JAPAN INTERNATIONAL
COOPERATION AGENCY

MINISTRY OF AGRICULTURE
AND COOPERATIVES,
THE UNITED REPUBLIC OF
TANZANIA

# THE STUDY
# ON
# THE SMALLHOLDER IRRIGATION PROJECTS
# IN
# CENTRAL WAMI RIVER BASIN, MOROGORO

## Volume II

## ANNEXES

JANUARY, 199



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JANUARY, 1998

NIPPON KOEI CO., LTD.
PACIFIC CONSULTANTS INTERNATIONAL INC.
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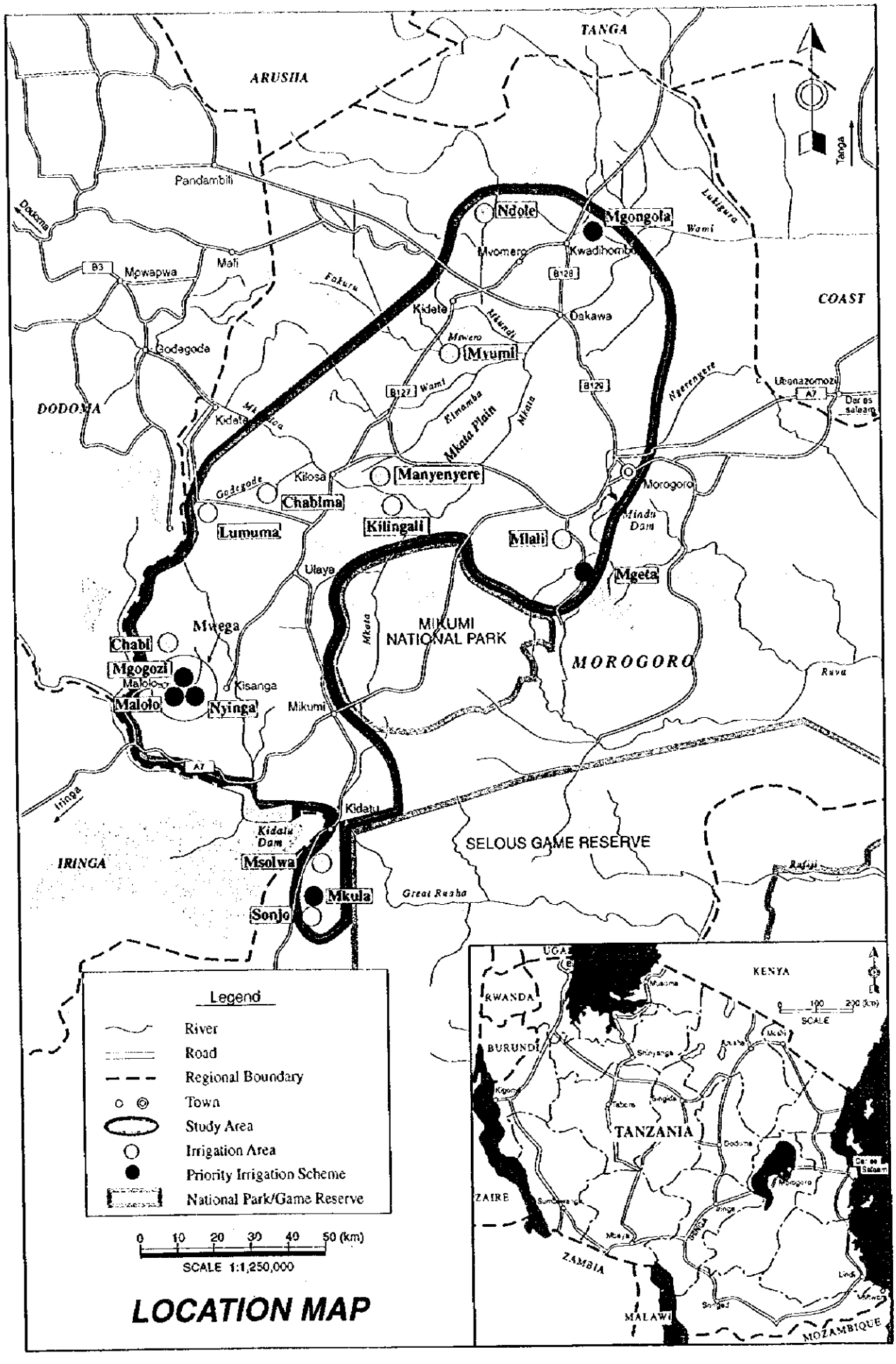


# LOCATION MAP

# THE STUDY
# ON
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# IN
# CENTRAL WAMI RIVER BASIN, MOROGORO

# ANNEXES

**Location Map of the Scheme Areas**
**Abbreviation and Measuring Units**

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## ATTACHMENT:

## ABBREVIATIONS

| | |
|---|---|
| ACC | Agricultural Coordinating Committee |
| AFD | African Development Fund |
| AFDB | African Development Bank |
| ALCOM | Aquaculture for Local Community Development Programme |
| ARTI | Agricultural Research and Training Institute |
| ASMP | Agricultural Sector Management Project |
| CA | Commissioner for Agriculture |
| CBS | Central Bureau of Statistics |
| CCT | Center for Cleaner Technologies |
| CCT | Christian Council of Tanzania |
| CIDA | Canadian International Development Agency |
| CMEWS | Crop Monitoring and Early Warning System |
| COASCO | Cooperative Audit and Supervision Corporation |
| COSTECH | Tanzania Commission for Science and Technology |
| CRDB | Cooperative and Rural Development Bank |
| CTDT | Center for Technology Development and Transfer |
| DALDO | District Agriculture and Livestock Development Officer |
| DED | District Executive Director (previously called to as District Development Director: DDD) |
| DEO | District Extension Officer |
| DESC | District Extension Steering Committee |
| DIO | District Irrigation Office |
| DIVEO | Division Extension Officer |
| DOE | Division of Environment |
| DSI | Development Studies Institute |
| EIA | Environmental Impact Assessment |
| EIRR | Economic Internal Rate of Return |
| ERP | Economic Recovery Program |
| FAO | Food and Agriculture Organization of the United Nations |
| FIRR | Financial Internal Rate of Return |
| FPCS | Farmers' Primary Cooperative Society |
| FPH | Foundation of Human Progress |
| FSAC | Financial Sector Adjustment Credit |
| FSU | Food Strategy Unit |
| GDP | Gross Domestic Product |
| GNP | Gross National Product |
| GOT | Government of the United Republic of Tanzania |
| GTZ | German Development Agency |
| HORTP | Horticultural Production Project |
| IAP-WASAD | International Plan for Water and Sustainable Agricultural Development |
| IBRD | International Bank for Reconstruction and Development |
| ICE | Institute of Continuing Education |
| ID | Irrigation Department of the Ministry of Agriculture and Cooperatives |
| IDA | International Development Association |
| IFAD | International Fund for Agricultural Development |
| IITA | International Institute for Tropical Agriculture |

| | |
|---|---|
| ILO | International Labor Organization |
| IRRI | International Rice Research Institute |
| ISEF | Irrigation Scheme Evaluation Form |
| ISID | Institutional Support to Irrigation Development |
| ITF | Input Trust Fund |
| JICA | Japan International Cooperation Agency |
| IMF | International Monetary Fund |
| KADEP | Kilimanjaro Agricultural Development Center |
| KDRDP | Kilosa District Rural Development Program |
| KOTACO | Korea Tanzania Company |
| LAMP | Land Management Program for Environmental Conservation |
| LART | Loans and Advance Realization Trust |
| LIFDCs | Low Income Food Deficit Countries |
| LITI | Livestock Training Institute |
| MATI | Ministry of Agriculture Training Institute |
| MDB | Marketing Development Bureau |
| MTS | Monthly Training Session |
| NAEP | National Agricultural Extension Project (Phase II of NALERP) |
| NALERP | National Agricultural and Livestock Extension Rehabilitation Project |
| NAFCO | National Agricultural and Food Corporation |
| NAITF | National Agricultural Inputs Trust Fund |
| NALRP | National Agricultural and Livestock Research Rehabilitation Program |
| NAP | National Agricultural Policy |
| NBC | National Bank of Commerce |
| NCSSD | National Conservation Strategy for Sustainable Development |
| NEAP | National Environment Action Plan |
| NEMC | National Environment Management Council |
| NEP | National Environmental Policy |
| NFS | National Food Strategy |
| NGO | Non-Governmental Organization |
| NIDP | National Irrigation Development Plan |
| NLUPC | National Land Use Planning Commission |
| NMC | National Milling Corporation |
| NPCD | National Plan to Combat Desertification |
| NSS | National Soils Service |
| NSWCP | National Soil and Water Conservation Program |
| NUWA | National Urban Water Authority |
| NVIDP | National Village Irrigation Development Program |
| O&M | Operation and Maintenance |
| ODA | Official Development Assistance |
| ODAB | Overseas Development Administration of British Government |
| PPMB | Project Preparation and Monitoring Bureau |
| PSAC | Public Sector Adjustment Credit |
| PSC | Project Steering Committee |
| RALDO | Regional Agriculture and Livestock Development Officer |
| RAQ | Rapid Appraisal Questionnaire |
| RAS | Regional Administrative Secretary |
| RBM | River Basin Management |
| RDD | Regional Development Director |

| | |
|---|---|
| REO | Regional Extension Officer |
| RIO | Regional Irrigation Officer |
| RPAC | Radiation Protection Advisory Committee |
| RPFB | Rolling Plan and Forward Budget for Tanzania (1994/95 - 1886/97) |
| RPO | Regional Planning Officer |
| RTF | Rationalization Task Force of Agricultural Sector Management Project (ASMP) |
| RTIP | Rehabilitation of Traditional Irrigation Projects |
| RUBADA | Rufiji Basin Development Authority |
| SCAPA | Soil Conservation and Agro-forestry Program |
| SECAP | Soil Erosion Control and Agro-forestry Program |
| SEP | Sokoine Extension Programme |
| SGR | Strategic Grain Reserve |
| SMS | Subject Matter Specialist |
| SNV | Netherlands Development Agency |
| SSMO | Sustainable Seed Multiplication Programme |
| SUA | Sokoine University of Agriculture |
| SUDECO | Sugar Development Corporation |
| TAFCO | Tanzania Animal Feed Company |
| TANSEED | Tanzania Seed Company |
| TANESCO | Tanzanian Electricity Supply Corporation |
| TARO | Tanzania Agricultural Research Organization |
| TBS | The Tanzania Bureau of Standards |
| TCA | Tanzanian Cotton Authority |
| TCC | Training Coordinating Committee |
| TFA | Tanganyika Farmers Association |
| TIP | Traditional Irrigation Improvement Project |
| TIRDO | Tanzania Industrial Research and Development Organization |
| TOSCA | Tanzania Official Seed Certification Agency |
| TPC | Tanganyika Planting Company |
| TU | Tuskegee University |
| TTF | Technical Task Force of Agricultural Sector Management Project (ASMP) |
| UAC | Uyole Agricultural Center |
| UMADEP | Uluguru Mountain Agricultural Development Project |
| UNCDF | United Nations Capital Development Fund |
| UNCHS | The United Nations Center for Human Settlements (habitat) |
| UNDP | United Nations Development Program |
| UNESCO | United Nations Education, Scientific and Cultural Organization |
| VEO | Village Extension Officer |
| WIA | Women in Irrigated Agriculture |
| WID | Women in Development |
| WFP | World Food Program |
| WHO | World Health Organization |
| WUA | Water Users' Association |
| WUG | Water Users' Group |
| WWF | World Wildlife Fund |
| ZCC | Zonal Communication Center |
| ZIO | Zonal Irrigation Officer |
| ZIU | Zonal Irrigation Unit |

## MEASUREMENT UNITS

**Extent**

$cm^2$ = Square-centimeters (1.0 cm x 1.0 cm)
$m^2$ = Square-meters (1.0 m x 1.0 m)

$Km^2$ = Square-kilometers (1.0 Km x 1.0 Km)
a. = Acre or Acres (100 $m^2$ or 0.1 ha.)

ha. = Hectares (10,000 $m^2$)
ac = Acres (4,046.8 $m^2$ or 0.40468 ha.)

