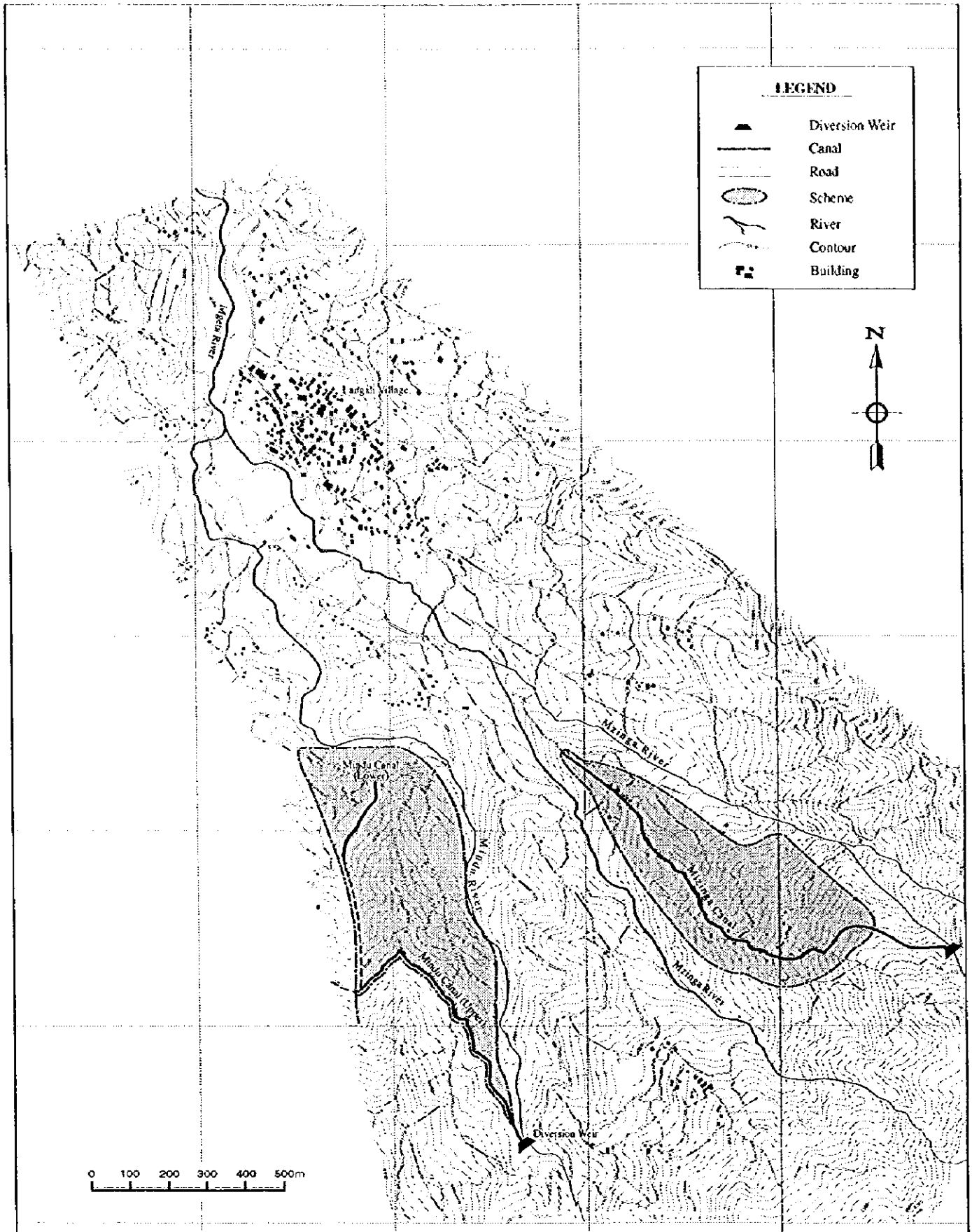
DIVISION - II

DEVELOPMENT PLAN OF MGETA SCHEME MOROGORO DISTRICT



General Layout Map of Mgeta Scheme (Mzinga Canal and Mindu Canal)

DIVISION - II.

FEASIBILITY STUDY ON THE SMALLHOLDER IRRIGATION PROJECTS IN CENTRAL WAMI RIVER BASIN

MGETA SCHEME

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER I. PRESENT CONDITIONS OF THE SCHEME AREA

1.1 Physical Nature of the Study Area

1.1.1 Location

Mgeta scheme area is located about 50 km south from Morogoro city in Morogoro District, Morogoro Region (See Location Map). The area lies in the Uluguru mountains in an altitude range from 800 m to 2,000 m.

1.1.2 Topography

The scheme area is served by numerous small irrigation systems diverting water from small streams running deep valleys in the Uluguru mountains. The irrigation areas are situated on the steep slope ranging from 10 % to 40 %, narrowly dissected by stream valleys.

1.1.3 Meteorology and Hydrology

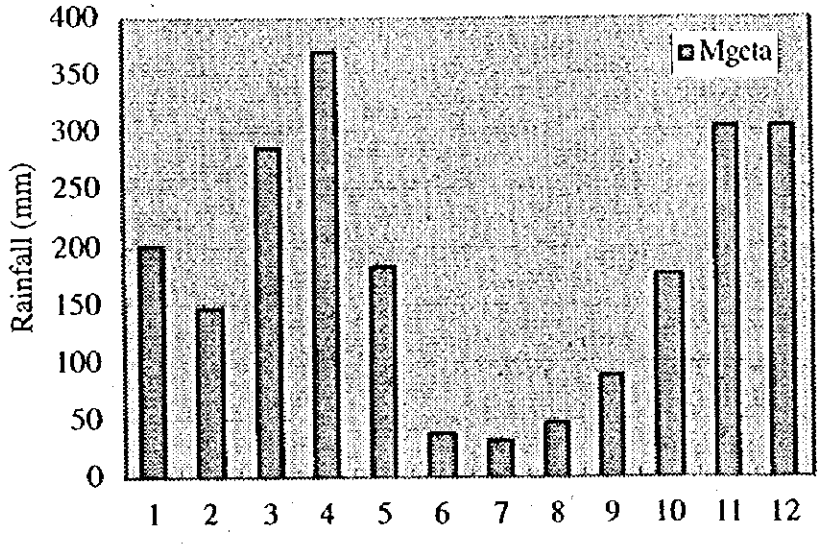
(1) Meteorology

(a) Rainfall

Annual rainfall in Mgeta scheme is 2,200 mm on an average. The rainy season is usually from November to May and the dry season is from June to October. The peak rainy season is April, in which monthly rainfall reaches nearly 400 mm.

Name of Scheme	Rainfall Station	Code Number	Annual Rainfall (mm)
Mgeta scheme	Bunduki station	973715	2,181

Mean Monthly Rainfall at Bunduki Station



(b) Other Climate Parameters

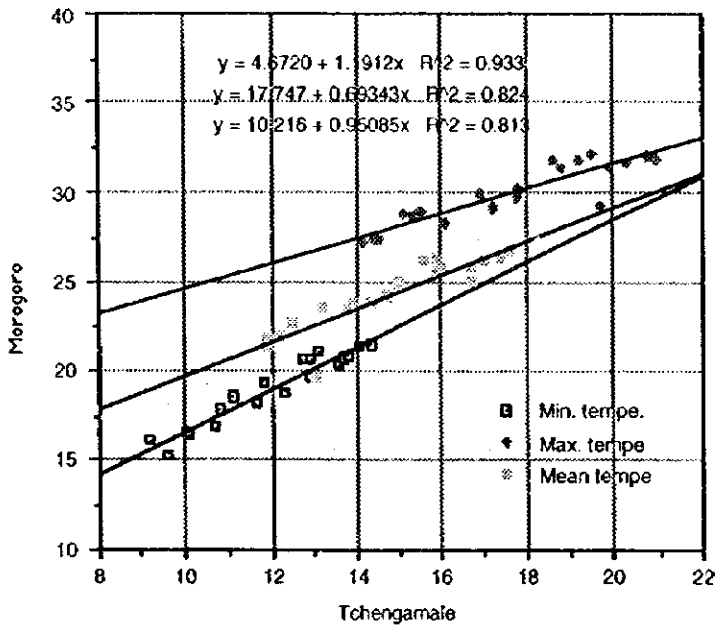
Climatological data such as temperature, humidity, and sunshine hours measured at Tchengamale by Franco Tanzania Horticultural Development Project were obtained. The period of the data is only about one and a half year from June 1988 to January 1990. The measurement point is located at the altitude of 2,000 m in the Uluguru mountains. On the contrary, the project area is located in the altitude from 1,000 m to 1,600 m. In order to estimate the climate in the project area, the climatological data at Tchengamale are compared with those at Morogoro meteorological station located at 506 m above sea level having long term climatological data, which shown in the following table. The correlation in temperature between Morogoro station and Tchengamale is shown in the following figure. In the data of sunshine hours, Tchengamale is about 70 % of Morogoro station. As the results of the comparison, temperature and sunshine hours were estimated in proportion to the altitude. No difference in humidity is observed between two stations.

Summary of Meteorological Data

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Mean
1. Morogoro Meteorological Station (El.506 m)													
(1) Mean Maximum Temperature (oC)	31.6	32.1	31.6	29.6	28.4	27.6	27.2	27.8	29.8	31.4	32.0	31.8	30.1
(2) Mean Minimum Temperature (C)	21.1	21.1	21.1	20.6	18.9	16.0	15.1	15.4	16.7	18.1	19.9	20.6	18.7
(3) Mean Temperature (C)	26.4	26.7	26.4	25.1	23.7	21.9	21.2	21.6	23.3	24.8	25.9	26.2	24.4
(4) Relative Humidity (%)	80.2	80.5	82.7	89.2	89.4	86.0	85.2	82.8	78.0	73.8	72.7	75.9	81.3
(5) Sunshine Duration (hr/day)	7.5	7.6	7.4	5.4	5.4	6.6	6.5	6.4	6.8	7.7	8.2	7.8	7.0
(6) Solar Radiation (l/day)	16.8	18.4	15.5	13.9	12.6	12.8	12.7	12.9	15.1	15.9	17.5	16.8	15.1
(7) Wind Velocity (m/s)	2.5	2.2	1.7	1.0	0.9	1.0	1.3	1.7	2.1	2.4	2.5	2.7	1.8
(8) Evaporation (mm/day)	5.8	6.7	5.6	3.9	3.1	3.1	3.4	4.1	5.6	6.3	6.7	6.3	5.1

Meteorological data except evaporation are available for recent 24 years.

