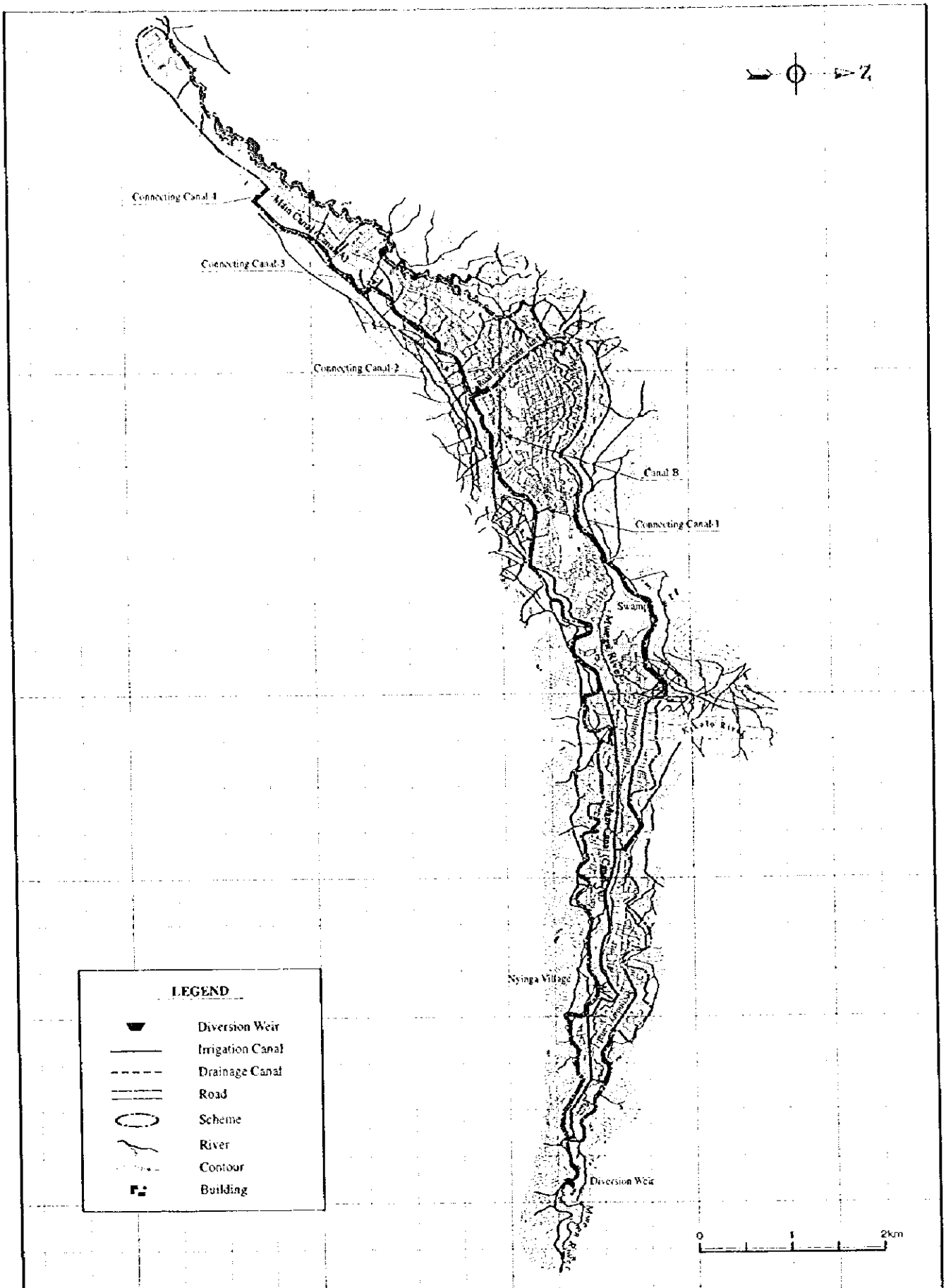
DIVISION - V

DEVELOPMENT PLAN OF MWEGA SCHEME KILOSA DISTRICT



General Layout Map of Mwega Scheme

DIVISION - V.

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

MWEGA SCHEME

TABLE OF CONTENTS

	Pages
GENERAL LAYOUT MAP OF MWEGA SCHEME	
CHAPTER I. PRESENT CONDITIONS OF THE SCHEME AREA	1
1.1 Physical Nature of the Study Area.....	1
1.1.1 Location	1
1.1.2 Topography and River System	1
1.1.3 Meteorology and Hydrology.....	2
1.1.4 Soils and Vegetation	3
1.2 Present Conditions of Socio-economy in the Study Area.....	5
1.2.1 Administrative Divisions, Public Administration and Demographic Data.....	5
1.2.2 Rural Infrastructure	8
1.2.3 Economic Activities.....	9
1.3 Present Conditions of Agriculture	9
1.3.1 Present Land Use	9
1.3.2 Land Ownership and Tenure System	10
1.3.3 Present Agricultural Production and Farming Practices	11
1.3.4 Activities of Agricultural Supporting Services.....	15
1.3.5 Marketing and Credits	16
1.4 Present Conditions of Irrigation Development	17
1.4.1 Existing Irrigation Schemes.....	17
1.4.2 Access Road.....	19
1.4.3 Irrigation Practices	20
1.5 Community Development and Activities.....	21
1.5.1 Organization of Village Community	21
1.5.2 Water Users' Group.....	22
1.5.3 Farmers' Co-operatives Society and Other Societies	24
1.5.4 Role of Women and Gender Groups in Farming and Community Activities.....	24
1.6 Assessment of Environmental Aspects.....	25
1.6.1 Natural Environment.....	25

Pages

1.6.2 Socio-economic Environment 26
1.6.3 On-going Actions/Program of the Environmental Conservation 27
1.6.4 Environmental Problems 27

CHAPTER II. DEVELOPMENT POTENTIAL AND CONSTRAINTS 29

2.1 Potential for Irrigated Agricultural Development 29
2.1.1 Land Resources 29
2.1.2 Water Resources 30
2.1.3 Human Resources 31
2.2 Problems and Constraints to Irrigated Agriculture Development 32
2.2.1 Social and Institutional Aspects 32
2.2.2 Financial Aspects 33
2.2.3 Technical Aspects 33

CHAPTER III. BASIC APPROACH TO THE PROJECT 37

3.1 Development Policy and Needs 37
3.1.1 Political Needs for Smallholder Irrigation Development 37
3.1.2 Development Needs and Wishes of Irrigation Beneficiaries 37
3.2 Basic Approach to the Project 38
3.2.1 Fundamental Objectives of the Project 38
3.2.2 Strategy and Development Framework 39
3.2.3 Basic Issue for Environmental Protection and Conservation 40
3.3 Land Use and Agricultural Production Plan 41
3.3.1 Land Use Plan 41
3.3.2 Selection of Proposed Crops 42
3.3.3 Proposed Cropping Pattern and Cultivated Area 44
3.3.4 Proposed Farming Practices 45
3.3.5 Anticipated Crop Yield and Production 49
3.4 Irrigation and Drainage Development Plan 49
3.4.1 Development Concept 49
3.4.2 Canal System Layout 51
3.4.3 Irrigation Water Requirement 52
3.4.4 Drainage Requirement and Flood Discharge 57
3.4.5 Engineering Design 59
3.4.6 Operation and Maintenance 63
3.5 Plan of Community Development and Reinforcement of Farmers' Organization 65
3.5.1 Water Users' Group 66
3.5.2 Women's Participation to Development 76
3.5.3 Training Program for WUG 76
3.5.4 Reinforcement Plan for Agricultural Extension Services 77
3.6 Environmental Conservation/Protection Plan 81
3.6.1 Environmental Impacts Assessment 81
3.6.2 Action Plan for Mitigation and/or Elimination of Negative Impacts 82
3.6.3 Monitoring Plan 83

Pages

CHAPTER IV. IMPLEMENTATION PLAN AND COST ESTIMATE..... 87

4.1 Construction Plan and Cost Estimate..... 87
4.1.1 Basic Consideration for Project Construction..... 87
4.1.2 Construction Schedule..... 87
4.1.3 Construction Plan..... 87
4.1.4 Cost estimate..... 88
4.2 Implementation Schedule on Institutional Work..... 91
4.2.1 Executing Agencies related to the Project Implementation..... 91
4.2.2 Organization for the Project Implementation..... 91
4.2.3 Organization and Schedule for Post-implementation of the Project. 92
4.2.4 Staff Required for Project Implementation..... 95

CHAPTER V EVALUATION OF THE SCHEME..... 99

5.1 Economic and Financial Evaluation..... 99
5.1.1 Economic and Financial Evaluation..... 99
5.1.2 Economic Evaluation..... 99
5.1.3 Financial Evaluation..... 100
5.2 Other Development Impacts..... 102
5.2.1 Engineering Aspects..... 102
5.2.2 Socio-economic Aspects..... 102
5.2.3 Institutional Aspects..... 103
5.2.4 Environmental Aspects..... 104

CHAPTER VI RECOMMENDATION TO PROJECT IMPLEMENTATION..... 105
6.1 Technical Aspects..... 105
6.2 Institutional Aspects..... 105

