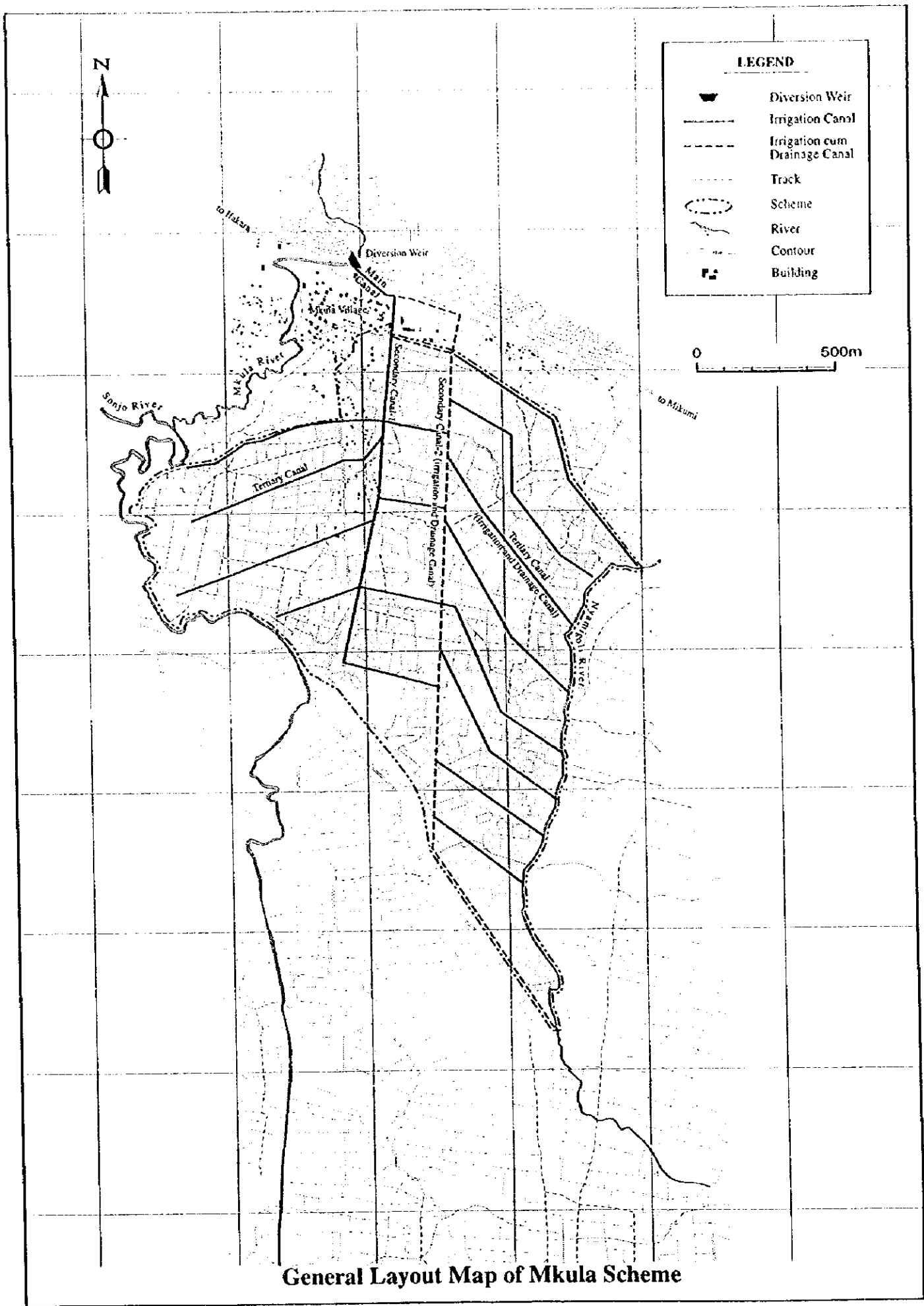


***DIVISION - IV***

***DEVELOPMENT PLAN OF MKULA SCHEME  
KILOMBERO DISTRICT***





**General Layout Map of Mkula Scheme**



**DIVISION - IV.**

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

**MKULA SCHEME**

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## CHAPTER I. PRESENT CONDITIONS OF THE SCHEME AREA

### 1.1 Physical Nature of the Study Area

#### 1.1.1 Location

Mkula scheme area is located in Kilombero District, Morogoro Region (See Location Map). The area lies south-west of Morogoro city and is easily accessible by the highway A7 (200 km) and the trunk road B127 (40 km). It lies between the Mkula river and the Nyamigoli river on a fan formation formed by both rivers.

#### 1.1.2 Topography and River System

##### (1) Topography

The area lies in a range from 285 m to 300 m above sea level. The topography of the project area is characterized as a gently undulating fan formation with an overall slope of 1 / 50 in the upper part to 1 / 200 in the lower part to the east in parallel to the Mkula river. The center part of the scheme area between the Mkula river and Nyamigoli river is relatively lower than the river sides.

##### (2) River system

Mkula river, which is a water source of Mkula scheme goes out from a mountainous area to the plain through fan formation at the foot of mountains. The Mkula river joins to the Sonjo river at about 1 km downstream of the existing intake weir site, which serving water to a part of the Mkula scheme area. After joining to the Sonjo river, the river gradually decreases its freeboard and starts to overflow from the point at around 3.5 km downstream of the intake site. The river has no water users other than Mkula scheme.

#### 1.1.3 Meteorology and Hydrology

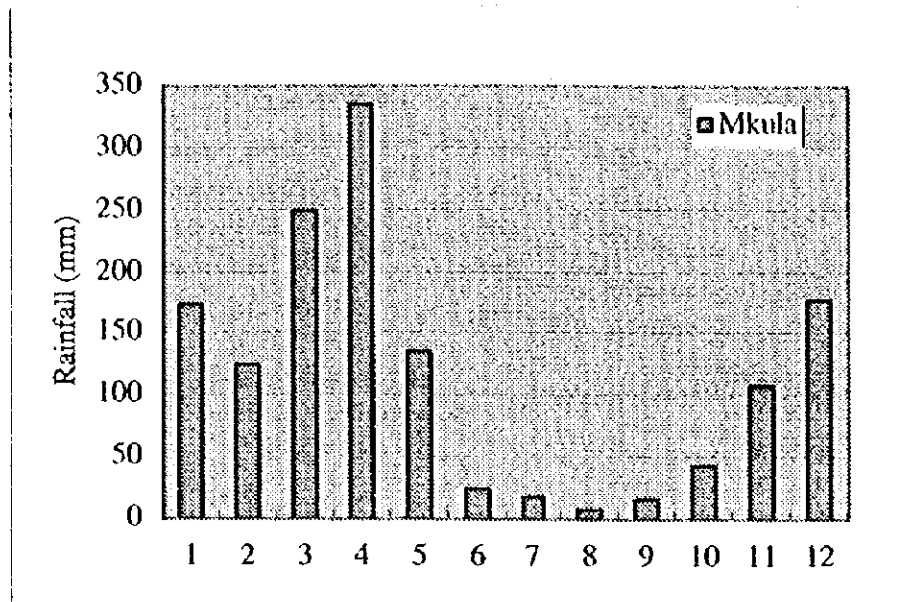
##### (1) Meteorology

###### (a) Rainfall

Mean annual rainfall in Mkula scheme area is 1,400 mm. The rainy season is usually from November to May and the dry season is from June to September. Peak rainy season is April.

