

### **3.4 Irrigation and Drainage Development Plan**

#### **3.4.1 Development Concept**

As stated in previous sections, "Farmers participatory approach to the Project" is a key subject for the irrigation development. "Farmers participatory approach" requires both GOT and beneficiaries to collaborate each other to establish self sustainable schemes. Under this approach, the beneficiaries are principally involved in the scheme study, design, construction activities and full responsibility of operation and management matters. Also, "environment-friendly development" is a key subject to maintain the sustainable schemes.

Based on the above approach to the Project, the following concepts are especially taken into account in the irrigation development for the Mgeta scheme

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

Based on the above basic concepts and also reflecting the beneficiaries wishes obtained through interviews and field discussion with them, irrigation development plans for the priority development schemes will be formulated. Major matters concretely put to the formulation of development plan are as follows:

#### **(1) Headworks**

The most important points are the control of diversion discharge and the flood release through the weir. The intake should be designed so as to divert required amount of water within allowable limit without adjusting of inlet opening, even if the river water level fluctuates or raised by flood. The weir is of fixed type.

#### **(2) Canal systems**

Two kinds of system will be introduced as a model development for the Mgeta scheme. One is a pipeline system and the other is an open canal system reinforced by canal lining.

#### **(3) Operation and maintenance concept**

In case of the pipeline system, the most importance from the maintenance point of view, is to maintain the pipe line system to be free from obstacles.

In case of open canal system, non-water supply period should be set up for canal system for maintenance and repairing in irrigation off season. During this period, all water in the irrigation canal system should be completely drained and dried up and damaged por-

tions of canal inside should be repaired. Once irrigation water supply is started, water is conveyed at a constant discharge level on the canal system without frequent operations of an intake. However, when river water resources are insufficient for irrigation water demands, careful water management including rotational irrigation water supply and/or selective use of limited water must be made among this system and other systems depending water resources on the Mzinga river and Mindu river.. These operation and maintenance works including technical and financial matters shall be managed by beneficiaries themselves under technical assistance from government agencies.

(4) Beneficiaries participatory to construction works

From the point of beneficiaries participatory approach, beneficiaries and local inhabitants are expected to largely participate in the construction of irrigation canals as a work force, since the earthworks and concrete works are mostly executed by manpower.

Based on the above basic criteria, the development plan for the Mgeta scheme is being formulated.

### 3.4.2 Canal System Layout

(1) Selection of canal system for model development

Existing canals are classified into two types from the view point of the canal alignment. One is a canal running along a contour line and the other runs on a ridge. From each of the categories, one typical canal is selected for the model development. 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 canal is that ( herein referred to as "Mindu canal") diverting water from the Mindu river at just the confluence point with the tributary to the left and running along contour lines supplying water to the area of around 25 ha in gross ( herein referred to as "Mindu area"). Figure 3.4.1 indicates the route of these canals and commanding areas.

(2) Selection of canal works

(a) Mzinga canal system

There are about 60 households on the ridges of Mzinga area. According to the interview survey to the inhabitants, they utilize canal-conveying water not only for irrigation but also for domestic purposes, however, for drinking purposes they usually take clean water directly from the Mzinga river or the Lukundi river and desire the drinking water supply. This water fetching is really a heavy work for the inhabitants in such steep mountainous areas. In order to release the inhabitants from this burden, considering the conveyance of drinking water as well as irrigation and domestic use, a pipe line system conveying water by gravity is proposed for Mzinga canal system, since the pipe line system can convey water keeping it clean and free from the soil erosion and also contributes to water saving better than in the open system. Length of the canal is about 1.3 km and difference of the head between the intake point and the canal end point is about 300 m. The longitudinal gradient is about 25 % on an average.

(b) Mindu canal system

The existing canal is well maintained except at a few weak points such as poor

thin banks and eroded drops. There are a few households only along the canal. This canal is, therefore, proposed to be improved with lining using cement concrete in most of the reaches. The length of the canal to be improved is about 1 km consisting of upper reaches of 0.75 km and lower reaches of 0.25 km as shown in Figure 3.4.1.

### 3.4.3 Irrigation Water Requirement

#### (1) General

Irrigation water requirement is estimated by using daily rainfall data and climatological data in accordance with the proposed cropping pattern consisting of double cropping of upland crops.

Irrigation water requirement is estimated for comparing the irrigation water demand with water resources and preliminary design of irrigation canal system. The estimate is carried out on 10-day basis in accordance with the following procedure.

- (a) To calculate potential evapotranspiration from climate data.
- (b) To estimate consumptive use of water by multiplying potential evapotranspiration by crop coefficient.
- (c) To estimate effective rainfall from daily rainfall.
- (d) To calculate net irrigation water requirement deducting the effective rainfall from the estimated consumptive use of water.
- (e) To calculate irrigation water requirement taking irrigation efficiency into account.

#### (2) Potential evapotranspiration

Potential evapotranspiration was estimated by the modified Penman method from the climatological estimate mentioned in Section 1.1.3. The following table shows the estimated potential evapotranspiration.

Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
Mgeta	4.0	4.0	3.7	2.8	2.5	2.4	2.4	2.8	3.5	4.1	4.4	4.2

#### (3) Water requirement for land preparation prior to upland crop planting

No water application is considered for land preparation of upland crop cultivation, since the loam dominates in cropping area is not so hard even under the dry condition.

#### (4) Crop coefficient and consumptive use of water

Crop coefficient adopted for estimating irrigation water requirements is shown in the following table. Consumptive use of water by crop is calculated by multiplying the potential evapotranspiration by the crop coefficient.

Crop Grow. Stage	1	2	3	4	5	6	7	8	9	10	11
Upland Crops	0.60	0.60	0.70	0.80	0.90	0.95	1.05	1.00	0.90	0.70	0.50

One growing stage = 10 days

(5) Effective rainfall and net irrigation water requirement

In order to estimate effective rainfall utilized for crop growing, daily rainfall data for 10 years from 1975 to 1984 of Mgeta rainfall gauge, of which code is 973715, located in Mgeta area are used.

Effective rainfall is estimated by daily water balance in a root zone of upland crops on the assumption that :

- (a) irrigation water is applied at the time when water content in the root zone of upland crop reaches specified minimum water content.
- (b) also when the water content in root zone becomes more than the field capacity, the excess water over the field capacity is not utilized for plant growth.

The minimum water content in the root zone is 45 mm supposing that the minimum water content nearly equals to the wilting point, which is generally about 90 mm/m in medium textured soil and that root zone is 50 cm, although it differs from kinds and growing stage of crops. Upper limit in root zone is a product of field capacity and root zone. The field capacity is assumed to be 210 mm/m considering that medium to coarse textured soil is dominant in the area. Root zone is 50 cm. Thus the upper limit in upland crop area is 105 mm. Available moisture contents is then 60 mm. Water extraction pattern is different in root zone. Generally, upper layer is bigger than lower one in water extraction by plant. Thus upper layer reaches to the wilting point faster than lower one. Considering the different water extraction pattern, it is assumed that irrigation water is applied at 70 % of total available moisture; 42 mm is extracted from the root zone.

The relation between rainfall and effective rainfall on 10 day basis are presented by the following equations obtained by least square method from the effective rainfall calculation results.

$$ER = 0.6 R$$

ER : effective rainfall (mm)

R : rainfall (mm)

Net irrigation water requirements are calculated by the above equations from crop consumptive use of water plus percolation loss.

(6) Irrigation efficiency

To account for losses of water incurred during conveyance and application to the field, an efficiency factor should be included when calculating the project irrigation water requirements. The irrigation efficiency is subdivided into conveyance efficiency, field canal efficiency, and field application efficiency. The conveyance efficiency is the ratio between water received at the headworks and that released to the tertiary canals. The field canal efficiency is the ratio between water received at tertiary canal head and that received at the inlet of the block of fields. Field application efficiency is the ratio between water directly available to the crop and that received at the field inlet.

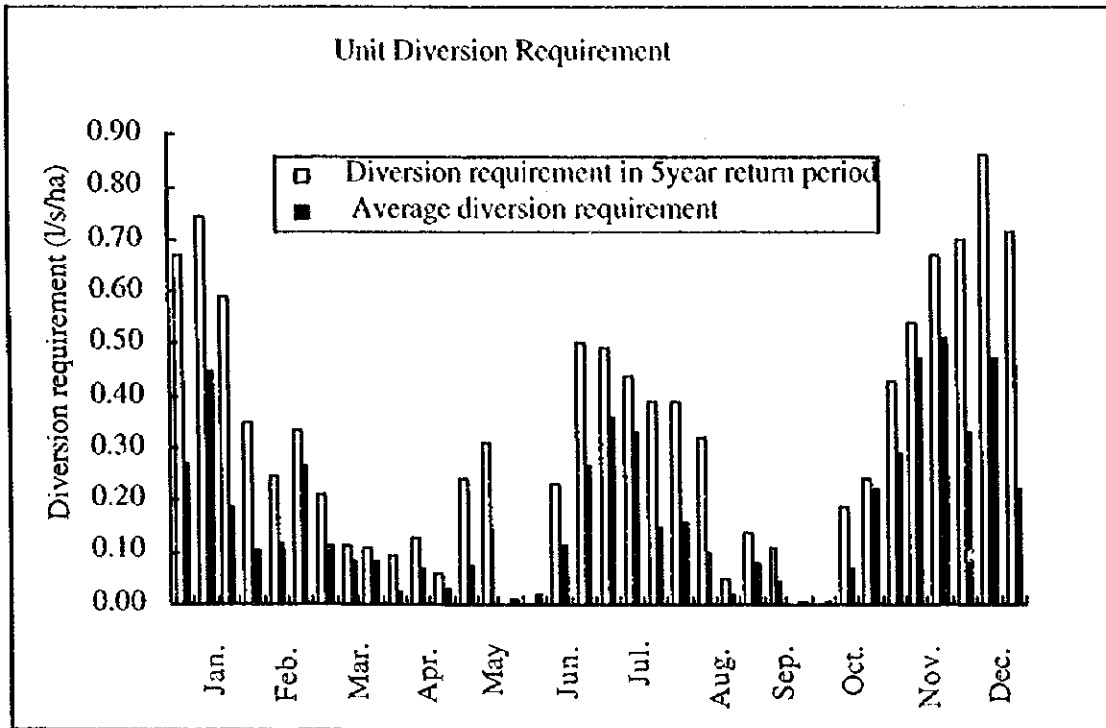
The conveyance efficiency ( $E_c$ ) is assumed to be 0.9 under the conditions of continuous supply with no substantial change in flow with canal lining in most of reaches or pipe line. Field canal efficiency ( $E_b$ ) is assumed to be 0.75 in consideration that field canals are earthen-made running very steep slopes. The field application efficiency ( $E_a$ ), 0.7 is taken for upland crop irrigation.

The irrigation efficiency ( $E_i$ ) is concluded as follows:

$$E_i = E_c E_b E_a = 0.47$$

(7) Irrigation water requirements

Irrigation water requirements are calculated by dividing crop water requirements by irrigation efficiency. The calculation results are shown in Table 3.4.1 on 10 day basis. The following figure shows the second biggest diversion water requirements on 10 day basis, which nearly correspond to those in five year return period, as well as the averages.



Monthly average diversion discharges are shown in the following table.