LIST OF TABLES

		Pages
Table 1.1.1	Physical Nature and Chemical Properties of Soils	T-1
Table 1.1.2	Physical Nature and Chemical Properties of Soils	T-2
Table 1.1.3	Description of Typical Soil Profile	T-3
Table 1.3.1	Present Farming Practices for Major Crops-Mwega Scheme	T-10
Table 1.3.2	Present Crop Budget for Major Crops in Mwega Scheme	T-11
Table 1.3.3	Annual Programme for Monthly Training Session for Kilosa District	T-12
Table 1.3.4	Target and Progress for Extension Services in Morogoro Region in 1996/97	T-13
Table 1.3.5	Retraining Programme of VEOs in Morogoro Region	T-14
Table 1.5.1	Present Condition for Water Users' Groups in Mwega Scheme	T-15
Table 1.5.2	Present Condition for O&M of Existing Irrigation Facilities - Mwega Scheme	T-17
Table 2.1.1	Criteria for Land Suitability Assessment for Irrigation Farming	T-22
Table 3.3.1	Outline of Group Discussion with Farmers	T-23
Table 3.3.2	Proposed Farming Practices in Mwega Scheme	T-27
Table 3.3.3	Schedule of Proposed Farming Practices by Crops	T-28
Table 3.3.4	Recommendable Agro-Chemicals by Crops	T-32
Table 3.3.5	Recommendable Application Rate of Agro-Chemicals by Crops	T-33
Table 3.3.6	Proposed Crop Budget for Major Crops in Mwega Scheme	T-34
Table 3.4.1	Unit Irrigation Water Requirement for Mwega Scheme	T-35
Table 3.5.1	Proposed Training Courses for O&M and Strengthening of WUG	T-38
Table 3.5.2	Training Schedule for Proposed Farming Practices by Crops in Mwega Scheme	T-39
Table 3.5.3	Training Plan for Farmers Concerned	T-41
Table 3.5.4	Schedule of Field Training for Proposed Farming Practices by Crops in Mwega Scheme	T-42
Table 3.5.5	Training Plan for DIVEO and VEOs Concerned	T-41
Table 4.1.1	List of Labor Cost	T-43
Table 4.1.2	List of Material Cost	T-43
Table 4.1.3	List of Machine Cost	T-43
Table 4.1.4	List of Unit Construction Cost	T-44
Table 4.1.5	Breakdown of Direct Construction Cost of Mwega Scheme	T-45
Table 5.1.1	Financial Crop Budget under the Present and Without-Project Condition in Mwega Scheme	T-47
Table 5.1.2	Financial Crop Budget under the With Project Condition in Mwega Scheme	T-48
Table 5.1.3	Economic Crop Budget under the Present and Without-Project Condition in Mwega Scheme	T-49
Table 5.1.4	Economic Crop budget under the With-Project Condition in Mwega Scheme	T-50
Table 5.1.5 (a)	Economic Farm Prices Calculation for Paddy	T-51
Table 5.1.5 (b)	Economic Farm Prices Calculation for Urea, TSP, SA	T-52
Table 5.1.6	Financial and Economic Prices of Inputs and Crops	T-53
Table 5.1.7	Calculation of Economic Net Benefit for Mwega Scheme	T-54

Pages

Table 5.1.8 Estimation of Costs for Economic Evaluation (Mwega)..... T-54
Table 5.1.9 EIRR Estimation for Mwega Scheme..... T-55
Table 5.1.10 (a) Sensitivity Analysis for Mwega Scheme..... T-56
Table 5.1.10 (b) Sensitivity Analysis for Mwega Scheme..... T-56
Table 5.1.10 (c) Sensitivity Analysis for Mwega Scheme..... T-56
Table 5.1.11 Calculation of Financial Net Benefit for Mwega Scheme..... T-57
Table 5.1.12 Estimation of Costs for Financial evaluation (Mwega)..... T-57
Table 5.1.13 FIRR Estimation for Mwega Scheme..... T-58
Table 5.1.14 Capacity-to-Pay Analysis for Mwega Scheme..... T-58

LIST OF FIGURES

Pages

Figure 1.3.1 Present and Proposed Cropping Pattern in Mwega Scheme F-1
Figure 1.3.2 Prevailing Structure of Extension Services under NAEP-II F-2
Figure 3.4.1 General Layout Map of Mzinga Canal and Mindu Canal (Mwega Scheme)..... F-3
Figure 3.4.2 Proposed Irrigation Diagram of Mwega Scheme F-4
Figure 3.4.3 Drainage Area of Small Streams in Mwega Scheme F-5
Figure 3.4.4 Mwega Headworks - general Drawing F-6
Figure 4.1.1 Proposed Construction Schedule in Mwega Scheme..... F-8
Figure 4.2.1 Proposed Organizational Structure and Staffing of the Morogoro Zonal Irrigation Office..... F-9
Figure 4.2.2 Implementation Schedule of Reinforcement Programme for Water Users' Group - Mwega Scheme F-10
Figure 4.2.3 Proposed Organizational Structure of the Offices of RALDO and DALDO F-11
Figure 4.2.4 Training Programme for Extension Staffs and Farmers F-12
Figure 4.2.5 Proposed Structure of Extension Services under NAEP-II F-13
Figure 5.1.1 Capacity-to-Pay Graphic Analysis..... F-14

CHAPTER 1. PRESENT CONDITIONS OF THE SCHEME AREA

1.1 Physical Nature of the Study Area

1.1.1 Location

Mwega scheme area is located in Kilosa District, Morogoro Region (See Location Map). It lies on a riverine terrace having an altitude range from 615 m to 535 m above sea level, The riverine terrace is formed by the Mwega river, which is one of the tributaries of the Great Ruaha. The area lies west of Morogoro city and is easily accessible by the highway A7 (200 km) and an earthen road (25 km).

1.1.2 Topography and River System

(1) Topography

The topography of the project area is characterized as a flat plain with an overall slope of 1 / 150 to 1 / 250 to the west in parallel to the Mwega river.

(2) River system

The Mwega river is a water source of Mwega scheme. It runs through the scheme area. Nyinga upper and middle areas are habitually inundated with flooding water from this river. In the reaches, the river has very small cross sectional dimensions of about 2.5 m in depth, 4 m in width and 1/2 in side slopes. The gradient is approximately 1 / 250. The river banks are densely covered by tall elephant grasses and the roughness coefficient is estimated to be high as 0.05 to 0.07. Under such current conditions, the river carrying capacity is limited to only at 11 to 12 m^3/sec against the flood discharge estimated at :

(a) 14 m^3/sec at 2 year return period
(b) 31 m^3/sec at 5 year return period
(c) 48 m^3/sec at 10 year return period
(d) 67 m^3/sec at 20 year return period

In the reaches in the Nyinga lower area, the river gradually increases in its depth to about 4 m depth immediately after the existing aqueduct crossing point in the middle reaches of the Mwega river. No flood usually occurs in this area, but the river banks are suffering from severe erosion due to fragile nature of soils and turbulent flood flow with steep river gradient.

After Kikalo river joins, the river again gradually becomes shallow and diverges to a few streams and forms a swamp in relatively large extent. On the main stream of the Mwega river, there are two concrete-made intakes so-called the intake A and the intake B. These are of fixed overflow weir type. In these reaches, the river frequently overflows its banks and these intakes also submerged during the flooding season. After passing the intake B, the river gradually deepen again, and increases its flood carrying capacity to its enough extent. There are no water users on this river other than Mwega scheme.

There are many small streams coming from the hills located in both sides of the Mwega river terrace. All the small streams flow only at the flood time. A stream flowing across Malolo settlement into the scheme area, so-called Mwagila river is the biggest amongst all and have a drainage area of 56 km2. This stream often damages the existing irrigation canals.

1.1.3 Meteorology and Hydrology

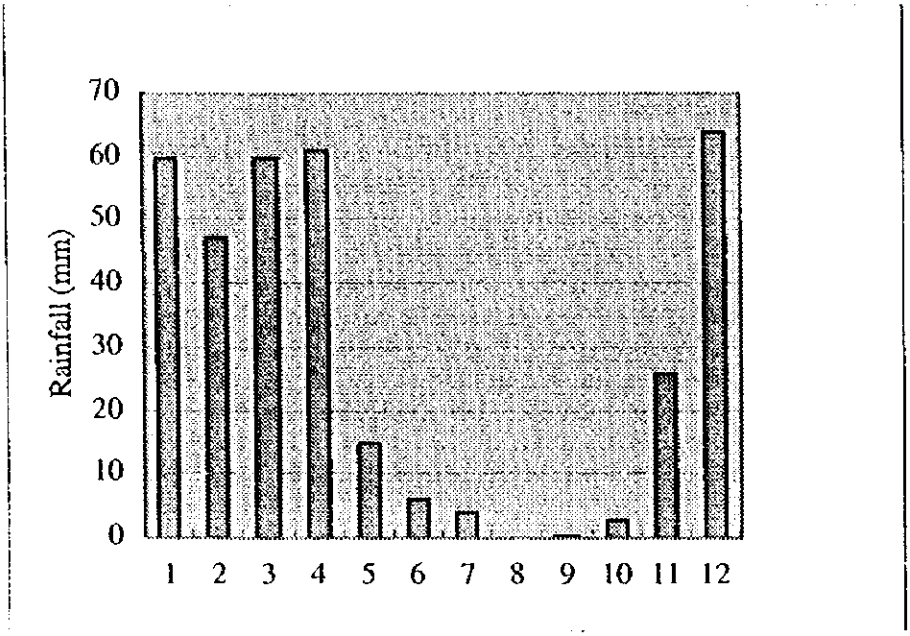
(1) Meteorology

(a) Rainfall

Annual rainfall in Mwega scheme is about 360 mm. The rainy season is usually from December to April, when monthly rainfall is around 60 mm, and the dry season is from May to November, when monthly rainfall is negligibly small.