Name of Scheme	Rainfall Station	Code Number	Annual Rainfall (mm)
Mkula scheme	Kilombero station	963729	1,425

Mean Monthly Rainfall at Kilombero station



(b) Other Climate Parameters

Meteorological data for Mkula scheme are available in Morogoro meteorological station. These data are summarized in the following table.

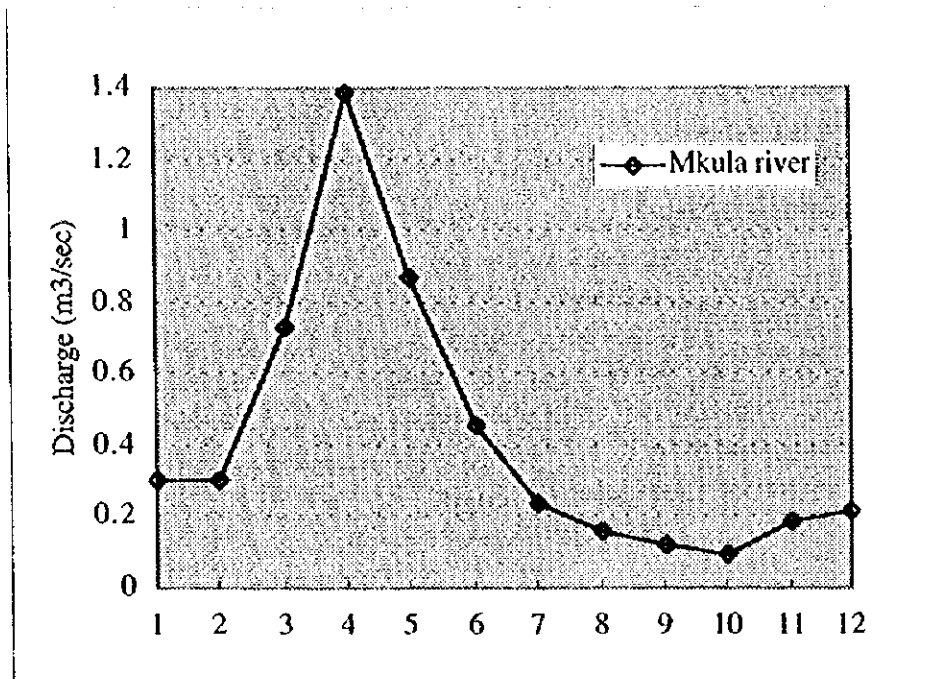
Summary of Meteorological Data

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Mean
<b>1. Morogoro Meteorological Station</b>													
(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 (I/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.													

(2) Hydrology

Estimated monthly mean discharge of the Mkula river is shown in the following figure.

Monthly Mean Discharge of Mkula River



In the mid rainy season from March to May, the river flow is more than 0.6 m<sup>3</sup>/sec on the monthly average, but in the dry season extremely decreases and reaches the lowest of 0.1 m<sup>3</sup>/sec in October.

Flood discharge of the Mkula river at the intake point is estimated as follows:

Return Period	Probability Flood Discharge (m <sup>3</sup> /sec)
10 year	28
20 year	40
50 year	59

#### 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 Mkula scheme. In performance of the field investigation and soil classification, the following 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 of Mkula scheme area are classified into three great soil groups,

i.e. Eutric Cambisols, Eutric Fluvisols and Eutric Gleysols, and further classified into four soil units according to the morphological soil features, i.e. soil texture, drainability and moisture regime. The soil map of the scheme area is as illustrated in Drawing No.401 in Drawings. The soil morphological characteristics and extent of each soil unit are shown in Table below:

Soils in Mkula Scheme

Mapping Unit	Mkl-1	Mkl-2	Mkl-3	Mkl-4
Area (ha)	70	75	27	3
Soil Unit	Eutric Cambisols	Eutric Gleysols	Eutric Fluvisols	Eutric Fluvisols
Pysiography	Fan (top to middle)	Fan (middle to edge)	Fan (depression)	Old natural levees
Topography	Flat - gentle slope	Flat	Flat	Undulating
Parent Material	Fan deposits	Fan deposits	Fan deposits	Alluvium
Soil characteristics				
Texture	CL/L~CL/SL	CL/SiCL~CL/SL	CL/SCL/SL~SCL	SL/LS/LS
Depth	> 150 cm	> 150 cm	> 150 cm	100 - 150 cm
Fertility	High	High	High	Mod. ~ Low
Drainability	Moderately well	Imperfect	Poor	Excessive
Depth of groundwater				
Rainy season	50 - 100 cm	30 - 50 cm	Flooding	50 - 100 cm
Dry season	> 150 cm	100 - 150 cm	50 - 150 cm	> 150 cm
Land Use	Upland field	Paddy field	Paddy field	Upland field

The soils of Mkl-1 are, one of the soil series of the Eutric Cambisols, extending the most upper and middle reaches of the fans with an area of 70 ha (40% of the gross scheme area), and clay loam to loam in texture, relatively high inherent fertility and moderately well drainability through out a deep profile. The soils units develop over the fan formation having a gentle slope at less than 2%. The land of this soil unit has been well reclaimed and planted with the upland crops mostly under the rainfed condition. The village yard is also settled on this land.

The soils of Mkl-2, a series of the Eutric Fluvisols, develop over from the middle reaches up to edge of the fan formation where the land is gently sloped approximately at 1%. These soils are clay loam to silty clay in texture, imperfect drainability throughout the deep profile and relatively high inherent fertility. The land of this soil unit has been cultivated extensively with paddy under rainfed conditions. Sugar cane is also grown in a part of this soil area. The dry season cropping in this soil area is limited to only vegetables mostly for domestic consumption within the village. The proportional extent of this soil unit is to be 75 ha (43%).

The soils of Mkl-3 are extended in the depressions of the fan formation as well as alluvial plain in the lower land of the scheme area. The soils, which are clay loam to sandy clay loam in texture, poor drainability, are regularly affected by the seasonal flooding or submergence in the rainy season, while dried up in certain depth of the surface profile during the dry season. A high groundwater table is found around 50 cm from the ground surface even in the dry season. The present land use is therefore limited to only paddy cultivation in the rainy season. The proportional extent of this soil unit is to be 27 ha (15%).

