOs/VEOs), a series of training programmes should be provided, aiming at reinforcement of their knowledge and technique, as shown in Tables 7.4.2 and 7.4.3 and summarized below:

1) For farmers concerned (see Table 7.4.2)

- Field training in the demonstration plots and farmer's fields
- Field tour to advanced areas

- Special training in KATC

2) For DIVEOs and VEOs (see Table 7.4.3)

- Workshop
- Management of demonstration plots
- Special training in KATC

It is proposed that the implementation of the reinforcement programme mentioned above be managed and monitored by the Agricultural Coordinating Committee which will be established as a new organization for the Project. Organization and terms of reference of this committee are elaborated in Sub-section 9.2.3.

7.5 Environmental Conservation / Protection Plan

7.5.1 Action Plan for Mitigation and/or Elimination of Negative Impacts

In order to eliminate or mitigate the environmental negative impacts in a satisfactory and successful way, the following measures are taken into consideration as the basic approach to environmental protection and conservation in the implementation of the Project.

(1) Measures for Mitigation of Direct Negative Impacts

(a) Influence of water-borne diseases

The following practices are generally accepted as the most practical approach to eliminate and/or mitigate the influence of water-borne diseases in the scheme areas.

- Periodic cleaning of the irrigation and drainage canals and drying up of these canals during the agricultural off-season so as to destroy the habitat of vectors and to eliminate intermediate hosts of diseases, as well as to cut off the life cycle of the causative agents of diseases, effectively.

- Consolidation of the sanitation facilities in the village areas. This is also essential for cutting off the life cycle of the causative agents of diseases, effectively and successfully. The consolidation of sanitation facilities shall be implemented within the framework of a national and/or regional health service programme, and all the design conditions which might be applied to the proposed sanitation facilities should comply with that programme.

- Utilization of agro-chemicals for directly controlling the habitats of vectors and intermediate hosts, immediately after draining out the irrigation water. This practice is, however, limited to only a small extent where such habitats are concentrated, i.e. waters impounded in small depressions and in paddy fields, dead water in canals, etc.

(b) Agro-chemical impacts and water contamination

As for the water contamination problems due to utilization of fertilizers and agro-chemicals, it is essential to prepare a standard guideline and advise

farmers how to use agro-chemicals, safely and satisfactorily. Leading such communal work is the essential basis not only for encouraging of the beneficiaries' participation in the Project, but also for promoting a sustainable agricultural development.

(2) Measures for Mitigation of Indirect Impacts

(a) Deforestation and degradation of vegetation

To properly maintain the present forest and vegetation against the negative impacts caused by fuel wood collection, it is necessary to make precise and fair demarcation and allocation, as well as limitation of the development area, etc. on the open forest. Afforestation is the most essential and practical way for conserving the vegetation, therefore, it must be incorporated into the implementation schedule of the Project.

(b) Social conflicts on land and water utilization

To eliminate the social conflicts on land and water utilization, it is essential to enforce the village act, and moreover, enpowerment of the leadership of the village community societies.

7.5.2 Monitoring Plan

The proposed monitoring plan is to verify the effectiveness of mitigation measures mentioned above, therefore, it should be carried out over the entire life of the Project.

The major items of environmental monitoring shall consist of the following:

- Execution of monitoring including compilation and analysis of the data accumulated and preparation of appropriate periodical reports and liaison with the other agencies concerned;
- Evaluation of the monitoring data and identification of unexpected environmental effects;
- Formulation of countermeasures to mitigate the unexpected negative effects; and
- Cooperation with the Project Office or other agencies concerned with implementation of any countermeasures or remedial measures required.

Originally, the monitoring should be carried out on the 4 items which are the subjects of EIA conducted under the Study. This plan proposes the monitoring of the Direct Negative Impacts which have the baseline data.

(1) Influence of Water-borne Diseases

(a) Disease vectors

Mosquitoes and snails, which are vectors of bilharzia, have to be monitored periodically in order to establish effective vector control measures. New benchmarks for this monitoring might be needed in the scheme area where the hydrological regime would be changed with the Project.

(b) Hygienic condition

The control of water-borne diseases in irrigation scheme areas can be successful if adequate and acceptable sanitation facilities for excreta disposal are provided and used. Monitoring of this condition in all schemes is very important. This will be done by inventorying sanitary facilities every year and checking whether there is an increase in the availability of such facilities.

(c) Community behavior

In all of the villages visited during the Study, it was observed that most of the villagers have the habit of washing and bathing in canals and rivers. This habit contaminates the water used for domestic purpose and, therefore, spreads water borne diseases. This should be monitored by village health workers. If the situation persists, the village authority should take action by introducing by-laws controlling such activities.

(d) Prevalence of endemic diseases

Monitoring the occurrence frequency of endemic diseases will indicate the effectiveness of disease control measures undertaken and enable to revise, if necessary, the adopted strategies; activities and resources allocations according to results of the monitoring.

(e) Water supply

It was noted during the field survey that most of the visited villages in the Project area use contaminated or untreated water from traditional irrigation canals and rivers, which leads to diarrhea diseases. Therefore, monitoring of water quality should be undertaken. Samples should be taken at least at 3 points for each scheme and twice a year.

(2) Agro-chemical Impacts and Water Contamination

(a) Monitoring items

Water

When toxic biocides end up in the water, the latter becomes contaminated. Toxic biocides kill aquatic species that would be beneficial to people and, if accumulated at high toxic levels, are harmful to human health. Monitoring the accumulated concentrations will help control of the negative impact of the biocides applied.

Soil

Much of active ingredients of biocides applied for crops enter the soil. Some of this poison can be absorbed and fixed by the soil particles temporarily and later get into the food chain where it may accumulate to toxic levels. Monitoring of the accumulation is required to avoid their danger to humans, animals and plant life as well as soil fertility.

Fish

Pesticides toxic to fish end up in the water, they kill fish that eat undesirable insects. The surviving fish may have accumulated toxic levels of active ingredients of the chemicals and when the fish are consumed by people the toxic will continue to accumulate in the human body and may reach harmful levels.

Vegetables

Long persisting chemicals applied to vegetables may accumulate to high levels in the plant tissues, resulting in harmful health effects on people who consume the vegetables.