Mean Unit Diversion Requirement

(Unit: litre/sec/ha)											
Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
0.30	0.16	0.09	0.04	0.07	0.13	0.28	0.09	0.04	0.10	0.42	0.34

The above figure indicates that diversion water requirement is high even in the rainy season in case of the drought year, in which rainfall is usually erratic. Peak irrigation water requirement is estimated at 0.8 litre/s/ha in December.

(8) Design canal discharge

Conveyance system consisting of a semi-closed system pipe line in the Mzinga system and a lining channel in the Mindu system is designed to supply water on 24-hour basis. The design discharges of the conveyance system are a product of irrigation area and the peak irrigation water requirement. The prospective irrigation areas are 14 ha in Mzinga system and 16 ha in Mindu system. Therefore design discharges are 11 litre/s for Mzinga conveyance canal and 13 litre/sec for Mindu system.

Offtakes to be provided on the conveyance canals will commands one hectare or less. Water diverted from offtakes runs or can not avoid to run along steep slopes. Considering both situations and easiness in water management, design discharge is fixed to be the small amount as 5 litres/sec.

### 3.4.4 Diversion Water Requirement and River Discharge

According to the observation of river discharge and hearing to the inhabitants, the Mindu river has a discharge of 30 to 40 litre/sec in July and August but the flow decreases as it passes through the dry season and reaches 10 to 15 litre/sec in November. It is however still almost sufficient for irrigation and domestic use under the condition that the limited water is efficiently utilized. As for the Mzinga river, it has a discharge of 50 to 60 litre/sec in July and August at the planned diversion point, also decreases usually up to 20 to 30 litre/sec in late dry season, of which amount depends on the river diverted to Nyandira village area as well as physical and climate conditions. During the mid-dry season, to Nyandira village area, which is a neighbor of Langali village in addition to the Langali area the Mzinga river water is diverted through a small channel running along contour line at an high altitude as 1700 m for supplementing the shortage in Nyandila vil-lage. On this occasion, if the basin of the Mzinga river suffers from the shortage, Nyandila vil-lage side must decrease the diversion amount in accordance with the request from the Mzinga river basin beneficiaries. The cropping area in the Mzinga river basin is about 40 ha, which is equivalent to 20 to 30 litre/sec in irrigation water requirement at the river level including our proposed model development area. Thus the water resources are judged to meet to the irrigation water requirements in the most of the seasons. Only the late dry season in a drought year is exceptional case in which careful water management is required for efficient use of limited water.

### 3.4.5 Drainage Requirements and Flood Water Discharge

Drainage in the meaning that excess water is smoothly drained from cropping fields without serious damages in the fields is very important in Mgeta scheme, since the area is a steep sloped area suffering from soil erosion with heavy rainfall intensity suggested by the following probability daily rainfall.

Probability Rainfall in Mgeta

Return Period	Probability Daily Rainfall (mm/day)	
	By Thomas	By Hazen
20	200	185
10	178	167
5	152	144
2	102	102

Data: Station code 973715, 10 years daily rainfall from 1975 to 1984.

In such a area, it is important for soil conservation to mitigate the concentration of storm water and to disperse it, from which point of view, soil surface should be covered with green vegetables in mid rainy season and sloping land should be terraced as much as possible. Also from the drainage measures point of view, expected wetted perimeters of every small drainage ways should be covered with vegetation, which increases the roughness of the wetted perimeter and prevents soil erosion, and water plunging points should be formed so as to efficiently dissipate water energy within the plunge pool, which itself should be protected with gravel and cobble stones against water erosion.

- Flood discharge from mountainous area

The peak flood discharges of the Mzinga river and the Mindu river are estimated by

the following rational formula.

$$Q_p = f r A / 3.6$$

where,  $Q_p$  : peak flood discharge (m<sup>3</sup>/sec)  
 $f$  : runoff coefficient, 0.7 is adopted.  
 $r$  : rainfall intensity over a period equal to the time of concentration (mm/hr)  
 $A$  : catchment area (km<sup>2</sup>),  
 2.4 km<sup>2</sup> in the Mzinga river and 2.7 km<sup>2</sup> in the Mindu river

The rainfall intensity, it is estimated by the following Kadoya and Mononobe equations.

$$t = C A^{0.22} r_e^{-0.35}$$

$$r = (R_{24} / 24) (24 / t)^{2/3}$$

where,  $t$  : the time of concentration (min. for first equa. and hour for second equa.)  
 $C$  : coefficient of the time of concentration, = 350 for mountainous area  
 $A$  : catchment area (km<sup>2</sup>)  
 $r_e$  : effective rainfall intensity during the time of concentration (mm/hr)  
 $R_{24}$  : daily rainfall (mm)

The probability flood discharge are as follows.

Probability Flood Discharge at Intake Site

	(Unit : m <sup>3</sup> /sec)	
	Mzinga river	Mindu river
20 year probability flood	19	21
50 year probability flood	22	25

### 3.4.6 Engineering Design

The project works consist of improvement of both the Mzinga canal and the Mindu canal.

#### (1) Mzinga canal system

The pipeline system consists of an intake, pipes, control stands, and outlet valves.

##### (a) Intake structure

The intake site is very steep and large stones mesh with each other. Water flows and leaks down the gaps and crevices among such large stones. These crevices and gaps are filled with stones and cement mortar and then a small weir made by wet stone masonry is built between large stones.

The intake structure will consist of an inlet wall, a head race channel, and an overflow stand. The inlet wall will play a role to prevent the head race channel from entering excess water. The head race channel will be of open type and

lead water to the pipe line. At the end of the head race channel, the overflow stand will exist. The stand divided into two rooms. The upstream room is a sand trap pond and clean water overflows the partition wall to the downstream room. The downstream room is a inlet box to the pipe line. The pipe inlet is equipped with a steel mesh screen to prevent pipe from entering obstacles and an inlet valve.

(b) Pipe line

The pipe will be a PVC (polyvinyl chloride) pipe in principle. The diameter is determined to be 100 mm so that the velocity becomes less than 2 m/sec, which is generally overall allowable velocity as an overall system. The PVC pipe is buried in earth about 50 cm below the ground surface. At the points where the pipe line bends, a thrust block made by concrete is provided. At the section where the pipe can not be buried due to rock formation, steel-made pipe will be provided without buried. The control stand will be provided every 50 m head difference. The stand is equipped with a float valve. Water level in the control stand rises to a certain level, the valve is automatically closed and when the water level lowers, the valve is opened and water enters to the stand. On the way of the pipe line, outlet valves will be provided at an interval of about 100 m. The primary dimensions of the pipeline is summarized below:

Pipe	Kind of type:	VP
	length :	1.3 km
	diameter :	100 mm
	Control stand :	5 nos.
	Outlet valves :	13 nos.

Water released from an outlet valve is led through a small earth channel to cropping fields or water can be fed by a vinyl hose attached to the outlet.

(2) Mindu canal system

(a) Intake

The existing intake site is steep along the river course and as the same of the intake of the Mzinga system, large stones mesh with each other. Water flows or leaks down the gaps and crevices among such stones. These crevices and gaps are filled with stones and cement mortar and then a small weir made by wet stone masonry is built between large stones.

The intake structure will consist of an inlet wall and a head race channel. The inlet wall will be provided to protect the head race channel against the river flood and also to prevent it from entering excess water. The head race channel will be of open type and lead water to the subsequent canal. Even if the inlet wall is existing, some excess water enters into the headrace channel. Thus the headrace channel will be furnished with a side channel spillway in a length of 15 m so that some excess water entering the headrace channel can overflow the side channel spillway and return back to the Mindu river. In order to protect the headrace channel from the erosion, the headrace channel will be covered with concrete including the side channel spillway slope to the Mindu river.

(b) Canal

Mindu canal runs mostly along the counter line having a gradient of 1/10 to 1/50 in first reaches from the intake to the point located at about 750 m point, where the Mindu canal meets a small valley having a very steep longitudinal



gradient of about 1/3. This valley is utilized for transportation of water to the lower part of the area. At the point immediate after the valley crosses an existing road, a diversion works consisting of a small weir and an intake will be provided on the valley to receive and divert water coming down the valley to the right. Then a canal running along the road is improved in the length of about 250 m. At this 250 m point, it meets to a small channel branching off from the Mindu canal at a 660 m point. Total length of the Mindu canal to be improved is estimated at 1 km.

The canal will be reshaped and lined with cement concrete with small cobble stones. Cobble stones are planted into the lining concrete to increase the roughness coefficient of canal wetted perimeter. The gradient of the canal is determined in the range from 1/30 to 1/50 so that the design velocity becomes less than 70 % of the hydraulic critical velocity. The basic dimensions of the canal is 0.25 m in width, 0.3 m in height and 0.5 : 1 in side slopes.

Offtakes will be provided at an interval of every 50 to 100 m where the canal is enlarged to 0.5 m and deepened to 0.5 m in the length of 3 m. The offtakes will be simply formed by cutting the canal bank by 15 cm in width and 20 cm in depth protected in the surface by cement concrete. Where water diverted from offtakes falls down along a very steep slope, a first point changing from the steep face to the gentle terrace will be improved and protected with cobble stones and cement mortar so as to dissipate the hydraulic energy.

Drops will be provided on the canal to dissipate hydraulic energy. The drops are designed to have a fall of 0.5 to 0.8 m and the total number of drops required is estimated at 34.

### 3.4.7 Operation and Maintenance

#### (1) Operation

##### (a) Operation of Mzinga system

In order to steadily take water from every outlet valves, the extent of outlet valve opening should be examined through field experiment after completion of the construction works. Once the allowable maximum opening extent is fixed, water can be diverted from every outlet valves at any time within the allowable extent of the valve opening. Every time, the outlet valves should be closed immediate after attaining the water supply. At night time, when nobody is watching, all the outlet valves should be in the closed position.

##### (b) Operation of Mindu system

The Mindu canal conveys water on 24 hour basis. The required discharge is only 13 litre/sec even at the peak time. It is, therefore, recommended to constantly divert water at the discharge of 13 litre/sec at the Mindu intake point except for the period of mid rainy season; March and April and maintenance period in October. During these periods, the intake should be closed. From the Mindu canal to field ditches, water should be diverted on rotation basis among offtakes on the Mindu canal in accordance with predetermined irrigation diversion schedule.

(2) Maintenance of facilities

(a) Maintenance of Mzinga system

Major maintenance works are as follows:

- To periodically inspect the intake and the pipeline system from the point of obstacles and sand deposits in the intake overflow stand and the control stands and from the point of the erosion hazard along the pipeline system.
- To periodically remove floating debris from the front of the inlet and sand deposits from the overflow stand of the intake.
- To repair the erosion portion on the right of way of the pipeline if any.
- To stop the water supply and repair the pipeline as soon as possible, if a leakage point is found.

(b) Maintenance of Mindu system

- To cut weed and trees from the right of way of canals especially from lining portions at least twice a year.
- To heighten depressing portions of canal embankment with earth materials.
- To repair the erosion portion on the right of way of canals with locally available materials and cement.

In the annual maintenance period, the intake is closed and all water in the canal system should be completely drained and dried up. Major maintenance works during the maintenance period are as follows:

- To remove deposits from canal insides.
- To repair eroded and damaged portions of canal insides.