Corelation in Temperature between Morogoro and Tchengamale

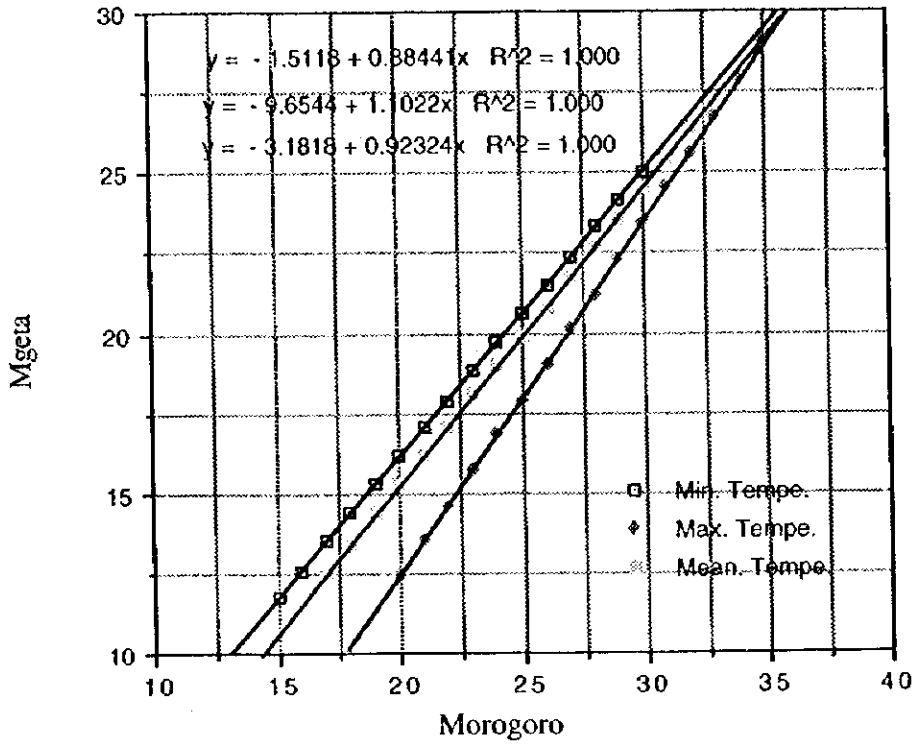


The correlation in temperature between Morogoro station and the Mgeta scheme area is shown in the following figure. The estimated mean temperature and sunshine hours in the scheme area are as follows.

Temperature and Sunshine Hours in Mgeta Scheme

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Mean
(1) Mean Temperature (C)	21.2	21.4	21.2	20.0	18.7	17.0.	16.4	16.8	18.3	19.7	20.8	21.0	19.4
(2) Sunshine Duration (hr/day)	5.3	5.3	5.2	3.8	3.8	4.6	4.5	4.5	4.8	5.4	5.8	5.4	4.9

Corelation in Temperature between Morogoro and Mgeta



(2) Hydrology

There are many small stream valleys in the Uluguru mountains. According to the discharge observation of two rivers such as the Mzinga river and the Mindu river, which have a catchment area of 2.4 km2 and 2.7 km2, respectively at the observation points, the flow discharges were 50 to 60 litre/sec in the Mzinga and 30 to 40 litre/sec in the Mindu in July. The discharge further decreases to 20 - 30 litre/sec in the Mzinga and 10 to 15 litre/sec in the Mindu in mid dry season according to inhabitants. The Mzinga river is larger in specific discharge than the Mindu. It is mainly caused by the forest covering rate against whole the catchment area. The specific discharge ranges from 11 to 25 litre/km2 in July and 5 litre/sec to 12 litre/sec in the late dry season.

1.1.4 Soils and Vegetation

The soil survey was carried out aiming at the soil classification as well as clarification-cum-assessment of the land suitability for the subjected irrigation development of Mgeta scheme. In performance of the field investigation and soil classification, the follow-

ing steps were taken as the schedule and procedure:

- Review of all the results of the reconnaissance soil survey which had been carried out by JICA Study Team for the master planning study in 1996,
- Interpretation of the aerial photographs on a scale at 1/10,000 that has also been prepared by the JICA Study Team in 1997,
- Clarification and identification of the essential soil groups and those proportional distribution using the detailed topographic maps (1/5,000), and
- Field confirmation and classification of the soil groups at the semi-detailed basis.

According to the FAO/UNESCO Soil Classification System (refer to the Soil Map of the World), the soils in Mgeta scheme area are identified as the Eutric Cambisols, which are originated from the weathered tuff. These soils are classified into two soil units, *i.e.* the Eutric Cambisols having clay to clay loam texture on the steep slopes (mapping unit Mgt-1) and the Eutric Cambisols with stony-cum-rocky sandy clay loam texture in the eroded slopes (mapping unit Mgt-2). The soil map of the scheme area is as illustrated in Drawing No. 201 in Drawings. The soil morphological characteristics and extent of each soil unit are shown in Table below:

Soils in Mgeta Scheme

Mapping Unit	Mgt-1	Mgt-2
Area (ha)	140	80
Soil Unit	Eutric Cambisols	Eutric Cambisols (stony)
Pysiography	Mountain	Mountain
Topography	Steep slope	Eroded or colluvial steep slope
Parent Material	Un-consolidated tuff	Un-consolidated tuff
Soil characteristics		
Texture	CL/L/SL	SCL/L/R (contained boulder/stones)
Depth	100 - 150 cm	50 - 100 cm
Fertility	Mod. - Low	Mod. - Low
Drainability	Well	Well to excessively well
Depth of groundwater		
Rainy season	> 150 cm	> 150 cm
Dry season	> 150 cm	> 150 cm
Land Use	Terraced upland field	Terraced upland field or Forest

The soils of Mgt-1 are found on the mountain slopes and ridges occupying 140 ha or 64% of the Mgeta scheme area. The land has been terraced with a width at 2 to 4 m and step height at 0.7 to 1.5 m for extensive cultivation of the upland crops under the traditional irrigation system. The soils have an moderately deep soil profile (1 to 1.5 m) with moderately fine texture and medium to low fertility. The drainability of these soils is generally well, while excessively well in some part where the soils developed with colluvial tuff at the lower reaches of the slopes.

The soils of Mgt-2 are mostly extended on the colluvial slopes formed at the mountainous foot and/or the extremely steep-slops at the middle reaches of mountain. The proportional extent of these soils is estimated to be 80 ha or 36% of the Scheme area. The soils commonly have sizable boulder and stones in the profile, and shallowly underlain by the base-rock where the soils are being affected by a severe erosion. Generally, the soils have sandy loam to sandy clay loam texture and low fertility. Drainability of these soils is well to excessively well in most cases.

The chemical properties and physical natures of the above soils are as shown in Table below. The reaction of surface soils indicates strong acid.

Physical Natures and Chemical Properties of Soils

Soil Mapping Unit	Soil Sample No.	Horizon Name	Depth cm	EC mS/cm	pH (1:2.5) H2O	pH (1:2.5) KCl	Particle Size Clay %	Silt %	Sand %	Soil Texture	Bulk Density g/cm3
Mgt-1	1	Ap	0-20	0.02	5.8	5.1	26	13	61	SCL	1.28
Mgt-1	2	Ap	0-20	0.22	5.1	4.7	45	35	20	C	1.14
Mgt-1	3	Ap	0-20	0.16	5.7	5.3	46	30	24	C	1.18

Soil Mapping Unit	Soil Sample No.	Total N %	Organic Carbon %	C/N Ratio	CEC me/100g	Exchangeable Cations Ca	Mg	K	Na	Total me/100g	Satur. Ratio %
Mgt-1	1	0.09	1.21	13.5	11.2	5.71	1.01	0.11	0.06	6.89	62
Mgt-1	2	0.50	4.66	9.3	22.4	3.66	0.98	0.70	0.05	5.39	24
Mgt-1	3	0.30	3.89	13.0	15.7	5.50	1.93	0.64	0.14	8.21	52

The land having slopes less than 40% is mostly cultivated with the up-land crops, i.e. maize in the rainy season and some vegetables in the dry season using a terraced-field system. The natural vegetation in and around the scheme area is seriously deteriorated through traditional shifting-cultivation as well as collection of fuel-woods up to present.

1.2 Socio-economic Setting

1.2.1 Administrative Divisions and Demographic Data

(1) Administrative Division

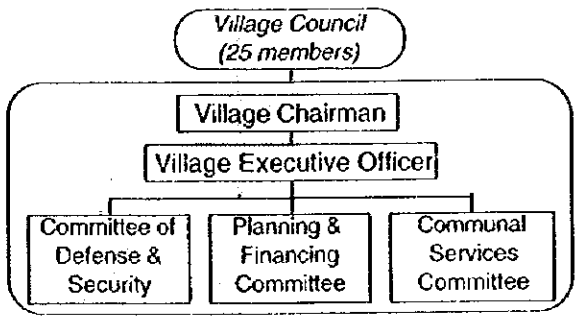
SCHEME	DISTRICT	DIVISION	WARD	VILLAGE
Mgeta	Morogoro Rural	Mgeta	Langali	4 villages
			Tchenzema	4 villages
			Kikeo	2 villages
			Bunduki	2 villages

(2) Public Administration

1) Administrative Structure

The village is the smallest unit of organization in the administrative structure. Within the village, the following administrative structure can be found:

Members of the Village Council include the Village Chairman and members of the Committees. The villagers elect all members of the Village Council, except the Village Executive Officer. The Village Executive Officer, who is selected among the villagers, is hired by the Village Council and is in charge of administrative works.



Administrative Structure

To facilitate the work of communication and co-ordination between the villagers and the village government, a number of villagers' clusters are formed.

Each cluster has a chairman who is also a member of one of the village committees.

After the Village Council unit, the next level of administrative unit is the Ward Committee integrated by a Ward Councilor, a Ward Executive Officer, and an assorted number of professionals in charge of evaluating proposals elevated to them by the village government. The Ward Councilor is elected from the different political parties in the ward. The Ward Councilor is supposed to attend the village meetings and represent the villages at the District level.

The next administrative level is the Division level. The Divisional Secretariat unit deals specifically with security and defense matters. At the District level, all District Council matters are conducted y a specific board known as Local Government Civil Service Commission. The highest authority is the District Commissioner.

2) Rules Formulation, Approval and Enforcement

Rules Formulation

Village rules, under the form of by-laws, are formulated by the villagers and their leaders. The need to formulate the by-laws comes from either the villagers or the leaders. A meeting is organized by the village government to discuss the proposed by-laws; the meeting involves the following members:

- All members of the Village Council;
- Village Executive Officer as secretary to this meeting;
- Clusters' chairmen;
- Representatives of different political parties;
- Other special members selected by the villagers.

In the meeting, a proposed by-law to regulate or legislate on problems encountered in the village is discussed. When the by-law has been formulated, the villagers are informed through posting the proposed by-law in the public information board for one month so that if there is any comment or objection, it can be put forward in advance. If there is no objection, the Village Council, through the Ward Councilor, elevates the by-law proposal to the District Council for its approval.

At the District level, the Full Council, which is the body that reviews and approves or rejects the by-law proposed by the Village, has the following members:

- District Executive Director;
- All department heads in the District Council;
- Ward Councilor from all villages concerned with the proposed by-law.

The by-law is scrutinized and, if approved, sent back to the village for its enactment. It must be noted that there is a specific time based on a yearly schedule set by the District Council for approval of all by-laws proposed by the villages within the District.

Enforcement

Enforcement of the by-laws is carried-out by the village government, especially by the Village Chairman and Village Executive Officer. Violation of the by-laws is considered as an offence and punishments/penalties are imposed as an immediate action.

The money amount to be paid as penalties, punishments or fines is set by the village government, based on the existing by-laws. Not fulfilling the conditions set by the punishment is a greater offence, which may lead the culprit to be sent to the court. The collected money goes to the Village Council.

3) Conflict Resolution Framework

When a conflict can not be settled up between the parties involved, they can decide either to let the problem be solved by the village government or settle it by a legal court.

When the problem is to be reviewed by the village government, the parties must accept the final decision adopted by it. However, of the village government fails to solve the conflict, other higher level administrative bodies, e.g., district office, regional office up to the ministry level are in charge of solving it.

(3) Population and Households

The Table below provides information on population, and households for the whole Mgeta scheme.