(b) Methodologies

The proposed monitoring methodology for each item is shown below:

Monitoring Items	Ingredients to be monitored	Method to be used
Water	Organochlorineseg HCH, DDT Dieldrin and heptaeclor	Gas-liquid chromatography
	Orgonophosphous (e.g. malathion) carbamates dithiocarbanates synthetic pyrethoroids	
Soil	NH-N, Copper (Cu), Sodium (Na), Calsium (Ca)	Kjeldahl method Sodium diethy ldithiocarbametes method, Atomic absorption spectroscopy
Fish	Organochlorineseg HCH, DDT Dieldrin and heptaeclor	Chromatographic techniques e.g. Gas-liquid chromatography
	Orgonophosphous (e.g. malathion) carbamates dithiocarbanates synthetic pyrethoroids	Thermic detectors Flame photometric detectors Spectrophotometric method
Vegetable	NH-N Organochlorines e.g. HCH, DDT Dieldrin and heptaeclor Orgonophosphous (e.g. malathion) carbamates dithiocarbanates synthetic pyrethoroids	Kjeldahl method Kjeldahl method
Soil over-richness	SA CAN NPK UREA (NH4-N) NH4NO3	Kjeldahl method Kjeldahl method followed by either a flame or atomic absorption method Kjeldahl method Kjeldahl method Steam distillation method

CHAPTER VIII. EVALUATION OF THE PROJECT

8.1 Cost Estimate

8.1.1 Conditions of Cost Estimate

The cost for the construction of the respective four schemes is estimated on the basis of the preliminary design of the project facilities and the following assumptions:

1) The exchange rate applied in the estimate is Tsh. 620 = US$ 1.00 = ¥ 120.

2) The construction works will be executed on a contract basis.

3) Unit costs are estimated referring to the relevant price information on the construction such as labour cost, material price and equipment hiring cost, collected from the Regional Engineers Office in Morogoro, the National Construction Council, and general contractors.

4) No compensation is considered for land acquisition for project facilities.

5) Cost for the preparatory works is assumed to be 5 % of direct construction cost. The preparatory works include temporary access, construction office and staff quarters, etc.

6) O&M facilities and equipment cost is estimated for operating the Project after completion of the construction works. The facilities and equipment taken up in this cost include project office, office equipment, O&M tools, and communication motor bikes.

7) Administration cost during construction stage is estimated on the basis of field inspection needs of the executing government staff.

8) Engineering services cost to be required for the project implementation including an institutional expert, water management expert, and agronomist is estimated in accordance with the implementation schedule. The engineering services are assumed to be undertaken for all the four schemes.

9) Physical contingency is assumed to be 10% of the direct construction cost.

10) Price contingency is assumed to be 3% for the foreign currency portion and 17% for the local currency portion of all the above cost items.

8.1.2 Cost Estimate

The total construction cost of each selected scheme and the annual disbursement schedule are summarized in the tables below. The breakdown of the total construction cost is given in Table 8.1.1.

Total Construction Cost

Name of Scheme	Total Construction Cost			Irrigation Area	Total Construction Cost per Ha		
	10^6Tsh.	10^3US$	10^6Yen	Ha	10^3Tsh.	US$	10^3Yen
Mgeta	156	252	30	30	5.,200	8,400	1,000
Mgongola	3,839	6,192	743	620	6,192	9,987	1,198
Mkula	619	998	120	149	4,154	6,698	805
Mwega	3,947	6,369	764	580	6,805	10,981	1,317
Total	8,561	13,811	1,657	1,379	6,208	10,015	1,202

Annual Disbursement Schedule

(Unit: 1,000 Tshs)

Name of Scheme	1st Year	2nd Year	3rd Year	4th Year	Total
Mgeta	15	140	1	-	156
Mgongola	301	2,278	1,217	43	3,839
Mkula	72	525	22	-	619
Mwega	282	2,350	1,303	12	3,947
Total	670	5,293	2,543	55	8,561

8.1.3 Operation and Maintenance Cost

Referring to the similar projects implemented in Tanzania such as the Ndungu Irrigation Project financed by the Government of Japan, the annual O&M cost after completion of the construction works is assumed to be 0.5% of the direct construction cost. Replacement cost is estimated at Tsh. 47.46 million for the pipeline and valves in the Mgeta scheme on the assumption that their useful life is 25 years.

8.2 Economic and Financial Evaluation

8.2.1 Economic Evaluation

The evaluation was carried out by identifying and valuing the costs and benefits that will arise in a "with" project situation and comparing them with the "without" project situation. The Economic Internal Rate of Return (EIRR) was calculated on a preliminary basis.

The evaluation was made based on the following basic assumptions:

1) The economic useful life of the Project will be 50 years.
2) All prices are expressed in constant prices prevailing on August of 1997.
3) Economic farm gate prices of paddy and fertilizers were estimated on the basis of the forecasted world market prices for 2000 of the World Bank as of July 23, 1997. Economic price of agro-chemicals, packing material, etc. were valued at their financial prices, while hired labour and machinery or draught cattle were converted into economic prices by applying the standard conversion factor to their financial prices. Other crops except paddy have been valued at their financial prices.

4) The exchange rate at Tsh. 620 = US$ 1, prevailing on August 1996, was used.

5) Standard Conversion Factor is 0.8.

6) O&M cost was considered to be 0.5% of the direct construction cost. At the moment of performing the economic evaluation, the O/M financial costs was converted into economic costs by applying the construction conversion factor.

7) On-farm development costs related to manual labor to be considered at the moment of performing the financial evaluation as the works are supposed to be performed by the farmers. When performing the economic evaluation, the full costs for on-farm development were included.

8) Contingencies, physical and price, have not been included within the costs for the evaluation. The price contingencies will be considered at the moment of carrying out the sensitivity analysis by considering an increase of investment costs of 27% (price contingency of 17% plus physical contingency of 10%)

(1) Economic Benefits

The table below shows a summary of the incremental benefits used in the evaluation. The irrigation benefits are primarily derived from the increased crop production (incremental benefit) attributable to a stable irrigation water supply. These benefits are estimated as the difference between the annual net crop production values under the "without" and "with" project conditions.

Economic Benefits

	Incremental Benefit (million Tsh.)
Mgeta	14.44
Mgongola	509.13
Mkula	73.00
Mwega	447.41

(2) Economic Costs

The table below shows the summary of economic development cost and O&M cost. The Project cost broadly comprises direct construction cost, cost for temporary works like mobilization, construction of lodgings for workers, compensation to land owners and crops, etc., administration cost, and engineering services cost. In the economic evaluation, the on-farm development cost was fully incorporated. To obtain the economic development cost, the cost for each scheme was multiplied by the construction conversion factor.

Summary of Economic Costs

(Unit: million Tsh.)