The soils of Mkl-4 are found on the natural levees developed along the middle reaches of the Sonjo river, and occupy only 3 ha or 2% of the gross scheme area. The soils are sandy loam in texture and medium to low soil fertility. The lands are well drained, that why cultivation of the upland crops is limited only in the rainy season or sugar cane in a small part.

The chemical properties and physical natures of the above soils are as shown in Table below. There are no alkaline and/or saline soils.

### Physical Natures and Chemical Properties of Soils

Soil Mapping Unit	Soil Sample No.	Horizon		EC mS/cm	pH (1:2.5)		Particle Size			Soil Texture	Bulk Density g/cm <sup>3</sup>
		Name	Depth cm		H <sub>2</sub> O	KCl	Clay %	Silt %	Sand %		
MkI-2	1	A1	0-28	0.06	5.6	5.1	36	37	27	CL	0.94
	2	AB	28-40	0.02	6.4	5.1	38	49	13	SiCL	0.87
	3	B2	40-90	0.02	5.8	5.3	34	27	39	CL	1.04
MkI-1	4	Ap	0-18	0.03	5.6	4.9	38	33	29	CL	0.93
	5	A1	18-50	0.01	5.7	4.8	40	33	27	CL	0.92
	6	B2	50-95	0.01	6.1	4.9	26	19	55	SCL	1.05

Soil Mapping Unit	Soil Sample No.	Total N %	Organic C %	C/N Ratio	CEC me/100g	Exchangeable Cations					Satur. Total Ratio %
						Ca	Mg	K	Na	Total	
MkI-2	1	0.25	3.19	12.7	25.1	10.08	6.82	0.18	0.14	17.22	69
	2	0.11	1.31	11.9	20.9	9.45	7.18	0.12	0.22	16.97	81
	3	0.12	1.49	12.4	17.9	8.69	6.90	0.12	0.13	15.84	88
MkI-1	4	0.25	3.33	13.3	23.8	8.12	3.20	0.39	0.14	11.85	50
	5	0.18	1.90	10.5	21.7	5.89	3.13	0.13	0.08	9.23	43
	6	0.07	0.58	8.3	12.4	3.23	2.39	0.09	0.07	5.78	47

## 1.2 Present Conditions of Socio-economy in the Study Area

### 1.2.1 Administrative Divisions, Public Administration and Demographic Data

#### (1) Administrative Division

SCHEME	DISTRICT	DIVISION	WARD	VILLAGE
Mkula	Kilombero	Mang'la	Langali	Mkula

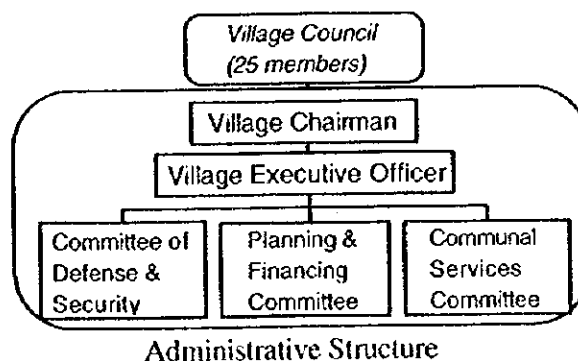
#### (2) Public Administration

##### 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 vil-

lagers 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.



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 by 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 condi-



tions 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, if 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.

Administrative Division and Population (1996)

Scheme	District	Division	Ward	Village	Population	Household
Mkula	Kilomero	Mang'ula	Mkula	Mkula	2,940	490

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 Mkula scheme.

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
Mkula	Mkula	2,940	713	746	1,088	193	200

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.
Mkula	Mkula	25	26	42	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

Access is easy because it is located near main road B127, which runs along the foot of the Gologolo Mountains connecting Ifakara, capital of Kilombero District, to the highway A7. This road is being improved with asphalt at the section from A7 junction to the Ruaha River crossing about 30km as a first phase and planned to be improved to Ifakara as a second phase.

#### (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
Mkula	Mkula	Non available	River water/wells

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
Mkula	Mkula	1	-	4	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)
Mkula	Mkula	-	-	-	2

### 1.2.3 Economic Activities

Economic activities are mainly based on agriculture. According to the Morogoro Regional Planning Officer, almost 95% of the economically active population is engaged in agricultural-related activities.

There are no industries except the Kilombero Sugar Company. This is a parastatal company located near the Mkula village. It provides employment to the villagers and most of the farmers who cultivate sugarcane in the area depend on the demand coming from this company. However, due to diverse financial and management problems, the company in recent years has not been able to sustain a stable demand for sugarcane produced in the area.

Processing of maize and rice by small-scale mills is the only processing activity in the area.

Concerning sources of off-farm income, the main one is to work as hired labour specially in the sugarcane fields during the harvesting time.

### 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 cultivated land is further classified into three sub-types, i.e. 1-a) paddy field; 1-b) upland field; and 1-c) sugarcane field.

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. 402 in the Drawings. The extent area by land units is summarized as follows:

Land Use Type	Area (ha)
Cultivated Land	161
Paddy Field	108
Upland Field	42
Sugarcane	11
Grassland	-
Forest & Wood Land	10
Settlement/Right of Ways	4
<b>Total</b>	<b>175</b>

Out of 175 ha surveyed in Mkula area, the cultivated land occupies 161 ha or 92%, of which paddy field shares 108 ha (62%), and followed by upland field 42 ha (24%) and sugarcane 11 ha (6%), respectively. Almost all of the paddy field is being used for rice production in the rainy season under rainfed conditions or under seasonal flooding. In the upland field, maize, sweet potatoes, cassava, beans, etc. are the predominant crops. These crops are also grown under rainfed conditions. Sugarcane is also grown in the upland field in scattered plots. In the early dry season, many farmers grow maize, beans, sweet potatoes both in the paddy and upland fields where the groundwater lies at shallow depth and maintains a favorable soil moisture.

The forest and wood lands including such fruit plantation as mango, banana, etc. and coconut trees occupy 10 ha (6%) of the total scheme area. The village settlement area and the land used as the right of ways of the existing roads are estimated to be 4 ha (2%).

#### 1.3.2 Land Ownership and Tenure System

The tenure system is generally based on traditional inheritance, land allocation by village council, land purchasing, land borrowing or renting. The most common tenure regime 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.

The JICA Study Team has estimated that the average landholding size per farm household for Mkula is 1.29 ha (rainfed plus irrigated areas). It has been estimated that 0.55 is within the irrigated area.

#### Landholding Size

Basic Information	
Number of households	490
Cultivated Area (ha)	
In the whole village	630
In the Study Area	149
Holding Size (ha)	
In the whole village	1.29
In the Study Area	0.55

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.