### 3.5 Plan of Community Development and Reinforcement of Farmers' Organization

The basic objectives of the community development and reinforcement of farmers' organization are to increase farmers' crop production and improve farmer's living standard. The major concepts to consider for achieving these objectives are as follows:

1) Strengthening of WUGs

GOT has worked out as a basic policy that the irrigation system should be maintained through the beneficiaries participatory approach. In accordance with this policy, the irrigation facilities rehabilitated or newly constructed by the project should be managed by the farmers themselves. After the completion of the project, it can be expected that the irrigation systems in the schemes will be improved and expanded considerably. To maintain successful and sustainable O&M of the schemes, it is essentially needed in advance to strengthen the existing WUGs or to establish new WUGs.

2) Close Linkage between WUGs and Village Government

Basically, the existing WUGs in the schemes have been organized independently without any legal advantages given by the village government. However, in fact, WUGs have greatly benefited from the village governments. The village government has two roles; one as the government administrative organ and the other one as the representative of the village community. The village

government is responsible for encouragement of all the village socio-economic activities including agricultural production, education, health, social welfare, culture, etc. The farmers always follow the decision of the village government, because its decision is made not only by the village administrative government but also as a representative of the village community. It is therefore recommended that WUGs should establish more closer linkages with their own village communities.

### 3) Strengthening of Government's Supporting Services to the Farmers

To achieve sustainable farming and O&M of irrigation systems of the farmers, there is still the need for a lot of continuous supporting services from the various agencies concerned. It should therefore be required to strengthen those supporting agencies to be involved in the farming and O&M as well as the WUG's activities.

### 4) Encouragement of Participation of Women in Irrigation Development

The project will propitiate reactivating of crop production, marketing of farm inputs and products, post harvest, transportation, social services, etc. Together with the above, village women will have many opportunities to join these activities. In this context, farmers' organizations should play an important role on encouraging those opportunities.

## 3.5.1 Water Users' Group

### (1) Objectives of WUGs

There is one existing WUG in each system. These existing WUG has a very loose organizational structure which consists of only one leader and no managing committee. This WUG is replaced to a new WUG which has various functions including marketing and credit, etc.

The main objective of WUGs which 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 crucial factor to improve the agricultural supporting 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 function of such supporting services like that agricultural cooperative in each scheme. In the project areas, there are following two ways for the establishment of such organization from the standpoint of institutional development:

- (a) Agricultural cooperatives having function of agricultural supporting services are established in each village related to the irrigation scheme. In this case, a village have two organizations; i.e., WUGs which are responsible for O&M of irrigation facilities, and agricultural cooperative handling agricultural supporting services.
- (b) WUGs cover not only O&M of irrigation facilities but also the agricultural supporting services. Namely, WUGs having both functions of O&M of irrigation facilities and agricultural supporting services are established in each village.

In the project areas, it is proposed to take (b), taking the following reasons into consideration. The activities of WUGs and agricultural cooperative should be linked

closely. The farmers will cultivate crops according to an irrigation schedule decided by WUGs, then supporting services such as credits and farm inputs should be supplied on time in accordance with their cultivation schedule. In case of unitary organization, those linkage can be taken easily.

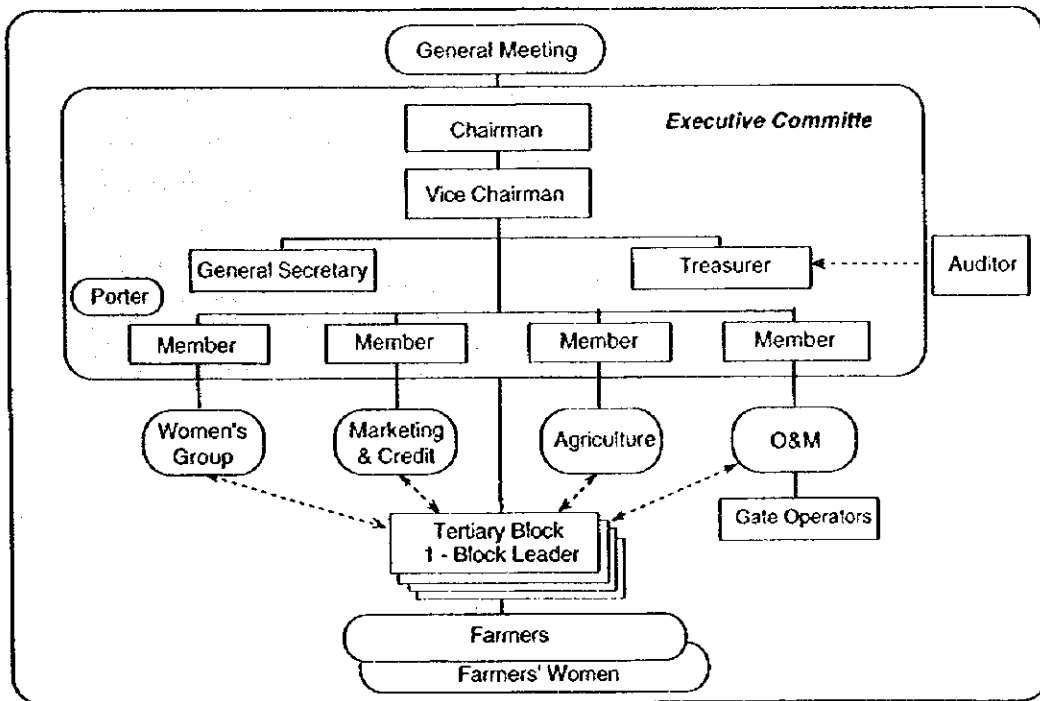
The members of WUGs should be the beneficiaries of the irrigation schemes, and its membership should be given to beneficiaries, irrespective of their gender.

(2) Proposed Organization and Activities

For the organizational structure of a WUG, two alternatives of Type-A and -B were studied, as shown in Figure 3.5.1. Both types have almost same structure, and the difference of two types is as follows:

- 1) Type-A is for the small projects having less than 100 farmers, and the farmers link directly with the executive committee.
- 2) Type-B is for the larger projects over 100 farmers. In this type, the farmers are divided into several sub-groups by each irrigation block or each village, and each sub-group links separately with the executive committee. A sub-group elects a representative who is the member of the executive committee of WUG.

Although the adoption of these types is entrusted to the farmers, it is recommended that 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. The number of farmers in the existing Mzinga and Mindu WUGs are estimated to be 60 and 46, respectively. Taking the size of both WUGs into account, the Type-A is proposed to them.



The proposed WUG consists of the following four (4) components; i.e., (i) general meeting, (ii) executive committee, (iii) audit, and (iv) service sections including O&M.

agriculture, marketing and credit, and women's group. Each sub-group has also a sub-executive committee and service sections of O&M, agriculture, marketing and credit, and women's group, and is responsible for WUG's activities within the sub-group's area. In addition, an irrigation group is organized by each tertiary block base, and each group elects one block leader. All of the WUG's activities are carried out through these block leaders. These 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 members of executive committee and auditor,
- Acknowledgment of the result of auditing,
- Acknowledgment 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 from the members and committees, etc.

#### 2) Executive Committee

The executive committee is comprised of the following members; Chairman, Vice Chairman, General Secretary, Treasurer, and several members who are representatives of the service sections. In the case of Type-B, several representatives of sub-group are included as the committee members. In addition, one or several porters who are volunteers are appointed in the committee in order to make close communication among the members and between the committee and the farmers. Main tasks of the committee are (i) to prepare annual management plans and budget, (ii) to instruct and supervise activities which are implemented by the service sections, (iii) to manage complaints and grievance from the farmers, (iv) to arrange and appoint volunteers employed in service sections (v) to manage accounting and general affair, (vi) to coordinate with other agencies and associations, and so on. The committee members take part of portion of these works. The regular meeting is held monthly for implementing these activities.

#### 3) Service Sections

Under the instruction and supervision of the executive committee, the routing 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 these main activities are as follows:

##### (a) O&M Section

- Preparation of irrigation schedule,
- Operation and maintenance of irrigation facilities,
- Estimation 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 VEOs and officers in the DALDO's office,

- Information services for new farming practices and varieties,
- Arrangement of farmers' meeting on agricultural extension,
- Providing machinery services,
- Promotion, arrangements and leading for group farming such as co-operative control of pests and diseases, transplanting and harvesting, etc.

(c) Marketing and Credit Section

- Implementation of cooperative purchasing and shipping,
- Storing arrangements of farm inputs and products,
- Agricultural credit services,
- Exploitation of new marketing channel, etc.

At the public meeting held in July 1997, farmers stated that marketing of products should be handled by individual farmer (see Attachment I). In coincide with their intention, marketing of products is excluded from the cooperative activities.

(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) Audit Section

Although the registered farmers' cooperatives should have the auditing of the authorized organizations like COASCO, it is proposed that a 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 check the WUG's accounting including collection of ISC, and reports those results at the general meeting.

(3) Irrigation Service Charge

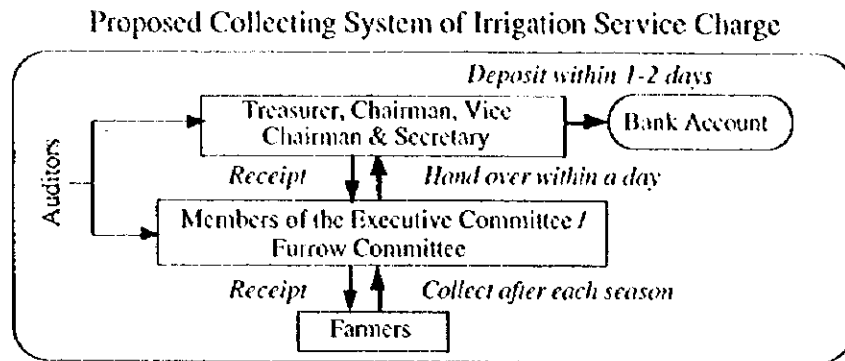
Irrigation Service Charge

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

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

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 collected amount are deposited immediately in WUG's bank account. For the collecting of ISC, the members make group consisting of 2-3 members, 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 treasurer collects those copies.



To achieve a good progress on collecting of ISC, it is recommended to adopt the following punishment rule and incentive to the articles and by-laws.

- 1) To the farmers who are not able to pay on time, WUG fines them some percentage of total ISC per month during the non-payment period.
- 2) When farmers pay full amount and on time, some percentage of its full amount is reimbursed to him as an incentive.

The executive committee is responsible for management and operation 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 the general secretary, as a routine of the WUG's works. For the latter, a committee meeting is held to assess its necessity and released its fund to 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 the WUG's leaders are volunteers work 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 the O&M of facilities are only transportation and stationery mentioned above, and it will be no need to collect a lot of membership fees from the farmers. The annual membership fees are collected by the same system with the irrigation service charge.

#### (4) By-laws of WUG

A standard article and by-laws of WUG have been prepared by the Department of Cooperative. But this is for the general cooperatives, and articles necessary to WUG which is responsible for the O&M of the project are not included at all. Although this standard articles and by-laws are adopted 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 member of WUG.
- (b) WUG has the right to collect ISC from the beneficiaries who received irrigation services from WUG, and the beneficiaries have the duty to pay its ISC to

WUG.

- (c) WUG inflicts a punishment on the beneficiaries who use irrigation water and facilities illegally and are not able to pay ISC.
- (d) The beneficiaries have the duty to participate in the communal works on O&M which are planned by WUG.
- (e) The tenant beneficiaries have a right to join WUG with the election to the executive members, and are in duty bound to pay ISC and membership fees, instead of the owner beneficiaries.