	Development Cost	O&M Cost
Mgeta	106.15	0.32
Mgongola	2,474.98	9.03
Mkula	425.43	1.28
Mwega	2,398.17	8.73

(3) Calculation of Economic IRR

It is assumed that benefits will increase 25% per year until reaching the project full production target at the sixth year. The table below summarizes the results of calculation of economic IRR:

Economic IRR

Scheme	Economic IRR
Mgeta	11.0%
Mgongola	16.7%
Mkula	13.8%
Mwega	15.4%

According to information received from the Planning Division of MAC, a project could be considered acceptable from the economic point of view if its EIRR is above 12%. Therefore, the Mgongola, Mkula, and Mwega schemes have acceptable economic EIRRs, while the Mgeta scheme has a low EIRR.

(4) Sensitivity Analysis

A sensitivity analysis was made to evaluate the soundness of the Project against possible future adverse changes in the following three conditions:

(a) Development costs increase 27%;
(b) Benefits decrease 10%;
(c) Combined effect of (a) and (b)

The results of the analysis are as follows:

Results of Sensitivity Analysis

	EIRR (%)			
	Mgeta	Mgongola	Mkula	Mwega
Condition 1	8.7	14.5	11.1	12.4
Condition 2	9.9	15.2	12.6	14.0
Condition 3	7.7	13.1	10.1	11.2

The increase of costs would have a stronger effect than the decrease of benefits on the Project. However, the combination of the two conditions has a stronger effect than when each condition is considered separately.

8.2.2 Financial Evaluation

(1) Financial Benefits

The procedure for calculation of the financial benefits are similar to the one used for calculation of economic benefits, except two variations: 1) Farmgate prices were used for all crops; 2) In the calculation of the net return of main crops, the financial crop production cost was evaluated using market prices. The table below shows the summary of the incremental benefits obtained for the evaluation.

Incremental Financial Benefit

Scheme	Incremental Benefit (million Tsh.)
Mgeta	14.16
Mgongola	464.92
Mkula	68.36
Malolo	429.03

(2) Financial Costs

The table below shows the summary of financial development cost and O&M cost for each scheme.

Financial Costs Summary

(Unit : million Tsh.)

Scheme	Development Cost	O/M Cost
Mgeta	126.01	0.40
Mgongola	2,899.55	10.87
Mkula	498.62	1.60
Mwega	2,868.49	10.92

(3) Calculation of Financial IRR

The table below summaries the results of calculation of financial IRR:

Scheme	Financial IRR
Mgeta	9.0%
Mgongola	13.4%
Mkula	11.3%
Mwega	12.6%

The Mgongola, Mkula, and Mwega schemes have acceptable financial IRRs while Mgeta has a low FIRR.

(4) Expected Effects on the Farm Economy

Farm economy under the present and with-project conditions was analyzed. Farm economy under the present condition are shown in Table 5.3.5 while the "with-project" conditions are shown in Table 8.2.1, respectively. Table 8.2.1 is summarized as follows;

Summary of Farm Economy Analysis (With-Project Conditions)

(Unit : Tsh. 1,000)

	Mgeta	Mgongola	Mkula	Mwega
Average Holding Size (ha)	0.80	1.62	1.29	1.28
- Within the Scheme Area	0.30	0.36	0.30	0.79
- Outside the Scheme Area	0.50	1.26	0.99	0.49
Gross Farm Income	536	819	486	1266
Production Cost	108	243	170	352
Net Farm Income	428	576	316	914
Living Expenditure	297	419	256	375
Tax and Duties	6	7	4	12
Reserve (Profit)	125	150	56	527

It is found that the expected net profit (reserve) by the Project represents 1.34 times the present net profit level for Mgeta Scheme; 30 times for Mgongola Scheme; 1.6 times for Mkula Scheme; and 6.5 times for Mwega Scheme.

The results above show that the net income hereby expected would allow the farmers to have funds to cover the capital fund for crop operation in the next year. Moreover, the farmers could cover the charges for O&M works of the irrigation facilities as well as annual amortization cost for the project cost, and enable them to obtain net reserve thereafter deducting the maximum duties.

The net reserve amount for each scheme is enough to have an effect on living expenditures in the sense that there will be more resources available to cover increased expenditures which, in turn will raise the living standards of the beneficiaries of the Project.

(5) Capacity to Pay

To evaluate the Project from the point of view of the farmers, an average farm budget was made for each scheme with future projections under the "with-project" conditions. The calculations are shown in Table 8.2.1 and a summary of the results is given below.

It must be noticed that the "capacity-to-pay" analysis for the Mgongola and Mkula schemes has been carried out considering that, applying the even-distribution principle for land reallocation, each household is allocated 0.36 ha and 0.30 ha respectively.

Summary of Capacity-to-Pay Analysis

(Unit : Tsh. 1,000)

	Mgeta	Mgongola	Mkula	Mwega
a) Holding Size	0.30	0.36	0.30	0.79
b) Gross Income	333	497	308	1178
c) Production Cost	78	150	106	334
d) Net Farm Income	255	347	202	844
e) Income Tax	6	7	7	12
f) O/M Cost	4	6	4	15
g) Amortization Cost	70	102	57	188
h) Net Reserve (Profit)				
In case of d-(e+f)	245	334	191	817
In case of d-(e+f+g)	175	232	134	629

The results above indicate that the Project will greatly improve farm economy; the net farm from the Project is as high as TSh. 134,000 or more and is high enough to provide the production capital funds to cover the production costs for the next cropping season as well as the O&M costs and the amortization costs of an assumed loan incurred to cover the costs of the Project.

The estimated O&M costs per ha and per household for each scheme is given below:

O&M Cost by Scheme

(Unit: Tsh)

	Mgeta	Mgongola	Mkula	Mwega
O&M cost per ha	13,333	16,629	10,738	19,138
O&M cost per household	4,000	6,086	3,265	14,979
		(12,216) *1		

*1: in the case of even distribution on land allocation by farmers in Mkindo

From the above figures, it is clear that the O&M cost could be covered by the beneficiaries in each scheme and would not represent a heavy financial burden.

(6) Pay-back Period Analysis

A pay-back period analysis was made in order to estimate how many years the Project would take to pay back the initial development costs and to show a profit, after considering all relevant monetary costs and benefits. To the development costs used for the financial evaluation made above, physical contingencies and price contingencies were added. The physical contingency is assumed to be 10% of the direct construction cost and the price contingency is assumed to be 3% for the foreign currency portion and 17% for the local currency portions.