For reference only, the information provided by the informal survey is given below:

#### Farmers-Provided Data on Land Holding

Number of Farmers covered by the Survey	407
Total Declared Area (ha)	225
Average Landholding (ha)	0.55

#### Frequency Distribution of Land Size Holdings in Percentage Terms

0 to <0.4 ha	15
0.4 to <0.8 ha	61
0.8 to <1.2 ha	20
1.2 to <1.6 ha	3
1.6 to 2 ha	1
2 to <4 ha	0
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

The existing agricultural activities in the project area have been limited, depending on various constraints which are caused from unpredictable weather conditions, manpower requirement, input supply conditions, etc., resulting in the difficulty of implementation of proper farming practice.

Maize and paddy are cultivated in the project area as dominant food crops, while

such other food crops and vegetables as sweet potatoes, cassava, tomatoes, beans, etc. are cultivated in the limited area. Sugarcane is also cultivated as cash crop and around 30 households out of 330 households in Mkula village have cultivated them.

Paddy cultivation is carried out in the lower elevated area, relying on the high soil moisture in the rainy season and seasonal flooding condition during March and April. Generally, paddy cultivation in the scheme is carried out under the extensive farming practices. After harvesting paddy, maize is cultivated in some area by applying capillary moisture during the dry season.

In upland field which is located in the upper elevated area, maize is dominantly cultivated under the rainfed condition during the rainy season. While in the dry season, maize are dominantly cultivated under rainfed condition in some part where the soils are moistened by capillary water from the shallow groundwater.. Other upland crops, that is sweet potatoes, beans, vegetables are also cultivated in the limited small area. Besides, sugarcane is also cultivated under rainfed conditions in the limited area.

Present cropping pattern under the present condition in the project area is shown in Figure 1.3.1

## (2) Farming Practices

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

### 1) Paddy

#### (a) Land preparation of the main field

Ploughing by hired tractors is predominant in land preparation, however harrowing is hardly carried out. It is estimated that a few tractors are hired in contract base of the individual farmers concerned. Quality of such land preparation as ploughing and harrowing is quite rough. Tractor availability is low and hence some farmers are forced to carry out land preparation manually by using hand hoe which is a laborious work. Labour for land preparation is arranged from family, while hired labours are also expected to make up for the lack of man-power of family labour. Ridge formation in the main field is not common because seasonal flooding is relied on paddy cultivation and further farmers are not aware of its advantage.

#### (b) Broadcasting

Broadcasting is mostly common in the area. Sowing is carried out after plowing by means of tractor or hand hoe. Dry seed of paddy without soaking is broadcasted before harrowing by tractor or hand hoe, at the right time of commencement of the rainy season. Depending on the rainfall pattern, sowing time might be shifted year by year. It is noted that paddy cultivation is affected by unreliable seasonal flooding which is not controlled by farmers.

#### (c) Application of fertilizer and agro-chemicals

No application of fertilizer and agro-chemicals are common in the area. Fertilizer to be applied is washed away due to seasonal flooding and further farmers are not aware of the effect of ridge formation on water preservation and fertilization. Insects and diseases are not so serious in the area.

(d) Maintenance activities in the main field

Due to the extensive farming of paddy cultivation under the seasonal flooding, sufficient maintenance is not expected. Weeding is not common, although this activity is done in the case of serious condition, by using 2,4-D or hand weeding. Bird is not a serious vermin in this area and hence bird scaring is not so common.

(e) Harvesting

Growth period of "Supa India" is estimated at around 150 days in the area. Harvesting work is commenced during the period from June to August depending on the occurrence of seasonal flooding on sowing. Drying activity after reaping is not so common. After reaping, paddy grains are threshed, winnowed, and bagged consequently. Bags of harvested paddy are carried to farmers house by themselves or hired persons, using bicycle or manpower. Harvested paddy is marketed as early as traders are available.

2) Maize

(a) Land preparation of the main field

Land preparation is carried out manually, while ploughing by a few tractors is also conducted in contract base of some individual farmers who have enough capitals for hiring tractor. However harrowing after ploughing is hardly carried out. Quality of land preparation by tractors is quite rough. Tractor availability is quite low. This point is elaborated in Section 2.3.6 of constraints and problems.

Some farmers prefer to prepare ridge for maize cultivation, while some farmers cultivate maize in the flat field. In the case of ridge preparation, farmers have believed that ridge formation protect maize plants against some damage caused by seasonal floods or high moisture content of soil, however it seems that there is no effect of ridge formation during the dry season because there is no damage by seasonal flooding.

(b) Major farming practices in the main field

Local maize which is "STAHA" or "TMV-1" is preferable in the area. Farmers have multiplied by themselves, not purchased the certified seeds. Dry seed of maize is drilled at the rate of 2 to 3 seeds a hole. Germination is promoted by rainfall during the rainfall in the rainy season and capillary moisture in the dry season. Some farmers conduct thinning 1 or 2 weeks after germination. No application of fertilizer and agro-chemicals are common in the area. Insects and diseases are not so serious in the area, although stalk borers, army worm, etc. are categorized into important insects. Weeding is carried out in common by hand hoe.

In some part, intercropping with maize and paddy is carried out during the rainy season.

Harvesting is continued little by little, depending on the degree of home consumption.

### (3) Crop Production

No application of fertilizer and agro-chemicals is common for major crops such as maize, paddy, and pulse in the area. Farmers multiply seeds for the following season by themselves rather than purchase of qualified seeds. Although sugarcane has been cultivated by limited no. of farmers, there is almost no harvesting in the project area.

Current cultivated area of sugarcane is estimated at around 30 ha by villagers of Mkula village as shown in Table 1.3.2. Sugarcane cultivated in and around Mkula village is charged by Kilombero Sugar Company. Total processing amount of the company has been declined year by year, that is total processing amount in 1996/97 is declined by 40 % for past 5 years. Actual processing capacity in 1996/97 is estimated at around 60 % of the installed capacity. Considering the condition of processing machine and management, this tendency will be continued to decline, but not be improved for a while.

The company contacted with outgrowers concerning sugarcane cultivation, that is the company intends to share 60 % of total processing amount, while outgrowers are offered to cover 40 % of total processing amount for the company. As a result, outgrowers contributed around 64,000 tons in the year of 1996/97. Out of this amount, share of Mkula village is estimated at around 0.6 %.

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

Present Crop Cultivation in Mkula Scheme

	Cultivated Area (ha)		Unit Yield (ton/ha)	Crop Production (ton)		
	RS*1	DS*2		RS	DS	Total
Paddy	108	-	2.0	216	-	216
Maize / Pulse*3	42	40	1.5	63	60	123
Sugarcane*4	11	11	-	-	-	-
Total	161	51				

\*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

\*4 : No harvesting for sugarcane for last few years

Based on the situation mentioned above, crop budget in the present condition is prepared as shown in Table 1.3.3.