#### (5) Registration and Water Right of WUG

As authorized farmers' organization, WUGs should be registered at government agencies. There are two ways for this registration. One is registration at the Ministry of Home Affairs and the other is MAC. In Tanzania, the organizations are classified into two types; "Association" and "Cooperative." The former Ministry handles the registration of "Association", and the latter is for "Cooperative." It is proposed that WUGs established in the Scheme are registered at MAC which is responsible for supporting services to such organizations.

WUGs should also take water right after registration. The Regional Water Engineer has handled the registration of the water right. The DALDO's office carries out necessary guidance and supporting services to WUGs for taking water right.

#### (6) Irrigation Meeting

The production activities of crops are closely linked with various agricultural support 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 an irrigation meeting under the presidency of WUG. The meeting is held before each cropping season, and consists of the following members:

- (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 village government (Village Chairman and Village Executive Officer), and
- (f) Banks, NGO and private sectors such as owner of farm machinery and dealer of farm inputs.

VEO and Irrigation Technician make necessary support to hold this meeting by WUG. In this meeting, the following items are discussed among the attendance. Based on the result of these discussions, WUG requests to 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 quantity of farm inputs such fertilizers and agricultural credits, and those supplying periods, etc.

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



## (7) Rural Credit Facilities

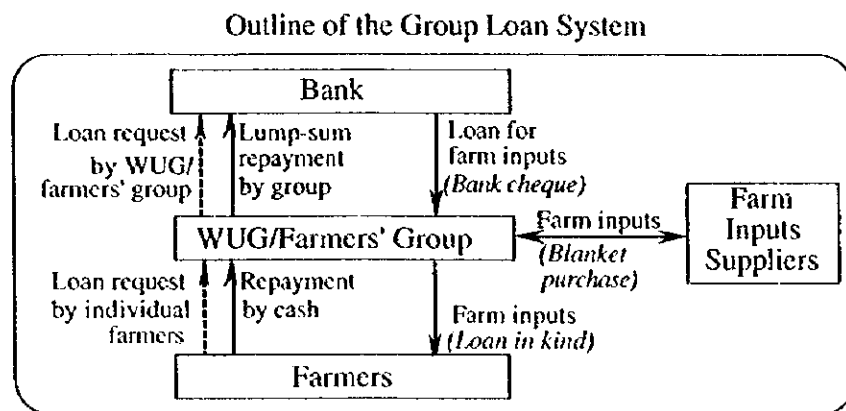
At the initial stage of the Project, the farmers need a considerable amount of loan for purchasing farm inputs. However, almost no agricultural credit is found in the project area at present. To overcome such situation, the following three credit systems are proposed to the schemes.

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

#### Layout of the Group Loan System and Procedures

The purpose of the credit system proposal explained below 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 a group loan system, which will be managed by WUG; this system not only covers agricultural credit but also encompasses marketing and technical guidance. This credit system is directly related to the marketing system proposed in the next section.

The figure below shows the outline of the proposed credit 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-chemical to be used.
- iv) The bank provided 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.
- v) 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.

- vi) 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 the 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 the WUG about the specific banking procedures to be followed for obtaining and repaying the loans. The training of the WUG on administration of the loan could be done through the 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 the WUG with an interest rate lower than the normal market rate; this is because the 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 the WUG's account, and WUG finances the farmers again. Surplus from the revolving loan goes to payment to the investor.

The Ndung irrigation project in the Kilimanjaro region has such revolving loan system. The cooperative of the Ndung project consists of 147 members, and has collected the share amounting to TSh.147 millions (Tsh.10,000/member). Based on these funds, the commercial committee organized in 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 the MAC, it is important and necessary that the farmers must have a simple credit organization like the one denominated "rotating-funds credit as-

sociation." This type of credit organizations which are more modest in purpose than the system above explained, 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 and 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.

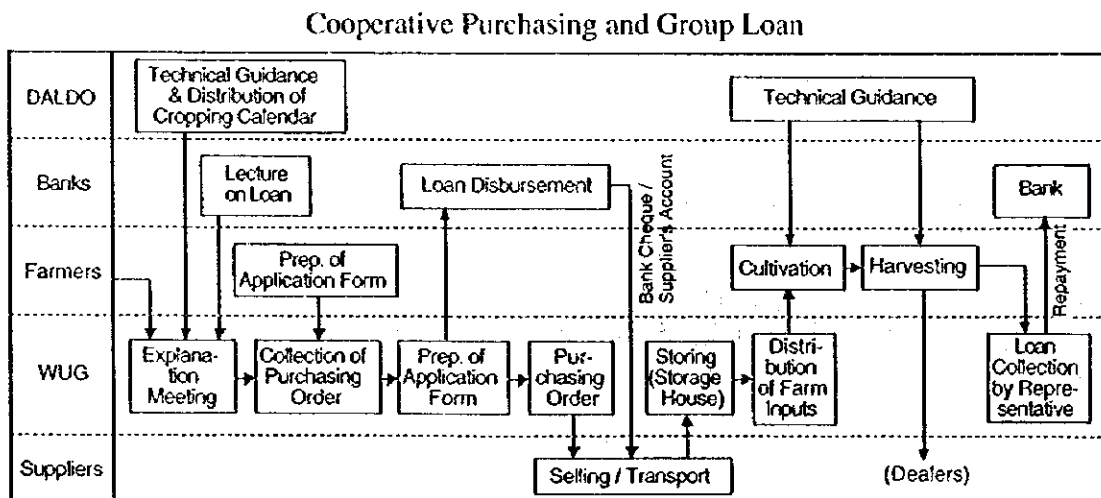
Penalties for defaulting must be established in the rules governing the association. These rules must be clearly defined and enforced. The peers' pressure plays an important role for the enforcement of the rules.

At present, the CRDB has stopped implementing a credit system with similar characteristics as the group loan system mentioned above. However, the 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 needed to employ a permanent staff for handling revolving loan.

By implementing these credit systems explained above, the farmers would have the benefit of accessing credit in an organized way.

### (8) Marketing System for Agricultural Commodities

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



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

- (a) The DALDO office will provide technical guidance on the inputs to be purchased and how to use them in a proper way. Also must distribute the cropping calendar adequate for the farming area. Previous of the reception of the farm inputs from the suppliers, the DALDO office through the VEO will provide technical guidance on cultivation and harvesting.
- (b) The bank granting the loan, together with the support of the DALDO will held an explanation meeting with the WUG where the system will be described and explained. The WUG will also receive a lecture on loan procedures by the bank's staff.
- (c) After deciding to adopt the system, the WUG members will determine the loan amount to be requested to the bank based on their inputs' requirements. The WUG then prepares the loan application and delivers it to the bank. At the same time, the WUG will contact the inputs' suppliers and present their purchase list. The bank will make the disbursement directly to the inputs' supplier.
- (d) The supplier will prepare the inputs' order for a timely deliver. After the bank makes the loan's disbursement, the supplier will transport the inputs to the storage facilities specified by the WUG.
- (e) After receiving the inputs, the WUG should distribute immediately them to the farmers.
- (f) The WUG collects the money for repayment to the bank from its members after harvesting. The WUG will be in charge of delivering the repayment to the bank.

For the selling of farm products, a cooperative shipping managed by WUG will be recommended as one of the countermeasures for improvement of the present marketing problems like low farm gate prices. However, at the public meeting held by the Study Team in July 1997, farmers have disagreed to this cooperative shipping of products, and they want to have individual shipping by each farmers. In accordance with their intention, the products are sold individually by the farmers.

#### (9) Facilities of WUG

The facilities necessary for the activities of WUG are an office building (50 m<sup>2</sup>), motorcycles (3-5 nos), and tools (shovels, hoes, etc.) for maintenance of the canals. All necessary administrative works including typing, printing, communication, etc. should be supported by the offices of DALDO or Division Extension Officer (DIVEO).

### 3.5.2 Women's Participation to Development

The project will contribute to energize those activities related with crop production, marketing of farm inputs and products, post-harvest, transportation, community services, etc. In parallel 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 group 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 poultry, sheep, goats, etc. by the women's groups.

WUGs should play an important role in promoting these activities, and the DALDO's office should provide necessary guidance to them. The establishment of women's group is proposed in both WUGs as mentioned in Sub-section 3.5.1 (2). A representative of the women's group joins the executive committee as its committee member, and participates in all WUG's management. The VEOs conduct supporting services to activate them in cooperation with the village government.

### 3.5.3 Training Program for WUG

Both WUGs in the scheme should be strengthened through forced training program. In addition, officers and front line staff below district level should also be trained and enough skilled on O&M activities, through provision of intensive training program. They still have not enough experience and knowledge on the O&M of irrigation systems.

For those training, a wide scale program will be introduced. Namely, the training program is implemented not only to the farmers and the staff below district level, but also to 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.

The DALDO's office is responsible for the conducting of training program. The training program is divided into four (4) courses depending on training contents and trainee's educational background; i.e., Course-A, -B, -C, and -D. The details are shown in Table 3.5.1, and summarized as follows:

Proposed Training Courses and Trainees

Training Courses	Period (day)	Trainees
Course-A	2	- District Commissioner, District Executive Director, District Administrative Officer. - Senior officials of the offices of RALDO and DALDO and the Zonal Irrigation Office. - Senior officials of the offices involved in WUA's activities (District Water Engineer, District Community Development Officer, District Cooperative Officer, etc.).
Course-B	5	- 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	- Farmer's level training to leaders of WUA, gate keepers and key farmers.
Course-D	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 the Zonal Irrigation Office, RALDO's and DALDO's offices, and DCO's office; and the Course-C is for farmer's level training including leaders of WUGs, gate operators, etc. The courses-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 supporting services, but some other contents such as new agricultural extension system and promotion of the women in development are also included in this training program, 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 program, the following training are proposed:

- 1) Special Training to VEOs and Irrigation Technicians: Before the implementation of the project, VEOs and Irrigation Technicians to be attached to the project dispatch to KATC (Kilimanjaro Agricultural Training Center) for level-up of their basic technical knowledge.
- 2) Follow-up Training to WUG: The DALDO's office implement occasionally follow-up training to WUGs according to the necessity for improvement of their management. The DALDO's office always monitor all WUG's activities through VEOs and Irrigation Technician, and prepare necessary training program for them.

### **3.5.4 Reinforcement Plan for Agricultural Extension Services**

#### **(1) Training Programme for Reinforcement of Agricultural Activities**

Through and after the project implementation, the agricultural extension services should be promoted for the improvement of the present agricultural productivity in the scheme. Subjects to be reinforced are listed up considering the current situation, and further the following order of priority is given, viewing the points of farmer's technical and financial capability as well as emergency degree;

##### First priority

##### a) Dissemination of proposed farming practices

Farmers are aware of shortage of knowledge concerning proper utilization of fertilizer and agro-chemicals. It is necessary to disseminate proper utilization of fertilizer and agro-chemicals. Further, proper practices of land preparation, sowing/planting, etc. should be also transferred, in order to improve the current situation.

##### b) Promotion of proper water management

It is, of course, important to effectively utilize limited amount of water resources. All the beneficiaries should be aware of critical stage which water is necessary for plant growth, and further proper amount of irrigation should be manifested, considering characteristics of crops and diseases/insects. Especially, it should be recognized that Club Root Disease is easily expanded under the wet soil condition.