The results of analysis shown in Table 8.2.2 indicate that the Project would turn a positive balance in the 10th year from the beginning of the Project. The pay back period is relatively short due to an adequate increased level of benefits accrued from the implementation of the Project. This fact, together with the results of the capacity-to-pay analysis, indicates the soundness of the Project as a whole.

8.3 Other Development Impacts

8.3.1 Technical Aspects

(1) Effect of Transfer of Technology

Local government staffs and farmers participating in the Project in the design and construction stages will have a big chance to obtain technical knowledge on design and construction of small irrigation and drainage facilities. The acquired knowledge will be very useful for the operation, maintenance and repair of irrigation and drainage facilities.

(2) Improvement of Local Transportation

Local transportation will be much improved by the rehabilitation and/or construction of local roads and farm roads. Especially the improvement of the Malolo-Chabi road with the provision of a new bridge across the Mwega river is expected to contribute substantially to the mass transportation of agricultural products and inputs and thus to drastically activate the local economy in Chabi and Mgogozi villages as well as Malolo village.

(3) Improvement of Water Supply for Cattle Raising

Shortage of water during the dry season especially in the Mwega area is a serious problem for cattle raising by Maasai and Mangati tribes. Upon the completion of the Project, the installed canal systems will secure stable water supply to cattle watering places.

(4) Ripple Effect

The successful project implementation including the operation and maintenance of facilities and water management will enhance the incentives to introduces improved irrigation and drainage facilities, O&M methods, and water management practices in the similar smallholder irrigation schemes.

8.3.2 Social and Economic Aspects

(1) Improvement of Living Conditions

The implementation of the Project will help the farmers to rely on themselves for improving their production and living conditions after being provided with adequate agricultural infrastructure and conditions.

(2) Increase in Employment Opportunities

The Project will generate employment opportunities for unskilled workers during the construction period. Most of the required manpower will be recruited from the farmers in and around the Project area. Moreover, workers will be able to gain experience and skills in various working fields. The accumulation of experience and skills will be very useful for O&M work of the farmers. The Project will create a demand for farm labour arising from the increased farming activities due to intensive use of the land resulting from year-round irrigation. It must be mentioned that during the construction period, the income of some farmers could be decreased due to interruption of farming in the fields where the construction works are being carried out. Adequate measures should be taken to mitigate this potential negative effect.

(3) Decrease in the Migration of Young People to Other Areas

Young people after seeing the development and progress in the areas benefited by the Project, could feel encouraged to stay in the region and dedicate themselves to agricultural activities. This will bring two positive effects: one is that the population could be stabilized due to the decrease in the migration of young people to other areas; and the other is that by providing occupation to the youth, the possibility of social problems created by idle unemployed people will decrease.

(4) Incentive for Adopting Improved Irrigation in Other Areas

With the completion of the Project, it could be expected that farmers in other agricultural areas as well as those in the Project area will become familiar with modern irrigation and drainage practices and the incentive for adopting improved irrigation and drainage practices will be greatly enhanced.

(5) Contribution to National Food Security

The Project will increase the staple food production, i.e., rice, maize, which will contribute to food security. The table below shows the contribution of the Project in main staple food products. When the project has accomplished its full production target, the contribution of cereals from all the 4 schemes will amount to 8,197 tons annually. This represents 4% of the total production of cereals in Morogoro Region in 1996.

Contribution to Production of Main Staple Food

(Unit: ton)

Schemes	Cereals	Beans	Vegetables
Mgeta	90	32	108
Mgongola	4,650	930	0
Mkula	987	62	0
Mwega	2,370	111	6,660

(6) Contribution to the Regional Economy

Once the Project has fully accomplished its production target, it is expected that, at 1996 prices, the gross production value from all schemes will be Tsh. 1,970 million per year. This amount represents 3% of Morogoro regional GDP in the year 1994.

Contribution to Regional GDP

Schemes	Tsh. 1,000
Mgeta	33,300
Mgongola	855,600
Mkula	152,340
Mwega	917,100

(7) Enpowerment of Women

Women will be benefited due to the increased production activities making it possible for them to participate in and share the Project's benefits. Due to the increased level of income and improvement of production conditions, female farmers would be able to have enough money and time to be involved in activities related to education, culture, leisure, etc. which will raise their living conditions.

8.3.3 Institutional Aspects

(1) Model Project for Institutional Development of Irrigation Projects in Morogoro Region

Under the strategic framework of NIDP, GOT has envisaged the development of 16 smallholder irrigation systems in Morogoro region. For the successful and sustainable development of these projects, one of the prime requirements is the strengthening of institutional aspects including WUGs and agricultural support services. The development plan formulated for the Project covers not only the engineering aspect but also the institutional aspect, and includes various ideas to attain sustainable O&M by the beneficiaries. Therefore, the implementation of this Project would give a good effect as a model of institutional development to the irrigation projects in the region. In addition, the government officials involved in the implementation of this Project will acquire a lot of

knowledge and experience on institutional development, which are prerequisite matter for successful implementation of those irrigation projects.

(2) Improvement of Agricultural Support Activities in the Rural Area

The Project proposes the formation of new WUGs or strengthening of those already in existence. WUGs will be provided with an opportunity to conduct fruitful economic activities. Furthermore, with the achievement of a successful administration of the irrigation facilities, it will be possible to expand their activities to many other fields besides water administration. The Project proposes to involve those groups in a credit and marketing system which will benefit all members.

(3) Strengthening of Rural Organization

Improvement of irrigation/drainage systems will facilitate the formation of other farmers' groups in the Study Area. Thus, implementation of the Project is highly beneficial in terms of strengthening of rural organization.

(4) Diminution of Irrigation Water-Related Conflicts

Due to the reactivation or creation of WUGs, the potential conflicts concerning irrigation water will diminish as the Groups will be in charge of managing the water distribution in an organized and fair way.

8.3.4 Environmental Aspects

(1) Minimization of Negative Impacts and Mitigation of Social Conflicts

The environmental impact assessment pointed out that the Project would bring such misgivings as influence of water-borne diseases, water contamination by use of chemical fertilizers and agro-chemicals, degradation of vegetation due to increase of fuel wood consumption, and social conflicts on utilization of the land and water resources. However, these effects could be mitigated through the application of an adequate environmental protection plan as the one previously mentioned in Chapter VII. Moreover, the negative impacts could be minimized without too much difficulty since all of the proposed schemes are of small size.

The negative impacts mentioned above will be monitored periodically to confirm the effectiveness of the mitigation measures. This will allow to identify potential dangers and adopt early mitigation measures.