### (4) Livestock and Inland Fishery

It is revealed that cattle grazing is not so common for farmers concerned in the Project area. No farmers have kept cattle, but such small animals as goats, chicken, etc. There are fish pond in the village, however activity is limited in the rainy season and quite low.

#### 1.3.4 Activities of Agricultural Supporting Services

##### (1) Extension Services Concerned in 1996/97 for Kilombero 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 re-

spond 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 1.3.4, however one or two of MTSs was merely held in each District as shown in Table 1.3.5. 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, 36 of VEOs are available in 47 villages of the whole Morogoro District. Out of 36 VEOs, 14 VEOs attended retraining programme of crop production or livestock by 1996/97. Moreover, during this fiscal year of 1997/98, 2 VEOs are required to attend the programme. Remaining 20 VEOs would attend the programme in 1998/99 onward. Progress of the retraining programme in Morogoro Region by District is shown in Table 1.3.6.

## (2) Extension Services in the Village Concerned

Agricultural supporting services in Mkula village are not attractive, although extension services are disseminated to farmers concerned by means of adoption plots, regular training, etc. as shown in Figure 1.3.2.

As one of attractive functions, VEO has tried demonstration concerning effect of fertilizer application on paddy production in the adoption plot. He selected aggressive farmers and disseminate available advanced farming practices for paddy cultivation. It is noted that farmers have noticed effect of proper application of fertilizer and proper planting density on increase of production.

### 1.3.5 Marketing and Credits

#### (1) Marketing System of Agricultural Production

##### (a) Traders System

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.

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.

In Mkula scheme, the traders have to pay to the village government a "trade tax" equivalent to Tsh.300 per bag of product. This income goes to the District and Village Councils as part of revenues.



(b) Estates System

In the case of the Kilombero Sugar Estate Company, it buys sugarcane from farmers located in the Mkula Scheme. As mentioned before, in the past the Estate provided to some of farmers, inputs and personnel and machinery for land preparation, planting and harvesting of sugarcane. Later, at the moment of purchasing the sugarcane from them, the Estate discounted the cost of the provided services. The Estate sent its own lorries for transportation of the sugarcane. However, farmers complained that there are times when the number of lorries was not enough to pick up the product and the harvest was left uncollected and rotted. Thus, even though farmers found convenient the supply of services from the Estate, they were also worried about the lack of independence at the moment of marketing the product or power at the moment of negotiating the price.

In recent years, the practice described above has been discontinued due to financial and managerial problems faced by the Estate Company. From 1997, the Estate will offer only transportation services to some of the growers, but the farmers still feel that they may not be adequate.

(2) Rural Credit

(a) Banking Institutions

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.

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 difficult the approach to the farmers for credit promotion.

(b) Kilombero Sugar Estate Company

In the past, the Kilomero Sugar Estate Company provided to some of farmers, inputs and personnel and machinery for land preparation, planting and harvesting of sugarcane. Later, when purchasing the sugarcane from them, the Estate discounted the cost of the provided services. This practice has stopped completely since 1995.

## 1.4 Present Conditions of Irrigation Development

### 1.4.1 Existing Irrigation Scheme

Present irrigation facilities, which consist of a headworks and canals of about 1 km long were constructed to irrigate 60 ha of land at the beginning of the 1980's. Then, the

intake gate and the canal were rehabilitated with technical assistance of the Zonal Irrigation Office in the period from 1993 to 1995.

Headworks is located on the Mkula river at about 20 m upstream from the bridge of the road B127 where the river has about 15 m in width and a steep gradient formed with stable rock formation. The headworks consists of a fixed weir and an intake. It is made by concrete. The weir is laid in L-shaped on the river in perpendicular and then in parallel to the river course along the right bank side. The parallel portion of the weir is formed as a side channel spillway. The weir portion in perpendicular to the river course is 10.3 m in width and the parallel portion to the river course is 7 m in length. The weir height is 0.3 m to 0.6 m from the upstream river bed.

The intake consists of a side channel spillway of 7 m long, and an inlet equipped with a steel slide gate just after the side channel spillway. The gate installed in 1994 was locally fabricated and is of good quality. The inlet crest height is only 0.5 m or less higher than the crest of the weir. Thus water overflows the inlet even in small flood flow.

The existing canal is provided with lining of wet stone masonry in the upstream reaches of about 300 m, of which first reaches, about 100 m is steep in the longitudinal gradient and water flows under supercritical condition. Immediately after passing through a culvert crossing under the road B127, the canal has a rectangular shape. It is made of wet stone masonry at the bottom slab and wet brick masonry for walls. All the inner surfaces are covered with cement mortar plaster, but the plaster has been eroded at many points especially at the joint between the stone and brick masonry. It appears to be caused mainly by poor composition of cement in the plaster and poor workmanship. Due to this damage and to the leakage of a lot of water, the main canal has never been used in the lower half reaches just after the branch canal diverts water to the right. Further, the outside faces of the main canal walls are not plastered and are just openly exposed without an embankment covering. Such defective situations have accelerated water leakage and also weakened the canal foundation.

Under such canal conditions, irrigation is meagerly practiced by a few water users including a school farm in the areas commanded by the branch canal and most of farmers are still engaged in rainfed agriculture. However the rainfed agriculture, especially rainfed rice cultivation practiced in the low-lying area is highly affected by floods and drainage problems. These factors make rainfed rice culture unstable.

#### **1.4.2 Access Road**

Mkula scheme is located adjacent to the trunk road B127, which runs along the foot of the Gologolo Mountains connecting Ifakara, capital of Kilombero district, to the highway A7 and thus easily accessible from the highway A7. This road has been almost improved with asphalt pavement at the section from the junction with the highway A7 to the Great Ruaha river-crossing about 30 km as a first phase and planned to be improved to Ifakara as a second phase.

### **1.5 Community Development and Activities**

#### **1.5.1 Organization of Village Community**

All of Mkula scheme is covered by the Mkula village. This village has a well matured community with a good social norms of life, even though the village's population consists of various tribes such as Mbunga and Hehe.

(As of September 1996)

		Mkula
Adminis- trative Division	- District	Kilombero
	- Division	Mang'ula-I
	- Ward	Mkula
	- Village	Mkula
Population		2,940
Household		490
Tribes		Mbunga 45%, Hehe 30%, Ndwewe 20%, Others 5%
Village Extension Officer		1
Irrigation Technician		.
Electric Supply		Part
Domestic Water Supply		Piped Water/River
Fuel for Cooking		Fuel Wood

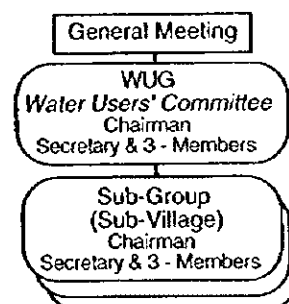
Source: Information and data obtained from village executive officer, village extension officer and farmers.