**Length**

mm = Millimeters
cm = Centimeters (cm = 10 mm)
m = Meters (m = 100 cm)
Km = Kilometers (Km = 1,000 m)

**Currency**

US$ = United State Dollars
US$1.0 = J¥120 = Tsh.620

J¥ = Japanese Yen
Tsh. = Tanzanian Shillings

**Volume**

$cm^3$ = Cubic-centimeters
(1.0 cm x 1.0 cm x 1.0 cm or 1.0 m-lit.)
$m^3$ = Cubic-meters
(1.0 m x 1.0 m x 1.0 m or 1.0 K-lit.)
lit. = Liter (1,000 $cm^3$)

**Weight**

gr. = Grams
Kg = Kilo-grams (1,000 gr.)
ton = Meter-tones (1,000 Kg)

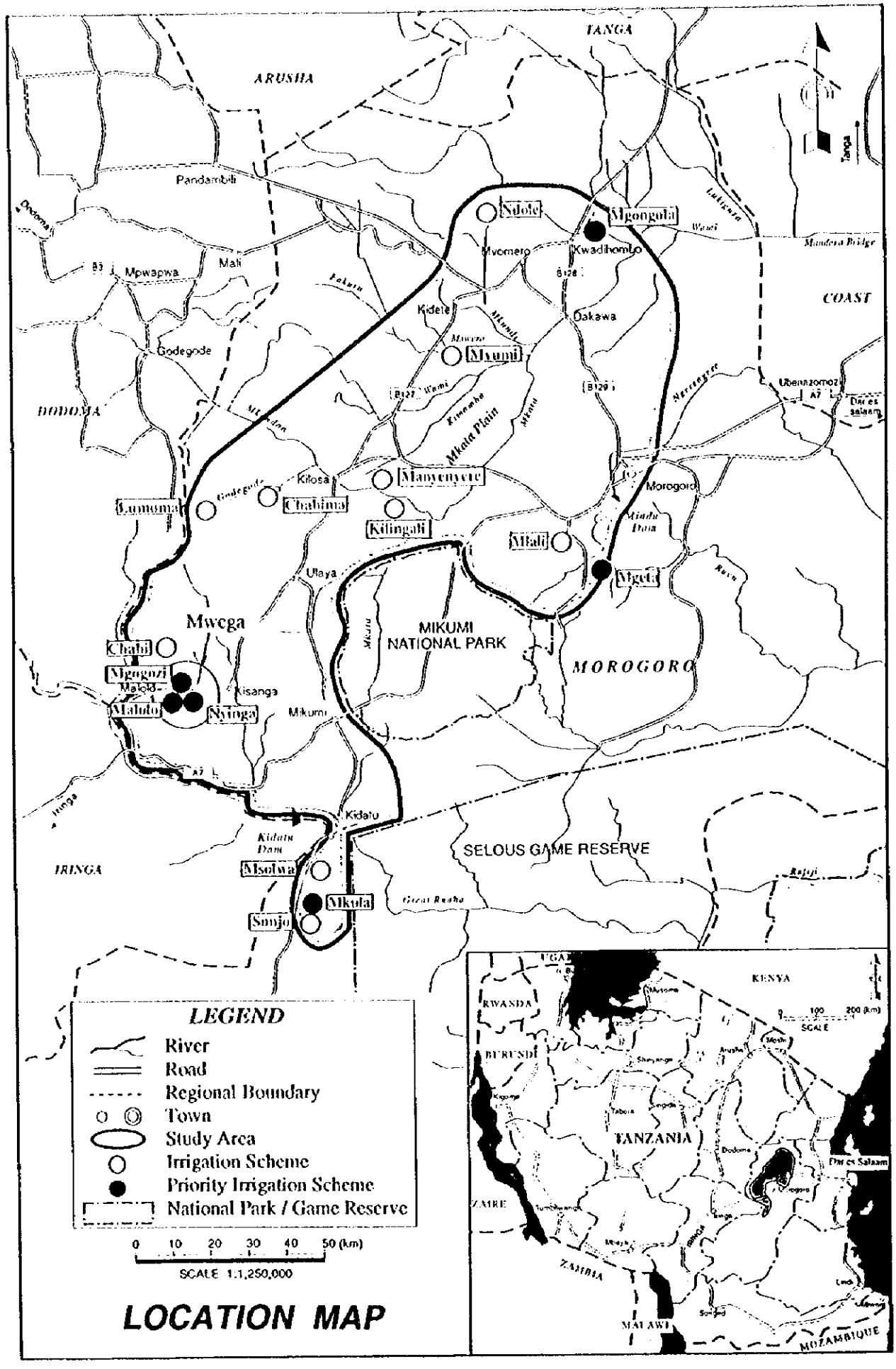
**Time**

sec. = Seconds

min. = Minutes (60 sec.)
hr. = Hours (60 min.)

# *DIVISION - I*

*MASTER PLAN OF THE SMALLHOLDER IRRIGATION PROJECT IN CENTRAL WAMI RIVER BASIN, MOROGORO REGION*


TANGA
ARUSHA
Pandambili
Ndole
Mgongola
Kwadihombo
Mvomero
Mpwapwa
Mali
Kidete
Dakawa
COAST
Myumi
Godegode
DODOMA
Ubenazomozi
Dar es salaam
Mkata Plain
Kilosa
Mamyenyere
Morogoro
Gumoma
Chabima
Kilingali
Mbali
Mgeta
Ulaya
Mwega
MIKUMI NATIONAL PARK
MOROGORO
Chabi
Mgogozi
Malolo
Nyinga
Kisanga
Mikumi
Kidatu
Kidatu Dam
SELOUS GAME RESERVE
IRINGA
Msolwa
Mkula
Sanjo
LEGEND
River
Road
Regional Boundary
Town
Study Area
Irrigation Scheme
Priority Irrigation Scheme
National Park / Game Reserve
0 10 20 30 40 50 (km)
SCALE 1:1,250,000
LOCATION MAP
KENYA
RWANDA
BURUNDI
TANZANIA
ZAIRE
ZAMBIA
MALAWI
MOZAMBIQUE
Dar es Salaam
SCALE 100 200 (km)

DIVISION - I.

# MASTER PLAN
# ON
# THE SMALLHOLDER IRRIGATION PROJECTS
# IN
# CENTRAL WAMI RIVER BASIN
# IN
# MOROGORO REGION, THE UNITED REPUBLIC OF TANZANIA

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# CHAPTER I. GENERAL BACKGROUND OF THE PROJECT

## 1.1 Historical Background of the Project

The Government of Tanzania (hereafter called to as GOT) has paid his utmost effort to growth of the smallholder farmers, and being promoted an extension of the technology on irrigated farming since the late 1980s, as a most important subject to the agricultural sector development. In collaboration with the UNDP/FAO, MAC elaborated the "National Village Irrigation Development Program (NVIDP)" and set forth the basic strategy on irrigation development for the entire country. MAC later prepared the "National Irrigation Development Program (NIDP)" and was launched on it in April 1994. In implementation of NIDP, MAC first grouped the irrigation schemes into six irrigation zones, and reviewed all the existing small scale irrigation schemes as well as small scale irrigation development schemes proposed by the local authorities. As a result of this action, MAC prepared the implementation plan (I/P) on the priority 156 schemes which were selected basically in due consideration of the technical, economic, and social aspects as well as willingness of the concerned beneficiaries in each scheme. The major schemes included in the I/P were subjected to rehabilitation of the irrigation-cum- drainage facilities and/or expansion of the irrigable area(s). In NIDP, MAC put a high development priority to the traditional small holder irrigation schemes in the Morogoro Irrigation Zone. These schemes are generally recognized as the essential areas for production of the staple food crops especially rice and maize, and at present, is playing the role of granary for consumers in Dar es Salaam. Thus, GOT is expecting that the irrigation schemes selected in the Morogoro Irrigation Zone will ensure a certain increment of food crop production through improvement of the existing irrigation system, and accordingly, contribute to the national food security as well as rural poverty alleviation.

With the above background, GOT requested the Government of Japan on May 24, 1993, to extend the technical assistance for execution of the feasibility study on the smallholder irrigation projects in the Central Wami River Basin of Morogoro Region. The Government of Japan responded to this request, and JICA dispatched the Preparatory Study Team in March 1996 for reviewing the proposed project, and set-up the Scope of Work (S/W) with GOT for extending technical assistance to the respective study and development planning for the proposed smallholder irrigation schemes on March 19th, 1996.

## 1.2 Socio-Economic Setting of Tanzania

### 1.2.1 Present Conditions of Socio-Economy in Tanzania

Tanzania has an physical extent of 945,200 km$^2$ consisting of 943,200 km$^2$ in the Mainland and approximately 2,000 km2 in Zanzibar and Pemba. The land area of Mainland is 881,300 km$^2$, the remaining 61,500 km$^2$ is of the water surface, i.e. lakes, rivers and reserviors. Out of the total extent of the land, approximately half of the land is in forest and woodland, about 40% is in savanna grassland, and only 8% of the land is cultivated at any one time.

The total population is estimated about 28.8 million as of the end of 1994, of which approximately 23.0 million or almost 80% live in the rural area. In the recent decade, the population increases at 2.8% a year, while the urban population, which is estimated about 5.8 million, is growing rapidly at 7 to 8% per annum. Approximately 4 million families mostly live in more than 8,000 villages in the entire country. The country has a low population density at about 32.8 persons/km$^2$, although there is a great internal variation. In some parts of the north and west highlands, the population density is rated at several hundred persons/km$^2$, while very low density in the central dry and/or savanna area. Out of the rural population, a small percentage of the families is engaging in the

fisheries as the main means of livelihood, either in coastal water or fresh water in rivers, lakes or reservoirs.

Concerning poverty, the World Bank constructed a relative poverty line to measure the level of poverty in Tanzania. A relative poverty line expenditure level of Tsh.46,173 per capita per annum in 1991 was set for Tanzania; it was found that about 59% of rural households are poor compared to 39% of non-Dar es Salaam and 5% of Dar es Salaam households who are considered poor. Even though the results were obtained for the year 1991, the conclusion that poverty is one of the main and pressing problems to be tackled by the government is still valid at present.

In the 1960s, the national economy was performed favorably with a GDP growth of about 5% annually. During the years from 1973 to 1984, however, its performance was slowed down and brought severe macro-economic imbalances due mainly to a series of external shock, i.e. quadrupling oil prices, drought, break up of the East African Community, the Kagera War with Uganda, expansion in debt-servicing, etc. combined with poor economic management policies. Encourage signs of economic recovery were observed during the period in implementation of the Economic Reform Program, and in fact, GDP annual growth was being ranged at 5.5% for the years 1986 to 1990 and 4.3% for 1991 to 1996.

Gross Domestic Product

(at Constant1985 Prices)

| | GDP (Tsh. million) | | | | | Average Growth Rate (%) | |
|---|---|---|---|---|---|---|---|
| Economic Sectors | 1986 | 1988 | 1990 | 1993 | 1996 | 1986-90 | 1991-96 |
| Agriculture | 51,634 | 59,380 | 66,084 | 81,965 | 94,339 | 5.8 | 6.1 |
| Mining & Quarrying | 333 | 317 | 428 | 1,182 | 1,542 | 5.6 | 25.1 |
| Manufacturing | 9,772 | 11,183 | 12,038 | 11,144 | 10,711 | 4.4 | -1.8 |
| Tourism & Commerce | 14,195 | 15,988 | 17,105 | 20,417 | 23,100 | 18.8 | 23.5 |
| Others | 25,750 | 34,730 | 37,158 | 36,690 | 40,965 | 9.0 | 2.8 |
| Total | 101,684 | 121,598 | 132,813 | 151,398 | 170,657 | 5.5 | 4.3 |
| GDP per Capita | 4,638 | 5,245 | 5,329 | 5,592 | 5,607 | 2.9 | 3.6 |

Source: Economic Bulletin of the Bank of Tanzania (March, 1997)

According to the Bank of Tanzania, during the year 1996, the GDP measured at 1985 prices, grew at a rate of 4.7% compared to an increase of 4.5% recorded in 1995 and 3.0% in 1994. The GDP in current prices reached a level of Tsh.2,852,280 millions. GDP per capita has grown for an average of 3.6% for the period 1991/96, given an annual average population growth of 2.8%

Concerning the composition of the GDP, the primary sector (comprising of agriculture, forestry, fishing, mining and quarrying) contributed the largest share of 58.2% to the real GDP, followed by the services sector (trade, finance, administration, transport, storage, communications and hotels) which accounted for 36.2, and the secondary sector (manufacturing, electricity, water supply and construction) 12.4%.

As a result of the firm intention of the Government of Tanzania of letting the private sector to be the leading sector of the economy, a divestiture programme affecting all production and services sector in which the government is involved, has been put into effect; up to February of 1997, divested parastatals reached a number of 137. On the other hand, the government also started a programme supported by the World Bank by which the state apparatus will be reduced in order to make it work more efficiently; as a consequence, a large number of public employees have been retrenched.

Following the divesture programme, the private sector increased its participation in the manufacturing, industry, and mining sectors. Specially, the industrial sector has shown a notable improvement during 1996 growing about 2% in real terms , compared

with a decline of about 1% in 1995

Investment has increased by 14.8% during the fiscal year of 1996. However, domestic saving financed only 28.6% of the investments; this means that investment heavily depends on foreign funds for its financing. The total of debt service, US$89.7 million for a total debt amount of US$7,833 million, as a percentage of the GDP was approximately 7% by June 1996. The financial system due to the poor performance of the parastatal financial institutions and relatively limited financial activities of the private institutions finds it difficult to generate and mobilize financial resources.

Inflation as measured by the National Consumer Price Index decelerated to 17.9 percent during the year ending June 1997 from 22.7 in the year to June 1996. The government expects to keep lowering the inflation rate by applying tight monetary and fiscal policies.

Concerning foreign trade, the period finishing in June 1996 showed a better performance compared with 1995. The overall balance of payments deficit declined to US$215.5 million during 996/96 compared with the deficit of US$387.81 million recorded during 1994/95. Gross reserves of the Bank of Tanzania reached US$327.53 which would allow to meet 8.5 weeks of imports compared with 6.7 weeks during the period 1994/95.

Trade account deficit decreased to US$545.77 million during 1995/96 compared with a deficit of US$731.98 million recorded for the period 1994/95. Exports were US$696.37 million in 1995/96 while imports were US$1,213.14 million. Main exports were coffee, cotton, sisal, tea, and tobacco. Main imports were machinery, fuel, textile and apparel, and motor cars; it must be noted that for the period 1995/96, imports for food and beverages declined from TSh.64,753 million to TSh.24,929. Food imports decreased mainly due to the good harvest of main staple foods obtained in the period 1994/95.

For the year 1997, the growth of the GDP can be slowed down as a result of the extended drought during the 1996/97 planting session. This draught affected the procurement of agricultural export crops which amounted in March 1997 to 248,708 tons, 22% less than the 254,308 tons procured during the same period of the 1996/96 period. Procurement of almost all export crops, except cotton and tobacco, declined.