Administrative Division and Population (1996)

Scheme	District	Division	Ward	Village	Population	Household
Mgeta	Morogoro	Mgeta	Langali	4 villages	6,740	5,871
			Tchenzema	4 villages	7,020	1,404
			Kikeo	2 villages	13,130	2,626
			Bunduki	2 villages	2,460	492

Source : Data from Ward Executive Officers, Village Executive Officers, Village Extension Officers

(4) Population Composition

To be used as a reference and indicative information on the demographic trends, the Table below gives information on the age composition for Mgeta scheme only for Langali village.

Age Composition of the Villages' Population

Scheme	Village	Total Population	0-6 Years	7-14 Years	15-45 Years	46-55 Years	56 Years and Above
Mgeta	Langali	8,500	1,870	2,125	2,805	1,105	595

The population composition data for the village can be further classified using the following categories:

- Pre-school age : 0-6 years
- School age : 7-14 years
- Working age : 15-55 years
- Old age : 56 years and above

The Table shows population composition in terms of the ratio between each population category shown above and total population.

Classification of Population According to Activity in Percentage Terms

Scheme	Village	Pre-school Age Pop./Total Pop.	School Age Pop./Total Pop.	Working Age Pop./Total Pop.	Old Age Pop./Total Pop.
Mgeta	Langali	22	25	46	7

The data above shows that the ratio working population/total population is high. This indicates that labour force is plenty in the scheme.

1.2.2 Rural Infrastructure

(1) Roads

There is a local trunk diverging from the highway A7 and going southward to Mgeta ward. The local trunk road is a laterite earthen road relatively well main-tained. However, once entering the mountainous area, rough rocky surfaces with deep erosion are observed at some points. These road surfaces should be im-proved by cutting rocks and filling gullies so as to make them smooth and well drained.

(2) Basic Services

The Table below shows the situation of basic services at village level.

Basic Services at Village Level

Scheme	Village	Electricity	Water Supply
Mgeta	Langali	Non-availale	Limited piped water/river water

Source : Data from Ward Executive, Village Executive Officer

(3) Social Infrastructure

The Table below shows the situation of social infrastructure at village level.

Social Infrastructure in the Villages

Scheme	Village	School	Dispensary	Church	Mosque
Mgeta	Langalo	1	1	2	1

Source : Data from Ward Executive, Village Executive Officer

(4) Agricultural Facilities

The Table below shows the situation of agricultural facilities at village level.

Agricultural Facilities in the Villages

Scheme	Village	Storage Facility	Rice Mill	Maize Mill	Mill (Rice + Mill)
Mgeta	Langali	1	-	3	-

1.2.3 Economic Activities

Agriculture is the main economic activity in the village. There are no industries in the scheme. The only processing activity is rice milling.

Some farmers also engage in off-farm activities in order to supplement their income. These activities often fall into the following categories: petty business like sale of own agricultural products and foodstuff during the market days which take place one day per week.; raising of poultry, pigs, and goats for sale; hiring themselves as labor to third parties.

1.3 Present Conditions of Agriculture

1.3.1 Present Land Use

The present land use is classified into four units, i.e. 1) cultivated land; 2) forest/wood land including tree plantation; 3) grassland including scarce bushes and shrubs; and 4) settlement area including right of ways such as roads and canals.

The land use survey was carried out through interpretation of the aerial photographs (1/10,000), field visual survey and interview with villagers. The present land use of the scheme area is then compiled using the detailed topographic map on a scale of 1/5,000, and the shortened map is attached as shown in Drawing No. 202 of the Drawings. The extent area by land units area is summarized as follows:

Present Land Use in Mgeta Scheme

Land Use Type	Area (ha)
Cultivated Land (Upland Crops)	140
Grassland	45
Forest & Wood Land	30
Settlement/Right of Ways	5
Total	220

Out of 220 ha in gross of the surveyed area, the cultivated land occupying 140 ha or 64 % has been reclaimed with terrace formation, and being cultivated with the upland crops. Maize and beans are mainly grown in the rainy season, while vegetables and beans are planted in the dry season under fully irrigated conditions.

The forest and/or wood-land has been reduced to 30 ha or 14% due to expansion of the farm land and demand increase of fuel-wood because of the recent increment of the population pressure to that land. The natural grassland occupies 45 ha or 20% of the total surveyed area. It is supposed that the present grassland are one of the typical degradation problems on the natural vegetation caused by human activities, i.e. traditional shifting cultivation in extremely steep slopes and unfavorable management of the forest resources.

The land used for infrastructure settlement, i.e. the right of ways of the major roads and the existing canals, foot-paths as well as residential yard of the farmers is estimated to be about 5 ha or 2% of the total surveyed area.

1.3.2 Land Ownership and Tenure System

The tenure system in the Study Area is generally based on traditional inheritance, land allocation by village council, land purchasing, land borrowing or renting. The most common tenure regime in the Study Area is the one based on "customary tenure", where land rights are transferred according to an ancestral tenure of land and/or the traditional inheritance accepted by the village council.

In Mgeta there is no more arable land to be able to allocate for the villagers. Since then, the cultivated land has been fragmented to small land holding sizes due to recent population increases and traditional inheritance through generations. Shrinkage of land

holding size per farm household has, therefore, become a serious problem in this area.

The JICA Study Team has estimated that the average landholding size per farm household for Mgeta is 0.80 ha (rainfed plus irrigated areas). It has been estimated that 0.30 is within the irrigated area.

Landholding Size

Basic Information	
Number of housholds	5,871
Cultivated Area (ha)	
- In the whole village	4,170
- In the Study Area	1,600
Holding Size (ha)	
- In the whole village	0.8
- In the Study Area	0.3

The average landholding size in the Study Area, 0.30 ha, has been estimated considering that the area in the Study Area is 30 ha and that there are 100 families from Mindu and Mzinga.

As a reference, a second source of information was used by first identifying the farmers living within the Study Area using a topographic map and identifying the plots' owners within this map. Then, the farmers were asked about the size of their landholding within the Study Area.

The average landholding size estimated from the informal survey is approximately 0.30 which agrees with the data estimated by the JICA Study Team.

For Mgeta, information was available only for Mindu village. However, the information was considered to be representative for the scheme. The results showed that the declared average landholding size in the whole scheme is approximately 0.8.

Farmers-Provided Data on Land Holding

Number of Farmers covered by the Survey	46
Total Declared Area (ha)	35.2
Average Landholding (ha)	0.77

Frequency Distribution of Land Size Holdings in Percentage Terms

	(%)
0 to <0.4 ha	43
0.4 to <0.8 ha	30
0.8 to <1.2 ha	20
1.2 to <1.6 ha	4
1.6 to 2 ha	2
2 to <4 ha	1
4 to <6 ha	0
6 to <8 ha	0
> 8 ha	0
TOTAL	100

It must be noted that the perception of the farmers concerning their own land holding size does not necessarily coincide with the actual land holding if actually measured in a topographic map showing the actual size of the plots.

1.3.3 Present Agricultural Production

(1) Cropping Pattern

Main crops in the rainy season cropping during the period from October / November to March / April, are maize, beans, and pulse crops. Normally, they cultivated under inter - cropping or single cropping system. Maize is cultivated for home consumption and pulse crops are cultivated as cash crops. In the dry season cropping during the period from March / April to October / November, such cash crops as cabbage, potatoes, pulse crops, etc. are dominantly cultivated under traditional irrigation system. Besides, several kinds of vegetables which are cash crops, such as lettuce, parsley, carrot, cauliflower, Chinese cabbage, onion, leek, sweet potato, tomato, green pepper, red pepper, egg plant, etc. are cultivated in some limited farm lands during the dry season.

Present cropping pattern is shown in Figure 1.3.1.

(2) Farming Practices

Farming practices for such major crops in the scheme as cabbage, pulse crops, and maize are summarized in Table 1.3.1 and major practices for each crop are elaborated as follows;

1) Cabbage

In the scheme, all the activities for cabbage cultivation is manually implemented by using such small equipment as hand hoe (*Jembe*), big knife (*panga*), hand sprayer, etc. Because the farm lands in form of terraces are located in the steeply slope area, tractor operation and working cattle is not used. Fertilizer and agro-chemicals are applied to a large extent, based on the instruction of extension services. Seeds are generally bought through traders or shops in the local market or Morogoro town. Major farming practices are elaborated as follows;

a) Land preparation

Land preparation is manually carried out by using hand hoe, but neither tractor nor working cattle are in common. Before starting cabbage cultivation, slope side of contour terraces is reshaped by means of scraping side slope and hence shallow ploughing and harrowing are conducted. Width of terrace is estimated at around 2.0 to 2.5 m. Furrow for leading water along the slope side of terraces is also rehabilitated.

b) Nursery Preparation

Generally, ridge formation is required for nursery bed. It is recommended that seed amount is around 150 to 200 g for one acre. Common variety in the scheme is Copenhargen Market, Glory of Enkhuizen. Nursery period to be required is estimated around one month.

c) Major Practices in Main Field

Ridge for seedlings to be transplanted is not generally formed. Planting density is in the range between 50 cm x 70 cm and 70 cm x 90 cm.

Application of fertilizer is a common activity in the scheme, based on the recommendation of extension office. As for basal dressing, 5 g of Urea is

generally applied one month after transplanting. Fertilizer is applied in the surface of field and further incorporated with soil by using small hand hoe. Some farmers apply a handful of compost per hill which are made from pig dung and grass residues before transplanting.

Weeding is manually carried out once or twice during the growth period, by using small hand hoe or just uprooting by hand.

In the scheme, club root (*Plasmodiophora Brassicae*) is a most serious fungus disease (a kind of mold fungi). Above ground parts of infected cabbage plants show wilting yellowing symptom. The affected root become large spindle shaped galls. Further explanation is described in Section 1.3.6 of this Division concerning constraints and problems. Due to this disease infection, farmers abandon to continue the cultivation or cultivate such some other crops as potatoes, legumes, etc. which are not susceptible to this disease, instead of cabbage. Regarding insects, diamond backmoth is the most dangerous pest of cabbage. Some farmers apply Sevin, Sumithion, etc. to control the pest.

Irrigation water is supplied once or twice a week, depending on the soil condition. Basically, irrigation water is controlled systematically. Farmers can irrigate any time whenever they want to do. As a result, during the peak season in the dry season, they are facing shortage of water.

d) Harvesting

Harvesting is carried out around 3 month after transplanting. Harvested cabbages are carried to local market which is held on Monday and Thursday by manpower.

2) Maize

Maize is mainly cultivated during the rainy season (October / November for sowing to March / April for harvesting). Extensive cultivation is dominant, after harvesting cabbage or pulse crops during the dry season. Such land preparation as ploughing and harrowing is roughly carried out by hand, following the commencement of rainy season. Sowing amount of seeds is estimated at around 2 to 3 seeds per hill, or 20 to 25 kg per ha. Seeds are multiplied by farmers themselves. No application of fertilizer and agro-chemicals are common in the area. Weeding is carried out once or twice during the growth period of maize.

Maize is harvested in March and April. Harvesting is not usually conducted at a time, but little by little depending on the degree of home consumption.

3) Pulse crops

In the project area, such pulse crops as beans, peas, etc. are cultivated as food or cash crops. During the rainy season, pulse crops are generally cultivated with maize in inter-cropping. During the dry season, they are cultivated in single cropping under irrigation. Even both seasons, extensive cultivation is conducted and no application of fertilizer and agro-chemicals is so common.