##### Second priority

##### a) Improvement of soil fertility

In Mgeta scheme, the soils developed in the steep slope have a shallow effective depth, coarse texture, and then high soil erosion is appeared in steep area. It is necessary to sustain the increase the crop production and protect crops against insect and disease, based on the improvement of soil fertility. As components for improvement of soil fertility, it is recommendable to consider reduction of plant residues to soil, application of compost and/or green manure, introduction of leguminous crop for nitrogen fixation, etc.

b) Implementation of soil conservation

Grasses play an important role in stabilizing sloping areas. Species like Napier/Elephant grass (*Pennisetum Purpureum*), Guinea grass (*Panicum Maximum*), etc. grow vigorously and are ideal for soil conservation properties for control of soil erosion. Further they are good sources of fodder for pig and other livestock.

Third priority

a) Adoption of improved tools

Normally, farmers have used big knife which is called "Panga" for multi-purpose, e.g. weeding, digging hole, tree cutting, etc. Considering the work efficiency, it is important to adopt proper tools for specified work.

b) Promotion of pig rearing

Considering improvement of soil fertility, it is necessary to adopt more compost which is made from pig dung and plant residues.

Subjects in the group of the first priority should be carried out to expect the rapid appearance of benefit from the project. Currently, farmers concerned have been facing to some constraints which decrease the agricultural productivity and further deteriorate the quality of farm products. Accordingly, subjects in the second priority are also 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 input in future, from the financial and technical points of view.

It is proposed to concentrate the implementation of the subjects in the first priority in order to improve the current situation. Additionally, it would be expected to include the second priority to grade up the improved situation. While, subjects which are ranked in the third priority are recommended to be achieved under long-range approach, therefore they are excluded from the building-up programme for the agricultural extension services.

Training programme be provided into the target group such as farmers concerned and frontline extension staffs (DIVEO and VEOs), in order to build up their skills and knowledge on relevant farming practices as shown in Tables 3.5.2 to 3.5.4. Outline of the training programme is described as follows;

1) Approach for training and education to farmers concerned

a) Field training in demonstration plots and farmers' fields

Based on the period of each farming practice of crops as shown in Table 3.5.2, field training programme for farmers will be conducted in demonstration plots to be managed through the project implementation, and further, in farmers' fields after the project implementation. This training plan will be managed by VEOs of Langali and Bumu villages under overall support of District Agriculture and Livestock Development Officer's office (DALDO's office), as shown in Table 3.5.3.

In principle, farmers should promote their capability on farming practices in collaboration with each other, based on the close communication and long term institutional building. Therefore, farmer's group is required to be organized each irrigation system, that is Mzinga and Mindu irrigation

systems. Each farmer's group will be provided field training which is shown in Table 3.5.4.

Each farmer's group should be self-governing and group member will select a leader. This leader should be an aggressive farmer who is interested in advanced farming practices and improvement of their living standard, further he has to take care of other members.

b) Field tour to advanced areas

It is important to inspect some areas in which farming technologies are advanced, in order to enlighten and educate farmers. For instance, Lushoto in Tanga Region is preferable inspection place for cabbage and other perishable crops cultivation, while Mbeya in Mbeya region is also recommendable place for potato cultivation.

2) Approach for training and education to DIVEOs and VEOs (see Table 3.5.5)

a) Workshop

Extension frontline staffs of DIVEO and VEOs are required to be trained through periodical workshop. Through workshop, purpose and procedure of the project implementation will be enlightened, and further proper method on dissemination of advanced farming technology and monitoring/review of the training programme should be lectured to them.

Through and after the project implementation, frontline staffs will discuss the results of monitoring and review concerning the procedure of the training programme. As a result, training programme and guideline of proposed farming practices should be properly modified.

b) Field training through and after the project implementation

Through the implementation of the demonstration plots, frontline extension staffs will be enlightened proper farming practices and theory of crop cultivation. Furthermore, monitoring and evaluation, yield analysis, water management, etc. are also guided to the frontline extension staffs. In principle, VEO has responsibility of management of demonstration plots and DIVEO assists that management. In order to effectively show farmers the results of the demonstration plots, the plots will be required to be settled at more than two places in the scheme. Guideline for proposed farming practices could be prepared in order to carry out effective field training for farmers, based on the findings and results which will be obtained through the implementation of demonstration plots.

After the project implementation, VEO will be required to coordinate the field training for farmers. Through the field training, the actual trial and dissemination concerning proposed farming practices, yield analysis, water management, etc. will be conducted by VEO.

It is proposed that the implementation of the training programme mentioned above for the relevant target groups 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 Section 4.2.



## (2) Supporting Services by Relevant Institutes

Research centres and other institutes concerned such as MATI, LITI, SUA, TOSCA, Special Programme of FAO, etc. are identified to support the extension services from technical point of views under NAEP II. That is, those institutes have carried out various training programmes, seminars and workshops, in order to support the extension activities of NAEP II. Depending on the future situation, the following supporting services to the Project will be expected to be carried out by those relevant institutes, in order to lead a successful implementation of the Project;

- a) Technical support from the on-going project concerning on-farm seed production.
- b) Education and training for farmers and extension staffs, concerning theory and methodology on specified topics through the regular programme.
- c) Implementation of farming system research approach.
- d) Identification of insects and diseases.

In order to widely disseminate the information concerning improvement of living standard in rural area, communication activity has been offered by the Zonal Communication Centre (ZCC) which was decentralized from the former Farmers Education and Publicity Unit. Under the NAEP II, ZCC has function to conduct various support services of extension services by means of mass-media, audio visual aids, etc. as follows;

- a) Poster, leaflets, booklets: These tools are useful to support the extension services by VEOs.
- b) Audio visual aids: These tools are useful to supplement the effect of study tour, residential courses, etc. Moreover, it is indispensable to support the lecture and practices in MTS and BMW as auxiliary material.
- c) Mobile extension service: It seems that there is the most useful tools for the dissemination toward a mass of villagers. Additionally, this tool also has a function as recreational facility.

Accordingly, it is expected that information of extension services be disseminated to the Project area by means of the function of ZCC.

## 3.6 Environmental Conservation/Protection Plan

### 3.6.1 Environmental Impacts Assessment

In Mgeta scheme Area, it is identified that the environmentally susceptible elements have been, more or less, affected even under the present conditions with the negative impacts due to "high annual increment of both human and livestock population", "high energy consumption chiefly of the forest resources", "rural poverty and low educational conditions", "unconsolidated rural health and sanitation service facilities", etc.

The negative impacts to be brought by the proposed project implementation could be classified into "direct impacts" and "indirect impacts."

#### 1) Direct Environmental Impacts

The following two environmental impacts have been pointed out as direct impacts of the proposed development.

- (a) Increment of water-borne epidemic disease risks;

It is foreseeable that the hydrological regime in the scheme areas would be

changed to a large extent, i.e. appearance of wide impounding area (in case of paddy growing season) through irrigation practices, and accordingly, diversification to a new ecological conditions. With such change of ecological conditions, the negative impacts would arise as an influence of the water-borne epidemic diseases, such as Malaria, Bilharzia Schistosomiasis, etc. due to population increase of vectors. Thus, in the implementation of the proposed project, particular attention shall be paid to this concern.

(b) Agro-chemical impacts and water contamination;

Utilization of chemical fertilizers and agro-chemicals is essentially needed for maintaining the agricultural production at a high level. Thus, in using those inputs, special attention should be paid to the fact that the toxic chemical elements from those inputs will surely be accumulated into the soils and excessive one contaminate water quality to a certain extent. Accordingly, those chemical elements bring a risk to human health as well as the natural eco-system especially for the aquatic species in the area.

2) Indirect environmental impacts

The indirect impacts which would be brought by the project implementation are the following two aspects:

(a) Deforestation and/or degradation of vegetation

When the development target is successfully achieved and accomplished activation of the agricultural production, the present living conditions could be up-graded, and consequently, energy consumption per household will largely be increased to a high level. This means that deforestation and/or degradation of vegetation will be accelerated due to increment of the fuel wood demand because of no alternative fuel sources in the rural area.

(b) Misgivings of social conflict

Although it shall be studied more precisely due to delicate issues in interest amongst the rural inhabitants, a social conflict on water rights, land ownership and tenure system, right of irrigable land occupancy, etc. is one of the misgivings in this scheme areas since the land and water resources in each scheme area have been mostly used to a maximum extent up to present.

### 3.6.2 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 recommended as the basic approach to an environmental protection-cum-conservation means in implementation of the proposed 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 an influence of water-borne diseases in Mgeta Scheme

#### Area.

- Periodic cleaning of the irrigation and drainage canals and drying up these canals during the agricultural off-season so that it can be got out the habitat available for the vectors and intermediate hosts of diseases as well as cut off the life-cycle of the causative agents of diseases, effectively.
- Consolidation of the sanitation facilities in the village area. This is also essential for cutting off the life-cycle of the causative agents of diseases, effectively and successfully. As far as consolidation of the sanitation facilities is concerned, it shall be based on a national and/or regional health service program, and all the design conditions which might be applied to the proposed sanitation facilities should comply with that program.
- Utilization of the agro-chemicals for directory controlling the vectors and intermediate hosts habitat, immediately after drained out the irrigation water. This practice is, however, limited to only a small extent where such vector or host habitat are concentrated, i.e. empounding in small depression with in the paddy field, dead water in canals, etc.

#### (b) Agro-chemical impacts and water contamination

As for the water contamination problems due to utilization of chemical fertilizers and agro-chemicals, it is essential to prepare a standard guideline and advice farmers how to use agro-chemicals, safely and satisfactorily.

In order to eliminate and/or improve the accumulation hazard of toxic chemical elements in the drainage canal system, introduction of an "organic farming practices" is crucial. It is also essentially needed to organize the irrigation beneficiaries into water users' co-operatives, and then, establish the plant protection cum sanitation control functions within the co-operatives. Leading such communal work is the essential bases not only for encouragement of the beneficially participatory approach to the project, but in fact, promotion of a sustainable development of the 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-cum-fair demarcation and allocation as well as limitation of the development area, etc. on the open forest, and set up by-law for collection of fuel wood. Afforestation program is the most essential cum practical way for conservation of the vegetation, therefore, it must be incorporated into the implementation schedule of this project.

##### (b) Social conflict in land and water utilization

To eliminate the social conflict in land and water utilization, it is essentially needed to enforce the village act, and more over, empowerment of the leadership of the village community societies.

### 3.6.3 Monitoring Plan

The proposed monitoring plan will work 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 the 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,
- Cooperation with the Project Office or other agencies concerned with implementation any countermeasures or remedial measures required,

Originally, execution of the monitoring should be carried out on the 4 items which were the subjects of EIA. This plan proposes for Direct Negative Impacts which have the baseline data.

#### (1) Influence of water-borne diseases

##### (a) Disease vectors

Mosquitoes and the snail vector for Bilharzia have to be monitored periodically in order to establish effective vector control measures. New benchmark for this monitoring might be needed in the scheme area where the hydrological regime would be changed with this project.