Name of Scheme	Rainfall Station	Code Number	Annual Rainfall (mm)
Mwega scheme	Malolo station	963606	362

Mean Monthly Rainfall at Malolo station



(b) Other Climate Parameters

Meteorological data for Mwega scheme are available only in Ilonga meteorological station. These data are summarized in the following table.

Summary of Meteorological Data

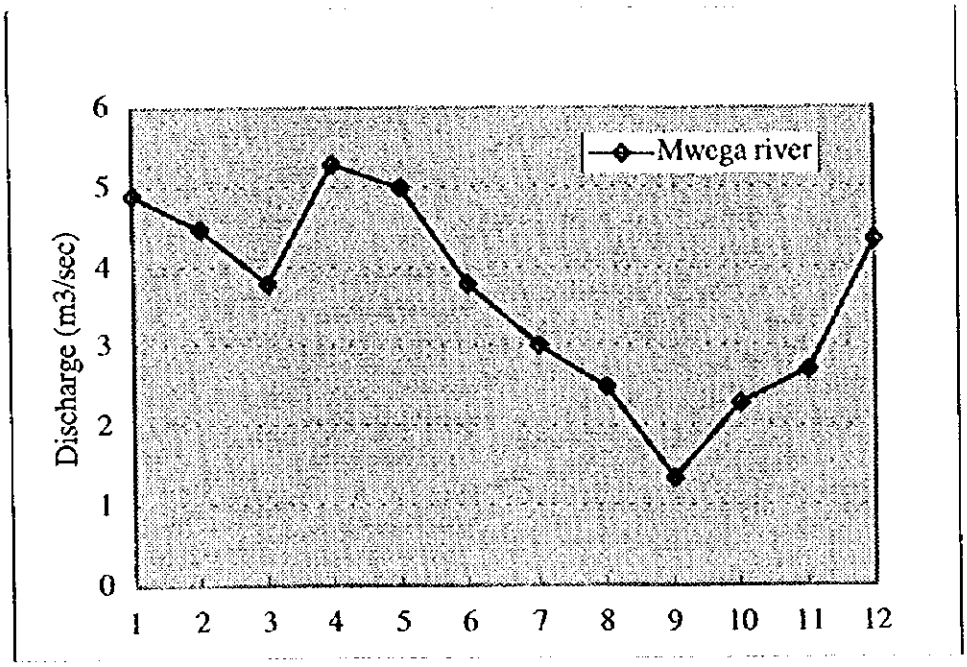
	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Mean
Ilonga Meteorological Station													
(1) Mean Maximum Temperature (C)	31.4	31.4	31.5	29.8	28.4	27.4	27.7	28.4	30.2	31.6	32.6	31.9	30.2
(2) Mean Minimum Temperature (C)	20.7	20.6	20.8	20.2	18.7	15.7	15.1	16.2	18.0	19.9	20.7	21.0	18.7
(3) Mean Temperature (C)	26.0	26.0	26.1	25.0	23.5	21.5	21.4	22.3	24.1	25.8	26.7	26.5	24.4
(4) Relative Humidity (%)	83.4	83.2	84.3	84.7	81.8	74.9	73.2	74.4	73.1	72.9	74.1	78.0	78.2
(5) Sunshine Duration (hr/day)	6.8	7.0	7.1	6.3	6.5	7.8	7.5	6.8	6.9	7.8	8.1	7.5	7.2
(6) Wind Velocity (m/s)	1.2	1.2	1.0	0.9	0.9	1.1	1.2	1.3	1.5	1.8	1.7	1.5	1.3
(7) Evaporation (mm/day)	5.7	6.7	5.5	4.0	3.1	3.1	3.4	4.0	5.6	6.4	6.7	6.2	5.0

Data available for 19 years.

(2) Hydrology

Estimated monthly mean discharges of the Mwega river at the most upstream of the scheme area are shown in the following figure.

Monthly Mean Discharge of Mwega River



The monthly mean river flow is 4 to 5 m^3/sec during the period from December to May and becomes the lowest of 1.9 m^3/sec in September.

Flood discharge of the Mwega river at the most upstream of the Mwega scheme area is estimated as follows:

Return Period	Probability Flood Discharge (m^3/sec)
10 year	48
20 year	67
50 year	99

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 Mwega 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 Mwega scheme are classified into three great soil groups, the Eutric Cambisols (CMe), Eutric Fluvisols (FLe) and Eutric Gleysols (GLe), and seven soil units (mapping unit 1 to 7) based on the soil-series. The soil map of Mwega scheme is as illustrated in Drawing No.501 in Drawings. The soil morphological characteristics and extent of each soil unit are tabulated as shown in Table 1.1.1 and summarized below:

Soils in the Mwega Scheme

Mapping Unit	Area (ha)	Soil unit	Land Form	Drainability	Soil Texture
Mwg-1	50	CMe(stony)	Colluvial slope	Excessive	L/SL
Mwg-2	165	FLe	Higher river terrace	Excessive	L~SL/SL
Mwg-3	25	FLe	Lower river terrace	Well	CL/CL
Mwg-4	160	FLe	Valley bottom	Well	SL/SL
Mwg-5	50	FLe	Valley bottom	Imperfect	CL/SCL
Mwg-6	235	FLe	Valley bottom	Poor	L~SL/SL
Mwg-7	55	GLe	Valley bottom swamp	Very poor	CL/CL~SiL
(Total)	740				

The soils of Mwg-1 are mainly extended on the colluvial fans developed at the mountain foot as well as old river terraces. The proportional extent of these soils is estimated to be 50 ha or 7% of the gross scheme area. The land has a gently undulating topography, and at present, cultivated extensively with upland crops under irrigated conditions. The soils have generally shallow profile underlain by the base-rock. Almost all the soils are moderate to coarse in texture, many gravel and stones, well drainability and low fertility.

The soils of Mwg-2 and Mwg-3 develop over the riverine terraces. Those proportional extents are to be 165 ha (22%) and 25 ha (3%), respectively. The soils of Mwg-2 are loamy to sandy loam in texture, while an effective soil depth is deeper than 1.5 m, a gentle-cum-single slope ranging at 2 - 3%, well drainability and moderately to low fertility. In contrast, the soils of Mwg-3 are clay loam in texture through over the profile, flat or almost flat in topography, well drainability, and relatively high inherent fertility. The land of both soils has been well reclaimed since long time years ago and cultivated with the upland crops, maize, onion, etc. under irrigated conditions.

The soils of Mwg-4, Mwg-5 and Mwg-6 develop entirely over the alluvial plain in valley bottom of the Mwega river. These soils are all derived from the recent alluvium deposits by the Mwega river, and accordingly, relatively fertile in most cases. These soils are differentiated each other according to the morphological features, *i.e.* texture, depth of profile, occurrence of the seasonal flooding and/or drainability. The soils of Mwg-4 are being extensively cultivated with the upland crops under well drained and irrigated conditions. The land of this soil unit is always free from the seasonal flooding, moderately fertile, sandy loam in texture, and moderately deep soil profile. The soils of Mwg-5 are also cultivated well with the upland crops under irrigated conditions and/or partly grow paddy where the land is imperfectly drained in the rainy season. The area of this soil unit is also free from the seasonal flooding. The soils are clay loam in texture throughout deep profile and relatively high inherent fertility. The soils of Mwg-6 are poorly drained due to low-lying topography, and accordingly, frequently affected by the seasonal flooding from the Mwega river in the rainy season. The soils are sandy loam in texture, moderate fertility and moderately deep soil profile. The land of this soil unit is cultivated with paddy in the wet season as much as using the seasonal flood-water and supplemented by irrigation whenever drought. In the dry season, the land also used for production of the upland crops under fully irrigated conditions. The proportional extents of each soils are to be 160 ha (22%), 50 ha (7%), and 235 ha (32%), respectively.

The soils of Mwg-7 are the typical Eutric Gleysols which develop under swampy and/or submerged conditions in the rainy season, while an extremely shallow groundwater table even in the dry season. The land of this soil unit is left fallow from any land use, and being covered with dense tall grasses (elephant grass).

The chemical properties and physical natures of the above soils are as shown in Table 1.1.2.

Surrounding the Scheme area, the land is being covered by baobab trees, cactus and thorny shrubs (mostly acacia species) under semi-arid climatic conditions.

1.2 Present Conditions of Socio-economy in the Study Area

1.2.1 Administrative Divisions, Public Administration and Demographic Data

(1) Administrative Division

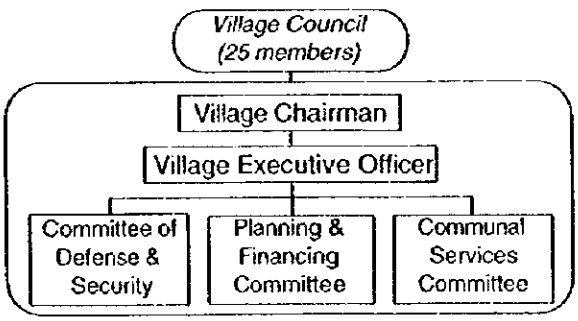
SCHEME	DISTRICT	DIVISION	WARD	VILLAGE
Mwega	Kilosa	Mikumi	Malolo	Malolo
		Mikumi	Malolo	Mgogozi

(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.