### 1.2.2 Present Conditions of Agriculture Sector in Tanzania

Agriculture is the mainstay of the Tanzanian economy. It absorbed almost 84% of the employed population and generates almost 50% GDP and 75% of the foreign exchange earnings. Majority of agricultural production, especially the staple food crops, i.e. maize and rice is produced by the smallholder farmers. In fact, more than 90% of all farmers (or about 3.7 million farm households) has less than 2 ha with the land use right. Out of them, some 3.5 million farm households are cultivating 0.9 ha on an average (refer to the Agricultural Sample Survey of Tanzania Mainland, 1989/90, the Bureau of Statistics).

In the Mainland of Tanzania, the agricultural land has been developed approximately 5.9 million ha up to present. The agricultural land belong to the smallholder farmers is about 4.5 million ha (or about 76% of the total agricultural land), and out of which, about 4.13 million ha is being cultivated for crop production, while the rest is used for pasture, forest and/or used for other purposes. The irrigation development is performed so far 160,000 ha that is corresponding to only 3.8% of the total cultivated land.

Cultivated Area and Production by Major Crops (1994)

| Major Crops | Cultivated Area (10,000 ha) | Production (10,000 ton) | Unit Yield (ton/ha) | Major Crops | Cultivated Area (10,000 ha) | Production (10,000 ton) | Unit Yield (ton/ha) |
|---|---|---|---|---|---|---|---|
| Cereals | 340 | 374 | 1.1 | Root-crops | 94 | 221 | 2.4 |
| Maize | 190 | 228 | 1.2 | Beans | 65 | 43 | 0.7 |
| Sorghum | 70 | 50 | 0.7 | Industrial Crops: | | | |
| Paddy | 45 | 64 | 1.4 | Cotton | 53 | 15 | 0.3 |
| Millet | 25 | 20 | 0.8 | Coffee | 30 | 7 | 0.2 |
| Wheat | 8 | 6 | 0.8 | Sisal | 6 | 3.5 | 0.6 |

Source Ministry of Agriculture and Cooperatives

Among the estimated 3.7 million smallholder farm households in Tanzania, the following farming systems are practiced: a) coffee and banana (16.6% of total households); b) maize-legumes (35.7%); c) pastoral (3%); d) agro-pastoral (7.6%); e) livestock-sorghum-millet (13.6%); e) wetland rice-sugar (2.5%); f) cassava-cashew nuts-coconut (21%).

Cereals are the most important food crop in the country. Maize is the preferred cereal. Rice has recently become very important not only as a food staple but also for the good returns it fetches in the urban markets. Production of major food crop for the period 1991-94 is as follows:

Cereals Production (1991 - 1994)

| Year | Maize | Wheat | Rice |
|---|---|---|---|
| 1991 | 2,331 | 84 | 624 |
| 1992 | 2,226 | 65 | 392 |
| 1993 | 2,282 | 59 | 641 |
| 1994 | 2,159 | 59 | 614 |

Note: Unit: 1,000 ton Data source: MDB

The economic performance of the agriculture sector during the past three years of 1991 to 1993 is recognized as quite satisfactory, if compared with a population growth at 2.8% per annum on an average for the same period. Namely, the growth of agricultural GDP averaged at 4.0% in 1991, and increased to 4.4% in 1992 and 7.3% in 1993. Food production generally balanced with the demand, although there were localized intermittent deficits in some areas caused by drought and inadequate marketing structure. Production of industrial and/or export crops was also good; however, export performance of the traditional crops was poor in this period due mainly to unfavorable prices in the international market in case of coffee, cotton and pyrethrum and inadequate processing facilities in case of cotton. In contrast, export of the non-traditional crops, i.e. groundnut, cowpeas, sunflower, soybean, etc. showed significant performance with export earnings increasing from US$ 25.6 million in 1990 to US$ 53.23 million in 1992.

Imports of agricultural products are mainly centered on cereal imports. Since 1992, imports of maize and rice have increased significantly. According to the Food Security Department, all 61,150 tons of maize imported in 1994 were donations, while the bulk of rice, 41,000 tons, and all 50,500 tons of wheat imported in 1994 were commercial imports by private traders.

The Table below gives information on main agricultural imports and exports.

Import and Export of Agricultural Products

(Unit : 10,000 ton)

| Main Agricultural Imports | | Main Agricultural Exports | |
|---|---|---|---|
| Maize | 2.50 | Coffee | 56.10 |
| Wheat | 5.50 | Cotton | 74.00 |
| Rice | 5.10 | Sisal | 0.73 |
| | | Tea | 24.90 |
| | | Cashew nuts | 48.20 |

Source : MDB

In 1994, the overall performance of agricultural production was slow-downed to a serious extent. The food production was about 30% decreased because of drought of the short rainy season (Vuli) and two months delay of the long rainy season (Masika) in the Southern Highland regions where maize production is accounted for almost 70% of that national output. Since then, the national food deficit became to about 435,000 tons of cereal equivalent. The industrial/export crops, especially coffee and cotton were also affected by drought problems, accordingly.

For the period 1995-96, agricultural production greatly improved, increasing its participation in the GDP from 55% in 1994 to 57% in 1995. Supply of all primary export crops increased when compared to the previous season. Total production of exports reached 301,200 ton for the season ending June 1996 compared to 224,100 tons for the period 1994-96, representing an increase of about 34.4%.

Production of major food crops recorded some mixed performance during the period 1995-96. The total output of cereals increased by 2.4% while that of non-cereals declined by 1.4%. The output of maize, the main staple food, increased by 2.8% to 2.64 million tons from 2.57 million tons recorded during 1994/95, while paddy production declined by 5.8% from 0.72 million tons in 1994/95 to 0.68 million tons in 1995/96.

Due to the draught extended during the planting season, the production of export crops was affected; by the end of March 1997, the production of those crops amounted only to 248,708 tons which represented 68% of the projected production of 365,200 tons for the 1996/97 season.

### 1.2.3 Necessity and Importance of Structural Improvement in Agriculture Sector

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

To successfully perform sustainable agricultural development in Tanzania, it is indispensable to consolidate the existing agricultural land through improvement such physical constraints as shortage of irrigation water, poor drainage, salinity and/or alkalinity problems, infertile soils, etc. as well as reinforcement of the agricultural infrastructure especially for marketing of the agricultural commodities. It is also essential to motivate greater population of smallholder farmers through promotion of a participatory approach to the agricultural development, and then, to adjust the productive structure in agriculture from the extensive operational form of the large scale national farms to the intensive operational form of the smallholder farming. In the current implementation of the Socio-Economic Development Program (the Rolling Plan and Forward Budget: 1994/95-

1996/97), GOT is paying at most effort to develop the agriculture sector with particular emphasis on; (i) to activate the smallholder farming as well as agricultural investors in the private sector; (ii) to increase production of the export oriented economic crops; (iii) to develop the agricultural infrastructure especially for improvement of accessibility to the market; and (iv) to solve the primary constraints through structural improvement of the existing traditional irrigation systems. To successfully accomplish the said agricultural development, GOT is implementing the following three national development programs.

(1) National Special Program on Food Production in Supporting Food Security (SPFP)

SPFP has started since May, 1995 under technical and financial assistance of FAO. This program is practically the pilot project for promotion of the food crop production increase, specifically maize in up-land field and rice in lowlying field, by growing up the participatory smallholder farmer's groups[1] . The specific terms and essential subjects of the program are as follows:

For Maize Production:

- Two to 3 years for primary operation at the first stage,
- Introduction of high yielding varieties, i.e. "Staha (composite)" and "TMV 1 (hybrid)"
- Control of plant spacing more adequately
- Protection against pest and diseases
- Seed treatment
- Oxenization, including land preparation, weeding, transportation, etc.
- Farm ridge formation as one of the water harvesting means for efficiently utilizing the rain-water.
- The target yield will be at 4 to 5 tons/ha to be 2 to 2.5 times of the present yielding conditions.

For Rice Production:

- Construction of the farm ridges as one of the water harvesting means for efficiently utilizing the flood-water.
- Introduction of the improved varieties, TXD-88 and 85, which had been developed by Chollima Agro-scientific Research Centre.
- Introduction of the transplanting method by use of the space marker (simple lining implement) as well as improvement of the direct seeding method using drill seeder.
- Introduction of the rotary weeder for weeding
- Soil fertilization technology
- Extension of the seed production technology for up-grading the quality of farmers' own seeds
- Extension of the foot-pedal thresher
- The target yield will be at 4 to 5 tons/ha to be 3 times or more than that of the present yielding conditions.

To the above context, it is also scheduling to provide a short term credit (term for 6 months and in kind credit, i.e. farming implement and inputs) for the registered participatory farmers' groups through the National Agricultural Inputs Trust Fund

1) The registered participatory farmers' group means the farmers' group who has organized by farmers themselves based on the participatory program of SPFP, and has registered in Ministry of Home Affairs taking through the legal procedure specified. Under assistance and supervision of the District Extension Officer, the farmers' group shall prepare and establish the by-law and/or necessary constitution. Opening of its bank account in the authorized bank(s) is also subject to successful registration.

(NAITF) which has been established under financial assistance by FAO.

(2) Agricultural Extension and Financial Supporting Service Programs

The Ministry of Agriculture and Cooperatives started the National Agricultural and Livestock Extension Rehabilitation Project (NALERP) since 1988/89 with financing from the World Bank (IDA), the African Development Bank (AFDB), and the Government of Tanzania. It was focused on enforcement of extension system, upgrading the quality of extension officers, and provision of physical infrastructure and logistical support to the system. It has covered 16 regions of Tanzania mainland including Morogoro Region. In parallel with the above program, the Southern Highlands Extension and Rural Financial Services Project, which covers the remaining 4 regions including Zanzibar, has been launched in 1993/94 under financial assistance of IFAD. NALERP was officially closed by September 30, 1996.

The National Agricultural Extension Programme Phase-II (NAEP-II) has been successively implemented since October 8, 1996 as Phase-II of NALERP. The objectives of this programme are to continue to improve the delivery of extension service to smallholder farmers in order to improve crop productivity and cost effectiveness as well as farmer's living standard. Major extension services under NAEP II has been conducted under four components, that is (i) institutional strengthening, (ii) extension education and training, (iii) extension communication support, and (iv) pilot initiatives.

(3) The National Irrigation Development Program (NIDP)

NIDP emphasizes on an important strategy for achieving the policy objectives envisaged in the national agricultural development program. Despite the vast rainfed arable potential, irrigation especially on smallholder schemes has a vital role to play in achieving the following primary objectives:

- To satisfy subsistence requirement in many parts of the country,
- To generate the local surpluses of main staples, particularly maize and rice, in order to facilitate food security at regional or national levels, and
- To ensure the production to be much needed for dietary supplement, i.e. vegetables, fruit, oil seeds, etc.

The strategy framework for implementing the policy on the irrigation development has been established with particular emphasis on "rehabilitation or up-grading of the traditional irrigation schemes". To this, it is expected that the maximum impact will have to be brought by irrigation beneficiaries themselves with whose independence of mind on participatory approach to the said irrigation development.

In Tanzania, some 100,000 farm families have been currently supported by themselves for obtaining agricultural production using the traditional irrigation system. These traditional irrigation schemes are in most cases required to up-grade and/or rehabilitate to allow increased water use efficiencies due to fair wear and tear, increase in population pressure (necessity of more wider irrigable land), degradation of vegetation in the catchment area that causes a reduction of water discharges especially in the dry season, in contrast, occasional rapid flooding in the rainy season, and perhaps changing the local climate, i.e. consequence drought even in rainy season, etc.

## 1.3 Environmental Protection and Conservation Issues

There are various efforts to address the environmental problem in Tanzania through policy, program and legislative framework. It includes the preparation of a National

Conservation Strategy for Sustainable Development (NCSSD, 1993), the Draft National Environmental Policy (NEP, 1996) by the Environmental Sector, Division of Environment of the Vice-president Office; a National Environmental Action Plan (NEAP) in June 1994 by the Ministry of Tourism, Natural Resources and Environment and the Overview Study Results of Existing Legislation Pertaining to Environment by the Division of Environment of the Ministry and National Environmental Management Council (NEMC, 1993).

The National Environmental Action Plan (NEAP) was prepared by the Ministry of Tourism, Natural Resources and Environment in 1994. The overall objectives of the Policy are outlined below;

1) to ensure sustainable and equitable use of resources for both present and future generations without degrading the environment.
2) to prevent and control degradation of life support system.
3) to conserve and enhance natural and man-made heritage, including bio-diversity of the unique ecosystems of Tanzania.
4) to improve the condition and productivity of degraded areas for all Nations.
5) to raise awareness and understanding of the linkages between environment and development and to promote participation in environmental action.
6) to promote international cooperation on the environment agenda.

An agricultural policy was prepared in 1983 by the Ministry of Agriculture, Livestock Development and Cooperatives (MAC). In 1995, the policy was revised and clearly stated the specific objectives to promote integrated and sustainable use and management of natural resources in order to conserve the environment. Concerning irrigation development, the following objectives for wetland management were considered:

1) promote integrated and sustainable use and management of natural resources such as land, soil, water and vegetation.
2) promote efficient utilization of irrigation water and proper drainage to avoid water logging which causes soil salinity as well as health problems to the community.
3) organize farmers' groups and associations which will be facilitated to undertake activities including distribution of cattle, inputs, management of grazing lands and dips.