##### (b) Hygienic condition

The control water-borne diseases in irrigation scheme can be successful if adequate and acceptable sanitation facilities for excreta disposal are provided and used. Monitoring of this condition in all scheme is very important. This will be done by taking inventory of sanitary facilities every year and check whether there is an increase in the availability such facilities. If no increase has been observed, proper measures should be taken by the village government together with the village health workers to further educate the villages on the importance of the issue and enforcing by laws where necessary.

##### (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 will persist, 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 ef-

fectiveness of control measures of diseases undertaken and be able to revise, if necessary, the adopted strategies; activities and resources allocations according to results of the monitoring.

(c) 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 water quality should be undertaken. The samples should be taken at least 3 points for each scheme and twice per year.

(2) Agro-chemical impacts and water contamination

Spraying agro-chemicals from the air result not only in the treatment of the target fields but also of the surrounding area, as the mist of the chemicals will be carried down wind. Much of the poison end up in the soil and also in open water bodies. Irrigation canals and water courses in which fish live are also affected. Some of the chemical will reach the target organism e.g. crop pests.

However, not only the fish that will be affected by the contaminated water but also people that are drinking or use that water. Therefore, monitoring programs will be essential to find out whether the water, the soil, the fish and plants from the sprayed fields contain residues of active ingredients of the particular biocides applied. It will be necessary to determine the amount accumulated in these four items and therefore, control their accumulation to levels of toxic to users and the environment.

(a) Monitoring items

Water

When toxic biocides end up in the water, it becomes contaminated. They kill aquatic species that would be beneficial to people and also accumulate to toxic levels, which are harmful to human health. Monitoring the accumulated concentrations will help control of the negative impact of the 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 surveying fish may have accumulated toxic levels of active ingredients of the chemicals applied which in turn when people consume the fish continue to accumulate in the human body and may reach toxic levels which are harmful.

Vegetables

Long persisting chemicals applied to vegetables active ingredients may accumulate in the plant tissues to high levels, resulting into harmful health effects to

those who consume the vegetables.

(b) Methodologies

The methodology for each item is shown below:

Monitoring Items	Ingredients to be monitored	Method to be used
Water	Organochlorineseg HCH, DDT Dieldrin and heptacclor Organophosphous (e.g. malathion) carbamates dithiocarbanates synthetic pyrethoroids	Gas-liquid chromatography
Soil	NH-N, Copper (Cu), Sodium (Na), Calsium (Ca)	Kjeldahl method Sodium diethyldithiocarbametes method, Atomic absorption spectroscopy
Fish	Organochlorineseg HCH, DDT Dieldrin and heptacclor Organophosphous (e.g. malathion) carbamates dithiocarbanates synthetic pyrethoroids	Chromatographic techniques e.g. Gas-liquid chromatography Thermic detectors Flame photometric detectors Spectrophotometric method
Vegetable	NH-N Organochlorines e.g. HCH, DDT Dieldrin and heptacclor Organophosphous (e.g. malathion) carbamates dithiocarbanates synthetic pyrethoroids	Kjeldahl method Kjeldahl method
Soil over-richness	SA CAN NPK  UREA (NH <sub>4</sub> -N) NH <sub>4</sub> NO <sub>3</sub>	Kjeldahl method Kjeldahl method followed by either a flame or atomic absorption method Kjeldahl method Kjeldahl method Steam distillation method



## CHAPTER IV IMPLEMENTATION PLAN

### 4.1 Construction Plan and Cost Estimate

#### 4.1.1 Basic Consideration for Project Construction

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

- 1) Construction works of the pipe line system and the lining canal system should be carried out by a qualified civil work contractor.
- 2) Manpower construction methods will be principally introduced for all the works, since the canals are very small scale and located on the steep slope mountains. From the view point of the beneficiaries participatory approach, local people should be employed as much as possible.
- 3) Consulting engineers should assist the Project office in the preparation of detailed design and tender documents, and the tendering and supervision of the construction works.
- 4) As the most of the beneficiaries have to be reorganized for operation and maintenance of project facilities and the water management, a water management expert and an institutional expert should be assigned from latter half of the construction works for a certain period.

#### 4.1.2 Construction Schedule

The construction schedule is shown in Figure 4.1.1. It includes the preparatory works such as survey, design and tendering, and the construction works. In the schedule, construction works are scheduled to be completed in one dry season.

#### 4.1.3 Construction Plan

##### (1) Workable days

Construction work progress is much affected by rainfall. Workable day for each month is estimated based on the daily rainfall data of Bunduki rainfall station on the assumption that the construction works are suspended in accordance with the following conditions.

Daily rainfall depth	Time to be suspended (days)
5-10	0.5
10-30	1.0
30 - 50	1.5
more than 50	2.0

The workable day is estimated at 275 days/year and if Sunday is deducted, it becomes 235 days / year. The workable day during the dry season for 5 months from June to October is estimated at 134 days and if Sunday is deducted, it becomes 115 days.



(2) Construction plan and method

(a) Mzinga system

All the construction works except minor works are scheduled to be completed during one dry season. The weir portion of the intake will be constructed in the mid dry season, when the river discharge is the least. The minor works such as provision of field ditches from outlet valves to their fields will be executed by beneficiaries following to the construction progress of the pipeline works.

Construction materials such as PVC pipes, valves and concrete materials, concrete forms are transported by man power from the nearest point of the traffic road. The average hauling distance of the materials is about 1 km. Also, most of the works such as excavation, installation of pipes, backfilling, concrete works, installation of valves are carried out by manpower. The common labors are employed from the local inhabitants.

(b) Mindu system

All the construction works are scheduled to be completed during one dry season. The weir portion of the intake will be constructed in the mid dry season, when the river discharge is the least.

Lining and concrete materials are transported by manpower from the nearest point of the traffic road. The hauling distance is 600 m on an average. Earth materials are obtained along the canal route. Most of the works will be carried out by man power. The lining concrete is put on the reshaped earth surface wetted with water and stones are planted in the fresh concrete immediate after the concrete is placed. The lining concrete should be thick paste having no slump.

#### 4.1.4 Cost estimate

(1) Condition of cost estimate

- 1) The exchange rate applied in the estimate is Tsh. 620 = US\$ 1.00 = Yen 120.
- 2) The construction works will be executed on the contract basis.
- 3) Unit costs are estimated referring to the relevant price information for the construction such as labour cost, material price and equipment hiring cost collected from Regional Engineers Office in Morogoro, National Construction Council and the general contractor.
- 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 facility and equipment cost is estimated for operating the project after

completion of the construction works. The facility and equipment taken up in this cost includes WUG office, office equipment, and O&M tool .

- 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 establishment and reinforcement of WUGs, training on water management and farming ,is estimated in accordance with the implementation schedule. The engineering services are assumed to be undertaken for all the four (4) schemes. Then the cost is allocated the each of the schemes.
- 9) Physical contingency is assumed to be 10 % of the direct construction costs.
- 10) Price contingency is assumed to be 3 % for the foreign and 17 % for local currency portions of all above cost items.

(2) Unit rates of major works

Labor cost, material cost, equipment and construction unit prices are listed in Table 4.1.1 to 4.1.4, respectively.

(3) Estimate of direct construction cost

The direct construction cost is shown in Table 4.1.5 and 4.1.6 and summarized below.

Direct Construction Cost	
(Tsh. million)	
Mzinga canal system	58.0
Mindu canal system	22.1
Total	80.1

The direct construction cost includes general expenses and profit of contractors.

(4) O & M facility and equipment , Administration , and Engineering services costs

The O & M facility and equipment cost is estimated at Tsh. 11.6 million as given below.

O & M facility and equipment cost	
(Tsh. million)	
Construction of WUG office	11.0
Purchase of Office equipment	0.5
Purchase of O & M Tools	0.1
Total	11.6

The administration cost is estimated at 3.6 Tsh. million as given below.

#### Administration cost

(Tsh. million)	
Allowance of officers	3.1
Transportation	0.5
Total	3.6

The engineering services fees are estimated based on the project implementation schedule, on the assumption that the engineering services will be undertaken for all the four (4) development priority schemes. Then, the engineering fees for Mgeta scheme is allocated according to the irrigation area in Mgeta scheme to total area of all the four (4) schemes. The costs are summarized as follow.

#### Engineering Services Fees

Engineering services cost for all four schemes	(Tsh. million)	1,227
Total area of all four schemes	(ha)	1,379
Irrigation area of Mgeta scheme	(ha)	30
Engineering services cost of Mgeta scheme	(Tsh. million)	26.7

#### (5) Construction cost

The construction cost is summarized in the table below.

#### Construction Cost

Item	(Unit: Tsh. million)		
	Foreign portion	Local Portion	Total
Direct construction cost	54.4	25.7	80.1
Preparatory works cost	2.7	1.3	4
O & M facility and equipment cost	0	11.6	11.6
Administration cost	0	3.6	3.6
Engineering services cost	26.7	0	26.7
Sub-total	83.8	42.2	126
Physical contingency	5.4	2.6	8
Sub-total	89.3	44.8	134
Price contingency	5	16.5	21.5
Total	94.3	61.3	155.6

#### (6) Annual disbursement schedule

The construction cost will be disbursed in accordance with the implementation schedule. The disbursement schedule is as follow:

#### Disbursement Schedule ( Tsh. million)

1st Year	2nd Year	3rd Year
14.6	140.4	0.6

#### (7) O&M costs

The annual O & M cost after the construction works is estimated at 0.4 Tsh. million at the rate of 0.5 % of the direct construction cost. Supposing that all the PVC pipes and valves are replaced 25 years after the construction, the replacement cost is estimated to 47.5 Tsh. million.

## 4.2. Implementation Schedule on Institutional Work

### 4.2.1 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 WUG, and (iii) O&M by the farmers. These 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	Zonal Irrigation Office	RAS, RPO, RALDO, DC, DALDO, RCO, DCOs, Village Government & Ward Councils
2) Project Implementation	D/D and construction - Establishment or re-organization of WUG - Land acquisition of right of way - Land re-allocation	Zonal Irrigation Office Village Government / Existing WUG	RAS, RPO, RALDO, DC, DALDO, RCO, DCOs, Ward Councils
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 just on-going in the 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.

### 4.2.2 Organization for the Project Implementation

The Commissioner of Agriculture and Livestock Development (CALD) in the Ministry of Agriculture and Cooperatives (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 projects implementation. At the regional level, the Zonal Irrigation Office in Morogoro Region under the Assistant Commissioner for Irrigation, CALD would have direct responsibility for the project implementation. The organizational structure of this office is presented in Figure 4.2.1. The main tasks of the Zonal Irrigation Office would be listed as below.