During the construction period, diverse construction detrituses will reach the rivers and traffic on the roads near or in the construction area could be interrupted. This however will be temporary disturbances that will disappear after completion of the construction works.

(2) Reduction of Conservation Costs

The Project, through a rational use of water and land resources will, make it possible to promote the conservation of those resources and, at the same time, will reduce the costs of protecting them.

CHAPTER IX. PROJECT IMPLEMENTATION PLAN

9.1 Implementation Schedule of Construction Works

9.1.1 Basic Considerations

The project construction plan is formulated on the basis of the following considerations:

(a) Construction works of major facilities should be carried out by a qualified civil work contractor. Other small facilities such as small field ditches and paddy ridges would be constructed by the beneficiaries themselves.

(b) Mechanized construction methods will be introduced principally for earthworks and major concrete works. Adopting the beneficiaries' participatory approach, local farmers should be employed as much as possible for labour works such as small earthworks and concrete lining.

(c) Consulting engineers should be employed to assist the Project Office in the preparation of detailed design and tender documents, and in tendering and supervision of the construction works. Experts required for the project construction works are assumed to consist of a project manager cum irrigation engineer, a topo-surveyor, two design engineers, one construction management engineer, and a quantity surveyor, construction specification writer.

9.1.2 Construction Plan

The construction schedule is shown in Figure 9.1.1. The schedule consists of the survey and design, tendering, and construction.

(1) Workable Days

Construction work progress will be much affected by rainfall. The number of workable days for each scheme is estimated as follows.

Workable Days for Construction

Scheme	During Dry Season	Workable Days per Year
Mgeta	115 from June to October	235
Mgongola	-	261
Mkula	144 from June to November	250
Mwega	-	285

Note: Sunday is deducted.

(2) Construction Plan

(a) Headworks

Construction or improvement of the headworks for the Mgeta, Mgongola, and Mkula schemes will be carried out mainly during the mid dry season, when the river discharge is the least. All major works will be completed by the end of the dry season. As for the Mwega headworks, the construction will take around one year after the preparatory works.

(b) Canals, roads and related structures

Construction or improvement of canals, roads, and related facilities for the Mgeta, Mgongola, and Mkula schemes will be carried out mainly during the dry season. In the case of the Mwega scheme, construction works can be carried out throughout the year. Aqueduct structures, bridge, cross drains, and siphons for crossing seasonal streams will be constructed in the dry season, when the river discharge is small. For the Mgongola scheme, the flood protection dikes will be firstly constructed and followed by drainage canals in order to protect the area against floods from the Mkindo and Mgongola rivers and to expedite drainage of inundation water. For all the schemes, the construction works should be carried out so as not to disturb the current irrigation water supply as much as possible, or if the construction works have to disturb the current water supply, the disturbance period should be shortened as much as possible.

(c) On-farm works

On-farm works such as construction of field ditches, paddy ridges and minor land leveling will be carried out by farmers themselves in accordance with the instructions of government agencies.

9.2. Implementation Schedule of Institutional Work

9.2.1 Executing Agencies Related to the Project Implementation

The implementation of the Project is divided into three stages: (i) preparatory works such as explanation meeting, (ii) implementation of the Project including detailed design, construction and strengthening of WUGs, and (iii) O&M by the farmers. The executing agencies would be as follows;

Agencies Related to the Project Implementation

Development Stage	Major Activities	Implementing Agencies	Main Supporting Agencies
1) Preparatory Work	Public meeting	ZIO	RAS, RPO, RALDO, DC, DALDO, RCO, DCOs, Village Government & Ward Councils
2) Project Implementation	D/D and construction	ZIO	RAS, RPO, RALDO, DC, DALDO, RCO, DCOs, Ward Councils
	- Establishment or re-organization of WUGs - Land acquisition for right-of-way - Land re-allocation	Village Government / Existing WUG	
3) O&M of Irrigation Facilities	- O&M of facilities - Farming	WUG (Farmers)	RALDO, DALDO, DCOs, Village Government

GOT has a restructuring plan of the Regional Government, and it is being implemented in Morogoro region. The study on the project executing agencies was therefore made on the basis of the organizational structure of the Regional Government as of August 1997.

9.2.2 Organization for Project Implementation

The Commissioner of Agriculture and Livestock Development (CALD) in MAC would be the executing agency of the Project. CALD would coordinate all activities of the relevant government agencies and regional administrative organizations in connection with the project implementation. At the regional level, ZIO in Morogoro Region under the Assistant Commissioner for Irrigation and CALD would have direct responsibility for the project implementation. The organizational structure of this office is presented in Figure 9.2.1. The main tasks of ZIO are listed below:

1) Financial arrangements for the project implementation
2) Arrangement of staff necessary for project implementation
3) Public meeting with farmers
4) Collection of farmers' request and review of the rehabilitation plan
5) Necessary supporting services to general meeting of village government / existing WUG
6) Exchange of agreement with the village government / existing WUG for final plan
7) Detailed design and supervision of all construction works

The implementation schedule of the construction works is presented in Figure 9.1.1. ZIO should implement not only construction works but also the public meeting in accordance with the farmers' participatory approach. Namely, this office will explain all of the plan and implementation schedule to the farmers at the public meeting before commencement of the Project, so that farmers fully understand the development plan and their obligation in participating to the project implementation.