Administrative Division and Population (1996)

Scheme	District	Division	Ward	Villages	Population	Household
Mwega	Kilosa	Mikumi	Malolo	Malolo	3,800	476
				Mgogozi	1,265	211
				Nyinga	200	50

Note : Considering only Malolo and Mgogozi Villages
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 Mgongola 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
Mwega	Malolo	3,800	799	723	1,558	608	113
	Mgogozi	1,265	342	258	431	151	88

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.
Mwega	Malolo	21	19	57	3
	Mgogozi	27	20	46	7

The data above shows that the ratio working population/total population is high showing that labour force will be available for the implementation of the Project. However, it must be mentioned that even with this high proportion of working age population, during the peak time of the harvesting season, estra labour is required to be hired from nearby villages.

1.2.2 Rural Infrastructure

(1) Roads

An access road to Malolo village branches off from the highway A7 at about 500m, Mikumi side, from the bridge crossing the Great Ruaha river. This access road is used to reach Malolo and Mgogozi villages. It is an earthen road relatively well maintained owing to the covering of the road surface by in-situ sand, which may be naturally formed by the fine soils naturally blown off from the weathered surface. The length is about 25 km from the A7 highway to Malolo village.

The road from Malolo village to Mgogozi village runs northward across the Mwega river. The road is deeply pitted by erosion and heavy traffic with weak foundation and water leaking from irrigation canals running along the road. A wooden bridge on the Mwega river that was used to connect both villages collapsed in 1997 making it difficult the transit between the two villages. From the collapsed bridge, the road branches off to Mgogozi village. The road to Mgogozi runs westward along the Mwega river about 3.5 km and then runs gradually turning left to northward about 1.5 km up to Mgogozi village center.

(2) Basic Services

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

Basic Services in the Villages

Scheme	Village	Electricity	Water Supply
Mwega	Malolo	Non available	River water
	Mgogozi	Non available	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
Mwega	Malolo	1	2	4	1
	Mgogozi	1	-	1	1

Source : Data from Ward Executive, Village Executive Officer, Village

For the case of the school in Malolo village, the physical infrastructure for the school is not big enough to receive all the students wanting to attend school.

The staff of the dispensaries usually consists of a medical assistant and/or registered nurse. For cases requiring a better equipment and staff, the patient must be taken to an urban center to be attended there.

(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 + Maize)
Mwega	Malolo	2	4	7	-
	Mgogozi	-	-	1	1

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

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 in the villages are engaged in agricultural-related activities.

At the villages, the processing activities for agricultural products are mostly centered on two main activities: milling of basic grains and local brew preparation from maize. The former activity is carried out at small-capacity mills, which are aimed to satisfy local demand for milling; there is no big-scale milling facility at or close to the villages. The latter activity is usually carried out at a domestic level and usually women are in charge of it; this activity is, on one hand, an important off-farm source of income for some families, and on the other hand, is a stable source of income for the village authorities.

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 at market stalls during the market days and hiring themselves as labor to third parties.

Concerning the last activity mentioned above, in Malolo, there is a seasonal labor shortage during the harvesting season. This shortage has to be satisfied with labor coming from Ilonga region in the case of Malolo. Seasonal employment becomes an important source of income specially for young villagers who do not posses lands of their own and have to supplement the income received from working at their families' fields by hiring themselves to third parties.

1.3 Present Conditions of Agriculture

1.3.1 Present Land Use

The present land use is classified into five units, i.e. 1) cultivated land; 2) forest/wood land including tree plantation; 3) grassland including scarce bushes and shrubs; 4) swamp and water surface like rivers; and 5) settlement area including right of ways such as roads and canals. The cultivated land is further classified into two sub-types, i.e. 1-a) paddy field and 1-b) upland 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. 502 of the Drawings. The extent area by land units is summarized as follows:

Present Land Use in Mwega Scheme

(Unit: ha)

Name of Sub-scheme	Cultivated Land			Grass-land	Forest/ Woodland	Swamp/ Rivers	Settle-ment	Total
	Paddy	Upland	Subtotal					
Malolo	118	266	384	0	27	29	40	480
Mgogozi	16	20	36	27	3	30	4	100
Nyinga	76	54	130	8	5	6	11	160
(Total)	210	340	550	35	35	65	55	740

The land of Mwega scheme has been almost all reclaimed as the farm land with development of the traditional irrigation furrow systems. The farm land occupies 550 ha or 74% of the total scheme area. Out of the total farm land, 210 ha is being used for paddy production, while the remaining of 340 ha is for upland crop cultivation in the rainy season. The paddy field is mostly extended along the middle and upper reaches of Mwega river. Paddy cultivation in the rainy season is in most cases fed by use of the seasonal flood-water and supplemented by the irrigation water as required. In the paddy field, farmers grow beans and onion in the dry season under fully irrigated conditions.

At the area of the lower reaches of Mwega river, the most land is used as the upland field since the land is free from the seasonal flooding, and the existing traditional furrow is not well functioning for maintaining paddy cultivation due to shortage of irrigation water. Maize is the predominant crop in the rainy season. Beans or onion are also grown under irrigated conditions in the dry season, but those are still limited to small extent.

The grassland is extended both sides of the upper reaches of canal from the Malolo intake-A. The proportional extent of this pasture land is about 35 ha or 5% of the total scheme area. The land is generally inundated at the depth around 30 cm in the rainy season, while used by the villagers for grazing of cattle and goats in the dry season.

The wood lands including patchy small plantation of mango and banana occupy 35 ha or 5%. The swamps and river surface occupy 65 ha or 9%. The largest swamp which is formed as a back-swamp and covers by dense-cum-tall grasses, lies at both banks of the middle reaches of the Mwega river. The land used for infrastructure settlement, *i.e.* the right of ways of irrigation canals, the existing roads and house yards, etc. is totaled about 55 ha in the entire scheme 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.

The JICA Study Team has estimated that the average landholding size per farm household for Mkula is 1.28 ha (rainfed plus irrigated areas). It has been estimated that 0.79 ha is within the irrigated area.

Landholding Size

Basic Information	Mwega
Number of housholds	686
Cultivated Area (ha)	
In the whole village	878
In the Study Area	580
Holding Size (ha)	
In the whole village	1.28
In the Study Area	0.79

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 land holding size estimated from the informal survey is approximately 0.79 ha. This data will be used as a reference for the average land holding size within the Study Area.

The frequency distribution of land size holding in percentage terms is given below. The result shows a concentration in the range of 0.4 ha to 0.8 ha.

Frequency Distribution of Land Size Holdings in Percentage Terms

0 to <0.4 ha	2
0.4 to <0.8 ha	56
0.8 to <1.2 ha	24
1.2 to <1.6 ha	11
1.6 to 2 ha	4
2 to <4 ha	3
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 and Farming Practices

(1) Cropping Pattern

Agricultural activities in the Mwega scheme predominantly contain onion cultivation under irrigation condition in the dry season, while paddy cultivation is carried out in the rainy season by using seasonal flooding.

Cultivation season of onion is different as to the topographic condition of the fields as well as irrigation systems. Namely, in the lower part of the scheme which is belong to Malolo area, onion is cultivated during the period from middle of March to late of September after harvesting maize, avoiding the high soil moisture in the rainy season and flooding condition during April.. On the other, in the upper part of the scheme which is belong to Mgogozi-Mwega and Nyinga area, onion is cultivated during the period from middle of May to late of November after harvesting paddy, avoiding the excess water from the Mwega river during the rainy season.

Area for paddy cultivation is composed of central part of the scheme which is lower side topographically and upper stream area of the scheme which is relatively elevated area. Basically, paddy cultivation rely on the seasonal flooding during the rainy season. Present situation on major farming activities for paddy cultivation has no more difference than onion cultivation. Namely, no farmers rely on working cattle and tractors for land preparation as well as transport of products.

Present cropping pattern in the scheme is shown in Figure 1.3.1.

(2) Farming Practices

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

1) Onion

(a) Land preparation

Land preparation is manually carried out by using hand hoe. Draught cattle are not in common, though cattle is kept by some farmers. While, no tractors for farming practices are available in the area and not hired from outside. Generally, man-power for land preparation which is most laborious activities relies on seasonal labours. Seasonal labours are relatively available from the adjacent regions, that is Dodoma and Iringa. Common land preparation in this area consists of ploughing and harrowing, but not so thoroughly completed.

Ridge formation for planting beds is not required due to high water permeability of sandy loam soil. That is, planting beds are just surrounded by small band in order to preserve irrigation water. The ordinary size of a planting bed is estimated at around 4 m long x 2 m wide and hereby around 400 planting beds are required for one acre of the main field.

(b) Nursery Preparation

Nursery area is surrounded by small band, in order to preserve irrigated water. Ridge is not necessary for seed bed. Seed amount is estimated at around 5 to 6 kg for one acre. Its required nursery size is around 600 m^2 for one ha of the main field. Common variety in the scheme is "Red Creole". It is noted that "Red Creole" is relatively flat shape, compact, durable in transit, compared with "Red Bombay". Concerning seeds, some farmers generally multiply by themselves, while some farmers relied on the market seeds which are multiplied by seed farmers in Arusha of Kilimanjaro Region. Nursery period to be required is estimated around one and half month (40 to 45 days).

(c) Transplanting

Planting density is in the range between 10 cm x 10 cm and 10 cm x 20 cm. Transplanting to the main field is done when the seedlings attain pencil thickness.

(d) Application of fertilizer

Application of fertilizer is a common activity in the scheme. In the nursery, a little amount of SA is applied around 2 weeks after sowing. As for

basal dressing, 50 kg of SA or Urea is generally applied 3 to 4 weeks after transplanting. Further, 50 kg of CAN is applied as 1st top-dressing 3 to 4 weeks after basal dressing. Fertilizer is applied in the surface of field and incorporated with soil by using small hand hoe.