- 1) Financial arrangements needed 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 construction supervision of all implementation works

The Zonal Irrigation Office should implement not only engineering works but also

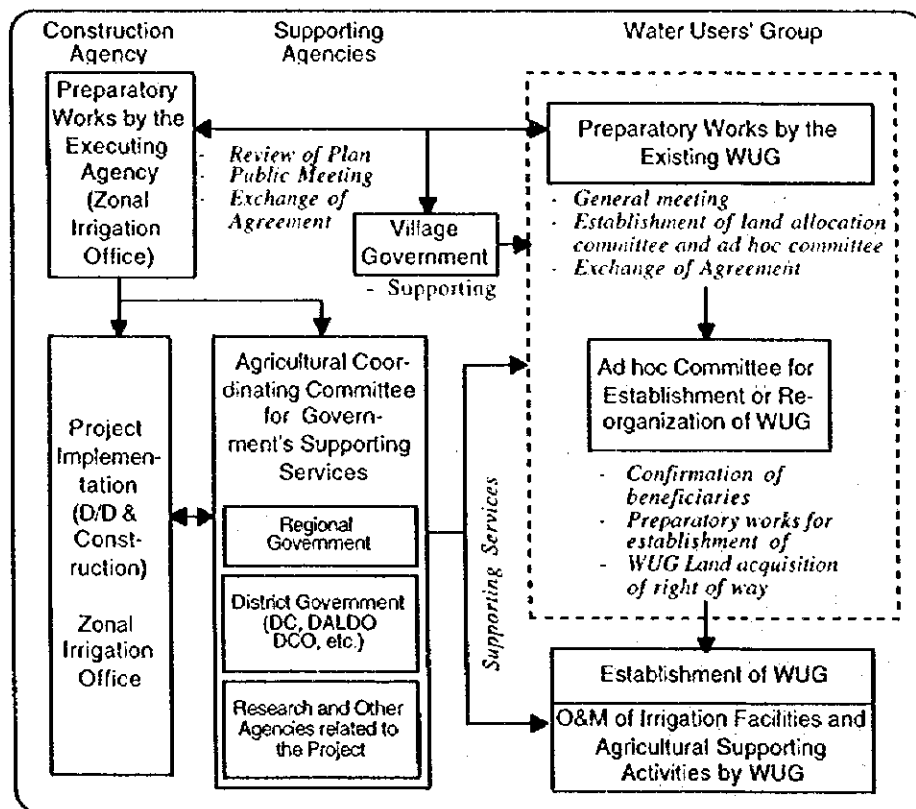
the public meeting in accordance with the farmers' participatory approach. Namely, this office explains all of the plan and implementation schedule to the farmers at the public meeting before commencement of the Project, and takes their full understanding for the development plan and farmers' participation to the project implementation.

#### 4.2.3 Organization and Schedule for Post-implementation of the Project

In order to achieve sustainable O&M of the facilities and successful irrigation farming, it is a prime requirement to strengthen WUG and agricultural extension services. Those proposed implementation schedule are described hereinafter.

##### (1) Implementation Schedule for Reinforcement Programme of WUG

All the irrigation facilities rehabilitated and expanded by the Project are managed and maintained by the beneficiaries themselves. In order to arouse the farmers' sense of belonging and responsibility to the O&M of facilities, it is proposed to implement the Project by the farmers' participatory approach. The schematic flow of the organizational set-up is shown below, and the details are presented in Figure 4.2.2.



The Mgeta scheme consists of two sites; Mzinga canal in Langali village and Mindu canal in Bumu village. Although the existing WUGs established in these canals have a long experience, their organizational structures are very loose, which consist of only one leader and no executive committee, respectively. Therefore, new WUGs having various functions proposed by the Project will be established in those canals.

The organizational set-up and strengthening of new WUGs are implemented in parallel with the detailed design and construction of the facilities, and closely linked together. At first, the public meeting is held at each project site, and the Zonal Irrigation Office has to 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 with them. In addition, it should also be discussed between them for farmers' duties to the project implementation such as land acquisition of right of way and land re-allocation which are implemented by the farmers themselves.

After the public meeting, the general meeting for the project implementation should be held by the existing WUG in each canal, which has attendance of all members of existing WUG. Then, the plan has to be acknowledged by the farmers with a full appreciation of its contents. The Zonal Irrigation Office and the existing WUG have to exchange an agreement document for the plan after the general meeting. The representative of village government countersigns to its document. The farmers' duties should be mentioned fully in this agreement.

The Zonal Irrigation Office will commence the project works including field investigation, detailed design and construction, while the existing WUG will make necessary arrangements for supplying laborers and local materials. In parallel with these project implementation, the new WUG should be established in accordance with the proposed plan. The existing WUG in each system should organize an ad hoc committee for establishment of new WUG. This committee consists of leaders of the village government and existing WUG, and has following activities. The District Commissioner and Ward Councilor provide necessary support to the village government, especially for the land acquisition of the right of way.

- a) Confirmation of beneficiaries
- b) Land acquisition of right of way
- c) Management of farmers' participation to construction works
- d) Preparatory works for re-organization of WUG (including preparation of draft by-laws and budget, receiving of candidate for leaders of WUG, arrangement of first general meeting, etc.)

The ad hoc committee arranges the establishment of new WUG, and it should be implemented until three (3) months before the completion of construction works. The DALDO's office should commence immediately the training to WUG. After the construction, new WUG carries out the operation and maintenance of the facilities. The government's agencies provide necessary supporting services for establishment and strengthening of WUG. Those major services are listed below.

DC/Ward Councilor

- Supporting land re-allocation and land acquisition

DALDO

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

DCO

- Institutional improvement for WUGs.

Main agency of the above supporting services is the office of DALDO. The proposed organizational structure of this office is presented in Figure 4.2.3. The supporting services of the DALDO's offices are mainly implemented through the irrigation technicians and VEOs who are attached to each schemes.

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

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

Training programme for the extension staffs and farmers will be arranged by the office of DALDO. The implementation schedule is divided into two stages such as through and after the project implementation.

Major activities through and after the project implementation are summarized as follows;

(i) through the project implementation

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

(ii) after the project implementation

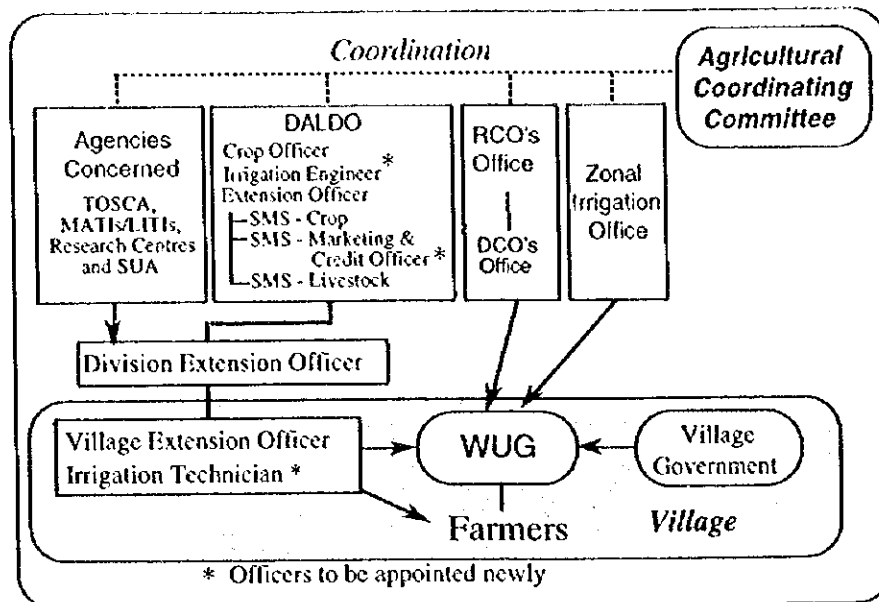
- Field training and field tour for farmers concerned
- Implementation of workshop for the front-line extension staffs

The schedule on the monthly-based training programme through and after the project implementation will be illustrated in Figure 4.2.4. The agricultural extension activities of DALDO's office are implemented under the powerful support from 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 effectively bring out the impacts of training programme and the government's supporting services, it is proposed to organize an Agricultural Coordinating Committee (ACC) in the Morogoro District Government, as shown in Figure 4.2.5. This committee, whose terms of reference are attached hereinafter, will coordinate all of the reinforcement and training programme.

This committee is chaired by DALDO. The activities of this committee will apply the participatory approach of the farmers concerned, in order to lead the sustainable implementation of agricultural development. The organizational structure and terms of reference for ACC are shown below.



1) Members of the Agricultural Coordinating Committee

The Agricultural Coordinating Committee consists of the following members;

- |                                |             |
|--------------------------------|-------------|
| 1. DALDO                       | - Chairman  |
| 2. REO                         | - Member    |
| 3. Zonal Irrigation Office     | - 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 |

2) Terms of reference for the Agricultural Coordinating Committee

The function of the Committee is summarized as follows;

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



#### 4.2.4 Staff required for Project Implementation

Prior to the implementation of the Project, the staffing of the Zonal Irrigation Office and the offices of RALDO and DALDO which are main supporting agencies of the Project should be strengthened. The proposed staffing to be newly deployed for the project implementation is as follows:

- i) **Agro-economist/Sociologist (Zonal Irrigation Office):**  
Prior to the implementation of the Project, an agro-economist/sociologist is appointed in the Zonal Irrigation Office. The preparatory works including meeting with farmers, collecting of farmers' intention to the Project and guidance to the general meeting of the village government are carried out mainly by this officer.
- ii) **Officer attached to the Project (RALDO's office):**  
To make close coordination between the Zonal Irrigation Office and RALDO's Office, an officer attached to the Project is appointed as a representative of RALDO's Office.
- iii) **Irrigation Engineer and Marketing and Credit Officer (DALDO's offices):**  
In order to achieve sustainable O&M of WUGs and effective irrigation farming of the farmers, supporting services for O&M of irrigation facilities and marketing and credit are crucial factors, and the DALDO's offices should play an important role to provide these services to WUG. At present, the DALDO's offices have however almost no specialist for these sectors. It is therefore proposed to appoint an Irrigation Engineer and a Marketing and Credit Officer in each DALDO's office, who have graduated from university or college and have a lot of experience on these sectors.
- iv) **VEOs and Irrigation Technicians:**  
At the filed level, it is also proposed to appoint a VEO in each village related to the scheme and an Irrigation Technician (IT) in each scheme. All necessary supporting services by the DALDO's office are implemented through these two officers.

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

#### Proposed Staffing for Project Implementation

Position	Present		Staff Required		Increment	
	VEO	IT	VEO	IT	VEO	IT
<b>Morogoro Zonal Irrigation Office</b>						
Economic & Social Survey Section						
Agro Economist/Sociologist	-	-	1	-	1	-
<b>Office of RALDO</b>						
Project Coordinator	-	-	1	-	1	-
<b>Office of DALDO, Morogoro</b>						
Irrigation Engineer	-	-	1	-	1	-
Marketing and Credit Officer	-	-	1	-	1	-
Village Extension Officer and Irrigation Technician						
(Project Site)						
- Langali Village	1	-	1	1 *1	-	1
- Bumu Village	1	-	1	-	-	-

\*1 Covers two systems.

VEO: Village Extension Officer

IT: Irrigation Technician

In addition, it is necessary to assign several specialist/experts, in order to train the above government's 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 needed to upgrade more their knowledge for the successful and effective implementation of the Project. The experts required for this purpose and their terms of reference are listed below

- i) O&M Expert
  - Preparation of O&M manual
  - Preparation of training materials for O&M and farmers' on-farm development
  - Training of officers involved in O&M and farmers' 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
- ii) Institutional Expert
  - Advice of 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 improving supporting activities
  - Monitoring and evaluation of agricultural supporting services for WUG
  - Follow-up training of officers
- iii) Agronomist / Agricultural Extension Expert - Technical advice for preparation of training programme coordinated by DALDO
  - Technical advice for participation approach in the field training programme
  - Implementation of workshop for senior staffs (DALDO, DEO, RALDO, REO, etc.)
  - Technical advice to the field training for DIVEO and VEO coordinated by DALDO
  - Technical advice to the field training for progressive farmers managed by VEO
  - Technical advice to the field training for general farmers managed by VEO
  - Technical advice for monitoring and review of the training programme and extension services
  - Technical advice for improvement of farming practices
  - Technical advice for preparation of guideline for proposed farming practices

The assignment schedule of each expert is shown in Figures 4.2.2 and 4.2.4.