Most of the troubles and/or problems among the villagers have been solved by the community according to their traditional norms. If it is difficult to settle them up within the community, the village government takes the initiative to do it. Almost no problem among tribes was found in all villages of the project area, with the exception of some conflicts between Masai and other tribes.

The Mkula 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. It can be said that the village communities and governments have functioned well, and have enough capacity to settle troubles and problems occurring in their villages.

### 1.5.2 Water Users' Group

At present, there is one irrigation system, but its total area is only 4 acres. In 1978, the irrigation development plan having 60 ha in Mkula village was commenced by the District Council, but the facilities were imperfectly constructed. In 1992, the Zonal Irrigation Office followed this plan under the budget of the Regional Government with farmers participation to the construction works. At this time, a WUG covering 60 ha was also established in the Mkula village. The organizational structure of this WUG is shown in the right figure.



The organizational structure of this WUG had consisted of a water users' committee and three sub-groups which were organized by each sub-village. However, almost no activity is shown in this WUG at present, because the irrigation area developed by them was only 4 acres and total members are only 5 farmers, as mentioned above.

### 1.5.3 Farmers' Co-operatives Society

In the Mkula village, there is no farmers cooperatives. The village chairman said that all of farming activities have been carried out individually, though many farmers desire to have a cooperative in order to solve present problems for credit and marketing of farm inputs and out puts.

### 1.5.4 Other Societies

There are three women's groups which were established under the guidance of the village government. Of these groups, "Kikundi cha Akina Mama Amani" is active group, and other two are now inactive. Each group has one acre of paddy field provided by the village government, and has cultivated paddy and maize.. They are also producing local beer in the off season. The table below provides information on the existing women's groups in Mkula scheme.

Existing Women's Groups in the Irrigation Schemes

Schemes	Village	Popula- tion	No. of group	Year established	Total members	Activities
Mkula	Mkula	2,940	3	1995	30	Paddy and maize cultivation

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

### 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:

Role of Women in Farming and Everyday Activities

		Mkula
(1) Role of women in farming		
-	Land preparation	Both
-	Seeding	Both
-	Transplanting	-
-	Weeding	Both
-	Fertilizing	Both
-	Spraying of chemicals	Male
-	Irrigating	-
-	Drying/bagging of products	Both
-	Harvesting	Both
(Heavy work)		
-	Selling of products	Male
(2) Transportation of water		
-	Distance (km)	Female
-	Frequency (times/day)	0.5-1
-		3-4
(3) Collecting of fuel food		
-	Distance (hrs.)	Female
-	Frequency (times/week)	3
-		2

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.

One important fact is that men are usually who control the household finance. All proceeds from farming activities are held by the male head of the household making women financially dependent on him. It is important that women should be empowered, not only by increasing their participation in the decisions governing the village but also by increasing the opportunities to become financially independent. The next section provides some proposals to achieve that end.

## **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 Mkula scheme. Many of the villagers in Mkula Scheme, who are located at low lying plains use 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.

#### **(2) Vegetation**

Vegetation in Mkula scheme could be classified as Closed woodland. Cultivated lands and scattered settlements (Bushland [other land]) and Bushland [Bushed Grassland] widely cover most of land within the proposed scheme area. While grassland communities appeared to be the dominant vegetation in the Mkula area, only "island" of woodlands and/or wooded grasslands are left. Woodland and Wooded Grassland could be commonly found in the surroundings, having rolling to hilly terrain, of villages in the Project Areas. However, the distance to Woodland from villages has been continuously increased because of woodland degradation.

#### **(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 Mkula scheme owning 1.29ha is about Tsh.223, 000, excluding off-farm income. Based on this figure and considering the regional poverty line of Tsh.262,395 for a household with 7 members, it would be possible to say that the typical household in this area is suffering from poverty

As far as environmental aspect in Mkula scheme 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 Disease

As summarized in the following table, it is obvious that the health service facilities in the Mkula area fall short of WHO recommended minimum requirement sets.

Health Service Facilities and Medical Staff in this Scheme Area

VILLAGE	Mkula
HEALTH UNIT	Sonjo Gov. Dispensary
Assistant Clinical Officer	2 persons
Material Child Health	1 person
Nurse Attendant	2 person
Watch man	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	Mkula
Total Population(persons)	2,947
Disease incidence(cases)	9,181
Morbidity (% to population)	312

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 49.3% 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	4,665	49.3
Diarrhoea Diseases	523	5.5
Intestinal Diseases	269	2.8
Schstosomiasis	8	0.1
(Sub-total)	5,465	57.7
Water related Disease:		
URTI	1,964	20.7
Pneumonia	423	4.5
Skin Diseases	983	10.4
Eye Diseases	354	3.7
(sub-total)	3,724	39.3
Other Diseases		
Ear Diseases	106	1.1
Anaemia	11	0.1
Gonorrhoea	69	0.7
Mental Diseases	22	0.2
Nutritional Disorder	10	0.1
Accident & Wounds	64	0.7
Total	9,471	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 is 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

<b>[A] Agronomic Factors</b>	
(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.
<b>[M] Management Factors</b>	
(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.
<b>[D] Land Development Factors (in the future development)</b>	
(l) Grading/leveling and ridging:	Grading/leveling, ridging, land consolidation, and clearing.
(d) Drainage, flood protection:	Drainage and flood protection.
<b>[E] Conservation and Environmental Factors</b>	
(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.403 in Drawings.

#### Land Class by Irrigation Suitability in Mkula Scheme Area

Soil Unit	Land Class	Sub-class	[A]				[M]		[D]		[E]			Area (ha)
			(r)	(n)	(t)	(f)	(a)	(w)	(l)	(d)	(s)	(h)	(e)	
(For Paddy Cultivation)														
Mk1-1	SR2	SR2r	2	1	1	1	1	1	1	2	1	1	1	70
Mk1-2	SR2	SR2fd	1	1	1	1	1	1	2	2	1	1	1	75
Mk1-3	SR3	SR3d	1	1	1	2	1	1	2	3	1	1	1	27
Mk1-4	NR	NRr	4	3	1	1	1	1	3	1	1	1	1	3
(Total)	SR1: 0 ha, SR2: 145 ha, SR3: 27 ha, NR: 3 ha												175	
(For Upland Crop Cultivation)														
Mk1-1	SU1	SU1	1	1	1	1	1	1	1	1	1	1	1	70
Mk1-2	SU2	SU2fd	1	1	1	2	1	1	1	2	1	1	1	75
Mk1-3	SU3	SU3fd	1	1	1	3	1	1	1	3	1	1	1	27
Mk1-4	SU3	SU3r	3	2	1	1	1	1	2	1	1	1	1	3
(Total)	SU1: 70 ha, SU2: 75 ha, SU3: 30 ha, NU: 0 ha												175	

The land of Mkula scheme (175 ha in gross) is graded into three suitability classes for irrigated paddy cultivation, i.e. suitable class (SR2) in the soil units of Mk1-1 and Mk1-2 (total 145 ha in gross), marginally suitable class (SR3) in the soil unit Mk1-3 (27 ha in gross), and un-suitable class (NR) in the soil unit Mk1-4 (3 ha in gross). Among three classes, the land graded into suitable class is only recommendable for paddy cultivation so far as to maintain sustainable-cum efficient utilization of the water resource in this scheme area.