In addition, as leading agencies (MTNRE, 1994), the organizations, which are addressed to conduct the National Environment Action Plan, are in the process of preparing an environment management system within the present parent bodies. The required actions of the Ministry of Agriculture as a Lead Agency are outlined below;

1) Strengthen soil and water conservation activities.
2) Re-assessment of range management in the communal sector and re-appraisal of livestock marketing.
3) Environmentally methods of tse-tse fly control by bush clearing and its related land degradation.
4) Improvement of water management in irrigation schemes.

## 1.4 Socio-Economic Setting of Morogoro Region

Morogoro region had a population of 1.25 million in 1990, and it is growing at a rate of 2.8% annually. Around 85% of the population live in rural areas. If the population density of the district is compared to other districts, it is relatively low; as the total administrative area of Morogoro is considered to be approximately 73,000 $km^2$, there is an average of 17 persons per $km^2$. However, within the district there are extensive forestry areas, plantations, and the national parks and wild-life reserves, since then, most of the population has to compete for available land. It has been estimated that there are

approximately 1.9 million rural households; as an average, each household has 5.1 members which do not differs too much from the national average. The proximity to Dar-es-Salaam, the capital of Tanzania, has a positive economic impact on the Morogoro economy; the economy enjoys a comparatively prosperous economy. However, the core of agricultural production are the smallholder farmers.

The following Table provides information on production, cultivated area, and the unit yield for major food crops for the period 1987/92.

Cultivation Area, Production and Yield of Main Crops of Morogoro Region

| | Cultivation Area (ha) | | | Production ('000) | | | Yield (ton/ha) | | |
|---|---|---|---|---|---|---|---|---|---|
| | 94/95 | 95/96 | 96/97 | 94/95 | 95/96 | 96/97 | 94/95 | 95/96 | 96/97 |
| Maize | 140 | 119 | 129 | 227 | 210 | 225 | 1.6 | 1.8 | 1.7 |
| Paddy | 92 | 86 | 81 | 181 | 167 | 166 | 2.0 | 1.9 | 2.0 |
| Cassava | 23 | 16 | 25 | 90 | 65 | 133 | 3.9 | 4.1 | 5.3 |
| Sorghum | 35 | 30 | 21 | 86 | 30 | 24 | 2.5 | 1.0 | 1.1 |
| Potato | 4 | 2 | 2 | 23 | 9 | 7 | 5.8 | 4.5 | 3.5 |
| Legumes | 28 | 17 | 8 | 25 | 14 | 7 | 0.9 | 0.8 | 0.9 |

Source: Morogoro Regional Office

Of major food crops cultivated in the region, paddy is a very important staple food crop. Morogoro is one of the main producers of rice in Tanzania. Paddy is being cultivated mainly in the rainy season under the following irrigated conditions: 1) rain-fed; 2) flood water-fed, and 3) artificial irrigation. The first two irrigation types are extensively prevailing in the region. For the variety of rice, the "Supa-India" is the most common and popular among the rice producers and consumers.

The main crops by zones and seasons are as shown below:

Main Crops According to Zone and Season

| Zone | Rainy Season | Dry Season |
|---|---|---|
| Mountainous Zone | Maize, Beans, Vegetables | Vegetables, Beans |
| Alluvial Plain Zone | Paddy, Maize | Beans, Maize |
| Piedmont Plain & Fan Zone | Maize, Sugarcane, Paddy | Maize, Beans, Sugarcane |
| Valley and Riverine Terrace Zone | Maize, Beans, Paddy | Onion, Beans, Tomato |

The livestock production in the region is the traditional types of cattle, sheep, goat, pigs, etc. Table below gives information on livestock for the last past 5 years:

Present Conditions of Livestock in Morogoro Region

| Main Livestock | 1987/88 | 1988/89 | 1989/90 | 1990/91 | 1991/92 | 1992/93 |
|---|---|---|---|---|---|---|
| Cow | 366 | 374 | 382 | 390 | 398 | 405 |
| Sheep | 53 | 53 | 53 | 53 | 53 | 53 |
| Goat | 169 | 176 | 184 | 192 | 200 | 209 |
| Pig | 10 | 11 | 11 | 12 | 12 | 13 |

Note : Unit of Herd : 1,000 Herd

Most irrigation facilities in the region are of the traditional furrow systems, and need rehabilitation or improvement. As mentioned before, smallholder farmers usually rely on traditional irrigation methods, and accordingly, its operation effect brings about the problem of dependency on natural water resources which may become scarce especially during the dry season. To successfully maintain sustainable crop production, it is, therefore essential to consolidate the existing irrigation systems through water resources development and structural improvement of the irrigation facilities.

The suppression of price controls on agricultural products as a part of the policy of free market adopted by the government has given an incentive to commercialization of products by private enterprises and cooperatives. However, the smallholder farmers do not have a direct access to the markets having to depend on intermediaries for the commercialization of their products. On the other hand, subsidies for agricultural inputs like fertilizers or agro-chemicals have been suspended as part of the economic reform policy adopted by the government. Inputs prices vary freely according to the market demand and supply and prices and sometimes are too expensive for the smallholder farmers, making them to use inputs in lower amounts than recommended. Specially for paddy production, use of fertilizers of agro-chemicals have not been used in recent years.

# CHAPTER II. PRESENT CONDITIONS OF THE STUDY AREA

## 2.1 Physical Nature of The Study Area

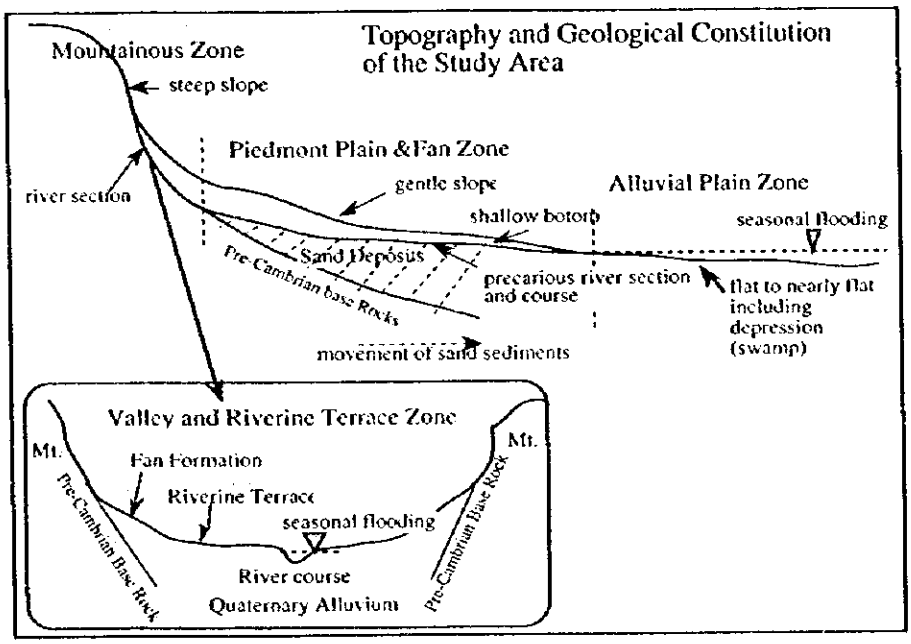
### 2.1.1 Location of the Study Area

The Central Wami River Basin (hereafter called to as the Study Area) lies within the geographical tract at 36° to 38° East-longitudes and 6° to 8° South-latitudes. More specifically, the Basin is extending western part of Morogoro city, the capital of Morogoro region which is located at about 200 km west of Dar es Salaam. The Study Area extends at the middle and upper reaches of Wami river, including a small part of the Ruvu and Rufiji river basins. Its physiographical area is approximately 11,460 km$^2$. Administratively, the Study Area belongs to three districts of Morogoro region, i.e. Morogoro, Kilosa, and Kilombero.

### 2.1.2 Topography and River Systems

(1) Topography

The topography and river systems in the Study Area are characterized according to the following Geological constitutions.




The Study Area is sur-rounded by four moun-tain ranges, i.e. the Ulu-guru Mountains in the south, the Nguru Moun-tains in the north, the Reveho Mountains in the west, and the Gologolo Mountains in the south-west. These mountains are generally characte-rized by its high altitude and steep slopes narrowly dissected by valleys. Of these mountains, only the land in the Uluguru Mountains are intensively utilized for crop cultivation except the highest places where the rain forest is being reserved. Since, a steep in mountainous slopes, the land suffers from serious environmental hazards, i.e., soil erosion and watershed degradation. Other mountains are mostly kept as forest reserve areas.

The alluvial plain (locally called to the Mkata Plain) vastly extends in the middle-reaches of the Wami river basin surrounded by the mountainous zone in the north, west, and the south. The plain has a gradient of 0.05 to 1 %, while consists of the meso- and micro-relief as well as wider swamp in the depressions. The area is habitually inundated with flooding water in the rainy season especially in February and March. The inundation depth ranges upto 1 m depending on the topography and ground elevation. In the central part from where Mkondoa river joins to Mkata river, a large swampy depression is extending astride Mkata river.

The piedmont plains and fans are located in between the mountains and the alluvial plain. It is characterized by gently undulating topography in the fan formation at the foot of mountains and descending to the alluvial plain zone. The slope gradient is ranging at 1 to 5 %. The groundwater table is generally shallow in the fans, and at the edge of the fan formation, that water springs in the ground surface and often formed swamp to a certain extent in downstream.

The area categorized into the Valley-Riverine Terraces lies in the mountainous range and forming a narrow strip with river sediments along a wide river valley. The area is slightly undulating with a surface gradient ranged at 2 to 10 %. It is sometimes found the perennial or seasonal swamps where the rivers have very shallow bottom like as Malolo and Mwega rivers.

(2) River systems

The Study Area is fed by the Wami river system and partly by the Ruvu river system in the south-eastern most and by the Rufiji river system in the south-western most. The Wami river and its tributaries originate the Nguru and Rubeho mountains and flows down the flat plain so-called Mkata Plain. Major tributaries of the Wami river are the Mkata, Mkondoa, and Miyombo rivers. The Ruvu river and its tributaries such as Ngerengere and Mgeta rivers receive their water from the Uluguru mountains. Small tributaries like Mlali river suffers from the sedimentation in fan formation. In the Rufiji river basin, the small tributaries such as Msolwa, Sanje, Mkula and Sonjo rivers, etc. originate from the Gologolo Mountains, and flow through the fans into the low-lying flood plain i.e. the Msolwa Plain and then extending to the Kilombero Plain. Mwega river is also a tributary of the Rufiji river flowing through the Great Ruaha river.

Generally, these rivers have a shallow bottom at lower-reaches due to heavy siltation, and accordingly, those river courses are easily changed by flood. A heavy sediment-load and unstability of these river are one of the serious physical constraints in irrigation development in the Study Area. In fact, the following troubles and/or damages are appeared up to present; "burying the intake structures under sediment", "difficulty in intake irrigation water due to change of the river course" and "crop damages by seasonal flood".

### 2.1.3 Meteorology and Hydrology

(1) Meteorology

The Study Area lies in between the Tropical Monsoon Climatic Zone in the east coast area and the Semi-arid Climatic Zone in the central to western most in Tanzania, and is characterized as the Tropical Savanna Climate having distinct two seasons, i.e. the rainy season and dry season. The rainy season is divided into two sub-season, namely the short rainy season (locally called as Vuli) from November to January, and the long rainy season from February to May (Masika). The general air-flow system is defined by the topography and it also influences the rainfall pattern. Mean annual precipitation over

2,000 mm is measured on the slope of the Uluguru Mountains. The western part of Uluguru Mountains lies on the rain shadow, and then, small amounts of rainfall are measured in the said area. While the mean annual precipitation in the alluvial plain zone decreases to 800 mm. Also the western part of Rucho Mountains lies on the rain shadow and small amount of rainfall are measured, while the mean annual precipitation in the western valley decreases to 360 mm. The typical rainfall pattern in the Study Area is shown below. Most rainfall can be expected in April, with smaller amounts in July / August.