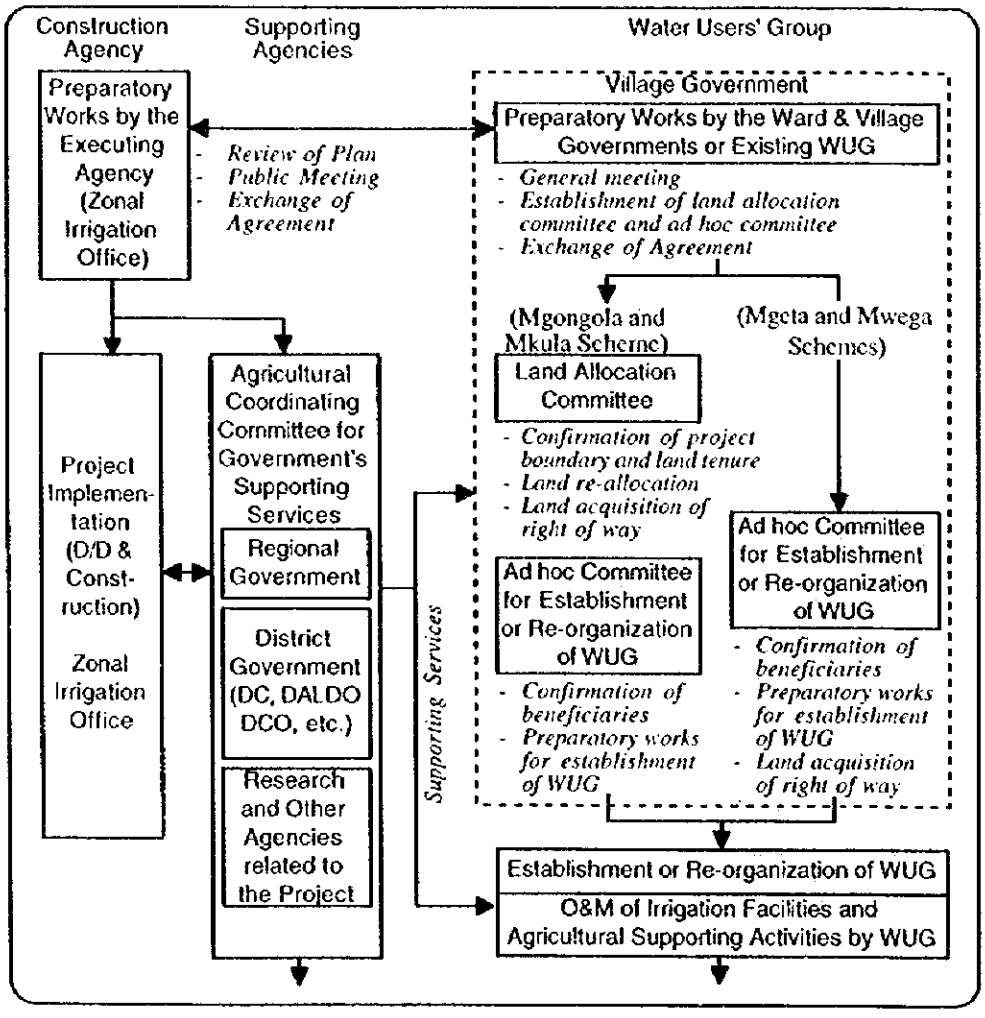
9.2.3 Organization and Schedule of Post-implementation Work

In order to achieve sustainable O&M of the facilities and successful irrigation farming, it is a prime requirement to strengthen WUGs and agricultural extension services. A proposed implementation schedule of these activities is described below.

(1) Implementation Schedule of WUG Reinforcement Programme

All the irrigation facilities rehabilitated and expanded under the Project will be managed and maintained by the beneficiaries themselves. In order to arouse the farmers' sense of belonging and responsibility for O&M of facilities, it is proposed to implement the Project on a farmers' participatory approach. The schematic flow of the organizational set-up and implementation schedule of WUG is presented below, and the details are shown in Figure 9.2.2.

Schematic Flow for Organizational Set-up
and Implementation Schedule of WUG



The organizational set-up and strengthening of WUG will be implemented in parallel with the detailed design and construction of the facilities, and closely linked with each other.

At first, a public meeting will be held at each project site, and ZIO will fully explain the rehabilitation plan to the farmers (beneficiaries). At this meeting, farmers' participation such as labour supply for construction works and supply of local materials should be discussed. In addition, the farmers' duties towards the project implementation such as land acquisition for right-of-way and land re-allocation, which are to be implemented by the farmers themselves, should also be discussed between them.

After the public meeting, a general meeting on the project implementation should be held by the village government or existing WUG, with the attendance of all farmers in the villages concerned. Then, the plan has to be acknowledged by the farmers with a full understanding of its contents. ZIO and the village government or WUG have to exchange an agreement on the plan after the general meeting. The farmers' duties should be mentioned fully in this agreement.

ZIO will commence the project works including field investigation, detailed design and construction, while the village government or WUG will make necessary arrangements for supplying laborers and local materials. In parallel with the project implementation, WUG should be established and strengthened in accordance with the proposed plan. The village government should take the initiative in implementing these activities, and organize a land allocation committee and an ad hoc committee for organizing WUG. These committees will consist of leaders of village governments and existing WUG. The District Commissioner and Ward Councilor will provide necessary support to the village government, especially for the land re-allocation and land acquisition for right-of-way. Specifically, the committees will have the following duties:

Land Allocation Committee
a) Confirmation of project boundary and land tenure
b) Land re-allocation
c) Land acquisition for right-of-way

Ad hoc Committee of WUG
a) Confirmation of beneficiaries
b) Management of farmers' participation in construction works
c) Preparatory works for establishment of WUG (including preparation of draft by-laws and budget, reception of candidacy for leadership of WUG, arrangement of first general meeting, etc.)

The ad hoc committee will arrange the establishment of WUG, and it should be established three months before the completion of construction works, at the latest DALDO's office should commence the training of WUG immediately. After the construction, WUG will carry out the operation and maintenance of the facilities. The governments agencies will provide necessary supporting services for the establishment and strengthening of WUG. The major services are listed below.

DC/Ward Councilor
- Supporting land re-allocation and land acquisition

DALDO
- Supporting the village government in holding the general meeting.
- Supporting the activities of the land allocation and ad hoc committees.
- Training on O&M of irrigation facilities and WUG's management including marketing, credits, etc.
- Providing technical supporting services for on-farm development.

- Providing overall engineering services for O&M of irrigation facilities

DCO
- Institutional improvement of WUG.

DALDO's office will be the main agency responsible for the above supporting services. The proposed organizational structure of this office is presented in Figure 9.2.3. The supporting services of DALDO's office will be implemented mainly through the irrigation technicians and VEOs who are attached to each scheme.

DALDO's office shall periodically monitor and evaluate the activities of WUG. The data and results of the evaluation will be fed back to improve O&M of the facilities and agricultural production in the project areas. In addition, DALDO's office will provide necessary support to settle WUG's problems observed through the monitoring, and implement follow-up training to WUG as the occasion demands.

(2) Implementation Schedule of Training Programme for Extension Staffs and Farmers

The training programme for the extension staffs and farmers will be arranged by the office of DALDO. The implementation schedule is divided into two stages, namely during and after the project construction, and the major activities to be undertaken are summarized below:

(i) During the project construction

- Preparation of materials for training programme
- Implementation of workshops for front-line extension staffs (DIVEOs and VEOs)
- Special training in KATC
- Implementation of demonstration plots for training of VEOs and aggressive farmers

(ii) After the project construction

- Field training for VEOs and farmers concerned
- Implementation of workshops for front-line extension staffs

The schedule of monthly training during and after the project construction is illustrated in Figure 9.2.4. The agricultural extension activities of DALDO office will be implemented with the powerful support of the agencies concerned, which are TOSCA, MATIs/LITIs, Research Centres including Dakawa Research Station, KATRIN, etc. and SUA.