As far as the upland crop production is concerned, majority of the land is accepted as suitable in classes (SU1, SU2 or SU3) although the land classified into SU2 and SU3 is subjected to improve drainage conditions in a part where the groundwater lies at the shallow soil profile.

#### 2.1.2 Water Resources

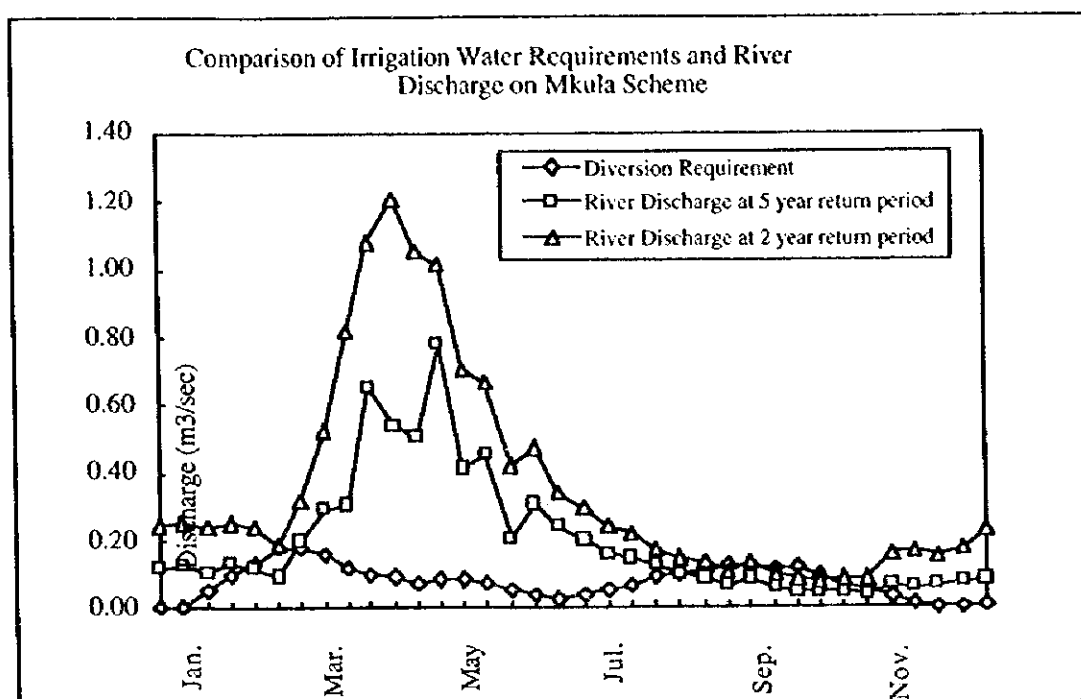
Surface water sources conceivable for Mkula scheme are only the Mkula river. The availability of the river water resources is shown in the following table on a monthly basis at 2, 5, and 10 year probability of drought.

#### Probability Monthly Discharge of Mkula River

Return Period	(Unit : m <sup>3</sup> /sec)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
10	0.08	0.08	0.19	0.40	0.45	0.19	0.14	0.08	0.06	0.03	0.03	0.05
5	0.12	0.12	0.27	0.57	0.55	0.25	0.17	0.10	0.07	0.04	0.06	0.07
2	0.25	0.23	0.56	1.12	0.80	0.41	0.25	0.15	0.11	0.09	0.14	0.18

Most of the water resources can be used for Mkula scheme, since no water is utilized other than the Mkula scheme in the downstream and the Sonjo river, of which water resources have not been utilized yet joins to the river at about 1 km downstream of the existing intake weir site.

The following figure shows the comparison of project irrigation water requirement and the Mkula river discharges in 2 year and 5 year return period of drought year. During the mid wet season the river is abundant, but gradually decreases from May and reaches the least in September and October, during which the river flow closes to the diversion water requirement at the normal hydrological year and is short against the requirement at the drought of 5 year return period. Also, in February, the relation between the demand and supply is expected to be sometimes tight. Such situations require for efficient use of the limited river water resources.



### 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 Mkula scheme.

Demographic Data for the Whole Scheme

Scheme	Total Population	No. of Households	Average Household Size	Average Holding Size per Household (ha)	Working Population
Mkula	2,940	490	6	1.29	1,234

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.

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.

#### **2.1.4 Delineation of Irrigable Area**

The Mkula river originates in the Gologolo mountains and flows down to east direction. The Mkula scheme area extends from the foot of the Gologolo mountains sloping down to east bordering the Mkula river at the south and a natural small stream called Nyamigoli river at the north. In the Master Plan Stage, land resources, 320 ha were identified as prospective fields for agriculture; they were actually cultivated with upland crops and paddy under rain-fed conditions. However, the soil investigation carried out in this Stage finds out that sandy soils are largely distributed in the lower part of the area along the Mkula river. The sandy soils forms pervious soil layer and thus the area covered with sandy soils is not suitable for applying traditional surface irrigation method like furrow and basin irrigation methods, since such methods incur large amount of irrigation water losses due to seepage. Also, the water resources of the Mkula river is limited in the dry season. Considering both factors, an objective development area was selected in the upper part of the fan formation between the Mkula river and Nyamigoli river. The gross area is 180 ha.

## **2.2 Problems and Constraints to Irrigated Agriculture Development**

### **2.2.1 Social and Institutional Aspects**

#### **(1) Weakness of Institutional Service System for Encouragement of WUG**

The strengthening of the existing WUGs is a prerequisite factor to make successful and sustainable O&M of the irrigation systems. For the activation and enlightenment of WUG, there are two ways: one is strengthening of institutional function and another is technical strengthening of O&M. The executing agency to be responsible for the former is the office of DCO and the latter is DALDO. However, these offices still have a weakness function for implementation of these activities. The DCO's office in Kilombero district mentioned that WUG differ from other cooperatives such as marketing and saving, and accordingly WUG is not included for their supporting activities. Even though these activities will belong to DCO, they have a poor experience on WUG, and so far no field staff assigned below district level. The DALDO's office also faces the same situation as the DCO's office, as mention below.