Rainfall Data

(Unit : mm)

| NAME OF STATION: | Jan. | Feb. | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BUNDUKI | 202 | 147 | 287 | 371 | 182 | 39 | 31 | 47 | 89 | 177 | 304 | 305 | 2,190 |
| KILANGALI FARM | 134 | 89 | 147 | 151 | 46 | 5 | 5 | 8 | 14 | 24 | 77 | 131 | 828 |
| MASKATI | 125 | 105 | 177 | 278 | 143 | 27 | 19 | 27 | 27 | 62 | 107 | 177 | 1,313 |
| MLALI | 112 | 41 | 197 | 202 | 83 | 5 | 1 | 4 | 16 | 44 | 90 | 104 | 902 |
| KISANGATA SISAL | 112 | 89 | 151 | 192 | 89 | 14 | 11 | 2 | 19 | 24 | 52 | 98 | 777 |
| KILOMBERO | 173 | 126 | 249 | 336 | 136 | 25 | 19 | 9 | 16 | 43 | 108 | 178 | 1,425 |
| LUMUMA | 121 | 83 | 149 | 234 | 125 | 19 | 10 | 5 | 17 | 51 | 79 | 117 | 1,045 |
| MALOLO | 60 | 48 | 60 | 61 | 15 | 6 | 4 | 0 | 0 | 3 | 24 | 64 | 362 |

Other Meteorological parameters are widely different for each specific zone. The mountain zone was high relative humidity and low temperature, compared with other zones in the Study Area. The alluvial plain and pediment plain & fan zones have a typical climatic pattern in the Study Area as shown in the following Table;

| Parameters | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (1) Mean Maximum Temperature (℃) | 31.8 | 32.0 | 31.8 | 30.1 | 28.9 | 28.1 | 27.9 | 28.6 | 30.5 | 32.1 | 32.9 | 32.3 |
| (2) Mean Minimum Temperature (℃) | 21.0 | 21.1 | 21.2 | 20.8 | 19.2 | 16.4 | 15.5 | 15.9 | 17.3 | 19.4 | 20.7 | 21.0 |
| (3) Mean Temperature (℃) | 26.4 | 26.6 | 26.5 | 25.5 | 24.1 | 22.3 | 21.7 | 22.3 | 23.9 | 25.7 | 26.8 | 26.7 |
| (4) Relative Humidity (%) | 82.7 | 83.4 | 84.8 | 86.8 | 85.3 | 81.6 | 79.8 | 77.9 | 74.5 | 74.1 | 74.9 | 78.8 |
| (5) Sunshine Duration (hr/day) | 7.2 | 7.3 | 7.3 | 5.8 | 5.9 | 7.2 | 7.0 | 6.6 | 6.9 | 7.8 | 8.2 | 7.6 |
| (6) Solar Radiation (l/day) | 16.8 | 18.4 | 15.5 | 13.9 | 12.6 | 12.8 | 12.7 | 12.9 | 15.1 | 15.9 | 17.5 | 16.8 |
| (8) Evaporation (mm/day) | 5.8 | 6.7 | 5.6 | 3.9 | 3.1 | 3.1 | 3.4 | 4.1 | 5.6 | 6.3 | 6.7 | 6.3 |
| (7) Wind Velocity (m/s) | 1.9 | 1.7 | 1.4 | 1.0 | 0.9 | 1.1 | 1.3 | 1.5 | 1.8 | 2.1 | 2.1 | 2.1 |

## (2) Hydrology

The Study Area consists of large mountain ranges and wide plains. Depending on the geographical positions and heights of these mountains, the rainfall distribution pattern changes vary widely. Because of this variation in rainfall and, moreover, due to the various types of vegetation (ranging from rain-forest to grassland), and different slopes and permeability of the catchments, the run-off pattern varies strongly from place to place. In general, the river discharge is higher during the period from November to May than that from June to October. The run-off patterns for six rivers such as the Miyombo, Mkindo, Sonjo, Lumuma, Mwega, and Mohazima are as shown below.

Run-off Pattern of Major Six Rivers (unit : $m^3$/sec)

| River Name | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC | ANNUAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Miyombo | 5.1 | 4.4 | 6.8 | 10.1 | 8.4 | 5.6 | 3.5 | 2.7 | 1.8 | 1.8 | 2.9 | 5.3 | 4.88 |
| Mkindo | 3.0 | 4.4 | 9.0 | 11.1 | 8.2 | 3.9 | 2.5 | 2.0 | 1.7 | 2.8 | 3.8 | 3.7 | 4.66 |
| Sonjo | 0.8 | 0.8 | 1.9 | 3.6 | 2.3 | 1.2 | 0.6 | 0.4 | 0.3 | 0.2 | 0.5 | 0.6 | 1.10 |
| Lumuma | 1.8 | 1.9 | 2.0 | 4.7 | 2.0 | 1.3 | 0.9 | 1.1 | 0.9 | 2.1 | 4.3 | 3.5 | 2.20 |
| Malolo | 5.6 | 5.1 | 4.3 | 6.1 | 5.7 | 4.3 | 3.5 | 2.9 | 1.6 | 2.6 | 3.1 | 5.0 | 4.15 |
| Mohazima | 1.8 | 1.9 | 1.8 | 2.1 | 1.5 | 0.9 | 0.7 | 0.7 | 0.5 | 0.6 | 0.7 | 1.1 | 1.19 |

### 2.1.4 Soils

(1) Soils in the Study Area

The soils in the Study Area are classified into "Fluvisols" and "Cambisols" of the great soil groups according to the soil classification standard (Soil Map of the World) specified by FAO/UNESCO. These soils are further sub-classified into 6 sub-groups and 11 soil phases if taking into account the soil texture qualities, drainability, effective soil depth, etc. as shown in the following Table.

Soils in the Study Area

| Zone* | Soil Name | Texture | Drainability | Soil Depth | Topography | Legend |
|---|---|---|---|---|---|---|
| I | Eutric Cambisols | L - SCL | well | 0.5-1.5m | mountain | CM-a |
| II | Luvic Cambisols | SL - L | moderately well | >1.5m | alluvial plain | CM-d |
| II | Vertic Cambisols | CL - SC | poor to imperfect. | >1.5m | alluvial plain | CM-e |
| II | Eutric Fluvisols | SL - LS | moderately well | 1-1.5m | levee | FL-a |
| II | Gleyic Fluvisols | CL - SiCL | poor | >1.5m | alluvial plain | FL-f |
| II&III | Eutric Fluvisols | CL - SiCl | imperfectly | 1.5m | alluvial plain | FL-a |
| III | Eutric Fluvisols | CL - SiC | imperfectly | 1-1.5m | fan | FL-c |
| IV | Eutric Fluvisols | LS - SL | imperfect. to well | 0.5-1.5m | valley bottom | FL-d |
| IV | Eutric Fluvisols | SL - CL | poor | 0.5-1.5m | valley bottom | FL-e |
| IV | Eutric Cambisols | L - CL | mod. well to well | 1-1.5m | terrace | CM-b |
| IV | Chromic Cambisols | SL - L | well | 0.5-1.5m | terrace/foothill | CM-c |

Remarks *: Zone I: Mountainous, Zone II: Alluvial plain, Zone III: Piedmont/fan, Zone IV: Valley and riverine terrace

In general, these soils are relatively fertile and sufficiently large moisture holding capacity to be suitable for crop cultivation and irrigation practices. With small exception, the soils developed in the steep slope have a shallow effective depth, course texture quality, and then, high erodebility.

### 2.1.5 Vegetation

The Study Area is extended at approximately 11,460 km$^2$, corresponding to about 15.7% of the total area of Morogoro region (73,040 km$^2$). Out of the said area, about 38% is covered by the forest in which some 3,630 km$^2$ is being registered as the forest reserves and remaining is still open wood land; about 30% is belong to the savanna including bush in a part, and 32% or approximately 370,510 ha is of the agricultural land inclusive of village yard, etc. Of the total agricultural land, estimated about 60,000 ha land is being under cultivation by the smallholder farmers, and greater remains are belong to the large scale state farms, i.e. sugar and sisal plantation. The irrigation development in the smallholder farms is only 5,000 ha (8%), and accordingly, remaining farm land is cultivated under rain-fed and/or flood water-fed conditions.

Study Area by Land Categories

(Unit: ha)

| | Topographic Zones | Physical Extent | Area Covered by Natural Vegetation | Agricultural Lands |
|---|---|---|---|---|
| I | Mountainous Ranges | 255,550 | 253,550 | 2,000 |
| II | Flood Plains | 500,000 | 425,000 | 75,000 |
| III | Piedmont Plains & Fans | 377,000 | 94,250 | 282,750 |
| IV | Valley & Riverine Terraces | 13,450 | 2,690 | 10,760 |
| | Total | 1,146,000 | 775,490 | 370,510 |

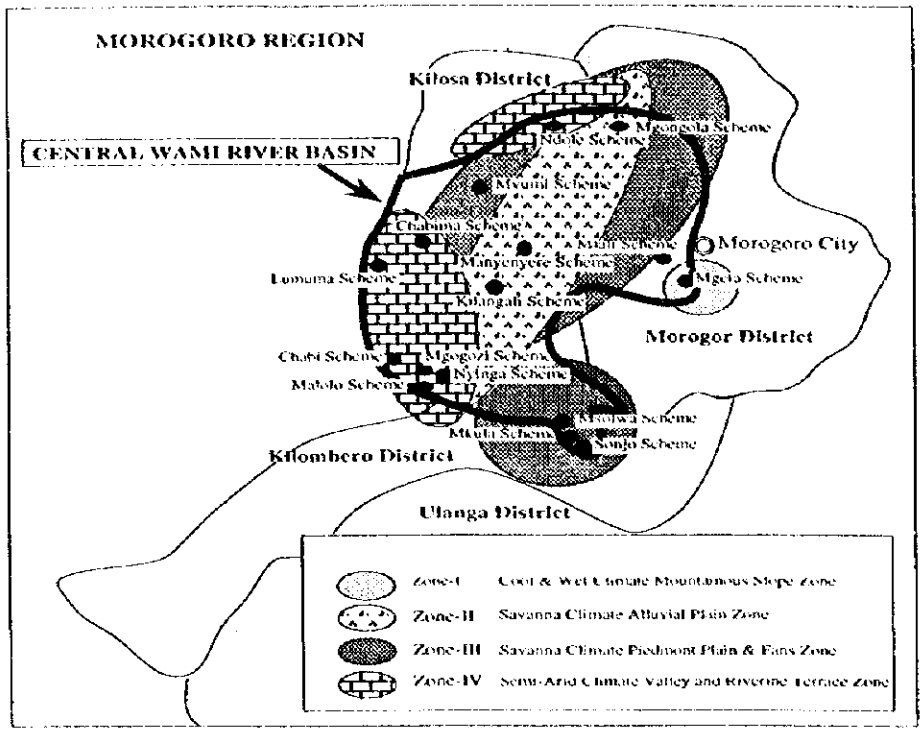
### 2.1.6 Physiographical Zones in the Study Area

The Study Area could physiographically be divided into four zones, i.e. "cool & wet climate mountainous slope zone", "savanna climate alluvial plain zone", "savanna climate piedmont plain and fan zone" and "semi-arid climate valleys & riverine terrace zone" taking into account the topographic constitutions, soils, river system, climate, and vegetation. Major characteristics of each zone are tabulated below.

| Specific Zones | | Major Characteristics |
|---|---|---|
| Zone-I: | Cool & Wet Mountainous Zone(Ulugunu Mountains) | - High altitude, extremely steep slopes, narrowly dissected by eroded gullies having serious environmental hazards, i.e. soil erosion, land sliding, watershed degradation, etc.<br>- Eutric Cambisols with undifferentiated soils on Pyroxene Granulite rocks having shallow effective soil layer and coarser textures.<br>- High annual rainfall at more than 2,000 mm<br>- Monsoon forest type vegetation in forest reserve, while maze and vegetables in the cultivated area |
| Zone-II | Savanna Climate Alluvial Plain Zone (Mkata Plain) | - Lowlying flat plain having a large swampy depression<br>- Quaternary alluvium to be classified into Eutric and Gleyic Fluvisols associated with Luvic and Vertic Cambisols. These soils are clayey to sandy loam in texture qualities and relatively fertile<br>- Deep inundation rated at 40 to 100 cm during the rainy season<br>- Grass savanna associated with swampy vegetation in the non-reclaimed area, while extensive cultivation of paddy in the reclaimed area. |
| Zone-III | Piedmont Plain & Fan Zone (Surrounding Mkata & Msolwa Plain) | - Gently undulating topography at the foot of mountains, and flat in lowlying flood plain in downward<br>- Eutric Cambisols originated from the Post Miocene deposits on the Precambrian rocks in piedmont plain, while Eutric Fluvisols (recent alluvium) in the fan formation<br>- Bush/grass savanna vegetation in the non-reclaimed area. In cultivation area, maize is predominant in piedmont plain and fans, while paddy in the seasonal flood plain. |
| Zone-IV: | Valley/Riverine Terrace Zone | - Narrow peneplain (fans) and riverine terraces having nearly flat in swamp to gently slope topography.<br>- Eutric Fluvisols associated with Eutric and Chromic Cambisols originated from the quaternary alluvium having loamy to sandy in texture qualities.<br>- Baobab-cactus type vegetation associated with acacia-grass savanna vegetation in the uncultivated area, while maize, paddy, onion, etc. in the cultivated area. |

The Figure below shows the distribution of the physiographical zones classified inthe Study Area.

Physiographical Zones in the Study Area




## 2.2 Socio-Economic Setting

### 2.2.1 Administrative Divisions and Demographic Data

The Table below presents the demographic data by administrative divisions in the Study Area.

Administrative Division and Population (1996)

| Scheme | District | Division | Ward | Village | Population | Household |
|---|---|---|---|---|---|---|
| 1) Mgeta | Morogoro | Mgeta | Langali | 4 villages | 6,737 | 1,815 |
| | | | Tchenzema | 4 villages | 7,024 | n.a |
| | | | Kikeo | 2 villages | n.a | n.a |
| 2) Manyenyere | Kilosa | Masanze | Mabwerewere | Tindiga | 4,500 | 900 |
| | | | | Malui | 4,000 | n.a. |
| | | | Kilangali | Kivungu | 2,940 | n.a |
| 3) Kilangali | Kilosa | Masanze | Kilangali | Kilangali | 3,038 | 420 |
| 4) Mvumi | Kilosa | Magolo | Msowero | Mvumi | 7,448 | 1,104 |
| 5) Mgongola | Morogoro | Mvomero | Hembeti | Mkindo | 4,222 | 300 |
| | | | | Dhombo | 1,850 | 620 |
| | | | | Hembeti | 2,401 | 530 |
| 6) Mlali | Morogoro | Mlali | Mlali | Mlali | 2,625 | 420 |
| | | | | Kipera | 3,111 | 664 |
| 7) Ndole | Morogoro | Mvomero | Maskati | Ndole | 1,043 | 250 |
| 8) Msolwa | Kilombero | Kidatu | Sanje | Msolwa | 2,996 | 658 |
| 9) Mkula | Kilombero | Mang'ula | Mkula | Mkula | 2,944 | 494 |
| 10) Sonjo | Kilombero | Mang'ula | Mkula | Sonjo | 1,774 | 497 |
| 11) Chabima | Kilosa | Masanze | Masanze | Chabima | 700 | 150 |
| 12) Lumuma | Kilosa | Kidete | Lumuma | Msowero | 1,076 | 207 |
| | | | | Idole | 3,055 | 443 |
| | | | | Mkughulu | 1,300 | 450 |
| 13) Nyinga | Kilosa | Mikumi | Malolo | Malolo | 200 | 50 |
| 14) Malolo | Kilosa | Mikumi | Malolo | Malolo | 3,800 | 320 |
| 15) Mgogozi | Kilosa | Mikumi | Malolo | Mgogozi | 1,265 | 280 |
| 16) Chabi | Kilosa | Mikumi | Malolo | Chabi | 1,076 | 260 |

Out of the 16 irrigation schemes, 5 of them (Mgeta, Manyenyere, Mgongola, Mlali and Lumuma) covers 2 or 3 wards while the rest only include one ward each.