4) Potato

In the project area, potato cultivation has been expanded as food or cash crop because cabbage has been infected with club root and its yield declined year by year. As a result, farmers have been instructed to cultivate another crops such as pulse crops, potato, etc. for certain years, instead of cabbage cultivation. Potatoes are cultivated during the dry season under irrigation.

Land preparation for potato is similar with the land preparation for cabbage cultivation. Farmers prepare ridge formation and plant seed potatoes. Normally, farmers have never stored the harvested potatoes as seed potatoes for the next season, but they buy marketed potatoes for their cultivation as seed potatoes. As a result, quality of seed potatoes is in low, some potatoes are contaminated by some diseases.

(3) Crop Production

No application of fertilizer and agro-chemicals is common in case of maize and pulse. As for seeds, farmers do seed multiplication by themselves rather than purchase of qualified expensive seeds.

While farmers who cultivate cash crops such as cabbage, potatoes, other perishable vegetables in the area generally adopt a traditional irrigation method and further desire a technical assistance concerning application of fertilizer, agro-chemicals for improvement of crop productivity, and effective irrigation method. They have tried to obtain some qualified seeds which ensure certain quality and productivity, although it is expensive or often not easy to obtain them in time. Furthermore, those commercial seeds are not qualified in some cases.

The present cultivated area and crop production in the scheme is estimated as follows:

Present Crop Cultivation in Mgeta Scheme

	Cultivated Area (ha)		Unit Yield	Crop Production (ton)		
	RS*1	DS*2	(ton/ha)	RS	DS	Total
Maize / Pulse*3	30	0	1.0	30	0	30
Cabbage	0	6	10.0	0	60	60
Potato	0	3	3.0	0	9	9
Pulse	0	9	0.7	0	7	7
Total	30	18				

*1 : RS : Rainy season (November to April)
*2 : DS : Dry season (May to October)
*3 : Maize is selected as a representative crop. That is, figures for maize is adopted concerning unit yield and production

Based on the situation mentioned above, crop budget in the present condition is prepared as shown in Table 1.3.2.

(4) Livestock and Inland Fishery

It is revealed that cattle grazing is not common for farmers concerned in the Project area, but pig farming is common in the area. Generally, piglet is reared and adult pigs are marketed to traders. Furthermore, such small livestock as chicken, goats, etc. are also raised for home consumption. Especially, population of pig is estimated at around 600 heads in Langali and Bumu villages.

In Langali village, cultivation of Telapia is also existing for local consumption in and around the village. This fish farming was introduced through Aquaculture for Local Community Development Programme of FAO. 14 fish ponds with various sizes are scattered in the village, but there are no fish ponds in the scheme area.

1.3.4 Activities of Agricultural Supporting Services

(1) Extension Services Concerned in 1996/97 for Morogoro District

During the first fiscal year of 1996/97 for NAEP II, it was expected that the major thrust of activities during the first and second quarters will be to smoothen the transition between NALERP and NAEP-II, while during the third and fourth quarters, the project was expected to concentrate on initiating and strengthening some new features which respond to the lessons learned in Phase I. Also an appropriate arrangement for other providers were considered to be included in the extension services to participate in extension dissemination activities, steps for great district focus, providing communication support, emphasizing farmers' group approach instead of individual contact, and further introducing additional means for enhancing farmer - extension - research linkages.

It is reported that the implementation of the 1996/97 extension programme has remained stagnant due to several factors, that is i) sporadic allocation of budget, ii) retrenchment exercise, iii) delay of deployment of staff to the districts and rural area (Annual Work Programme for 1997/98, Morogoro Region).

12 Monthly Training Sessions (MTSs) in Morogoro District were expected to be held for improvement and enhancement of knowledge and technique of DIVEOs and VEOs, as shown in Table 1.3.3, however one or two of MTSs was merely held in each District as shown in Table 1.3.4. While Bi-Monthly Workshops (BMWs) was held hardly once.

Aiming at increasing skills of VEOs concerning both livestock and crop production aspects, they have obligation to attend retraining programme. Currently, 131 of VEOs are available in 215 villages of the whole Morogoro District. Out of 131 VEOs, 57 VEOs attended retraining programme of crop production or livestock by 1996/97. Moreover, during this fiscal year of 1997/98, 45 VEOs are required to attend the programme. Remaining 29 VEOs would attend the programme in 1998/99 onward. Progress of the retraining programme in Morogoro Region by District is shown in Table 1.3.5.

(2) Extension Services in the Village Concerned

Agricultural supporting services in two villages such as Langali and Bumu are not so attractive, although extension services are disseminated to farmers concerned by means of adoption plots, regular training, etc. as shown in Figure 1.3.2.

In the villages concerned, there is some programme by means of management of adoption plots for livestock concerned and fishery. The main subjects are (i) training of farmers on animal feeds, (ii) poultry keeping, (iii) construction of animal houses, and (iv) disease control of animals. In Langali, there are six (6) groups for implementation of adoption plots, that is 2 group for pig, 2 groups for poultry, 1 group for fish, and 1 for improved goat. While in Bumu village, there is only one (1) group for piglets keeping for improvement of living standard of farmers.

VEOs have held monthly group meetings in both villages, in order to disseminate some information and knowledge concerning advanced farming techniques.

1.3.5 Marketing and Credits

(1) Marketing System of Agricultural Production

At present, the marketing of agricultural production is being done under a free market system. It means that there is no governmental intervention in the marketing process. Through this process, prices are set up freely.

The main crops in the Mgeta scheme are maize and horticultural products. Traders go to the villages and pick up the products already bagged or packed. The traders usually set up the price and the farmers usually have to accept them due to lack of market power. The traders take advantage of the lack of solidarity among the farmers to force them to accept their prices; the traders know that if a farmer does not accept the proposed price, there will be another farmer who will accept it. In Langali Village, the traders come to the village on market day when most of the farmers have brought their products for sale and propose to them to buy their products. Usually some refuse to sell at the traders' price but there are some farmers that will accept it. After these farmers accept, the others have no choice but to relent as they do not have other choice.

Prices vary depending of the sales' timing. At harvest time, prices are low, three months later they rise and reach a peak before the dry season.

Farmers also sell their products by themselves in Morogoro city market. This is not the norm, as most of the farmers around the Study Area prefer to have the traders take care of the commercialization of their products.

(2) Rural Credit

At present the two main banks operating in the Morogoro region, the National Bank of Commerce (NBC) and the CRDB (1996) Limited face restriction on agricultural loans' granting. However, both banks are not granting loans to small scale farmers within the scheme.

The NBC stopped granting soft loans due to the poor performance of the loans granted to small-scale farmers; the NBC is in the middle of a restructuring process which also creates uncertainty on the present and future policy to be adopted for loans to small-scale farmers.

The CRDB (1996) Limited started operations just in July 1996. It inherited the infrastructure of the old CRDB that went bankrupt opening the way for its privatization. At the beginning of its operations, the CRDB (1996) was ordered by the Bank of Tanzania not to grant new rural loans, but to only renew the old loans given by the old CRDB. It is only since April 1997 that it has started to grant new loans but mostly are commerce and services sectors' loans. The bank faces infrastructure and staff constraints which diffi-cult the approach to the farmers for credit promotion.

There are no stable or reliable credit sources available at the moment for the small-scale farmers. They must look for informal credit sources, like relatives, friends, etc.

1.4 Present Conditions of Irrigation Development

1.4.1 Existing Irrigation Scheme

Mgeta scheme consists of numerous small and micro scale traditional furrow systems with total irrigable area of 2,000 ha in gross. These are scattered all over the Uluguru mountains in Mgeta Division of Morogoro District. These irrigation furrows lie in steep

slope ranging from 10 % to 50 % and altitude ranging from 800 m to 2000 m above sea level. Of Mgeta scheme, an area of 220 ha located in the south-east of Langali settlement, belonging to the basins of Mzinga river, Lukundi river and Mindu river, all of which joins to Mgeta river was investigated in detail as the model area for development planning. The selected area lies in the range from 1,000 m to 1,600 m above sea level.

In this study area, 23 intakes are counted as shown in Figure 1.4.1. All the intakes are free flow type, which simply made with locally available materials such stones, soils, wood and weed except a few intakes, for which cement mortar or masonry works are partly utilized. As such, they are subject to repair or reconstruct every year in the beginning of dry season. The canals run either along contours and/or ridges. Total length of canals is about 10 km in the 220 ha (45 m/ha). The commanding area for each intake averages about 10 ha, of which irrigation area is about 6 ha on an average. All the canals are formed as earth canals without any related structures. These canals are, more or less, facing erosion problems.

In the rainy season little irrigation generally needs because of the abundant rainfall. At the beginning of the dry season, farmers re-construct the traditional intakes and reshape the canals and furrows, where those might be closed by siltation and eroded or washed away during the rainy season.

A major canal diverts water to terraced farm plots through small furrows (side ditches). It is often seen that water application is done by a person holding a bowl and repeatedly fetching water from the side ditch and splashing directly to the plant for about one to three throws depending on previous soil moisture condition. Once the first terrace is satisfied, the first inlet is closed and water is directed to flow to the second low-lying terrace. The same application method as for the first terrace is repeated in second terrace and sequent terraces.

Gully erosion hazard is observed in several parts where a canal runs along contours and water overflows the canal banks to steep slopes. The canal on the ridge lying between Mzinga and Lukundi rivers has been utilized for more than 70 years. Its bottom has been irregularly and deeply eroded with flow. A land sliding is also observed in several parts.

1.4.2 Access Road

There is a local trunk road diverging from the A-7 highway and going southward to Mgeta ward. The local trunk road is a laterite earthen road relatively maintained well, however, once entering into the mountainous area, rough rocky surfaces with deep erosion are observed at some points. There is also a very steep longitudinal slope with rough rocky surface just before the road crosses the Mgeta river.

1.5 Community Development and Activities

1.5.1 Organization of Village Community

The Mgeta scheme is located at two villages, Langali and Bumu. These villages have a well matured community with a good social norms of life. The population and household are shown below.

(As of September 1996)

Administrative Division	- District	Morogoro	
	- Division	Mgeta	
	- Ward	Langali	
	- Village	Langali	Bumu
Irrigation System		Mzinga System	Mindu System
Population		3,000 *1	1,400
Household		600 *1	290
Tribes		Luguru 100%	Luguru 100%
Village Extension Officer		1	1
Irrigation Technician		-	-
Eelectric Supply		-	-
Domestic Water Supply		Piped water/Canal/River	River/Canal
Fuel for Cooking		Fuel Wood	Fuel Wood
Others			Luga-Luga Group*2

*1 Estimated by Langali Ward Office.
*2 As of Oct. 1996. The cooperative has almost no activity at present.
Source: Source: Information and data obtained from ward executive officer, village executive officer, village extension officer and farmers.

The each village has an administrative organization which is organized as the smallest unit of the administrative structure. The organizational structure of this village government is shown in the figure in Sub-section 1.2.1 (2). Under a village council, the village government consists of a chairman, a village executive officer and several committees including a committee of defence and security, planning and financing committee, communal services committee, etc. Members of the council and the village chairman are elected by the village people. A village executive officer who is in charge of administrative work and has a relatively higher educational level, is employed after being selected from the village people.

1.5.2 Water Users' Group

Mgeta scheme which was selected as one of the priority projects covers two villages, Langali and Bumu. There are many small scale irrigation facilities in both villages, and all these facilities have a certain organization for operation and maintenance. These irrigation facilities had been constructed by the farmers since long time ago (before the independence), and farmers have a long experience for irrigation farming. Within the facilities investigated by the study team, the most oldest facility is in 1936 and the latest one is in 1996.