(2) Lack of Supporting System for O&M of Irrigation Facilities by the Farmers

The DALDO's office in Kilombero district is responsible for technical supporting services to the farmers' O&M. This office has however weak organization and staffing for execution of those services. Although several irrigation officers have been appointed in the office, there is no front line staff who have direct contact with farmers and WUGs. At present, DALDO has entrusted the implementation of these services to the village extension officers, but they have inadequate experience and knowledge for O&M of irrigation systems.

(3) Inactive Farmers' Cooperatives

In the Mkula area, there is no farmers' cooperative at present. The farmers in the Schemes are confronted with various problems in their activities; i.e., marketing of products, farm inputs supply, purchasing prices of farm inputs, agricultural credits, etc. To solve and/or improve these problems, it is necessary to establish farmers cooperative having function of agricultural supporting services.

### 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 Tsh65,500 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 farm income for a typical household owning 1.29 ha is about Tsh.223,000, excluding off-farm income. Based on this figure and considering the regional poverty line of Tsh.262,395 for a household of 7 persons, it would be possible to say that the typical household in this area is suffering from poverty.

(2) Difficulties for Credit Access

- (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 government policy is to encourage the farmers to develop agriculture by themselves 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) Low Availability of Tractor and Limiting Factors for Tractor Operation

Tractor operation is required for ploughing work of paddy and maize cultivation in the project area. Demand of tractors is highly concentrated in October and November. Number of tractors which are available in and around the project area is quite limited. Through the interview survey of the study team, it seems that number of tractors which are available in neighbouring villages for land preparation in October and November are estimated at around a few.

Furthermore, there are some negative conditions to restrict the commitment of tractor for land preparation in the surrounding project area as follows:

- (a) Farmers' fields are small size and scattered. Considering the cost performance of tractor operation, tractor owners prefer to contract land preparation in the clustered fields.
- (b) Soil condition is quite tough for ploughing by tractors, although that condition is suitable for paddy cultivation.
- (c) Some fleet of tractors which is reported to be 15 to 20 tractors are deployed from Iringa area to Ifakara and surrounding area. Compared with the opportunity of land preparation between Ifakara and the Project area, cost performance of Ifakara area is higher than in the Project area, from the view point of distance. That is, tractor owners dispatch their tractors to the Project area before land preparation will be commenced in their own area during the period from January to February.
- (d) It is reported that there are some cases which size of the farmers' fields is misrepresented intentionally or accidentally to the tractor owners when land preparation is requested by the farmers. In that case, it is difficult to form a relationship of mutual trust between farmers and tractor owners, causing careless operation for land preparation or misunderstanding of mutual attitude.

Affecting the factors mentioned above, it is difficult for the farmers to expect land preparation in the proper season. Even if land preparation is done, ploughing is generally very shallow and rough because the tractor operators pay much attention to any damage in the tractors and cost performance, not quality of land preparation.

##### 2) Shortage of Certified Seeds

Farmers in the Project area select the seeds from their own farms by themselves, in order to secure seeds for the following cropping season. Crops concerned are paddy, maize, beans, etc. and some vegetables. Purchase of certified seeds for those crops are not so common. The reason is explained that the price of certified seeds is expensive for them and further supplied amount of certified seeds is not enough.

Regarding paddy, farmers have cultivated their preferable varieties such as "Supa India", "Kihogo Red", or other local varieties, although major variety is "Supa India". During rainy season, varieties of paddy are mixed due to the floods which bring seeds of other varieties from upstream farm. Main reason is that high percentage of shattered paddy grains is occurred during the former

ripening period due to the careless harvesting of over-ripened paddy.

For maize, although registered cultivars such as "Staha" and "TMV-1" are common among farmers, they produce seeds by themselves instead of purchase of the certified seeds. It seems that application of certified seeds is not so critical issue for them under the situation of prevailing extensive farming.

### 3) Unstable Supply of Fertilizer and Agro-Chemicals

Farmers concerned have complains about the expensive price and availability of fertilizer and agro-chemicals in and around the area due to lack of dealers or stockists. Regarding this area, traders who have dealt with fertilizer or agro-chemicals are only in the village, otherwise they have to go to stockists which are located in Kidatu or Ifakara town.

### 4) No Application of Fertilizer

As for paddy cultivation, no application of fertilizer is common in the Project area. It is mentioned that farmers are not keen to apply fertilizer because application of fertilizer causes lodging of rice plant during maturing stage and further farmers can not expect any positive effect of the application under seasonally habitual flooding condition during the rainy season. Actually, there are no research results concerning the effect of fertilizer application on lodging for "Supa India" which is a common variety in the Project area. As for maize, no application of either fertilizer or agro-chemicals is common in the Project area.

### 5) No Pre-selection of Seeds before Sowing

As for paddy cultivation, seed soaking is not common practice as a way of pre-selection of seeds. As seed selection by either fresh water or salt water is highly effective, seed selection is strongly required to get high rate of germination and healthy seedlings, aiming at the increment of the paddy productivity.

### 6) No Construction of Field Bund

Current paddy cultivation is relying on seasonal flooding condition. Therefore, it is not easy to drain water from paddy fields and also retain water in paddy fields. Major farmers are not aware of advantage of ridge formation.

### 7) High Shattering Rate on Harvesting

It seems that paddy is not harvested in the proper time. The reason might be that farmers themselves are not aware of proper harvesting time or they had some shortage of manpower on harvesting. The delay of harvesting causes high rate of shattering, the increase of cracked grains and decreases the grain quality.

### 8) Shortage of Knowledge on Proper Farming Practices

Farmers have cultivated such major crops as paddy, maize, 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 expect to cultivate pulse crops, especially beans, cowpeas,

etc. as food crops. Before and even now pulse crops have been cultivated, but sometimes flower shedding, pod dropping, damage by insects or diseases, etc. are occurred. As a result, cultivation of pulse crops has not been expanded. It is necessary to identify the reason why pulse crops is not cultivated well and demonstrate the proposed farming practices in order to promote the increment of production.

(2) Constraints and Problems in Irrigation Facilities

Existing problems and constraints for the Mkula scheme are summarized as follows:

- Limited water resources: The Mkula river water resources are limited in comparison with the extent of land resources along the Mkula river, which is utilized for crop cultivation under rainfed condition. Only a part of the area about 149 ha in net can be irrigated.
- Headworks : Water is leaking through the bottom of the fixed weir and the side channel spillway. Also, river water overflows through the existing intake and canal into the inland, when river water level rises by a flood due to the insufficient height of the inlet wall.
- Canals were not constructed and maintained well. No embankment are provided in elevated reaches of the flume section. Water leaks much in the downstream of the canal and thus the canal is abandoned without use in the downstream reaches.
- Low-lying basin situated in the central parts between the Mkula and Nyamigoli rivers is often inundated with water in the rainy season with no drainage facilities.