### 2.2.2 Rural Infrastructure

(1) Access Road

Access roads to the smallholder irrigation schemes are generally poor. These roads have a width of only about 3 to 4 m without a paved surface.

1) Access Road to Schemes in Mountainous and Valley/Riverine Terrace Zones

The existing access roads to each scheme in the Mountainous and Valley/Riverine Terrace Zones generally run along a river meandering with ups and downs through the hills. A traficability of these roads is generally poor. A width of the roads is as narrow as 3 m in most cases. Many of them have no river-crossing structures. Therefore, vehicular transit is difficult during the rainy season. Especially a road from Kilosa via. Chabima to Lumuma is difficult to transit by car. The road acutely meanders with ups and downs and has no river crossing structures in the section after the Chabima scheme area.

2) Access Road to Schemes in Alluvial Plain Zone

The access roads to each scheme in the Alluvial Plain Zone are characterized as un-consolidated earth road constructed by use of the alluvial muddy and without pavement or embankment. During the mid rainy season from February to March, it is often submerged with flooding water where the land is depressed at some sections. These roads have to be improved with provisions for drain culverts, road embankment and pavement.

3) Access Road to Schemes in Piedmont Plain & Fan Zone

Access to the schemes in this Zone is easy in most cases since the schemes are located quite close to the trunk roads. However, almost all of the access road to the headworks and/or the cultivated field is an unconsolidated earth road, and subject to improvement.

(2) Other Social Infrastructures

a) Most of the villages have a primary school. Unfortunately, in some cases the infrastructure is dilapidated due to lack of maintenance. Also, there is a lack of teaching materials at some schools.
b) As most of the villages do not have tap water, it has to be fetched from rivers or shallow wells. Sometimes the water source is not near the village and fetching water several times per day is too much time-consuming. Water-borne diseases are also common, i.e., diarrhea, colitis.
c) Lack of electricity severally limits the range of economic activities that can be carried out, specially those related to storage and processing of agricultural products.
d) Most of the villages have a dispensary or have one relatively near them. These dispensaries usually are only for first-aid services. The staff usually consists of a medical assistant and/or registered nurse. For cases which require a better equipment and staff, the patient must be taken to a urban center to be attended there.

### 2.2.3 Socio-Economic Activities

Each village in the Study Area consists of few to several tribes. Those inhabitant are organized them into the traditional village community and play social as well as economic activities without any serious conflicts.

All the villagers has, more or less, the cultivated land within the village area, and earns their incomes from the crop production. However, since most of their land is not satisfactorily consolidated yet, the agricultural production is still at the subsistence level. Nevertheless, agriculture provides employment to more than 95% of the economically active population in the villages. The activities are carried out at their own fields, third-party fields, and private and parastatal estates. The commercial and services sector do not absorb employment in a significant way. 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.

## 2.3 Present Conditions of Agriculture

### 2.3.1 Present Land Use

The present agricultural land use in the Study Area is summarized as follows:

Agricultural Land Use in the Study Area

| Schemes | Net Agricultural Land (ha) | | | Cultivated Area (ha) | | | Cropping Intensity (%) |
|---|---|---|---|---|---|---|---|
| | Irrigated Area | Rainfed Area | Toal | Wet Season | Dry Season | Total | |
| Zone I | | | | | | | |
| Mgeta*1 | 1,600 | 3,110 | 4,710 | 4,710 | 1,600 | 6,310 | 134 |
| Zone II | | | | | | | |
| Manyenyere | 290 | 1,250 | 1,540 | 1,540 | 0 | 1,540 | 100 |
| Kilangali | 65 | 495 | 560 | 560 | 0 | 560 | 100 |
| Mgongola | 40 | 2,710 | 2,750 | 2,750 | 40 | 2,790 | 101 |
| Zone III | | | | | | | |
| Mlali*1 | 2 | 838 | 840 | 840 | 130 | 970 | 115 |
| Mvumi | 8 | 1,620 | 1,628 | 1,628 | 0 | 1,628 | 100 |
| Msolwa*1 | 0 | 900 | 900 | 900 | 400 | 1,300 | 144 |
| Mkula*1 | 0 | 630 | 630 | 630 | 280 | 910 | 144 |
| Sonjo*1 | 0 | 350 | 350 | 350 | 150 | 500 | 143 |
| Zone IV | | | | | | | |
| Chabima*1 | 0 | 240 | 240 | 240 | 20 | 260 | 108 |
| Lumuma | 380 | 280 | 660 | 660 | 280 | 940 | 142 |
| Ndole | 8 | 110 | 118 | 118 | 8 | 126 | 107 |
| Nyinga*2 | 90 | 60 | 150 | 150 | 40 | 190 | 127 |
| Malolo | 400 | 210 | 610 | 610 | 160 | 770 | 126 |
| Mgogozi*3 | 220 | 0 | 220 | 220 | 35 | 255 | 116 |
| Chabi | 270 | 10 | 280 | 280 | 200 | 480 | 171 |
| Total | 3,373 | 12,813 | 16,186 | 16,186 | 3,343 | 19,529 | 121 |

Note: *1 : As for cultivated area in the dry season, some cultivated area under rainfed in which soil moisture is maintained by high ground water and cultivated area of sugarcane which has long growth period are respectively included.
*2 : Mwega sub-scheme in Mgogozi scheme is included.
*3 : Kikalo sub-scheme

Irrigation activities in the Study Area is still limited to only 8% of the total

agricultural land due to mal-conditions of irrigation facilities and damages by frequent occurrence of flooding in the rainy season. Irrigation efficiency has also been gone down due to heavy sedimentation at the intake weir and major canals, resulting in some difficulty on smooth water distribution and its management.

(1) Zone-I : Cool & Wet Mountainous Zone

The agricultural land in this zone is wholly reclaimed in the steep mountain slopes. In the rainy season, maize, beans, peas, etc. are cultivated mainly under the rainfed condition. While in the dry season, vegetables and beans are the essential crops for marketing. Since it has a certain rain distribution even during the dry season, beans are grown mostly under rainfed conditions. Such vegetables as cabbage, lettuce, cauliflower, leek, etc. are grown under fully irrigated conditions.

(2) Zone-II: Savanna Climate Alluvial Plain Zone

As shown in the above Table, some part of the cultivated area is categorized as an irrigable land. The irrigable land is, however, not always irrigated sufficiently due to poor functioning or low working efficiency of the irrigation facilities. Accordingly, most of the agricultural land in this zone is cultivated under rainfed conditions, except about 40 ha of paddy field in Mkindo Irrigation Scheme which was developed as the pilot project as the upper reach of Mgongola scheme. Paddy is a main crop in the lowlying area where a seasonal flooding stand in the rainy season. While, maize, sorghum, cotton, and such oil seeds as sun-flower, sesame, etc. are major production in rather elevated area.

(3) Zone-III : Savanna Climate Piedmont Plain & Fan Zone

Paddy is the main crops in the lowlying fan formation. While maize, beans and other upland crops are grown in the piedmont plain and upper reach of the fan formation. In exceptional case in Mvumi irrigation scheme, double cropping of maize and beans are being practiced by farmers in the area where soils are sufficiently moistened by capillary water from the shallow ground water even in the dry season. Other than those crops, sugarcane is also extensively cultivated under rain-fed conditions in and around the piedmont plains and fans in case of Mkula, Msolwa, and Sonjo schemes.

In Mlali scheme, the existing irrigation facilities have not been functioning well due to degradation of intake weir and main irrigation canal caused by heavy siltation. Therefore, majority crops are grown mostly under rainfed conditions. In the dry season, tomatoes are cultivated in a small extent using the natural soil moisture maintained by shallow ground water.

(4) Zone-IV : Semi-Arid Climate Valley/Riverine Terrace Zone

In the schemes in this zone except Chabima and Ndole schemes, the riverine terraces are intensively utilized for agricultural production throughout a year under fully irrigated conditions. The major production are maize and paddy in the rainy season, and onion and beans in the dry season, respectively. In case of Chabima and Ndole, agricultural land is used only in the rainy season for subsistence production, i.e. maize, beans, etc. Recently, farmers in these schemes have developed a traditional irrigation furrows, but those are still at a marginal level.

### 2.3.2 Land Ownership and Tenure System

The tenure system in agricultural land holding is generally based on the 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 respects.

In most villages in zone-IV, there are no more arable land to be able to allocate for the villagers. Since then, the cultivated land has been fragmented to small due to recent population increases and traditional inheritance through generation changes. Shrinkage of land holding size per farm household has, therefore, become a serious problem in this area. Land holding size per farm household in each scheme is estimated to be 1 to 1.5 ha on an average as shown below :

Landholding Size by Scheme

| | Population | Family Size (person) | No. of Household (no.) | Holding Size per Household | | |
|---|---|---|---|---|---|---|
| | | | | Irrigated (ha) | Rainfed (ha) | Total (ha) |
| Zone I | | | | | | |
| Mgeta | 29,354 | 5 | 5,871 | 0.27 | 0.53 | 0.80 |
| Zone II | | | | | | |
| Manyenyere | 11,440 | 6 | 1,907 | 0.15 | 0.66 | 0.81 |
| Kilangali | 3,040 | 7 | 434 | 0.15 | 1.14 | 1.29 |
| Mgongola | 8,470 | 5 | 1,694 | 0.02 | 1.61 | 1.63 |
| Zone III | | | | | | |
| Mlali | 5,740 | 5 | 1,148 | | 0.73 | 0.73 |
| Mvumi | 7,450 | 4 | 1,863 | | 0.87 | 0.87 |
| Msolwa | 3,000 | 6 | 500 | | 1.80 | 1.80 |
| Mkula | 2,940 | 6 | 490 | | 1.29 | 1.29 |
| Sonjo | 1,770 | 7 | 253 | | 1.38 | 1.38 |
| Zone IV | | | | | | |
| Chabima | 700 | 5 | 140 | | 1.71 | 1.71 |
| Lumuma | 5,440 | 7 | 777 | 0.49 | 0.36 | 0.85 |
| Ndole | 1,040 | 4 | 260 | 0.03 | 0.42 | 0.45 |
| Nyinga | 470 | 4 | 118 | 1.27 | | 1.27 |
| Malolo | 3,800 | 8 | 475 | 0.84 | 0.44 | 1.28 |
| Mgogozi | 1,000 | 7 | 143 | 1.54 | | 1.54 |
| Chabi | 1,080 | 6 | 180 | 1.50 | 0.06 | 1.56 |

### 2.3.3 Present Agricultural Production

(1) Present Cropping Pattern and Farming Practices

1) Present Cropping Pattern

Maize, paddy, beans, sorghum, etc. are cultivated in the Study Area as dominant food crops, while vegetables, i.e. onion, tomatoes, cabbage, cotton, sunflower, sugarcane, etc. are the dominant economic crops. Major crops by schemes and cropping seasons are summarized as follows:

| Irrigation Schemes | Rainy Season | Dry Season |
|---|---|---|
| Zone-I | | |
| 1. Mgeta scheme | Maize, Beans | Cabbage, Beans |
| Zone-II | | |
| 2. Manyenyere scheme | Paddy, Maize, Cotton, Sorghum, Sunflower | |
| 3. Kilangali scheme | Paddy, Maize, Sorghum, Sunflower | |
| 4. Mgongola | Paddy, Maize, Cotton | Paddy |
| Zone-III | | |
| 5. Mlali scheme | Paddy, Maize, Sorghum | Tomato |
| 6. Mvumi scheme | Paddy Maize, Sorghum, Cotton | |
| 7. Msolwa scheme | Paddy, Maize, Sugarcane | Maize |
| 8. Mkula scheme | Paddy, Maize, Sugarcane | Maize |
| 9. Sonjo scheme | Paddy, Maize | |
| Zone-IV | | |
| 10. Chabima scheme | Maize | Beans |
| 11. Lumuma | Paddy, Maize, Beans | Onion |
| 12. Ndole scheme | Maize, Beans | Maize, Beans |
| 13. Nyinga/Mgogozi Mwega | Paddy, Maize | Onion, Beans |
| 14. Malolo scheme | Paddy, Maize | Onion, Beans |
| 15. Mgogozi Kikalo scheme | Maize | Onion, Beans |
| 16. Chabi scheme | Maize, Beans, Paddy | Onion, Maize, Beans |

2) Farming Practices

Generally, the farming practices prevailing in the Study Area are a simple and mostly similar, regardless each scheme is located at different physiographical areas. Major topics on the present farming practices are summarized as follows:

a) Direct seeding method is predominant in paddy cultivation, although transplanting method has been introduced in Mkindo Pilot Irrigation Scheme. No application of fertilizer and agro-chemicals are commonly practiced in case of paddy cultivation by the direct seeding method. Since the year of 1995, the Special Program for enhancement of food security has been implemented in Morogoro and Kilombero Districts under the technical and financial assistance of FAO. Advanced farming practices including transplanting and application of fertilizer are disseminated through this program.

b) As for vegetable cultivation, i.e. tomatoes, onion, cabbage, etc., the agro-chemicals are applied in common, while an amount of those agro-chemicals is still small to a marginal level. It is due to the fact that the prices of agro-chemicals are expensive, and on the other hand, plant protection technology is so far not transferred to farmers. Poor farm inputs supply system is also the constraint in this farming.

c) In case of such food crops as paddy and maize cultivation under rainfed conditions, no fertilizers and agro-chemicals are applied in common in the Study Area. As for seeds, farmers utilize their own seeds rather than that of the qualified seeds purchased. Since then, contamination of the crop varieties have been contaminated, and accordingly, deterioration of quality of harvested products is appeared to a serious extent. The harvesting work is also much disturbed due to different maturation of the mixed varieties.

d) Some numbers of farming tractors, which are mostly owned by largeholder farmers, are available in and around the Study Area. Those tractors are utilized for land preparation at the rental basis. Those tractors are, however, too short for assisting in soil preparation of all the farm land in the Study

Area, and accordingly, more than 50 % of farmers are cultivated the land by use of the handy implements.

e) In predominant cases, crop cultivation is practiced by the family labor force in the Study Area. Seasonally hired labor is observed only in the case of onion cultivation, i.e. for soil preparation, transplanting of onion nursery to main field, harvesting and sacking work.