A water users' group (WUG)[1] has been organized by each intake weir or each branch canal base. The interview survey to farmers was carried out by the Survey Team in order to grasp the present condition of these WUGs, and the survey result is shown in Tables 1.5.1 and 1.5.2. The size of each WUG differs largely. The largest system is 130 farmers and the smallest one is only 4 farmers. These WUGs have very simple organizational structure. It is estimated that a half of WUGs has only one leader and no executive committee for O&M, and the remaining WUGs have no leader with loose organization. All these WUGs have no registration to the Government agencies, and has no water right.

WUGs in the villages are divided into two types from the standpoint of water distribution system; one is the WUGs having rotational irrigation system and another type is

[1] This report refers all of farmers' organizations or groups related to the operation and maintenance of irrigation facilities as "water users' group (WUG)." In Tanzania, such organizations are classified into two types; "Association" and "Cooperative", and the former is registered at the Ministry of Home Affairs and the latter is at MAC. "WUG" in this report has no relation with those organizations and it is one ad hoc technical term.

for non-rotational irrigation. In general, the former WUGs have a problem of water shortage, and the farmers have taken water in turn at 3- to 8-day intervals. In the latter WUGs, any farmer in WUG can take water at any time under traditional rule[2] with mutual consent of farmers. Irrigating period is decided by the farmers themselves depending on the farm size and available water. For both types, irrigation has been carried out in the daytime, but in case of water shortage, farmers takes water in the nighttime.

In most cases, maintenance of facilities is done by the farmers' communal work. If farmers do not join to the work, WUG punishes absentees with a fine. No irrigation service charge is common among WUGs, and if WUG requires some funds for repairing of facilities, they collect contributions from the farmers.

There are some water dispute among the farmers and between WUGs, but these are not so serious problems, and all those have been settled by the farmers themselves. Common problems shown among WUGs are as follows:

- Water shortage in the dry season
- Slashing out of intake weir due to flood water
- Damage of canal embankment and soil erosion due to over flow
- Water leakage

In the proposed rehabilitation plan, two existing irrigation systems will be selected as pilot project. One is Mzinga canal in Langali village and the other is Mindu canal in Bumu village. The present condition of these existing WUGs are shown below.

	Mzinga System (Langali Village)	Mindu System (Bumu Village)
Year constructed	*	1970
No. of farmers	60	46
Irrigation area (gross) (ha)	22	25
Organization of WUG	WUG has only one leader, and no executive committee.	
Irrigation period	May - November	
Water allocation	No fixed schedule. Farmers can take water at any time under traditional rule.	
Maintenance	Communal work	
Irrigation service charge	No irrigation service charge	
Water dispute	- Some water dispute among the farmers in the dry season. - Not so serious problem, and settled by farmers themselves.	
Articles and by-law	Non	Non
Registration of WUG	Non	Non
Water right	Non	Non
Problems	- Water shortage in the dry season - Slashing out of intake weir - Erosion due to over flow. - Leakage of water	
Remarks	Farmers have a long experience on O&M of irrigation facilities, and almost no institutional problem is shown in both WUG.	

* No data is available. The irrigation facilities in this system have been constructed by the farmers long ago, and they have a long experience for irrigation farming as well as Mindu farmers.

2 A farmer who takes water puts stones or sticks at its intake. Other farmers should take water from its downstream, and can not take water from its upstream.

1.5.3 Farmers' Co-operatives Society

There is one Cooperative Society which covers Langali and Bunduki Wards. It is Twalangize Cooperative Society which has handled mainly cooperative shipping of coffee. The membership of Twalangize is less than 300 farmers, and its management area covers many villages in Langali and Bunduki Wards. It seems that its service area is too large relative to their management capability, because they do not have transportation and communication facilities such as lorries and telephone.

Schemes	Villages	Population	No. of Coop.	Year established	No. of farmer	Remarks
Twalangize Coop.			1	1995		Twalangize Cooperative covers
	Langali	3,000			n.a.	Langali and Bunduki wards.
	Bumu	1,400			n.a.	Marketing of coffee

Source: Information and data obtained from ward executive officer, village executive officer, village extension officer and farmers.

The Cooperative has been registered as authorized organizations under the Cooperative Act. No.15, 1991. The members who benefit from the Cooperatives are mainly coffee cultivators.

1.5.4 Other Societies

In Bumu village, there is one farmers' group which consists of 12 male farmers and 8 female farmers. Main activities of this group are for business of farm products, farm inputs, living goods, etc. According to the village chairman in Langali village, one women's group was organized, but it has no activity at present. Any other farmers' group and society are found in Langali and Bumu villages.

1.5.5 Role of Women and Gender Groups in Farming and Community Activities

The table below shows the everyday and farming activities that women carry out in the villages:

		Mgeta
(1) Role of women in farming		
- Land preparation		Both
- Seeding		Both
- Transplanting		Both
- Weeding		Both
- Fertilizing		Both
- Spraying of chemicals		Both
- Irrigating		Both
- Drying/bagging of products		Male
- Harvesting		Both
(Heavy work)		(Male)
- Selling of products		Male
(2) Transportation of water		Female
- Distance	(km)	0.5
- Frequency	(times/day)	3
(3) Collecting of fuel food		Female
- Distance	(hrs.)	*
- Frequency	(times/week)	*

Source: Interview survey to farmers, village executive officers and village extension officers.

In most cases, transportation of water and collecting of fuel wood are entrusted to

women, while land clearing and spraying of chemical are carried out by men. Other farm works are done by both men and women. It may be said that women play an important role in farming and everyday activities.

1.6 Assessment of Environmental Aspects

1.6.1 Natural Environment

(1) Water Resources and Water Quality

A number of rivers and streams are found within Mgeta scheme. The rivers and streams are descending with narrow valleys having rocky river beds. All of the villagers in Mgeta scheme, who are in mountainous areas use surface water from streams. As the results of the field survey, no constraint of water quality is found for drinking purpose except long distance to water resources.

(2) Vegetation

Vegetation in Mgeta scheme could be classified as Forest, Woodland[closed]. Cultivated lands and Bushland also cover some of land within the proposed scheme areas. Woodland and Wooded Grassland could be commonly found in the surroundings, having rolling to hilly terrain, of villages in Mgeta scheme.

(3) Wildlife

The wildlife is dominated as "generalist." They are mainly vermin species i.e. baboons, monkeys, wild pigs, and birds. The "specialist" in species is not founded in the scheme area.

1.6.2 Socio-economic Environment

(1) Poverty

At the present, according to the Morogoro Regional Planning Office (MRPO), the poverty line for the region is of an annual Tsh.37, 500 per capita (US$63). This would mean a poverty line equivalent to Tsh. 262,395 for a household of seven members. This level is even below the national poverty line of annual Tsh. 65,500 per capita (US$110) and less than half of the GDP per capita Tsh.93, 534 (US$157)

The results of the field survey and farm economy analysis indicate that the net income for a typical household in the Mgeta scheme owning 0.30 ha is Tsh.297, 000. Based on this figure, it would be possible to say that the typical household in this area is very close to the poverty line at the national level (Tsh.458,500 for a household with 7 members).

As far as environmental aspect in Mgeta Scheme Area is concerned, it is observed that an existence of such large number of poor farmers have environmental consequences not only disruption of the natural environment, but in fact, encourage to any social conflicts.

(2) Major Diseases

As summarized in the following table, it is obvious that the health service facilities

in the Mgeta area fall short of WHO recommended minimum requirement sets.

Health Service Facilities and Medical Staff in this Scheme Area

VILLAGE	Langali
HEALTH UNIT	Mgeta Health Center
Clinical Officer	2 persons
Assistant Clinical Officer	1 person
Health Assistant	1 person
Public Health Nurse "B"	1 person
Laboratory Auxiliary	1 person
Nurse Auxiliary	6 persons
Nurse Attendant	1 person

Under the said health-environment in this scheme area, a high morbidity has been reported by the concerned village dispensary. The following Table shows an estimated morbidity in the villages in this scheme are.

Morbidity by Population in the Villages

Village	Langali
Total Population (persons)	1,684
Disease incidence (cases)	8,270
Morbidity (% to population)	491

Out of the total cases of the diseases morbidity, "Malaria" is the endemic disease, and the most hazardous in this scheme area. An morbidity of malaria shows 49.7% of the total disease incidence cases in this scheme area. Other than malaria, it is also identified that the water-borne diseases, i.e. "Intestinal Diseases", "Diarrhoea Diseases", "Bilharzia Schistosomiasis" are also a risky endemic diseases in this scheme area. Besides, it is also remarkable that the water-related endemic diseases, i.e. "Upper Respiratory Tract Infection (URTI)", "Pneumonia", "Skin Diseases", "Eye Diseases" also share a large part of the total incidence of diseases. A morbidity of all these endemic diseases is come up more than 94% of the total diseases incidence cases Major diseases influenced in this scheme area, and those incidence cases as in 1995/96 are summarized below:

Major Diseases and Incidence Cases by Scheme Area

Major Diseases	Cases	Rate
Water-borne Diseases:		
Malaria	472	49.7
Diarrhoea Diseases		5.4
Intestinal Diseases	330	3.8
Schstosomiasis	16	0.2
(Sub-total)	5,180	59.1
Water related Disease:		
URTI	1,634	18.6
Pneumonia	926	10.6
Skin Diseases	299	3.4
Eye Diseases	247	2.8
(sub-total)	3,106	35.4
Other Diseases		
Ear Diseases	108	1.2
Anaemia	113	1.3
Gonorrhea	33	0.4
Mental Diseases	188	2.1
Nutritional Disorder	10	0.1
Accident & Wounds	36	0.4
Total	8,774	100.0

1.6.3 On-going Actions/Program of the Environmental Conservation

A few programs for environmental conservation have been conducted and attempted to contribute towards attainment of an integrated sustainable development of agriculture activities through coordinated efforts in the field and to alleviate environmental problems in the Area. Particularly, TIP Program, Integrated Sustainable Agricultural Program in Mgeta area are considered as important components of the actions for the environmental conservation.

1.6.4 Environmental Problems

Considering the present environmental conditions in the Study Area mentioned above, the following overall environmental problems could be listed, as a results of the determinable impacts of this trend.

- Deforestation due to fuel-wood collection, fire and clearance for shifting cultivation and grazing area expansion, clearance for tse-tse fly control etc.
- Pressure on the natural resources generated by farmers due to a steady rising of population
- Pressure to grazing land through alienation and conversion to agricultural land and expansion of settlements
- Trends in diseases and poor sanitary conditions in the Area
- Poor drainage and wet conditions during rainy season
- Sewage discharge from agricultural and rural activities
- Non-legal village demarcation and securing right of land tenure

CHAPTER II. DEVELOPMENT POTENTIAL AND CONSTRAINTS

2.1 Potential for Irrigated Agricultural Development

2.1.1 Land Resources

The land suitability classification for assessment, and then, demarcation of irrigable area was made according to the specific criteria which has been prepared during the master planning stage in 1996 with reference to the "Guidelines: Land Evaluation for Irrigated Agriculture" published by FAO (1985) and the Tanzanian system for paddy irrigation as well as taking into account the land, soil and agricultural conditions in the Central Wami River Basin.