(3) Establishment of Agricultural Coordinating Committee

In order to secure the effectiveness and success of the training programme and the Government's supporting services, it is proposed to organize an Agricultural Coordinating Committee for each district concerned as shown in Figure 9.2.5. This committee, whose scope of work is attached hereinafter, will coordinate the overall reinforcement programme.

This committee will be chaired by RALDO. The activities of this committee will be performed on the basis of participatory approach by the farmers concerned, in order to achieve sustainable of agricultural development.

(a) Members of the Agricultural Coordinating Committee

The Agricultural Coordinating Committee will consist of the following members:

1. RALDO	- Chairman
2. REO	- Member
3. ZIO	- Member
4. DALDO	- Member
5. Farmers' Organization(s)	- Member
6. TOSCA	- Member
7. MATIs/LITIs	- Member
8. Research Centres	- Member
9. SUA	- Member
10. District Extension Officer	- Secretary

(b) Scope of work of the Agricultural Coordinating Committee

The Committee's functions are as summarized below:

1. To monitor and evaluate the progress of project implementation, activities of WUG and farmers, and study necessary supporting services for further development.
2. To coordinate all of the agricultural supporting services.
3. To monitor and review the agricultural supporting services, and provide necessary advice to the agencies concerned.
4. To monitor and review the progress of the agricultural training programme for VEOs and farmers.
5. To hold periodical meetings of the Committee

9.2.4 Staff Required for Project Implementation

Prior to the implementation of the Project, the staffs of ZIO and the offices of RALDO and DALDO, which are the main supporting agencies of the Project, should be strengthened. The proposed additional staffs to be deployed for the project implementation are as follows:

1) Agro-economist/Sociologist (ZIO): Prior to the implementation of the Project, an agro-economist/sociologist will be appointed in ZIO. The preparatory works including meeting with farmers, survey of farmers' intention towards the Project and guidance for the general meeting of the village government will be carried out mainly by this officer.

2) Project Coordinator (RALDO's office): To make close coordination between ZIO and RALDO's office, an officer attached to the Project office will be appointed as representative of RALDO's office.

3) Irrigation Engineer and Marketing and Credit Officer (DALDO's offices): In order to achieve sustainable O&M by WUGs and effective irrigated farming by farmers, supporting services for O&M of irrigation facilities and marketing

and credit are crucial factors, and DALDO's offices should play an important role to in providing these services to WUG. At present, however, DALDO's offices have almost no specialists in these sectors. It is therefore proposed to recruit an Irrigation Engineer and a Marketing and Credit Officer who graduated from university or college and have a lot of experience in these sectors, for each DALDO's office.

4) VEOs and Irrigation Technicians: At the field level, it is proposed to appoint a VEO for each village related to the scheme and an Irrigation Technician (IT) for each scheme. All necessary supporting services of DALDO's office will be implemented through these two officers.

The number of staffs to be deployed in each office is summarized below. It is proposed that these staffs will be deployed before the implementation of the Project.

Proposed Staffing for Project Implementation

Position	Present			Staff Required		Increment	
Morogoro Zonal Irrigation Office							
Economic & Social Survey Section							
Agro Economist/Sociologist		-		1		1	
Office of RALDO							
Project Coordinator		-		1		1	
Office of DALDO, Morogoro							
Irrigation Engineer		-		1		1	
Marketing and Credit Officer		-		1		1	
Village Extension Officer and Irrigation Technician							
(Project Site)	Villages	VEO	IT	VEO	IT	VEO	IT
- Mgeta	2 *1	2	-	2	1 *2	-	1
- Mgongola	3	3	1	3	1	-	-
Office of DALDO, Kilosa							
Irrigation Engineer		-		1		1	
Marketing and Credit Officer		-		1		1	
Village Extension Officer and Irrigation Technician							
(Project Site)	Villages	VEO	IT	VEO	IT	VEO	IT
- Nyinga	- *3	-	-	- *4	- *4		
- Malolo	1	1	-	1	-	-	-
- Mgogozi	1	-	1	1	1 *2	1	-
Office of DALDO, Kilombero							
Irrigation Engineer		-		1		1	
Marketing and Credit Officer		-		1		1	
Village Extension Officer and Irrigation Technician							
(Project Site)	Villages	VEO	IT	VEO	IT	VEO	IT
- Mkula	1	1	-	1	1	-	1

*1 Mgeta scheme consists of 2 villages. *2 Covers two villages.
*3 Sub-village of Malolo. *4 Covered by Malolo staff.
VEO: Village Extension Officer IT: Irrigation Technician

In addition, it is necessary to assign several specialist/experts, in order to train the above government officers involved in the project implementation and the agricultural supporting services to WUGs and farmers. Although these officers have a basic knowledge with some experience, it is necessary to upgrade their knowledge for successful and effective implementation of the Project. The experts required for this purpose and their tasks are listed below

1) O&M Expert

- Preparation of O&M manual
- Preparation of training materials for O&M and on-farm development
- Training of officers involved in O&M and on-farm development
- Providing necessary advice for improving supporting activities
- Monitoring and evaluation of agricultural supporting services for O&M and on-farm development
- Follow-up training of officers concerned

2) Institutional Expert

- Advice on establishment and strengthening of the Government's supporting system
- Preparation of manual for WUG's management
- Preparation of training materials for WUG
- Training of officers involved in supporting services to WUG
- Providing necessary advice for improve supporting activities
- Monitoring and evaluation of agricultural supporting services for WUG
- Follow-up training of officers concerned

3) Agronomist / Agricultural Extension Expert

- Technical advice on preparation of training programme coordinated by DALDO
- Technical advice on participation approach in the field training programme
- Implementation of workshops for senior staffs (DALDO, DEO, RALDO, REO, etc.)
- Technical advice on field training of DIVEO and VEO coordinated by DALDO
- Technical advice on field training of aggressive farmers managed by VEO
- Technical advice on field training of general farmers managed by VEO
- Technical advice on monitoring and review of the training programme and extension services
- Technical advice on improvement of farming practices
- Technical advice on preparation of guideline for proposed farming practices

The assignment schedule of each expert is shown in Figures 9.2.2 and 9.2.4.