## CHAPTER V EVALUATION OF THE SCHEME

### 5.1 Economic and Financial Evaluation of Each Scheme

#### 5.1.1 Economic and Financial Evaluation Basis

The evaluation has been carried out based on the Project costs and incremental benefits that have been estimated in both a "with" and "without" project situations. Economic and financial Internal Rate of Return (IRR) has been calculated for this evaluation to this evaluation. It has also taken into account the "capacity to pay" of a typical farm household, annual O&M costs, and the amortization cost for the development funds".

The net benefits coming from comparing the "with" and "without-project" situations have been calculated for the "with" and "without-project" situations (see Table 5.1.1, 5.1.2, 5.1.3, and 5.1.4 for financial and economic crop budgets used for the calculation); then, using the net return for each crop, the respective financial and economic net benefits have been calculated.

The economic evaluation has been 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) Table 5.1.5 shows the financial and economic prices for inputs and crops used in the evaluation. Economic farm gate prices of fertilizers were estimated on the basis of the forecasted world market prices for 2000 of the World Bank as of July 23, 1997. For the economic evaluation, agrochemicals and packing material have been valued at their financial prices; hired labour and machinery or draught cattle have been converted into economic prices by applying the standard conversion factor to their financial prices. Crops have been valued at their financial prices.
- 4) The exchange rate at Tsh.620 = US\$1, prevailing on August 1996, was used.
- 5) The standard conversion factor is 0.8.
- 6) Operation and Maintenance Cost has been considered to be 0.5% of the direct construction cost. At the moment of performing the economic evaluation, the O/M financial costs will be converted into economic costs by applying the standard conversion factor.
- 7) 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%).

#### 5.1.2 Economic Evaluation

##### (1) Economic Benefits

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.

The calculation of the economic benefits is shown in Table 5.1.6.

The net benefits accrue to TSh.14.44 million.

## (2) Economic Costs

Project costs broadly comprises direct construction costs, temporary works like mobilization costs, construction of lodgings for inside workers, compensation to land owners and crops, etc., administration costs, and engineering services costs. To obtain the economic development costs, the development costs have been multiplied by the standard conversion factor for those items where applicable (engineering services have been valued at their full cost).

The total economic cost is TSh.106.15million. Replacement costs are Tsh.37.97 million and take place in the 28th year since the start of the project implementation.

The O/M cost is TSh.0.32 million per year.

Table 5.1.7 shows the calculations for the economic costs.

## (3) Calculation of Economic IRR

Benefits increase 25% per year until reaching its full production target at the sixth year. Table 5.1.8 shows the calculation of the EIRR for Mgeta scheme. 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%. The EIRR for Mgeta is 11.0% which is below the standard.

## (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:

- i) Development costs increase by 27%;
- ii) Reduction of benefits by 10%;
- iii) Combined effect of (a) and (b)

Table 5.1.9 shows the procedures for application of the sensitivity analysis.

The results of the calculation are as follows:

Sensitivity Analysis Result			(Unit : %)
	Condition 1	Condition 2	Condition 3
EIRR	8.7	9.9	7.7

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

### 5.1.3 Financial Evaluation

#### (1) Financial Benefits

The procedure for calculation of the financial benefits are similar as the one used for economic benefits with two variations: 1) farm gate prices have been used for all crops; 2) at the moment of calculating the net return of main crops, the financial crop production

costs have been evaluated using market prices.

The net benefits accrue are TSh.14.16. Table 5.1.10 shows the calculation of the net benefits.

(2) Financial Costs

The financial development costs are TSh.126.01 million. The O/M cost is TSh.0.40 million per year. Table 5.1.11 shows the calculation of the financial costs.

(3) Calculation of Financial IRR

The FIRR for Mgeta scheme is 9.0%. Table 5.1.12 shows the calculation of the FIRR.

(4) Expected Benefits for the Farm Household

To assess the expected financial benefits for the farm household, a farm economy analysis has been performed for the "without-project" and "with-project" situations. The "without-project" situation is considered to be the same as the "present conditions" situation. The analysis has been performed for the total average holding size of a household, meaning that the holding sizes within the scheme and outside the scheme have been considered. The Table below shows the results of the analysis.

Farm Economy Analysis (Unit : 1,000 TSh.)

	Without Project	With Project
Average Holding Size (ha)	0.80	0.80
- Within the Scheme Area	0.30	0.30
- Outside the Scheme Area	0.50	0.50
Gross Farm Income	341	536
Production Cost	54	108
Net Farm Income	287	428
Off-farm Income	109	0
Total Income	396	428
Living Expenditure	297	297
Tax and Duties	6	6
Reserve (Profit)	93	125

The Project will bring about an increment of net reserve of TSh.32,000. The net reserve of the "with-project" situation is 1.34 times the one of the "without-project" situation. Based on the results of the analysis, it is possible to say that the farm household is expected to be benefited by the Project.

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 the 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.

#### (4) Capacity to Pay

To evaluate the Project from the point of view of the farmers, an average farm budget analysis was made for each scheme with future projections under the "with-project" conditions. The calculations are shown in Table 5.1.13 and a summary of the results is given below. For purposes of the analysis, the hypothetical situation of the beneficiaries of the Project receiving a loan to cover the development costs of the Project has been considered; thus, for the capacity to pay analysis, the cost of amortization of the loan has been considered. The conditions of the loan are as follows: interest rate of 1% to be paid in 30 years; the amount used for the analysis represents the annual amount that the household have to pay to amortize the loan per year.

Capacity to Pay Analysis (unit : 1,000 TSh.)

a) Holding Size (ha)	0.3
b) Gross Income	333
c) Production Cost	78
d) Net Farm Income	255
e) Income Tax	6
f) O/M Cost	4
g) Amortization Cost	70
h) Net Profit	
In case of d-(e+f)	245
In case of d-(e+f+g)	175

The results above indicate that the Project will bring about a great improvement to the farm economy; the net farm income is high enough to cover the production cost for the next cropping season, the O/M cost, and the amortization costs. Fig. 5.1.1 graphically shows the results of the analysis made above.

## 5.2 Other Development Impacts

### 5.2.1 Technical Aspects

#### (1) Effect on transfer of technology

Local government staffs and farmers participating to the project through the design and construction stages will have a big chance to obtain technical knowledge on design and construction in small irrigation facilities, which are very useful for the operation, maintenance and repair of irrigation facilities.

#### (2) Improvement of drinking and domestic water supply

By the provision of a permanent headworks and canals, farmers can take water from the canals at any time throughout a year even in mid rainy season, during which the diversion points are usually closed or diversion devises are washed away by flood at present.

(3) Demonstration effect

Successfully progress of the project implementation including the operation and maintenance of facilities and water management will enhance the incentive to introduce the improved irrigation and drainage facilities, O&M methods, and water management practices in the similar smallholder irrigation schemes.

### 5.2.2 Socio-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 manpower will be supplied from the farmers in and around the Project area. Moreover, workers will be able to gain experience and skillfulness 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 not being able to work in the fields where the construction works are being carried out. Adequate measure should be taken to mitigate this potential negative effect.

(3) Decreasing the out migration of young people to other areas

Young people after seeing the development and progress experimented by 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 by decreasing the out migration of young people to other areas; and the other is that by providing occupation to the young, the possibility of social problems created by idle unemployed people will decrease.

(4) Incentive for adopting improved irrigation to other area

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 Project will make it possible for Mgeta scheme to contribute with 90 ton of cereal, 32 ton of beans, and 108 ton of vegetables per year.

(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 the Mgeta Scheme will be TSh.33 million



per year.

(7) Empowerment of women

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

### 5.2.3 Institutional Aspects

(1) Model project for institutional development of irrigation projects in Morogoro region

In the Mgeta Division including 4 Wards of Mgeta, Tchenzema, Kikeo, and Bundoiki, there are many WUGs established at each intake weir or branch canal. These WUGs have a loose organizational structure. Although these WUGs are functioning well for management of the present traditional irrigation system, it requires for those strengthening, if they wish to increase more in their productivity through improvement of water supply and production environment. The development plan formulated in the Mgeta scheme covers not only engineering aspect but also 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 for the institutional development of WUGs. In addition, the government officials involved in the implementation of this Project will have a lot of knowledge and experience on institutional development, which are prerequisite matter for strengthening of WUGs.

(2) Improvement of agricultural supporting activities in the rural area

The Project proposes formation of new WUGs. The 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 involve those groups in a credit and marketing system which will benefit all members.

### 5.2.4 Environmental Aspects

(1) Minimizing of negative impacts and mitigation of social conflicts

The environmental impact assessment pointed out that the Project would bring such misgivings such as "influence of water-borne diseases", "water contamination by use of chemical fertilizers and agro-chemicals", "degradation of vegetation due to increment 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. Moreover, the negative impacts could be minimized without too much difficulty since all of the proposed schemes are small sized.

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 detritus will reach the rivers and traffic on the roads near or in the construction area could be interrupted. This will be temporary disturbances that will pass away after finishing 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 VI. RECOMMENDATION TO PROJECT IMPLEMENTATION

### 6.1 Technical Aspects

#### (1) Early implementation of the Project

Through the investigation and studies of Mgeta scheme, it has been concluded that the implementation of irrigation development in Mgeta scheme is technically sound and economically feasible. The development will contribute to a stabilisation and an increase in the agricultural production under full irrigation condition, ensuring an increase in farmer's income and living standard, and creating employment opportunities. It has been also recognised through the interview survey and public meetings that (1) the farmers in Mgeta scheme area are looking forward to the implementation of the project and that desire to positively participate in the implementation of the project and (2) they basically have a capacity to make operation and maintenance of irrigation facilities and proper water management by themselves, although the proper technical supports through training and guidance are required at the initial stage of the project operation. It is also expected that the realisation of the project will surely have a considerable effect on the other existing irrigation schemes scattering over the Mgeta ward and the similar topographic areas. It is recommended, therefore, to implement the irrigation development as early as possible.

#### (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 and to make soil conservation on the very steep slopes. For the development, the steep mountainous slopes should be demarcated and the demarcated area shall be strictly prohibited from using the area for other purposes than afforestation and fuel wood development.

### 6.2 Institutional Aspects

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

- 1) Staff to be newly deployed for the project implementation is estimated to be ; an agro-economist/sociologist in the Zonal Irrigation Office, a project coordinator in the RALDO office, two officers (irrigation engineer and marketing and credit officer) in the DALDO office and an irrigation technician in the scheme. The executing agencies concerned should arrange these staffs necessary for successful implementation of the Project.
- 2) At present, GOT has a plan for restructuring of the regional government. According to this plan, the Morogoro regional government will be simplified in its organization and staffing, and the district governments will be strengthened. In the Project, the district governments such as DALDO and DCO have direct responsibility for the supporting services to WUGs to be established in the schemes, and the strengthening of these district governments under the restructuring plan will bring a good result to attain sustainable project. It is therefore recommended to accelerate further this restructuring plan of the Morogoro region.