The specific criteria for land classification has been established according to the technical requirements and/or limitations to irrigation development or irrigated farming. The rating parameters are set up according to the four major factors, i.e. agronomic aspect (A), farm management aspects (M); future land development aspects (D); and environmental conservation aspects (E). The climatic and socio-economic factors are not considered herein the rating parameters. Consequently, eleven elemental factors are examined as the essential parameters for rating the land suitability classes. The specific criteria for assessment of the land suitability for both irrigated paddy and upland crop cultivation is as shown in Table 2.1.1. As for the land suitability assessment for irrigated upland farming, maize and vegetables (onion and tomato) are primary taken up as the key crops.

Rating Factors for Irrigation Suitability Assessment

[A]	Agronomic Factors	
	(r) Conditions of rooting zone:	Soil texture, effective soil depth, drainability, percolation, and water holding capacity.
	(n) Soil nutrients:	Organic carbon, total nitrogen, available phosphate, CEC, exchangeable potassium, total cation, and micro nutrients.
	(t) Soil toxicity:	EC, sodium absorption ratio, pH, and other toxicity.
	(f) Flooding risk:	flooding frequency and inundated period.
[M]	Management Factors	
	(a) Accessibility to farm:	Distance from village and farm road condition.
	(w) On-farm workability:	Slope, micro-relief, stones/rocks, soil consistence, farm size, and easiness of irrigation management.
[D]	Land Development Factors (in the future development)	
	(l) Grading/leveling and ridging:	Grading/leveling, ridging, land consolidation, and clearing.
	(d) Drainage, flood protection:	Drainage and flood protection.
[E]	Conservation and Environmental Factors	
	(s) Long-term Prevention of salinity:	Salinity/sodicity prevention.
	(h) Prevention of groundwater and surface water:	Groundwater, surface water, watershed conservation of upstream.
	(e) Soil erosion:	Occurrences of erosion and requirement of erosion control.

There after examination of all the elemental factors, the following "land suitability classes" and/or "sub-classes" are applied to the final judgment of land suitability for irrigation development both for paddy and upland crop production.

Land Suitability Classes and Sub-classes

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

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

According to the above land suitability assessment, the land in the scheme area is classified as shown in Table below. Distribution of the land suitability classes is illustrated as shown in Drawing No. 203 in Drawings.

Land Class by Irrigation Suitability in Mgeta Scheme Area

Soil Unit	Land Class	Sub-class	[A]				[M]		[D]		[E]			Area
			(r)	(n)	(t)	(f)	(a)	(w)	(l)	(d)	(s)	(h)	(e)	(ha)
	(For Paddy Cultivation)													
Mgt-1	NR	NRe	3	2	1	1	3	3	3	1	1	2	4	140
Mgt-2a	NR	NRrwe	4	2	1	1	3	4	3	1	1	2	4	40
Mgt-2b	NR	NRrwle	4	2	1	1	3	4	4	1	1	2	4	40
(Total)	SR1: 0 ha, SR2: 0 ha, SR3: 0 ha, NR: 220 ha													220
	(For Upland Crop Cultivation)													
Mgt-1	SU3	SU3awe	2	2	1	1	3	3	2	1	1	2	3	140
Mgt-2a	SU3	SU3rawle	3	2	1	1	3	3	3	1	1	2	3	40
Mgt-2b	NU	NUrwle	4	3	1	1	3	4	4	1	1	2	4	40
(Total)	SU1: 0 ha, SU2: 0 ha, SU3: 180 ha, NU: 40 ha													220

The land of Mgeta scheme is entirely not acceptable for paddy cultivation (NR) due to serious limitation to both soil and topographic conditions, i.e. low water retaining capacity (high percolation), soil erosion cum land slide risks due to extremely steep slope.

As for upland crop production, the land of the soil units Mgt-1 and Mgt-2a where land slope is less than 40% (total 180 ha in gross), is assessed as marginally suitable (SU3). Precise management of irrigation-cum-drainage work is essential and crucial so as to maintain terraced field against soil erosion and land sliding. The land of the soil unit Mgt-2b (40 ha in gross) where the land slope is more than 40% is not recommendable (NU) for any crop production from both technical and economic points of view. The land is strictly subject to protection/conservation against serious soil erosion and land slide hazards.

2.1.2 Water Resources

The Mgeta scheme depends on irrigation water on numerous small streams of the Mgeta river. As a whole the water resources are judged to be sufficient considering plenty of water in the Mgeta river, however, the intake facilities are very poor and water can not be efficiently diverted in most of intakes.

2.1.3 Human Resources

Farming activities by a household are carried out by the husband and wife and supported by all young members above 15 years old. The available family force carries

out most of the farm.

The Table below gives information on total population, number of households, average household size, average holding size, and working population for Mgeta scheme.

Demographic Data for the Whole Scheme

Scheme	Total Population	No. of Households	Average Household Size	Average Holding Size per Household (ha)	Working Population
Mgeta	29,354	5,871	5	0.8	13,503

Based on the figures shown above it would be possible labor force availability may not be a problem when implementing the irrigation project. However, it will be necessary that in order to promote farming and/or crop diversification under the condition with the proposed irrigation development, the youth must be organized into working groups either in-household or in-community in the scheme.

The limited land together with the population growth faced by Mgeta Scheme will push the inhabitants in the future to look for another lands. The Mkula plain is one of the available alternatives for the young population in search of new lands.

It is also essential to up-grade the quality and/or skillfulness of the labor force to accomplish the sustainable irrigation-based agricultural production. At present, there is access to primary schools located in or near the villages. However, the physical conditions are usually not the best and there is a notorious lack of teaching materials. This in turn affects the level and quality of education received by the students.

If a student proceeds to secondary school, usually it is not near the village and must live outside the village. In case that the student finishes primary school and wants to receive basic technical education but not to go to formal secondary school, at present there is no possibility, unless he or she goes outside the village. Lack of basic training facilities is a big constraint for the technical education of young people who want to receive it.

On the other hand, farmers also need to be advised on cultivation techniques and systems and the extension officers must play that advisory. However, it has been found that most extension officers do not have adequate working conditions or training leading to an unsatisfactory performance from the point of view of the farmers.

The government should make efforts to provide facilities for basic technical education for the youth and improve the technical level of the extension officers.

2.2 Problems and Constraints to Irrigated Agriculture Development

2.2.1 Social and Institutional Aspects

The farmers in Langali and Bumu villages have a long experience of irrigation farming, and they have operated and maintained their facilities during the long period over 40 years. Although there are some water disputes among the farmers in a WUG and between WUGs, all those are settled by farmers themselves. It can be said that no institutional problems are shown in their WUGs themselves. The farmers in both villages have however various problems such as water leakage, poor supply system of farm inputs, luck of agricultural credit services, etc. without institutional matters. Therefore, it is expected that these WUGs should play more important role to solve them.

2.2.2 Financial Aspects

(1) Poverty

At present, according to the Morogoro Regional Planning Office (MRPO), the poverty line for the region is of an annual Tsh.37,500 per capita (US$63). This would mean a poverty line equivalent to Tsh.262,395 for a household of seven members. This level is even below the national poverty line of annual Tsh.65,500 per capita (US$110) and less than half of the GDP per capita Tsh.93,534 (US$157).

The results of the field survey and farm economy analysis indicate that the net income for a typical household in the Mgeta Scheme owning 0.30 ha is Tsh.297,000. Based on this figure, it would be possible to say that the typical household in this area is very close to the poverty line at the regional level and quite below the poverty line at the national level (Tsh.458,500 for a household with 7 members).

(2) Difficulties for Credit Access

The farmers face the following problems related to rural credit:

(a) Small-scale farmers can not easily access formal credit sources as they lack adequate financial and physical collateral acceptable to those sources;
(b) Lack of awareness of the existence of such formal sources or lack of understanding of the procedures to access credit;
(c) Lack of financial institutions near the village. The farmers usually have to travel to big urban centers to find a bank or credit institution;
(d) Lack of an effective agricultural promotion credit policy. The gov-ernment policy is to encourage the farmers to develop agriculture by them-selves but the lack of a public financial support does not allow them to be provided with adequate and enough financial resources.

(3) Lack of Joint Communal Efforts to Generate Funds

The farmers are not inclined, due to bad experiences in the past with organized groups, to create organized groups for the specific purpose of raising or generating funds. Behind this problem is the fact that leadership is lacking for the promotion of organized efforts for the raising funds among the farmers themselves.

2.2.3 Technical Aspects

(1) Constraints and Problems in Agricultural Activities

1) Shortage of Certified Seeds

Regarding such food crops as maize, pulse crops, etc., farmers in the Project area select the seeds from their own farms by themselves, in order to secure seeds for the following cropping season. Purchase of certified seeds for those crops are not common. The reason is explained that the price of certified seeds is expensive for them and further supplied amount of certified seeds is not sufficient.

For Irish potatoes, some farmers get normal potatoes locally in the village market, while some farmers buy them from the market of Morogoro town and hence adopt them as seed potatoes. That is, potatoes which are harvested in the farmer's field are not stored as seed potatoes for the following cropping

season, farmers sale or consume all potatoes which are harvested. As a result, normal potatoes which are available in the market are applied as seed potatoes. Furthermore, even if potatoes are harvested and stored, seed potatoes put up the shoots before sowing season due to poor storage skill. Potatoes in the town market are not specific for seeds and hence farmers have been bringing diseases.

2) Club Root Disease of Cabbage

Cabbage cultivation has a long history, or more than 30 years in the project area. Since 1993/94 or thereabouts, reports on "Club Root" disease (*Plasmodiophora Brassicae*), which is a fungus disease, has been occurred in Langali village. According to the report of extension office in Langali village, this disease has been spread in Langali, Pindi, and Kibaoni villages. Especially, damage in Langali village is remarkably serious. While no symptom have been developed in some villages of Nyandila, Chenzema, etc.

Regarding affected cabbages by this disease, above ground parts show wilting yellowing symptom. The affected roots become large spindle shaped galls. This fungus is soil borne and persists in soil at least 7 years. Soil pH of less than 7.2 favours disease development. According to the infection of this disease, farmers have been compelled to change other crops instead of cabbage during dry season or surrender the agricultural activities.

Due to the tendency of this disease to appear in acid soils, it could be checked relatively by the addition of a heavy dressing of lime, that is up to four tons per acre, which should be applied before planting the crop preceding susceptible one. As a high water content of the soil is necessary for infection of this disease, crop should be grown on well drained land. Rotational cropping is also a kind of countermeasure, that is potato, lettuce, etc. which are not cruciferous crops, should be incorporated with the combination of rotational cultivation.

3) Soil Erosion in the Terrace Culture

Although extension services have been instructed to emphasize the importance of soil conservation, some farmers are not aware of disadvantage of soil erosion. That is, there are some cases which irrigation is drained through terraces, but not through channel. Also slope of the terraces are scrapped off and reshaped every cropping season. Further weeds which have been covering land surface are uprooted and land surface is uncovered by anything except planted crops.

4) Deterioration of Soil Fertility

As mentioned in Section 2.1.4 Soil and Vegetation, dominant soil type of Eutric Cambisols is formulated by tuff which is not so fertile and moderately permeable. This soil flows out minerals in the process of weathering and contribute the crop production temporarily. However, if there is no additional supply of nutrition, its soil fertility will be deteriorated. In the project area, as chemical fertilizer and organic matter is hardly supplied under the existing crop cultivation, soil fertility has kept on decreasing.