CHAPTER X. CONCLUSIONS AND RECOMMENDATIONS

10.1 Conclusions

Through the investigation and studies, it can be concluded that the Project consisting of the four priority development schemes is economically viable and technically feasible from the viewpoint of engineering, institutional and social aspects, environment, and national economy. The following development fruits are expected from the Project implementation: (i) stabilization and increase of agricultural production under full irrigation and (ii) increase of farmer's income and living standards. The Project will also contribute to activating the regional economy and improving national food security, though the development size itself is not so large.

In addition, the following conclusions were obtained through the field survey, the farmers' intention survey and the public meetings held in each scheme area:

1) Farmers in the priority development scheme areas are looking forward to Project and desire to participate positively in the implementation of the Project.

2) At the public meetings, farmers showed a positive attitude of self-reliance, in particular with regard to their participation in the construction works, land acquisition for the right-of-way, and on-farm development. As for O&M by the farmers themselves, all farmers have agreed with this as well as the payment of an irrigation services charge. They have a positive attitude toward the project implementation, and it may be said that such farmers' attitude will be very helpful for sustainable O&M of the Project. Moreover, all farmers have accepted the strengthening plan of WUGs, and the farmers' positive participation in its implementation is expected.

3) The farmers basically have capability to undertake operation and maintenance of irrigation facilities and proper water management by themselves, although proper technical support through training and guidance is required at the initial stage of the Project operation.

4) As the model development, it is also expected that the realization of the Project will have a considerable ripple effect on smallholder irrigation schemes scattered all over the country.

Judging from the above conclusions and development needs, it is recommended to implement the Project as early as possible.

10.2 Recommendations

10.2.1 Technical Aspects

(1) Phasing of Project Implementation

As explained in Chapter IX, it is planned that the Project consisting of the four priority irrigation schemes, be implemented in one lot and during a period of 4 years, under the condition that the Tanzanian Government arranges all the funds necessary for its implementation through foreign aid or from its own budget. If budgetary arrangements

have some difficulties, it is recommended to adopt a stagewise implementation of the four schemes in accordance with the available funds, taking the following technical aspects into account.

1) The Mwega and Mgeta schemes have a high priority from the viewpoint of development needs. The Mwega scheme is located in the semi-arid zone where irrigation development is indispensable for agricultural production activities. In addition, the arable lands in the area are limited due to their topography. Under such physical conditions, the farmers in the Mwega scheme area are poor. In order to alleviate poverty in this area, intensive land use and crop diversification based on irrigated farming are prerequisite factors. It is noted that the farmers in the Mwega scheme area have a long experience in irrigated farming and O&M of facilities, and have a positive attitude towards the participation in the Project implementation. These factors will help ensure the project sustainability.

   As for the Mgeta scheme, the development size itself is small, because this scheme was selected as a development model in the area which has various problems such as soil erosion and landslide due to inappropriate irrigation systems constructed on sloped land. In view of the environmental conservation in the area, it can be concluded that the implementation of the Mgeta scheme is of paramount urgency among the four schemes.

2) The Mkula and Mgongola schemes have almost no difficulty from the technical viewpoint, but a sensitive issue still remains in their implementation, that is the re-allocation of farmlands. Because the lands to be developed newly by the schemes occupy a large portion of the total development area, it is necessary to re-allocate those lands in accordance with the policy that development fruits should be distributed to farmers equally and as many as possible. Although this land re-allocation may be possible in the both schemes, because over 90% of farmers have agreed with the allocation plan so far, it is recommended to proceed with adequate preparatory works like public meetings to get farmers' consensus before the commencement of the schemes.

   In the case of the Mwega and Mgeta schemes, most of the lands are covered by the existing irrigation systems. Therefore, such sensitive land re-allocation is not necessary,, because almost all farmers can have a piece of irrigated land to be rehabilitated under the Project.

Thus, the Mwega and Mgeta schemes have a high priority for irrigation development, followed by the Mkula and Mgongola schemes. If GOT has some difficulties in budgetary arrangement, it is recommended to apply a phasewise project implementation as mentioned above.

(2) Afforestation Development

Afforestation development is a key factor to maintain the rural communities, especially to ensure a steady supply of fuel woods near the communities in all the scheme areas and to conserve soil on the very steep slopes in the Mgeta scheme area. The hauling distance to obtain fuel woods gradually increases in recent years as the population increases at a rather high rate.

Areas adjacent to the irrigation fields such as those along the proposed flood protection dikes in the Mgongola scheme and along the main and secondary canals in the Mwega scheme are suitable for producing trees, since such areas usually contain water infiltrated from the adjacent irrigation fields. It is, therefore, recommended to implement afforestation development around the irrigation areas.

10.2.2 Institutional Aspects

In order to achieve successful and effective implementation of the Project, it is recommended that the executing agencies concerned undertake the following activities:

1) Staffs to be deployed newly for the project implementation are estimated to consist of 10 officers including irrigation engineers, irrigation technicians, VEOs, etc. The executing agencies concerned should arrange these staffs for successful implementation of the Project.

2) At present, GOT has a plan to restructure the regional government. According to this plan, the organization and staffing of the Morogoro regional government will be simplified, and those of the district governments will be strengthened. In the Project, the district government agencies such as DALDO and DCO offices have direct responsibility for providing supporting services to WUGs to be established in the schemes. The strengthening of these district governments under the restructuring plan will enable to secure the project sustainability. It is therefore recommended to further accelerate this restructuring plan in Morogoro region.

3) In accordance with the Government's policy that development fruits be distributed to the farmers equally and as many as possible, the developed lands in the Mkula and Mgongola schemes will be re-allocated to the farmers. The village governments should take the initiative in implementing the re-allocation of these lands. The result of the public meeting held by the Study Team in July 1997 shows that over 90% of the farmers in both scheme areas agreed with the land re-allocation plan. For the Mkula scheme, land re-allocation will be possible because lands will be re-allocated only to the farmers within the Mkula village. However, it seems that the Mgongola scheme will have some difficulties in land re-allocation for the following reasons: The Mgongola scheme covers the farmers in Mkindo, Dihombo and Hembeti villages, but the development lands to be allocated to them are located in Mkindo village, and have been cultivated by the Mkindo farmers. Therefore, the executing agencies and the district governments should provide necessary support to the village governments and farmers for implementation of land re-allocation in these villages. In addition, ZIO should hold a public meeting and confirm again the farmers' intention on the re-allocation before the commencement of the Project, even though they had agreed with it so far. If the re-allocation covering the three villages is rejected by them, ZIO should prepare some alternative plans. There would be no problem if the re-allocation cover only the Mkindo villagers or priority is given to them.