The present conditions of farm input utilization per ha for major crops is estimated as follows:

| | | Paddy DS*1 | Paddy TP*1 | Maize | Beans | Tomato | Onion | Cabbage |
|---|---|---|---|---|---|---|---|---|
| Seed | kg/ha | 90 | 50 | 20 | 20 | 0.5 | 5 | 0.2 |
| Fertilizer | | | | | | | | |
| Urea | kg/ha | - | 125 | - | - | - | 125 | - |
| SA | kg/ha | - | - | - | - | 125 | 125 | 150 |
| Agro-chemicals | | | | | | | | |
| Insecticides | lit./ha | - | - | - | - | 2.0 | 2.0 | 2.0 |
| Herbicides | lit./ha | - | 2.5 | - | - | - | - | - |
| Fungicides | lit./ha | - | - | - | - | - | - | - |
| Others | | | | | | | | |
| Labour Requirement | | | | | | | | |
| Family Labour | m-d/ha*2 | 80 | 130 | 90 | 80 | 160 | 160 | 160 |
| Hired Labour | m-d/ha | 60 | 87 | 45 | 35 | 74 | 165 | 34 |
| Total | m-d/ha | 140 | 217 | 135 | 115 | 234 | 325 | 194 |

*1 DS: Direct Sowing, TP: Transplanting *2 m-d: man-day

(2) Crop Production

As mentioned in the preceding section, the farm land is not satisfactorily reclaimed and/or sufficiently consolidated yet so far. Under such inadequate field conditions, the productivity of each crop is still low at the subsistence level. The unit yield of major crops is estimated at as below.

Unit Yield of Major Crops (Unit: ton/ha)

| Descriptions | Lower Yield | Higher Yield | Descriptions | Lower Yield | Higher Yield |
|---|---|---|---|---|---|
| under rainfed conditions: | | | under irrigated conditions: | | |
| Paddy | 1.5 | 2.5 | Paddy | 2.5 | 3.5 |
| Maize | 1.5 | 2.2 | Onion | 9.0 | 13.0 |
| Beans | 0.5 | 1.0 | Cabbage | 10.0 | 15.0 |
| Sugarcane | 35.0 | 45.0 | Tomatoes | 5.0 | 10.0 |
| Sorghum | 0.7 | 1.3 | - | - | - |
| Cotton | 0.5 | 1.0 | - | - | - |
| Sunflower | 0.5 | 0.7 | - | - | - |

Note: Paddy yield under the irrigated conditions is referred to that from Mkindo Pilot Scheme

The following Table shows the present cultivated area by major crops and those estimated production:

Annual Cultivated Area of Major Crops by Scheme (ha)

| | Paddy | Maize | Beans | Onion | Tomatoes | Cabbage |
|---|---|---|---|---|---|---|
| Zone I | | | | | | |
| Mgeta | - | 3,110 | 2,930 | - | - | 270 |
| Zone II | | | | | | |
| Manyenyere | 520 | 720 | - | - | - | - |
| Kilangali | 320 | 190 | - | - | - | - |
| Mgongola | 2,100 | 670 | - | - | - | - |
| Zone III | | | | | | |
| Mlali | 200 | 300 | - | - | 130 | - |
| Mvumi | 668 | 880 | - | - | - | - |
| Msolwa | 380 | 280 | - | - | - | - |
| Mkula | 220 | 310 | - | - | - | - |
| Sonjo | 130 | 130 | - | - | - | - |
| Zone IV | | | | | | |
| Chabima | - | 240 | 20 | - | - | - |
| Lumuma | 30 | 340 | 290 | 280 | - | - |
| Ndole | - | 58 | 68 | - | - | - |
| Nyinga | 10 | 140 | 30 | 10 | - | - |
| Malolo | 100 | 490 | 50 | 130 | - | - |
| Mgogozi | - | 220 | 5 | 30 | - | - |
| Chabi | 10 | 100 | 270 | 100 | - | - |
| Total | 4,688 | 8,178 | 3,663 | 550 | 130 | 270 |

Annual Crop Production by Scheme (ton)

| | Paddy | Maize | Beans | Onion | Tomato | Cabbage |
|---|---|---|---|---|---|---|
| Zone I | | | | | | |
| Mgeta | - | 3,110 | 1,465 | - | - | 2,700 |
| Zone II | | | | | | |
| Manyenyere | 832 | 720 | - | - | - | - |
| Kilangali | 512 | 190 | - | - | - | - |
| Mgongola | 3,360 | 670 | - | - | - | - |
| Zone III | | | | | | |
| Mlali | 320 | 300 | - | - | 780 | - |
| Mvumi | 1,069 | 880 | - | - | - | - |
| Msolwa | 608 | 280 | - | - | - | - |
| Mkula | 352 | 310 | - | - | - | - |
| Sonjo | 208 | 130 | - | - | - | - |
| Zone IV | | | | | | |
| Chabima | - | 240 | 10 | - | - | - |
| Lumuma | 48 | 340 | 145 | 2,800 | - | - |
| Ndole | - | 58 | 34 | | - | - |
| Nyinga | 16 | 140 | 15 | 100 | - | - |
| Malolo | 160 | 490 | 25 | 1,300 | - | - |
| Mgogozi | - | 220 | 3 | 300 | - | - |
| Chabi | 16 | 100 | 135 | 1,000 | - | - |
| Total | 7,501 | 8,178 | 1,832 | 5,500 | 780 | 2,700 |

(3) Livestock and Inland Fishery

The livestock production is just at the subsistence level in the Study Area.

Major Livestock in the Study Area

(Unit : Head)

| | | Cattle | Goat | Pig |
|---|---|---|---|---|
| Zone I | | | | |
| | Mgeta | 5 | 3,020 | 1,420 |
| Zone II | | | | |
| | Manyenyere | 614 | 348 | - |
| | Kilangali | - | - | - |
| | Mgongola | - | - | - |
| Zone III | | | | |
| | Mlali | 1,467 | 388 | - |
| | Mvumi | - | - | - |
| | Msolwa | 10 | 110 | 20 |
| | Mkula | - | - | - |
| | Sonjo | - | 50 | 10 |
| Zone IV | | | | |
| | Chabima | - | 70 | - |
| | Lumuma | 300 | 1,000 | 100 |
| | Ndole | - | - | - |
| | Nyinga | - | - | - |
| | Malolo | - | - | - |
| | Mgogozi | - | - | - |
| | Chabi | - | - | - |
| | Total | 2,396 | 4,986 | 1,550 |

Cattle is one of the most essential livestock in the Study Area. Most of cattle belongs to pastura-lists who shift a grazing area, season and season, and therefore, utilization of the draft animals (oxen) for farming practices is not common in the area. Number of major livestock is estimated as shown in Table in left hand.

The inland fishery is not settled in the area, except some minor fish cultivation in Mgeta scheme where some farmers grow Telapia in the small pond for home consumption.

### 2.3.4 Activities of Agricultural Supporting Services

(1) Extension

Deployment of Extension Officers in Three Districts Concerned

| District | Division | No. of DIVEO | No. of VEO | No. of Village | Irrigation Schemes Concerned |
|---|---|---|---|---|---|
| Morogoro District | Kingolwira | 1 | 16 | 19 | |
| District Extension Officer | Mgeta | 1 | 8 | 24 | Mgeta |
| Subject Matter Specialist | Mlali | 2 | 10 | 16 | Mlali |
| Crop extension officer | Bwaikira | 2 | 3 | 21 | |
| Livestock extension officer | Mkuyuni | 1 | 3 | 20 | |
| | Mvuha | 2 | 2 | 22 | |
| | Mvomero | 1 | 12 | 27 | Ndole, Mgongola |
| | Matombo | 2 | 3 | 33 | |
| | Turiani | 2 | 11 | 24 | |
| | Ngerengere | 1 | 5 | 19 | |
| | Total | 15 | 73 | 225 | |
| Kilosa District | Kilosa / Mjini | 1 | 3 | 18 | |
| District Extension Officer | Masanze | 1 | 5 | 14 | Chabima, Kilangali, Manyenyere |
| Subject Matter Specialist | Kimamba | 1 | 8 | 14 | |
| Crop extension officer | Ulaya | 1 | 6 | 9 | |
| Livestock extension officer | Mikumi | 2 | 10 | 26 | Malolo, Nyinga, Chabi, Mgogozi |
| | Magole | 2 | 12 | 29 | Mvumi |
| | Gairo | 2 | 12 | 27 | |
| | Kidete | 1 | 1 | 8 | Lumuma |
| | Nongwe | 1 | 0 | 10 | |
| | Total | 12 | 57 | 155 | |
| Kilombero District | Kidatu | 1 | 3 | 4 | Msolwa |
| District Extension Officer | Mang'ula | 2 | 9 | 12 | Sonjo, Mukla |
| Subject Matter Specialist | Ifakara | 1 | 8 | 10 | |
| Crop extension officer | Mngeta | 1 | 4 | 8 | |
| Livestock extension officer | Mlimba | 1 | 5 | 11 | |
| | Total | 6 | 29 | 45 | |

The extension services at regional level are led by Regional Extension Officer (REO), while by District Extension Officer (DEO) at the district level under supervision of REO. Division Extension Officer (DIVEO) is deployed in each division office, and acting the extension services under the control of DEO. Village Extension Officers (VEOs) are also deployed for extending technical guidance to farmers at the village level. At present, the number of VEOs is only 19 staffs in total, and accordingly, their extension services merely cover in 19 villages out of 44 villages in the Study Area. Deployment of the extension officers by respective three districts is as shown in the above Table:

(2) Implementation of research and training

1) Research Institutes and Research Center

MAC has divided the agricultural area in the main-land of Tanzania into 7 eco-agricultural zones for doing specific researches and training activities in agricultural technology. In each zone, numbers of the research institutes and research centers were established for research and study subject to crops and livestock production specified for each zone. Morogoro region has been grouped into the Eastern Zone covering 4 regions, i.e. Tanga, Coast, Dar es Salaam, and Morogoro.

Ilonga Agricultural Research and Training Institute (ARTI) in Kilosa district was established as the headquarters of the research institutes in the eastern zone. Under the ARTI, KATRIN and Chollima Agro-Scientific Research Center established in Ifakara in Kilonbero district are respectively conducting the following research works:

- KATRIN Research Center: Research on paddy cultivation technology under the National Rice Research Program.
- Chollima Agro-Scientific Research Center: Agronomic research, breeding and training of extension officers covering the technology on paddy, maize, and vegetables

In addition to the above two research centers, Dakawa Research Center has also been established in Morogoro district under technical and financial assistance provided by the North Korean Government. The Center is carrying out the research work on paddy, maize and some tropical vegetables.

2) SOKOINE University of Agriculture

SOKOINE University of Agriculture was established in 1984 and has three faculties and two institutes. Three faculties consist of agriculture, forestry, and veterinary. While, two institutes consist of Institute of Continuing Education (ICE) and the Development Studies Institute (DSI). ICE offers short term in-service program to field operational staff as well as training and extension services to farmers and community leaders. DSI acquaints undergraduate students to the challenges of development today and how to overcome them. At present, this university has commenced some scientific research on agro-ecosystem in collaboration with KYOTO university of Japan.

3) Training Institutes (LITI and MATI)

As for training activities on agricultural field, the agricultural training institute (MATI) and Livestock Training Institute (LITI) have been established in Ilonga

and Morogoro, respectively. These institutes are functioning for education and training of the extension officers at the diploma and certificate levels, and also re-training of VEOs. Besides, the Farm Development Center was established by the grant aid assistance of the Chinese Government in Msolwa village in Kilonbero district, while one similar to the said center is being under construction in Mkindo village close to Mgongola irrigation develop-ment scheme.