5) Lack of Knowledge on Proper Farming Practices

Farmers have cultivated such major crops as cabbage, potato, maize, pulse crops, etc. based on their knowledge which have been accumulated from their long experience. That is, their technique on farming practices has not been improved for many years and advanced knowledge has not been disseminated

to farmers concerned. Actually, they have noticed importance of improvement of current farming practices, but they do not have any useful information how farming practices will be improved. For instance, they are aware of the importance of application of fertilizer and agro-chemicals in order to improve crop productivity, however they do not have neither knowledge nor information how much of fertilizer and agro-chemicals is proper amount and which stage is proper timing for application.

Some farmers have cultivated such pulse crops of pole climbing type. However, they have not applied any poles or sticks to sustain the plant itself. In this case, they explain that no blanches of trees to be adopted as a pole are available in and around the village. However, they are not aware that branch is not a only measure to be adopted, but also maize stalks, stems of pigeon pea, etc. are also acceptable as a pole.

(2) Problems and constraints from irrigation and drainage points of view

Major problems in the existing scheme are soil erosion in canal wetted perimeters and soil erosion and land sliding on the steep slopes caused by rainfall and irrigation water.

CHAPTER III. DEVELOPMENT PLAN ON IRRIGATION-BASED AGRICULTURE

3.1 Development Policy and Needs

3.1.1 Political Needs for Smallholder Irrigation Development

GOT has put the highest priority on the agricultural sector development with particular emphasis on attainment of the following objectives as the primary but the most important issues for implementing the current socio-economic development program.

1) To satisfy subsistence requirement in a large part of the country,

2) To generate the local surpluses of main staple food production, especially maize and rice, in order to facilitate food security either at the villages as well as regional or national levels, and

3) To ensure the production to be much needed for dietary supplement, i.e. vegetables, fruit, oil seeds, etc.

Then, to materialize the above policy objectives, GOT has first launched the irrigation-based agricultural development in line of the strategic framework with emphasizing on "rehabilitation or up-grading of the traditional irrigation schemes" and "up-grading traditional water harvesting technology." To this concern, GOT highly expected that the maximum impact will have to be brought by irrigation beneficiaries themselves, who shall aggressively participate in the above mentioned irrigation development based on a sense of participatory approach.

3.1.2 Development Needs and Wishes of Irrigation Beneficiaries

The development needs and wishes of irrigation beneficiaries are identified through on-field guidance to and technical discussion with the farmers in Mgeta scheme area, and confirmed through the public meeting held with all the irrigation beneficiaries.

All the farmers benefited from the existing irrigation systems attach the highest priority on "rehabilitation-cum-improvement of the irrigation facilities", and then, "expansion of irrigable land" as much as water resources are become available. Concerning the above two points, farmers emphasis on the following assistance for efficient operation and management of the irrigation facilities as well as irrigated farming:

1) Irrigation Development:

- Provision of a concrete intake weir with gate structure so far as to properly manage water diversion as well as to mitigate the costs and/or burden which has been spent for renewal of the traditional-type intake weir every year.
  If possible, provision of dam/reservoir for maintaining stable supply of irrigation water in the critical drought season of September and October.
- Provision of movable pipe-line system.
- Provision of the basins in canal system for utilization of domestic water.
- Technical assistance for improvement of the irrigation and drainage facilities at the on-farm level as well as guidance for improvement of the irrigation technology for efficient utilization of the water resources.

2) Agricultural Development:

- Steady-cum-timely supply of farm inputs, i.e. qualified seeds, safety-cum-effective agro-chemicals, etc.
- Adjustment of the prices on farm inputs, farming implements and tools, and agri-cultural production.
- Assistance for introduction of more effective farm machinery and implements, i.e. tractor, thresher, sprayer, light-carrier, etc.
- Provision of an intensive guidance especially on improvement of agricultural technology, i.e. irrigation-based farming practices, weeding as well as pests and diseases control, soil fertilization practices, etc.
- Provision of guidance for crop diversification with particular emphasis on economic crops as well as information on agricultural production markets.

3) Institutional Supporting Services:

- Provision of more opportunity for women's participation to any project activities.
- Extend financial assistance to women's groups for activating their income generation.
- Provision of technical training programs, including study tour not only for men's groups but also women's groups
- Activation of the agricultural extension services, including demonstration of irrigation-based farming technology.
- Provision of technical training courses especially those related to technology for irrigation-based agricultural production as well as operation and maintenance (O&M) of irrigation facilities through rehabilitation-cum-reinforcement of the existing farmer's training centers.
- Provision of guidance for reinforcement of the existing water users' groups and then step forward organization of the water users' cooperatives.
- Provision of opportunities for access to credit services, satisfactorily and successfully.

4) Supporting Infrastructure for Irrigation-based Agricultural Development:

- Rehabilitation or renewal of facilities to be used for community activities.
- If possible, provision of micro-hydropower generation system.

3.2 Basic Approach to the Project

3.2.1 Fundamental Objectives of the Project

The agriculture in Tanzania continues to play the most important role for maintaining the national economy. However, it has a delicate structure for production against the physical constraints, and improvement of its productive conditions is still at the primary level. Accordingly, to sufficiently support the national food security conditions as well as satisfactorily maintain the foreign trade balance, further expansion and stabilization of the agricultural production are essential and the primary subject of the agricultural sector.

Mgeta scheme is an unusual case in the irrigated agriculture development, not only for the Wami River Basin but also for Morogoro region. The traditional furrow system was developed in the extremely steep-sloped land since long time ago with production of maize as the staple food and high-valued economic crops, i.e., vegetables and fruits in the smallholder farming. However, the agricultural production per farm household is still at a subsistence level. A limited arable land due to narrow and steep slopes in the mountain ranges is one of the critical constraints in this scheme area. Besides, a fragmentation of the

land titles to a petty farming sizes through recent generation changes make farmers difficult to improve the farm economy and getting out a rural poverty.

Dealing with the present agricultural conditions of the scheme area and then to respond to the national needs on the agricultural sector development, the following three points have set up as the basic objectives for the subjected irrigation-based agricultural development in Mgeta scheme:

1) To up-lift income level of the smallholder farmers to get out a rural poverty and step forward socio-economic activities in the rural area,

2) To ensure sustainable agricultural development, and then,

3) To contribute to a national food security through increasing staple food production.

3.2.2 Strategy and Development Framework

To successfully accomplish the above objectives, the following programs have been taken up as the strategic approach to development of the scheme.

1) Rehabilitation and/or improvement of the existing traditional irrigation systems and expansion of an irrigable land as much as water resources are available.

   Development goal expected by both government and beneficiary farmers is primary to increase and stabilize the staple food production through ensuring a supplementary irrigation to the rainy season cropping, and to improve an agricultural productivity as well as to generate farm economy by promotion of an intensification-cum-diversification of the crop production in the dry season, and consequently, maintain a sustainable irrigation-based agricultural development in the respective scheme areas.

   For accelerating further increment and stabilization of the agricultural production, and hence, maintaining a sustainable development of farm economy in smallholder farming, a consolidation of the existing irrigation system is the basic subject in this scheme. This is also effective to conserve such delicate environment as friable soil in steep slopes against soil erosion and land sliding hazards.

2) Intensification-cum-diversification of agricultural production through on-farm development.

   As stated in the preceding Section 1.3.1 of Chapter I, almost all of the arable land has been reclaimed up to date. Thus, an increment of irrigable land could be expected only 8 ha in case of the model development schemes even though an optimum use of available water resources is practiced under the conditions with improvement of the existing intake weir and canal system. This mean that the average farming size per household will remain as small at less than one acre (0.4 ha). To generate farm income of such smallholder farmers more than that at the present poverty line, therefore, it is crucial and essentially needed to promote an intensification and diversification of crop production.

   To achieve the above goal, an extension of irrigation as well as irrigated farming technology to the farmers is indispensable, accordingly, through reinforcement of the respective institutions.

3) Community development especially reinforcement of the existing farmers' organization, i.e. the water users' groups (WUG).

Institutional organization of farmers into the formal cooperatives society will much be effective not only for regularization of communal activities, mitigation of social conflicts, access to the group loan in the national credit facilities but also for empowerment of the cooperative members in marketing of both farm inputs and production. Thus, herein the Project, a community development especially reinforcement of the existing farmers' organization, i.e. the "Water Users' Groups (WUG)" in the scheme area is one of the essential program for accomplishment of the above tasks of the beneficiary farmers. The organization of the cooperative societies will also bring various job opportunities for participation of those women in the rural area.

4) Social and/or agro-forestry approach to the environmental protection-cum-conservation

As have been stated in the previous Section 1.6 of Chapter I herein above, degradation of the natural vegetation and/or exhaustion of forest resources are ex-tending to a hazardous extent in and around the scheme area due to a heavy population pressure to the land inclusive of those resources. A social and/or agro-forestation approach will highly be effective to maintain, and then, recover the said resources if the present on-going afforestation programs are scheduled in combined with the proposed land use plan prepared hereby.

To formulate the development plan and make preliminary design of this scheme, it is to emphasize that "farmers participatory approach to the Project", "reinforcement of women, youth and gender groups in the development" and "environment-friendly development" shall be the basic concept so as to maintain a sustainable development of this Project.

3.2.3 Basic Issue for Environmental Protection and Conservation

The development plans mentioned above aim at attainment of food crop production increase for the national self-sufficiency and promotion of crop diversification cum intensification for stabilization and up-grading of the farm economy through consolidation of the agricultural land particularly with emphasis on rehabilitation and/or improvement of the traditional smallholder irrigation furrow systems. The environmental impact assessment (EIA) made herein the feasibility study revealed that the following 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", "unconsolidated rural sanitation facilities", etc. Among those negative impacts, the following environmental aspects shall be carefully taken into consideration when the proposed development plan will be implemented hereafter.

1) Direct Environmental Impacts

Agro-chemical Impacts and Water Contamination

Utilization of chemical fertilizers and agro-chemicals for maintaining the agricultural production at a high level would cause water contamination as well as accumulation of toxic elements into the water in the scheme areas. 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. In case of the implementation of this project, however, it is foreseeable that the said negative

impacts might not so seriously extend to the surrounding area because the proposed schemes are at small scale. However, special attention should be paid to the fact that the toxic chemical elements will surely be accumulated to a certain extent if the agro-chemicals are not utilized properly.

2) Indirect Environmental Impacts

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 upgraded, 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 collection. Thus, in the land use planning, it shall pay special attention to allocate certain land for afforestation of the fuel wood.

3.3 Land Use and Agricultural Production Plan

3.3.1 Land Use Plan

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

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

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

Proposed Land Use of Mgeta Scheme

(Unit : ha)

Land Use Type	Present	Proposed	Remarks
Upland field	140	140	
Grassland	45	45	the land should be subject to afforestation
Forest/Wood lands	30	30	
Settlement/Right of ways	5	5	canals, roads/footpaths, residential yards
Total	220	220	

Practically, no change of land use is expected in this scheme area. To continuously cultivate the present farm plots, efficiently, and to maintain sustainable crop production to an economical extent, conservation of soils in the terraced plots is essential and crucial. The land lain waste from the previous cultivation should be subject to afforestation so as to conserve those lands against serious soil erosion and land slide hazards and maintain natural environment in this area. Particular attention shall be paid to the facts that the land having steep slopes more than 40% is always affected by so serious soil erosion and land slide problems, and accordingly, an economical crop production is never foreseeable. Therefore, the said land should not be utilized for terraced field, and maintain the vegetation by means of afforestation practices.