(e) Plant protection and weeding

Thrip is recognized as a dominant insect. Farmers apply 1 liter of Sumithion, splitting 2 times.

Weeding is manually carried out once or twice during the whole planting time, by using small hand hoe or uprooting.

f) Water management

Irrigation is supplied 2 to 3 times a week, depending on the soil condition. During the peak season for irrigation requirement, that is during the period from July to September, irrigation is often limited in around 30 minutes for each farmer.

(g) Harvesting

Harvesting is carried out when the neck of plant dries. After picking them up, onion bulbs are dried in the field for 1 or 2 days. Generally, farmers do not store harvested onions until the price will be raised up, but sell them to traders as early as they are available, while there are some cases which traders directly come to farmers' fields and purchase all the harvested onions.

2) Paddy

(a) Land preparation

Present situation on land preparation for paddy cultivation has no more difference than onion cultivation. Land preparation is manually done by using hand hoe, but neither tractor nor working cattle are not available. Labour for land preparation is arranged from family, while seasonal labours are also expected to make up for the lack of man-power of family labour.

(b) Planting

Transplanting is a mostly common practice, while broadcasting is also applied in some part. Seeds are multiplied by farmers themselves, not renewed by the certified seeds. Normally, one seedling per hill is transplanted with range between 10 cm x 10 cm and 10 cm x 20 cm. Major cultivar is "Supa India", while other local varieties are also cultivated by some farmers. As a result, some farmers have complains concerning seed contamination. That is, "Supa India" has been mixed up with other varieties, because seeds of other varieties are flown into from other fields by flooding.

(c) Harvesting

Growth period of "Supa India" is estimated at around 150 days in the area. Harvesting work is commenced during the period from the beginning of April to beginning of May when grains are completely dried. Drying activity after reaping is not so common. After reaping, paddy grains are con-

sequently threshed, winnowed, and bagged immediately in the field. Bags of harvested paddy are carried to farmers house by themselves or hired persons, using bicycle or manpower. Harvested paddy is soon sold whenever traders are available.

3) Maize

(a) Land preparation of the main field

Present situation on land preparation for paddy cultivation has no more difference than onion and paddy cultivation. Similarly, land preparation is manually done by using hand hoe, but neither tractor nor working cattle are not available. Labour for land preparation is arranged from family, while seasonally hired labours are also expected to make up for the lack of man-power of family labour. Ridge is formed for irrigation.

(b) Major farming practices in the main field

Maize is mainly cultivated by means of ridge culture under irrigation condition during the rainy season in the elevated area, but not in the lower area. 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. 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. Intercropping with maize and legumes is commonly carried out.

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

(3) Crop Production

Unit yield of major crops in the Mwega scheme is confirmed based on the result of Master Plan study last year and field investigation this years.

In case of major food crops such as paddy, maize, pulse crops, etc., no application of fertilizer and agro-chemicals is common in the area. As for seeds, farmers do seed multiplication by themselves rather than purchase of qualified expensive seeds.

On the other farmers who cultivate onion generally apply traditional irrigation method and desire some assistance concerning application of fertilizer, agro-chemicals for improvement of crop productivity, and effective irrigation method. Further, they have tried to obtain some qualified seeds which ensure a certain quality and productivity, although it is expensive or often not easy to obtain them in time. Furthermore, the quality of those seeds are not unified in some cases.

It seems that crop productivity in the area is still in low level and unit yield of major crops is estimated considering the result of additional field investigation as well as statistical data as below.

In case of major food crops such as paddy, maize, pulse, etc., no application of fertilizer and agro-chemicals is common in the area. As for seeds, farmers do seed multiplication by themselves rather than purchase of qualified expensive seeds.

Concerning onion cultivation, farmers have striven to apply commercial seeds which is able to purchase from seed farmers in Arusha. However, those seeds are not inspected and certified by authorized institute such as Tanzania Seed Certification Agency (TOSCA). Some seeds are contaminated with other varieties or the quality of seeds is deteriorated.

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

Present Crop Cultivation in Mwega Scheme

	Cultivated Area (ha)		Unit Yield	Crop Production (ton)		
	RS*1	DS*2	(ton/ha)	RS	DS	Total
Paddy	210	0	2.0	420	0	420
Maize / Pulse*3	266	114	1.5	399	171	570
Pulse	0	70		0	56	56
Onion	0	182	0.8	0	1,820	1,820
Total	476	366				

*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 limited for farmers concerned in the Project area, that is it is reported that around 200 heads of cattle is just kept by around 10 farmers Such small livestock as chicken, goats, etc. are raised for home consumption. While inland fishery is not available in the Project area. Livestock population in the village is summarized as follows;

1.3.4 Activities of Agricultural Supporting Services

(1) Extension Services Concerned in 1996/97 for Kilosa 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, 65 of VEOs are available in 132 villages of the whole Morogoro District. Out of 65 VEOs, 38 VEOs attended retraining programme of crop production or livestock by 1996/97. Moreover, during this fiscal year of 1997/98, 12 VEOs are required to attend the programme. Remaining 15 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 Malolo and Mgogozi 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 no programme by means of management of adoption plots for agricultural activities during last physical year due to lack of financial budget. However, it is possible to disseminate available improved technology to general farmers under the proper situation. For instance, VEO transferred advanced technology concerning paddy cultivation which was disseminated through the programme of the Monthly Training Session for VEOs, therefore transplanting method of paddy cultivation has been adopted in this scheme.

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.

For the case of Mwega scheme, where paddy, maize, onions, tomato and beans are the main crops, 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.

(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 difficult 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

Mwega Scheme constitutes three sub-schemes with adjoining land namely Nyinga, Mgogozi-Mwega, and Malolo Schemes. All principally abstract water from the Mwega river and hence the name Mwega Scheme.

(1) Nyinga sub-scheme

There exist three intakes all diverting water from the Mwega river. The first and third ones from the upstream are serving the left bank area of the Mwega river and the middle intake is serving the right bank area. All the intakes are simply made of earth, stones and wooden works. The first intake herein referred to as "the upper Nyinga intake" is located in the concave side of the river, where the river width and depth from the bank crest are 15 m and 1.5 m, respectively. Gabion works are used for raising river water level. There is a canal bank-cutting portion at about 70 m downstream of the canal from the intake site, through which a lot of water diverted returns back to the river, and the remaining water goes down to the irrigable land. It appears that the bank-cutting portion was provided to drain the excess water from the free intake. The canal almost runs alongside the existing access road for about 1.5 km from the intake site. The commanding area is a narrow strip of about 21 ha in gross extending between Mwega river and the canal.

The second intake herein referred to "the middle Nyinga" is located on the right concave side of the river, where a spur is close to the left bank and the right is flood plain. The river width and depth from the bank crest are 8 m and 1.2 m, respectively. The water level for irrigation is raised to about 0.4m by damming up using earth bags and wooden works and diverted through a free intake to an earthen canal . The river freeboard is only 40 to 50 cm in front of the dammed-up portion. The canal runs along the river for about 60 m and then turns right-angled to the right. The commanding area of about 30 ha in gross lies in the right bank of the river. This area is mainly cultivated with paddy in the rainy season.

The third intake, herein referred as, "the lower Nyinga" intake is located on the left concave side of the river about 300m downstream of the middle intake. This intake was newly constructed by farmers in 1994 with an earthen canal at about 2.5 km upstream of a former intake. The former intake was completely washed away during the rainy season in 1993. The river width and depth from the bank crest at this new site are 5 m and 2 m respectively. Water is dammed up by using earth bags and wooden works and diverted to the canal through a free intake. The canal was newly constructed along 2.5 km and thereafter connects with the old canal system. The gross area commended by this canal is about 74 ha on the left bank of the river. In addition, this system is serving a part of Mgogozi-Mwega scheme as explained below.

(2) Mgogozi-Mwega sub-scheme

A free intake serving the Mgogozi-Mwega area was completely washed away by a seasonal flood in 1995 rendering Mgogozi-Mwega scheme to suffer from acute water shortage. In and around the ruined intake site, the river meanders with a steep river gradi-

ent and is heavily eroded in the concave sides where the river bank slopes down almost vertically. The river depth from the river crest of the left bank is about 4 to 5 m and river width is 20 to 25 m. This site is no longer suitable for construction of a new one.

The situation of acute water shortage without irrigation water was partly improved by an aqueduct constructed by the assistance of TIP across the Mwega river in 1996. The aqueduct is located at about 300 m upstream of the former intake site or about 1.2 km downstream of the newly constructed lower Nyinga intake. The site is formed with rock in the river bed. The aqueduct consists of a 30 cm PVC pipe supported by concrete piers and is supplying irrigation water coming from the lower Nyinga intake. The conveyance capacity seems to be insufficient to cover all the Mgogozi Mwega area of 60 ha in gross. The area of downstream half of the Mgogozi-Mwega area has no irrigation water at present due to no crossing structure on the Kikalo river.

(3) Malolo sub-scheme

There are two irrigation systems, herein referred as Malolo intake -A system and Malolo intake -B system.

(a) Malolo A - system.

The Malolo intake -A is located at about 1.5 km upstream of the Malolo intake B. The site is located in a seasonal swampy area composed of sandy soil. The two diversion canals which were dug during the headworks construction are still functioning. The weir/intake was built with concrete in 1972 together with the intake B. The intake -A consists of an overflow weir and an intake. The crest length of the overflow weir is only 5 m. Apparently intake A suffers from sand sedimentation. It is estimated that the river bed had been raised by about 1m in both downstream and upstream reaches of the weir, almost equal to the adjacent field height in the upstream of the weir at present. The sedimentation process may be amplified by the damming effect of the intake weir of Malolo intake-B. The free-board of the river banks is about 0.5m only even in the dry season. Due to this phenomenon and with an insufficient crest length of the weir, the river water often overflows the whole structure and beyond in the rainy season, and therefore it is highly apprehensive that the present river course may be changed easily in near future, even by consecutive common floods. The intake is free intake type and thus diversion discharge largely depends on the river water level.

The main canal of the Malolo A system, here in referred to as " the canal-A", conveys diverted water to the left river terrace. At a point of 70m downstream a major canal so-called the Church Canal branches off from the canal-A and runs almost parallel with it for about 300m. It conveys water to the church farm in Malolo Village. The earth embankment separating both canals is very thin within the parallel reaches where a big amount of water leakage was encountered from the church canal to the canal -A. However, at the end of 1996 the church canal was lined with stone masonry thus eliminating the leakage problem.

The canal-A is earthen canal type, about 9 km in total length and commanding 167 ha in gross. In several places the canal has steep longitudinal slopes, where it has been deeply eroded by high flow velocity. Also the canal banks are too low or has insufficient freeboard in many portions where water easily overflows. The canal is often damaged by flood water coming from the hill side in the reaches of Malolo settlement, where a super passage of flood is available but it seems to be too small against flood flow.

(b) Malolo B-system

The intake site is located at the edge of seasonal swamp, which is always, more or less, inundated with flooding water of the Mwega river in the mid rainy season. The headworks consists of a fixed weir and two intakes such as the right and left intakes for diverting water separately to the right and left river terraces. These were built by use of concrete in 1972 and are still functioning. The fixed weir has a crest length of only 5 m. It dams up river water by about 1m. The presence of the weir has manifested sand sedimentation of about 1 m in thickness in the upstream reaches and probably affected to the submerged condition of Malolo Intake A. The original right intake was buried with sediment and replaced with the present one built at about 20 m upstream of the original inlet point. The intake is a free flow type. The left intake is equipped with a stoplog guide. They are diverting water to the irrigable area without control of the discharge or in the other words, the diversion discharge largely depends on the river water level.

The left main canal, herein referred as "the canal-B" conveys water to the left river terrace together with another major canal branching off from the canal-B, hereinafter refereed as "the canal-C." The canal-B and C have a length of about 8 km and 2 km, respectively. Both canals command the irrigable area of about 250 ha in gross.

A right main canal, herein refereed as "the canal-D" irrigates the right river terrace of about 60 ha in gross. Its length is about 3 km. All the canals B, C and D are earthen type.

During the rainy season, irrigation is not essentially required due to the habitual flooding as well as high groundwater table in the upper and middle part of Malolo area. Moreover, these areas suffer from the uncontrolled excess water, which is mainly caused by overflow from the Mwega river and non control of water coming into the canal systems through the intake-A and B. Conversely in the downstream area, irrigation is surely required even in the rainy season.

During the dry season, the major canals convey water more than irrigation water demands. Farmers usually take water at any time whenever they want in the upstream and middle areas of Malolo scheme. On the other hand, the downstream area always suffers from the shortage of irrigation water due to high water losses from canals A and B at their upstream and middle reaches, which are caused by poor maintenance and operation.

1.4.2 Access Road

From the highway A7, an access road to Malolo village branches off from the highway A7 at about 500 m Mikumi side from the bridge crossing the Great Ruaha river. This access road is serving the four schemes such as Malolo, Nyinga, Mgogozi, and Chabi schemes. It is an earthen road relatively maintained well owing to the covering of the road surface by in si-tu sand, which may be naturally formed by that fine soils are naturally blown off from the weathered surface. The length is about 25 km from the A7 highway to Malolo village. The road crosses several seasonal streams.

From Malolo village to the Nyinga scheme area, a jeepable road is available. This local road runs along the foot of hills in the south of the Mwega river so as to avoid the flooding river terrace. The road length from the center of Malolo village to the most upstream of the Nyinga scheme area where a free intake is located is about 9 km. The road is ups and downs according to the hilly topography in about two third section and the remaining most upstream section runs smoothly just the border between the hill and the

Nyinga river terrace. The up-down section gets dilapidated by erosion. Concrete barrels of a canal coming from the Malolo A intake are exposed and projected by soil erosion.

The road from Malolo village to Chabi and Mgogozi villages runs northward across the Mwega river in the river terrace in about 1.0 km section, where the road is deeply pitted by erosion and heavy traffic with weak foundation and water leaking from irrigation canals running along the road. A bridge on the Mwega river is of a net single span of 12 m. The superstructure is temporarily made of wood. Heavy traffic is always exposed to the danger of collapse in such a structure. The abutments are made of stone masonry. Then after crossing the Mwega river, the road branches off to both Chabi in left and Mgogozi in right.

1.4.3 Irrigation Practices

(1) Conveyance system

(a) Nyinga area

All the intakes such as the upper Nyinga, the middle Nyinga, and the lower Nyinga divert water all day long without control the flow discharge and diverted water is continuously conveyed through canals.

Farmers can take water from the canal twice a week in their rule in the upper Nyinga area. But, they usually take water at any time except the time of severe drought. At severe drought time when water is insufficient, water is distributed in accordance with irrigation rotation schedule determined by the beneficiaries. In the middle Nyinga area, farmers usually take water flowing through the canal into their fields at day time in accordance with water allocation schedule determined by a group leader, although it can be taken freely at night time. As for the area served by the lower Nyinga intake, the area is divided into four blocks, and the blocks alternatively take water for three days.

The intake is rehabilitated every year usually prior to the dry season as communal works of beneficiaries. Absentees are punished with a fine. The main canal is being kept clean by de-silting, reshaping, and weeds removal by all the farmers in the canal reaches leading and bordering to their plots.

(b) Malolo area

As previously explained, the intake A and B divert water without discharge control. Area commanded by the irrigation canal A and B are divided into seven blocks, among which rotational irrigation is practiced at seven day interval. Generally a farmer takes water once a week and its irrigation duration differs depending on the farm size and kind of crops and the growing stage.

(c) Mgogozi-Mwega area

Irrigation water is continuously conveyed to the Mgogozi-Mwega area through the aqueduct passing over the Mwega river from the lower Nyinga intake since 1996.

(2) On-farm irrigation practices

Irrigation water application is usually made in the daytime, and also in case of water shortage, even in the night time. Irrigation water is diverted from a major canal to a field ditch or directly to the field through a simple earth turnout, which is just a soil clod

blocking water on the main canal or just a canal-bank cutting thus allowing water to be diverted. Diverted water is conveyed and eventually spread to a series of small rectangular basins. The water supply to these basins is such that water is first admitted to the first basin, once this first basin is satisfied, the first inlet is closed and the second inlet is opened for supplying the second basin. This process goes on until all such basins are saturated. In areas where basins are arranged on a uniform sloping land, a cascade water supply through a series of basins is also observed.

1.5 Community Development and Activities

1.5.1 Organization of Village Community

The villages in the project area have a well matured community with a good social norms of life, even thought the village's population consists of various tribes such as Sagara and Hehe, as shown in the following table.

(As of September 1996)

		Mwega		
Administrative Division	- District - Division - Ward - Village	Kilosa Mikumi Malolo		
		Nyinga *1	Malolo	Mgogozi
Population		(200) *1	3,800	1,270
Household		(50) *1	480	210
Tribes			Sagara 68%, Hehe 20%, Gogo & Others 12%	Sagara 85%, Hehe 10%, Gogo 2%, Others 3%
Village Extension Officer		-	1	-
Irrigation Technician		-	1 *2	-
Eelectric Supply		-	-	-
Domestic Water Supply		River	Well/River	River
Fuel for Cooking		Fuel Wood	Fuel Wood	Fuel Wood

*1 Sub-village of Malolo. Numbers of population and household in Nyinga are included in Malolo.
*2 Irrigation technician under TIP
Source: Information and data obtained from ward executive officer, village executive officer, village extension officer and farmers.

Most of the troubles and/or problems among the villages 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.

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. 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. It will be expected to establish farmers' organization functioning well in these villages.

1.5.2 Water Users' Group

There are 8 WUGs in Mwega scheme. Their present conditions are summarised hereinafter, and the details are shown in Tables 1.5.1 and 1.5.2.

(1) Upper Nyinga

The irrigation facilities of Upper Nyinga was constructed before the 1920s, and completely damaged by the flood in the 1920s. In the 1940s, the canal was reconstructed by the farmers. WUG of consists of only 9 farmers including a chairman. WUG has no rotational irrigation. Namely, water allocation is decided by the leader, and any farmer can take water at any time, under the approval of the leader. In general, a farmer takes water twice a week. All canals and intake weir are maintained by the farmers' communal work which consists of 1-2 times per year and 5 days per one time. WUG collects one chicken/person from absentees of the communal work.

(2) Middle Nyinga

The irrigation facilities were constructed by the farmers in the 1980s. The number of farmers is estimated to be 40 excluding Mgogozi farmers. The organizational structure of WUG's committee consists of a chairman, a secretary, and 2 block leaders. Farmers are divided into 2 blocks. Each block takes water for 3 days, and the remaining one day is free to all farmers. Within a block, water allocation is decided by the block leader, considering the crops, farm size and soils. Irrigation is carried out only in the daytime, but farmers can take water in the nighttime. WUG arranges communal works for maintenance of irrigation facilities, which are carried out 2 times per year and 5 days per one time. Absentees of communal work are punished with a fine of Tsh.2,500/person, but almost all farmers have joined to this work.