3.3.2 Selection of Proposed Crops

(1) Group Discussion with Farmers concerning Agricultural Development Plan

In the course of the field study in the Master Plan level which was conducted in Phase-1 last year, farmers' needs, conception, complains, etc. was revealed to some extent and recognized by the Study Team. Considering the information which were collected, the agricultural development plans for the proposed 16 irrigation schemes were individually formulated in the Master Plan.

In Phase-3 for the Feasibility Study, the Study Team tried to identify what the farmers really desired to do in the future development, reach a consenesus with farmers, and encourage them to participate in the development project.

The Study Team arranged several group discussions with various type of such villagers as female farmers, male farmers, key persons in the village community as shown in Table 3.3.1. A variety of opinions, conceptions, complains, requests, etc. were emerged in the discussions with farmers. It is indispensable to provide opportunities which villagers speak their minds, opinions, etc. freely. The Study Team carefully arranged such group discussions with various type of villagers so that each attandants could open his / her mind and manifest his / her opinion.

Major topics in group discussions concerning agricultural development in Mgeta scheme are summarized as follows;

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

(2) Selection of Proposed Crops

The following points are confirmed to select the proposed crops for the Project area through a series of group discussions in the field work of the Feasibility Study.

1) To be major crops which are proposed in the National Agricultural Development Plan

   In the National Agricultural Development Plan, increment of food crop production has been proposed, especially maize and paddy. Furthermore, the plan has proposed to increase rice production to 800,000 tons by the year of 2000.

2) To be relatively familiar to the farmers as well as extension officers concerned

   Proposed crops and its farming practice should be acceptable to the farmers and extension officers. Even if the crops are more beneficial, it is not recommendable to propose the crops which are not familiar with them.

3) To be acceptable to the farmers in the view of farming practices

   Utilization of farm machinery is not common in the Project area, while proper farming technology is also hardly disseminated. Accordingly, it is not practicable to rapidly introduce new crops for which modernized or advanced farming practice is indispensable.

4) To consider the preferable crops of farmers in the Project area

In order to confirm the preference concerning promising crops of the beneficiaries, group discussion was conducted.

5) To effectively use water resources

Water resources should be effectively allocated for the Project. In view of effective water use, it is required to select the promising crops.

6) To contribute maximum benefit to the farmers in the Project area

Project implementation will contribute in benefiting the farmers directly. Their living standard and nutritious condition will be improved through the project implementation. Accordingly, irrigable land in the Project area should be utilized at its maximum.

Based on the consideration for the points mentioned above, the development plan in this scheme will aim at keeping up increment of sustainable production of maize as food crop as well as such cash crops as cabbage, potatoes, pulse crops, and other various vegetables.

3.3.3 Proposed Cropping Pattern and Cultivated Area

(1) Proposed Cropping Pattern

In preparing the proposed cropping pattern for the Project area, the following points, which were considered through the Master Plan study, were confirmed in the course of a variety of group discussions which was conducted in the field work of the Feasibility Study.

1) To minimize the crop water requirement

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

2) To consider the existing cropping pattern

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

3) To maximize utilization of irrigation water and the cropping intensity

Effective use of irrigation water is strongly required in order to utilize the limited water resources and extend the irrigation area maximally. Furthermore, cropping intensity is proposed to intensify up to 200 %, aiming at future sustainable prosecution of proposed farming practices. High cropping intensity of over 200 % is not practicable in the Project area, from the view point of occurrence of insects and diseases, farmer's familiarity, labour productivity, and water management, etc.

The proposed cropping patterns which are illustrated in Figure 1.3.1 considerably meet all these requirements and conditions mentioned above.

(2) Cultivated Area and Cropping Intensity

After rehabilitation of irrigation system, supplemental irrigation in rainy season will be ensured, while irrigation efficiency in dry season will be improved. The expansion of irrigated cultivation will be realized. On the other, it is assumed that future situation without project is almost same as the present situation, because the irrigation facilities will not be rehabilitated.

Cultivated area by crop and cropping intensity without and with project conditions is shown as follows;

Cultivated Area and Cropping Intensity in Mgeta Scheme

	Without Project Condition				With Project Condition			
	Project Area (ha)	Cultivated Area		Cropping Intensity (%)	Project Area (ha)	Cultivated Area		Cropping Intensity (%)
		RS	DS			RS	DS	
Mgeta								
Maize/Pulse*1		30	0			30	0	
Cabbage		0	6			0	6	
Potato		0	3			0	3	
Pulse		0	9			0	21	
Total	30	30	18	159	30	30	30	200

RS : Rainy season, DS : Dry season
*1 : Maize is a predominant crop.
Without-Project Condition is the same condition as the present one.

3.3.4 Proposed Farming Practices

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

It is not practical to recommend ideal farming practices which are entirely different from the prevailing farming practices. Each component of proposed farming practices should be formulated considering the prevailing situation on availability of machinery and animal power, labour requirement, etc., considering the guideline on farming practices which are proposed by the extension office. Furthermore, it is necessary to improve extensive cultivation and disseminate practical farming practices.

Fertilizer and organic materials should be effectively applied rather than in the current situation, from the viewpoint of sustainability of soil fertility and increment of crop production under irrigated condition. Dissemination on application of agro-chemicals to the farmers should be paid careful attention. It is noted that farmers are aware of effect of agro-chemicals, however most of them have no sufficient knowledge on identification of pests and diseases and proper application of agro-chemicals.

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

Proposed farming practices for major crops is given in Table 3.3.2. Guideline of time schedule for crop cultivation is shown in Table 3.3.3. Further, recommendable agro-chemicals and its application dosage are shown in Tables 3.3.4 to 3.3.5, respectively.

Basically, no special practices to be extremely complicated and advanced are not included. Although farmers concerned are trained by frontline extension staffs and they have willingness to improve the present situation, it seems that information and knowledge are not enough. It is recommended that proposed farming practices should be adopted through the implementation of demonstration plots, and modified if necessary. Topics of proposed farming practices for major prospective crops are shown below;

1) Cabbage

a) Land preparation

Land preparation is manually carried out by using hand hoe. Before starting cabbage cultivation, slope side of contour terraces is reshaped by means of scraping side slope and hence shallow ploughing and arrowing are conducted. Furrow for leading water along the slope side of terraces is also rehabilitated. It is necessary to consider the land concervation by menas of contour cultivation.

b) Nursery Preparation

Generally, ridge formation is required for nursery bed. It is recommended that seed amount is around 400 to 500 g for one acre. Common variety in the scheme is Copenhargen Market, Glory of Enkhuizen.. Nursery period to be required is estimated around one month.

c) Major Practices in Main Field

Ridge for seedlings to be transplanted should be formed. Planting density is in the range between 50 cm x 70 cm and 70 cm x 90 cm.

As for basal dressing, fertilizer with N:P:K=50:40:0 will be applied before transplanting. Fertilizer should be applied into each hill. Farmers should be recommended to apply a handful of compost per hill which are made from pig dung and grass residues before transplanting. Further, top dressing with N:P:K=50:0:0 should be applied near each hill raround 20 days after transplanting. Fertilizer is applied in the surface of field and further incorporated with soil by using small hand hoe.

Weeding is manually carried at least twice during the growth period, by using small hand hoe or just uprootingby hand.

In the scheme, club root (*Plasmodiophora Brassicae)* is a most serious fungus disease (a kind of mold fungi). In order to protect cabbage plants against this disease, it is recommended to uproot the infected palnts and tkae it away from the field. Regarding insects, it is recommended to apply proper agro-chemicals as shown in Tables 3.3.4 and 3.3.5. Irrigation water is supplied once or twice a week, depending on the soil condition. Wet condition in farm land should be strictly prohibitied to depress the expansion of Club Root Disease.

2) Maize

a) Land preparation

Land preparation is manually carried out by using hand hoe. Manner of land preparation is almost similar with cabbagge mentioned above.

b) Major Practices in Main Field

Seed amount is estimated at around 20 to 25 kg per ha. Planting density is in the range between 70 cm x 90 cm and 90 cm x 100 cm.

As for basal dressing, fertilizer with N:P:K=15:20:0 will be applied before planting. Fertilizer should be applied into each hill. Further, top dressing with N:P:K=15:0:0 should be applied near each hill 40 days after transplanting which is a stage of ear formation. Fertilizer is applied in the surface of field and further incorporated with soil by using small hand hoe.

Weeding is manually carried at least twice during the growth period, by using small hand hoe or just uprootingby hand.

In the scheme, serious damages by insects or diseases are not found so far. Regarding insects, it is recommended to apply proper agro-chemicals as shown in Tables 3.3.4 and 3.3.5.

3) Pulse crops

a) Land preparation

Land preparation is manually carried out by using hand hoe. Manner of land preparation is almost similar with cabbagge mentioned above.

b) Major Practices in Main Field

Seed amount is estimated at around 20 kg per ha. Planting density is in the range between 20 cm x 30 cm and 40 cm x 50 cm.

As for basal dressing, fertilizer with N:P:K=40:0:0 will be applied before transplanting. Fertilizer should be applied into each hill. No top dressing should be applied. Weeding is manually carried at least twice during the growth period, by using small hand hoe or just uprootingby hand.

In the scheme, serious damages by insects or diseases are not found so far. Regarding insects, it is recommended to apply proper agro-chemicals as shown in Tables 3.3.4 and 3.3.5.

4) Potato

In the project area, potato cultivation has been expanded as food or cash crop because cabbage has been infected with club root and its yield declined year by year. As a result, farmers have been instructed to cultivate another crops such as pulse crops, potato, etc. for certain years, instead of cabbage cultivation. Potatoes are cultivated during the dry season under irrigation.

a) Land preparation

Land preparation is manually carried out by using hand hoe. Manner of land preparation is almost similar with cabbagge mentioned above.

b) Major Practices in Main Field

Seed amount is estimated at around 1,000 kg per ha. Planting density is in the range between 50 cm x 70 cm and 70 cm x 100 cm.

As for basal dressing, fertilizer with N:P:K=15:30:0 will be applied before planting. Fertilizer should be applied into each hill. Further, top dressing with N:P:K=15:0:0 should be applied near each hill 70 days after transplanting which is a flowering stage. Fertilizer is applied in the surface of field and further incorporated with soil by using small hand hoe.

Weeding is manually carried at least twice during the growth period, by using small hand hoe or just uprootingby hand.

In the scheme, serious damages by insects or diseases are not found so far. Regarding insects, it is recommended to apply proper agro-chemicals as shown in Tables 3.3.4 and 3.3.5.

Based on the proposed farming practices, crop budget is prepared as shown in Table 3.3.6.

3.3.5 Anticipated Crop Yield and Production

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

The crop yield under the conditions without and with projects is estimated as follows.

Unit Yield of Major Crops in Mgeta Scheme

(Unit: ton/ha)

Crops	Present	Without	With
Maize	1	1	3
Pulse	0.7	0.7	1.5
Cabbage	10	10	15
Potato	3	3	6

Target yield of prospective crops described above was estimated, based on the available information obtained from group discussion with farmers as well as regional office and research stations.

Production in Mgeta scheme under the without and with project conditions is summarized as follows.

Increment of Crop Production of Major Crops in Mgeta Scheme

(Unit: ton)

Crops	Present/Without	With	Increment
Maize / pulse *1	30	90	60
Cabbage	60	90	30
Potato	9	18	9
Pulse	7	32	24

*1: Maize is applied as representative crop.