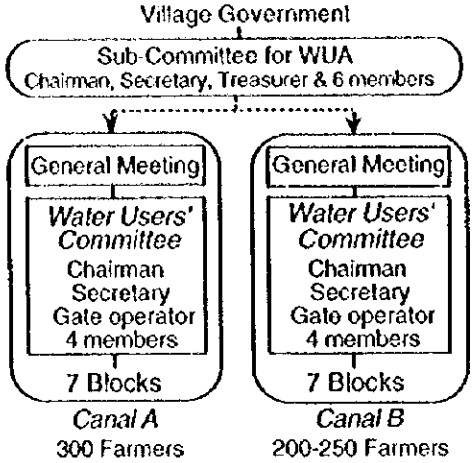
(3) Lower Nyinga

The irrigation facilities were constructed by the farmers themselves in 1996. The organizational structure of WUG consists of a chairman, a secretary, and several block leaders. The number of farmers in this system is 60. Farmers are divided into 4 blocks, and each block takes water for 3 days (rotational irrigation at 12-day intervals). Within a block, water allocation is decided by a block leader, depending on the farm size. Irrigation is carried out normally in the daytime, though farmers can take water in the nighttime. Communal works of 2-3 times per year and 2-3 days per one time are carried out for maintenance of facilities. All facilities are maintained by all farmers and without piece work. Absentees are punished with a fine of Tsh.500/person. According to the leader, almost all farmers have joined to the communal works.

(4) Canals A and B

Canals A and B were constructed by the farmers before independence. Total farmers belonging to both canals are 500-550. WUGs of both canals have same organizational structure which consists of a chairman, a secretary, a gate operator, and 4 committee members. In addition, they have almost same operation and maintenance activities for irrigation facilities between them. WUGs were organized in 1992-1993. Before the establishment of these WUGs, the farmers' groups having simple structure had been organized for both canals.

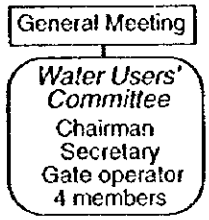
Both canals have 7 irrigation blocks, respectively. Under rotational irrigation system at 7-day intervals, each block takes water for 1 day. Each block has different water allocation to farmers. In general, farmers in a block are divided into two groups, and each group takes water during 6 hrs. Thus a farmer takes water once a week, though its irrigation period differs depending on the farm size. Irrigation is carried out in the daytime, and in case of water shortage, farmers can take water in the nighttime.



The operation and maintenance of facilities are carried out by farmers' communal works under management of the village government. For such services, the village government has a sub-committee belonging to the planning and financial committee. Then, the sub-committee arranges the communal work for canals A and B. Namely, the leaders of WUGs report to the sub-committee for necessity of canal cleaning or maintenance of intake weir. In response with this report, the sub-committee dispatch several inspectors to the fields. If its necessity is confirmed by them, the sub-committee announce the communal work to all farmers of WUG as a village government order. The communal work is carried out 3-4 times per year. Each farmer takes over a portion of canals for maintenance, while the maintenance of intake weir and emergency repair are carried out by all farmers. All canals are cleaned by the communal work of 2 days/week and within 2-3 weeks. Almost all farmers have joined to canal cleaning. The village government collects a fine of Tsh.1,200-2,000 from absentees.

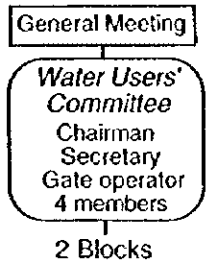
(5) Canal C

Canal C has unclear water allocation, because its operation was commenced by the farmers just from 1996. Canal C had been used by the District Council, and handed over to the farmers in 1996. Total number of farmers is estimated to be 80. WUG has almost same organizational structure with WUGs of canals A and B. The maintenance of facilities is carried out by farmers' communal work. Each farmer takes over a portion of canals, and the maintenance of intake weir is carried out by all farmers and without piece work. WUG arranges this communal work and has no relation with the sub-committee of the village government like canals A and B.



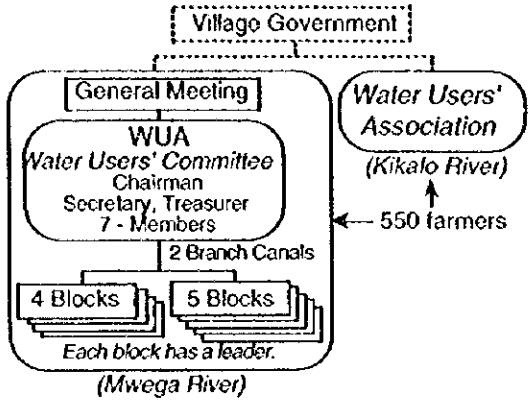
(6) Canal D

Canal D has been constructed by the farmers before independence. Total number of farmers is estimated to be 30 including Masai people. Canal D has two branch canals, and one branch takes water for 4 days and another branch for 3 days. Within a branch canal, any farmers can take water at any time. Water is allocated to each plot by mutual consent among the farmers. WUG arranges communal work for maintenance of facilities with irrespective of the village government, as well as canal C. This work is carried out 2 times per year (June and November) and 2-3 days per time. WUG collects a fine of Tsh.1,000 from absentees.



(7) Mgogozi-Mwega

There are two WUGs in Mgogozi village; one is in the Mwega river irrigation system and another one is the Kikalo river irrigation system. The former system is included in Mwega scheme. These WUGs were established under the guidance of TIP in 1996, though irrigation groups having simple structure had been organized formerly. Almost all farmers in Mgogozi village hold the lands in both irrigation systems, which are estimated to be 550 persons.



The Mwega river irrigation system has two branch canals and 9 irrigation blocks which consist of 4 blocks belonging to one branch and 5 blocks to another branch. Each block takes water for 3 days, and within a block, each farmer takes water in turn depending on the farm size. Thus a farmer in the blocks of former branch canal has irrigated at 12-day intervals, and the latter is at 15-day intervals. WUG in the Mwega irrigation scheme own an intake weir jointly with WUG in the Nyinga lower irrigation system. Formerly, water had been allocated to WUGs at 3-day intervals. Since new aqueduct was constructed in 1996, both WUGs has taken water continuously and without rotational supply.

The maintenance of the facilities is carried out by the farmers' communal work which consists of 2 times per year and 2 days per time. The village government manages all of communal work. There is no fixed schedule on this work, and farmers can carry out canal clearing individually and at anytime. In case of no cleaning, the village government punishes its farmer with a fine (Tsh.500-1,000).

1.5.3 Farmers' Co-operatives Society and Other Societies

In Mwega scheme, no farmers' cooperative is organized at present. As for the women's group, there are five (5) groups in Malolo village and one in Mgogozi village. These were organized under foreign aid assistance programmes. The size of a group averages 6 members. Their activities are mostly crop cultivation in the rainy season and production of local beer in the off season. The table below provides information on the existing women's groups in the Mwega scheme area.

Existing Women's Groups in the Irrigation Schemes

Schemes	Village	Population	No. of group	Year established	Supporting Agencies*2	Total members	Activities
Mwega	Nyinga	(200)	-	-	-	-	
	Malolo	3,800	5	n.a.	PRDVL	30	Crop cultivation / Local beer
	Mgogozi	1,270	1	n.a.	PRDVL	5-7	Afforestration

PRDVL: Planning of Rural Development at Village Level, the World Bank

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

1.5.4 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:

		Mwega
(1) Role of women in farming		
- Land preparation		Both
- Seeding		Both
- Transplanting		Both
- Weeding		Both
- Fertilizing		Both
- Spraying of chemicals		M
- Irrigating		Both
- Drying/bagging of products		Both
- Harvesting		Both
(Heavy work)		(Male)
- Selling of products		Male
(2) Transportation of water		Female
- Distance	(km)	0.5-2
- Frequency	(times/day)	3-6
(3) Collecting of fuel food		Female
- Distance	(hrs.)	3-5
- Frequency	(times/week)	2

M = Male, F = Female, B = Both
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 Mwega scheme. Many of the villagers in Mwega 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 for drinking purpose except long distance to water resources.

(2) Vegetation

Vegetation in Mwega Scheme could be classified as Wooded grassland, Dry open grassland. 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 Mwega 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 Mwega Scheme. 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 Mwega scheme owning 1.28ha is about Tsh.359, 000, excluding off-farm income. Based on this figure and considering the national poverty line of Tsh.458,500 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 Mwega 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 Mwega area fall short of WHO recommended minimum requirement sets.

Health Service Facilities and Medical Staff in this Scheme Area

VILLAGE	Malolo
HEALTH UNIT	
Malolo Gov. Dispensary	
Assistant Clinical Officer	1 person
Health Assistant	1 person
Material Child Health	1 persons
Malolo Mission Dispensary	
Clinical Officer	1 person
Nurse Officer	1 person
Material Child Health	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

	Malolo
Total Population(persons)	4,215
Disease incidence(cases)	15,752
Morbidity (% to population)	374

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 37.2% 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 to-

tal incidence of diseases. A morbidity of all these endemic diseases is come up more than 78% 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	7,449	37.2
Diarrhoea Diseases	1,400	7.0
Intestinal Diseases	1,122	6.0
Schstosomiasis	189	0.9
(Sub-total)	10,210	50.7
Water related Disease:		
URTI	2,699	13.4
Pneumonia	488	2.4
Skin Diseases	1,297	6.4
Eye Diseases	1,058	5.3
(sub-total)	5,542	27.5
Other Diseases		
Ear Diseases	368	1.8
Anaemia	1,433	7.1
Gonorrhea	474	2.4
Mental Diseases	129	0.6
Nutritional Disorder	858	4.3
Accident & Wounds	1,118	5.6
Total	20,132	100

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, Kilosa District Rural Development Program 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.503 in Drawings.

Land Class by Irrigation Suitability in Mwega Scheme Area

Soil Unit	Land Class	Sub-class	[A] (r)	[A] (n)	[A] (t)	[A] (f)	[M] (a)	[M] (w)	[D] (l)	[D] (d)	[E] (s)	[E] (h)	[E] (e)	Area (ha)
(For Paddy Cultivation)														
Mwg-1	NR	NRr	4	2	1	1	1	3	3	1	1	1	2	50
Mwg-2	NR	NRr	4	2	1	1	1	3	3	1	1	1	2	165
Mwg-3	SR2	SR2rwl	2	1	1	1	1	2	2	1	1	1	1	25
Mwg-4	SR3	SR3r	3	2	1	1	1	1	2	1	1	1	1	160
Mwg-5	SR2	SR2rd	2	1	1	1	1	1	1	2	1	1	1	50
Mwg-6	SR2	SR2rnfd	2	2	1	2	1	1	1	2	1	1	1	235
Mwg-7	NR	NRfd	3	2	1	4	1	1	3	4	1	1	1	55
(Total)	SR1: 0 ha, SR2: 310 ha, SR3: 160 ha, NR: 270 ha													740
(For Upland Crop Cultivation)														
Mwg-1	SU2	SU2rnwe	2	2	1	1	1	2	1	1	1	1	2	50
Mwg-2	SU2	SU2rnwe	2	2	1	1	1	2	1	1	1	1	2	165
Mwg-3	SU1	SU1	1	1	1	1	1	1	1	1	1	1	1	25
Mwg-4	SU2	SU2n	1	2	1	1	1	1	1	1	1	1	1	160
Mwg-5	SU2	SU2rfd	2	1	1	2	1	1	1	2	1	1	1	50
Mwg-6	SU3	SU3fd	2	2	1	3	1	1	1	3	1	1	1	235
Mwg-7	NU	NUrfd	4	2	1	4	1	1	4	4	1	1	1	55
(Total)	SU1: 25 ha, SU2: 425 ha, SU3: 235 ha, NU: 55 ha													740

The swamp classified into the soil unit of Mwg-7 (55 ha in gross) is not suitable to develop either for paddy or upland crop production (NR, NU) due to regular-cum-deep seasonal flooding and poor drainage risks. The land of soil units Mwg-1 and Mwg-2 (total 215 ha in gross) is also not suitable for paddy cultivation (NR) due to low water retaining capacity of soils, while suitable for upland crop production. Soil fertilization is essentially needed so as to maintain sustainable crop production in this area.

The other lands, i.e. the soil units of Mwg-3, Mwg-4, Mwg-5 and Mwg-6 (total 470 ha in gross) are recognized as suitable not only for paddy production (SR2-SR3), but also for upland crop cultivation (SU1-SU3) though soil fertilization, drainage improvement, deep plowing etc. are required in a part.

2.1.2 Water Resources

The following table shows the availability of water resources of the Mwega river on a monthly basis at 2, 5, and 10 year probability of drought.

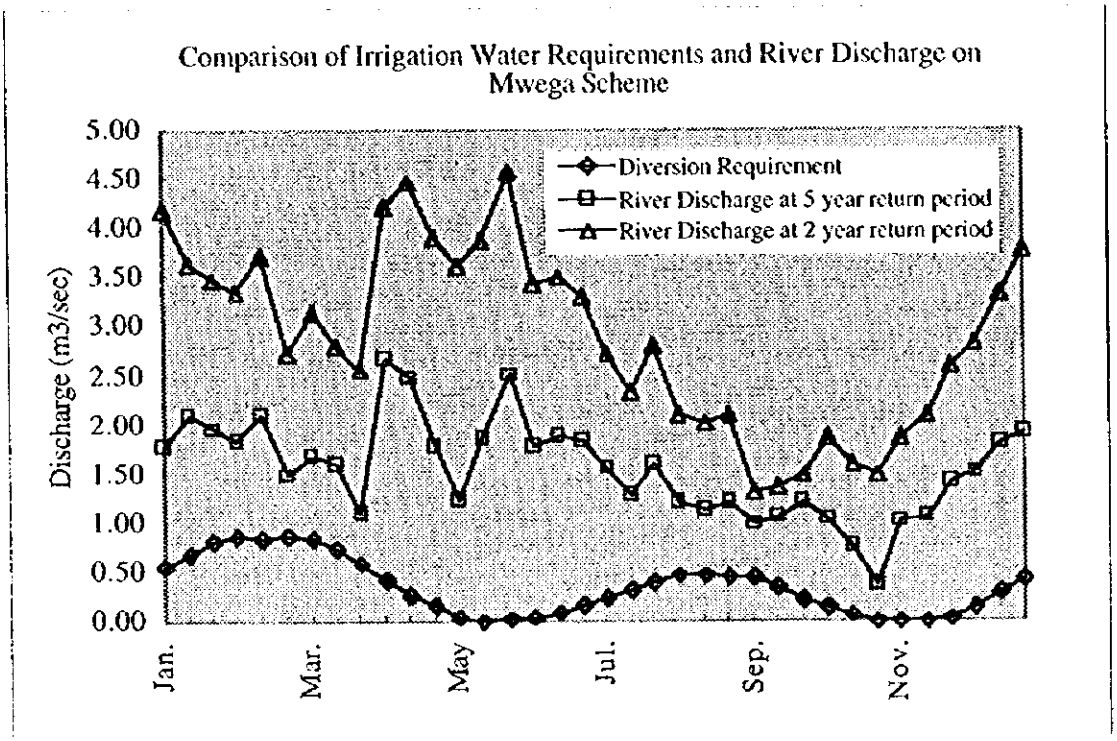
Probability Monthly Discharge of Mwega River

(Unit : m3/sec)

Return Period	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
10	1.40	1.33	1.06	1.71	1.27	1.33	1.11	0.89	0.97	0.49	0.84	1.26
5	1.96	1.81	1.48	2.32	1.87	1.84	1.49	1.19	1.10	0.73	1.17	1.76
2	3.78	3.28	2.84	4.20	4.03	3.42	2.63	2.08	1.39	1.66	2.19	3.32

Most of the water resources can be used for the Mwega scheme, since no water is utilized other than this scheme.

A following figure shows the water resources of the Mwega river and the project irrigation water requirements estimated based on the proposed cropping pattern. The river has plenty of water throughout a year for the irrigation of the scheme area even at the drought of 5 year return period.



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 Mwega scheme.

Demographic Data for the Whole Scheme

Scheme	Total Population	No. of Households	Average Household Size	Average Holding Size per Household (ha)	Working Population
Mwega	5,535	809	7	1.28	3,154

Based on the figures shown above it would be possible labor force availability may not be a problem when implementing the irrigation project.

It will be also 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.

2.2 Problems and Constraints to Irrigated Agriculture Development

2.2.1 Social and Institutional Aspects

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

There is eight (8) WUGs in Mwega scheme. Although these existing WUGs have almost no problem from the standpoint of institutional aspect for O&M of irrigation system. It is however expected to strengthen their activities for improving present agricultural supporting services such as marketing of farm inputs and agricultural credit. In addition, the facilities to be proposed in the scheme will need some advanced O&M techniques. For the activation and enlightenment of present WUGs, there are two ways: one is strengthening of institutional function and another is technical strengthening for those services. The executing agency to be responsible for the former is the office of DCO and the latter is DALDO. However, the DCO's office in Kilosa district have a poor experience on WUG, and so far no field staff assigned below district level.

The office of DALDO in Kilosa district is responsible for technical supporting services to the farmers. At present, the DALDO's office has several irrigation officers in charge of those services, and has dispatched one Irrigation Technician to the irrigation system of TIP in Mgogozi village. This officer is now providing various supporting services to the farmers and existing WUGs.

(2) Inactive Farmers' Cooperatives

In the Mwega 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 hav-

ing 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 TSh37,500 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 1.28 ha is about TSh.359,000, excluding off-farm income. Based on this figure and considering the national poverty line of TSh.458,500 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) 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 such as onion and tomatoes. 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.

Concerning onion, certified seeds of "Red Creole" , which is imported and multiplied by seed farmers in Arusha, is sold to farmers through traders. In that case, farmers seeds which are grown locally is not in good because it is mixed with other local varieties.

2) 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 Iringa, e.g. Tanganyika Farmers Association (TFA).

Furthermore, farmers are sometimes forced to buy some fake agro-chemicals which are mixed and diluted with kerosene or water.

3) 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.

4) 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.

5) 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.

6) Shortage of Knowledge on Proper Farming Practices

Farmers have cultivated such major crops as onion, 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 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 in which stage they have to be applied.

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

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

- Insufficient flood-carrying capacity of Mwega river and habitual flooding in the upstream and middle reaches in Nyinga.

- Insufficient flood-carrying capacity of Mwega river and habitual flooding in the upstream half reaches of Malolo area, which is aggravated by the presence of Intake A and B weirs, of which flood-releasing capacity is small, and uncontrolled diversion of water at Intake A and B.

- Traditional intakes made by locally available materials such as earth, wood, and stones are washed away by floods every year.

- Water shortage in the downstream half of Malolo area due to insufficient canal flow caused by high water losses in the upstream reaches and the downstream half of the Mgogozi Mwega area located after passing the Kikalo river due to little water availability.