(3) Supply of Farm inputs

1) Crop Seeds

The breeder seeds for paddy, maize, sorghum, and legumes are all controlled and preserved by ARTI and KATRIN. The breeder seeds are then released to five national foundation seed farms which are scattered entire Tanzania for multiplication of the foundation seeds. Out of 5 national foundation seed farms, 2 seed farms are located in Morogoro region, i.e. Kilangali Foundation Seed Farm which is very close to Kilangari scheme in Kilosa district and Msimba Foundation Seed Farm in Morogoro district. The former farm is specified as paddy seed grower, while the latter one for maize, sorghum, beans, etc. Certified seeds are multiplied in the authorized seed companies and those foundation seed farms by themselves. In general, production of certified seeds are seriously short if compared with that of demand. Therefore, majority of farmers is being multiplied their own seeds by themselves.

2) Fertilizers and agro-chemicals

Transportation of inputs is usually far difficult due to poor traficability of the access roads to most of the villages. Lack of adequate transportation means, i.e. lorries, truck, etc. are further worsen the said situation.

The farm inputs are not always delivered on time. It is also the serious constraint that the prices of farm inputs are charged for high due to add "premium" for supplement to the transportation costs according to the distances and road conditions. Accordingly, majority of farmers are much discouraged to use such farm inputs. The following Table shows the location of farm inputs markets to be usually used by farmers in the respective irrigation schemes.

| Market | Village |
|---|---|
| Kilosa | Mvumi, Lumuma, Manyenyere, Kilangali, Chabima |
| Morogoro | Mlali, Mgeta, Ndole, Mgongola |
| Mkamba | Msolwa, Mkula, Sonjo |
| Ilonga | Malolo, Chabi, Nyinga, Mgogozi |

(4) Agricultural Credit

As for a formal credit in Morogoro region, the main formal lenders are the National Bank of Commerce (NBC) and the Cooperative and Rural Development Bank (CRDB). Customers of these institutions tend to be medium to large land-holder farmers. The annual interest rate charged for medium and long term credits vary from 30% (NBC) to 36% (NBC).

The Agricultural Input Trust Fund (ITF) organized in 1994 with the help of FAO aims at granting credit to financially reliable stockists for purchasing of agricultural inputs. The ITF allocates the funds for the purchase of the inputs, based on the financial and

distribution capability of each stockist. District Office acts for a contact office of the fund .

### 2.3.5 Marketing System of Agricultural Production

As for the present marketing of agricultural production, there is no public intervention in the marketing process. Through this process, the prices of agricultural commodities are set up freely. These prices are agreed between the traders and farmers through their negotiation, time to time. The prices usually vary depending of the sales' timing, namely, at the harvesting time, the prices lie at lower level, while three months later, those gradually rise up and reach to a peak before starting the dry season (off-harvesting season).

## 2.4 Present Conditions of Smallholder Irrigation Systems

There are at least 34 smallholder irrigation schemes in the Study Area. These schemes are generally composed of one or a few small irrigation systems mostly commanding less than 100 ha each. Of these smaller schemes, 16 schemes have been listed as prospective development schemes in NIDP. The present conditions of these 16 schemes are summarized below:

(1) Irrigation Scheme in the Mountainous Zone

There is only one irrigation scheme, so-called the Mgeta scheme in the Mountainous Zone. It consists of numerous small irrigation systems lying in steep slope ranging from 10 to 40 %. Almost all intakes are simply made by locally available materials such as stones, soils, wood, and weed. As such, they are subject to reconstruction every year in the beginning of the dry season due to the damage caused by flood. Almost all the canals are formed as small earth canals without any related structures. The main canal runs across hill side and diverts water to small furrows (side ditches) to irrigate cultivated terraces. This type of irrigation causes soil erosion especially where water is conveying from one terrace to another due to very steep slope and fragile nature of soils. In the rainy season no irrigation needs, because of the abundant rainfall. The annual average of rainfall is about 2,200 mm of which more than 80% concentrate in the rainy season from December to May. Excess water of rainfall is usually drained through the existing canals and furrows. In the dry season, rotational irrigation is commonly practiced.

(2) Irrigation Schemes in the Alluvial Plain Zone

Of 16 schemes, Manyenyere, Kilangali, and Mgongola schemes belong to the Alluvial Plain Zone. All the schemes lie in the low-lying flood plain of the Wami river basin. The schemes are generally characterized by the flooding water-fed irrigation for rice cultivation in the rainy season. No cultivation is practiced in the dry season, accordingly.

As for Manyenyere and Kilangali schemes, the irrigation and drainage facilities are all very poor. Diversion weirs are concrete-made overflow type, which inherently accelerates sedimentation by a backwater effect. Their scale is very small against river flood scale. Most of the canals have an irregular shape with very poor embankment so that water easily spills out through the embankment. There are no canal-related structures except those of Kilangali scheme where four division structures have been recently constructed. These canals, however, seem to play an important role in smoothly

spreading flood water over the paddy field in the initial stage of the rainy season and in smoothly draining inundation water from the fields to rivers in the late rainy season.

Facing this situation of very poor irrigation and drainage facilities, farmers lead a river stream by cutting low river banks and/or a canal stream by damming it back with mud and cutting its canal banks to their fields after direct seeding of paddy. Such an irrigation practice is usually carried out in early rainy season of December. In mid rainy season, normally from February and April, the river discharge increases and then water overflows the low river banks and canal embankment. Accordingly, the paddy fields are totally inundated with flooding water. In the late rainy season, usually May, water in paddy fields decreases as the river water level gradually lowers. Finally in June most of paddy fields are dried up.

Mgongola scheme is a new scheme but to be extended from Mkindo scheme, which has been implemented as the pilot scheme. At present the proposed area is being cultivated with paddy by utilizing flooding water as well as rainfall in the rainy season.

(3) Irrigation schemes in the Piedmont Plain & Fan Zone

Of the 16 schemes, five schemes belong to the Piedmont Plain & Fan Zone. Of five schemes, Msolwa, Mkula, and Sonjo schemes are distributed on the fan formations of Kilombero valley extending along the foot of the Gologolo Mountains in the south-west of the Study Area. These three schemes are blessed with ground water resources as well as rainfall though it is not always secured. The ground water table lies about 1 m below the ground surface or less even in the dry season. Annual rainfall reaches 1,400 mm. The Mlali scheme is located at the northern foot of the Uluguru Mountains. This area also has the shallow ground water, which lies about 1 m below the ground surface or less even in the dry season. The annual rainfall is relatively low at about 900 mm.

Msolwa Scheme

Irrigation facilities were constructed in the 1970's. At present, head works and a main canal about 2 km together with the related structures are still functioning, although the intake gate and spillway gate are ruined and water leakage is observed along the main canal. At present, only water is meagerly being utilized for one acre of tree nurseries managed by World Wide Fund for Nature at present.

Mkula Scheme

Present irrigation facilities were constructed to irrigate 60 ha of land at the beginning of the 1980's and rehabilitated in 1993 to 1995. At present, head works are functioning well, though a big amount of water leaks through the bottom of the weir and the side channel spillway. Existing canal system consists of a main canal of about 1 km, branch canal of 0.2 km, and a few field ditches. The main canal has been eroded at many points, especially in the joint of flume type between the stone and brick masonry and not been used in the lower half reaches just after the branch canal diverts. At most of the elevated reaches, the outside faces of the canal walls are openly exposed without an embankment covering, which has facilitated water leakage and weakened the canal foundation. Under such canal conditions, irrigation is meagerly practiced only in a few hectares.

Mlali scheme

Headworks and a canal system were constructed in the 1950's. The irrigation area

actually exploited was 65 ha. in the right bank area. The weir portion has been completely buried under sand sediments. The intake has also been almost buried and clogged with the sediments up to the top of the intake conduit. Under such a situation, the intake can divert very little amount of water to the main canal.

The main canal having a length of 1.4 km is still functioning even in spite of suffering from the sand sediment in the upstream of 200 m reaches and the high leakage loss from the wetted perimeter in entire reaches. Secondary canals have also been ruined.

In the rainy season, farmers use the flooding water from Mlali river at the downstream area for paddy cultivation ,while the irrigation water from the existing main canal is utilized at the upper part of the area. In the dry season, irrigation is meagerly practiced only in a few ha for cultivation of upland crops.

Myumi Scheme

Head works and a canal system were constructed in the 1970s, but the headworks were completely buried by sediment brought by Kisangata river, which at present is flowing about 400 m away from the said intake site. All the canals have been so severely ruined that they can hardly be recognized at present. In such a situation, only in the rainy season, flooding water from the Kisangata river is utilized for paddy cultivation in the downstream-limited low-lying flood plain located along the river.

(4) Irrigation schemes in the Valley/Riverine Terrace Zone

Of the 16 schemes, seven schemes belong to the Valley/Riverine Terrace Zone. The schemes in this zone except Chabima scheme are generally characterized by intensive irrigated farming for cultivation of upland crops with poor irrigation facilities .

Most of the irrigation systems have a small commanding area of less than 100 ha, consisting of a traditional free intake and one or a few canals. Malolo scheme and Ndole scheme only have permanent intakes. The traditional free intake is simply made by locally available materials such as soils, wood, weeds, earth bags, etc. In the rainy season, such traditional intakes are often damaged and washed away by flood, since then, have to be repaired or re-built every beginning of dry season. All the canals are simply earthen-made canal having a small capacity less than 200 lit./sec. These canals are relatively well maintained by the water user's groups of farmers. In most cases, no canal-related structures are existing in these irrigation systems.

Usually in the rainy season, irrigation can not be practiced because such traditional intake structures are easily damaged and/or washing away by flood. At present, this is one of the serious disturbance in agricultural production especially in the areas such as Chabi, Mgogozi, and Malolo schemes where the annual rainfall is as small as 340 mm.

Present condition of irrigation and drainage facilities in each of schemes are summarized as follows:

Chabima Scheme

In 1984/85, irrigation system was constructed, but upon the completion, the intake weir was damaged. Since then the system was abandoned. At present, only a few farmers are meagerly irrigating their farms directly diverting a river stream using a small primitive furrows.

Lumuma Scheme

In Lumuma valley, the agricultural production has been intensified cum diverted extensively through traditional irrigation development as far ago since the 1940s. The irrigation area extends astride the Lumuma river. Total irrigation area served by the Lumuma river is roughly estimated to be about 1,420 ha including Mpwapwa district side. The irrigation area in Lumuma scheme is about 480 ha consisting of 160 ha in Msowero village, 130 ha in Idole village, and 190 ha in Mkunghulu village. There exist 14 traditional intakes in the Lumuma scheme. The main and secondary canals are well maintained under the control of furrow committee of the water user's groups.

Ndole Scheme

A simple headworks and a small portion of the canals were constructed in 1995. The headworks consists of the intake and a small dividing wall. The intake is made up of stone masonry and equipped with a steel slide gate which only lacks lubrication. The canal is characterized with deep and shallow depth at various points. It traverses through a very steep slope of about 20 to 30% but be positioned well through contours. The excavated length is approximately 0.5 km and a further 2 km length is in progress through voluntary efforts of the member of village society. At present only 10 ha area can be irrigated.

Nyinga Scheme

There are three traditional intakes diverting water for the Nyinga scheme area from the Mwega river. Two intakes: the first and third ones are serving the left bank area of the Mwega river and a middle intake is serving that of the right bank area. Total commanding area is estimated at 110 ha in gross.

Malolo Scheme

There are two irrigation systems, Malolo intake A system and Malolo intake B system. Both intake A and B were constructed in 1972. The intake A is located at about 1.2 km upstream of the Malolo intake B. Both intake A and B have a overflow type weir of which crest length is 5 m. At present, both intakes are suffered from sand sedimentation. In the upstream of both intakes, the river bed is rising up almost equal to the adjacent field elevation, while the river banks have only a height of 0.5 m from field surface. In such a situation and with insufficient crest length of the weir, river water often overflows the whole structure in the rainy season. Further in case of the intake A, it is highly apprehensive that the present river course may be changed in the near future by floods. A main canal of the Malolo A system conveys diverted water to the left river terrace. The canal length and the commanding area are about 12 km and 190 ha in gross. The left main canal of the intake B also conveys water to the left river terrace. The canal-B has a length of about 12 km and commands the irrigable area of about 250 ha in gross. The right main canal irrigates the right river terrace of about 60 ha in gross. Its length is about 2.5 km.

Mgogozi Scheme

Mgogozi scheme consists of Mgogozi Mwega sub-scheme and Mgogozi Kikalo sub-scheme. A free intake of Mgogozi Mwega sub-scheme was completely washed away by the seasonal flood in 1995 and no water is diverted into the irrigable area at present. In and around the ruined intake site, the river meanders with a steep river gradient and is heavily eroded in the concave sides where the river bank slips down almost vertically. These facts prove that this site is not

suitable to build head works. Mgogozi Kikalo sub-scheme is served by four intakes diverting water from the Kikalo river. The first one is located at just upstream of a concrete-made weir. The intake itself is a free intake. Other three intakes are the traditional free intakes without any related structures. The seasonal flood sometimes occurs due to insufficient flow capacity of Kikalo river in the rainy season. In the dry season, the area suffers from the shortage of irrigation water due mainly to a small run-off of the Kikalo river.

Chabi Scheme

Chabi scheme consists of two sub-schemes, i.e. Chabi sub-scheme and Mohazima sub-scheme. The total irrigation area is estimated about 340 ha in gross of which 130 ha is shared by Chabi sub-scheme and remaining 210 ha in Mohazima sub-scheme. One intake (locally called to ILO intake), which has been constructed on the Mohazima river under financial assistance of the International Labor Organization (ILO), diverts water for irrigation of the area in Mpwapwa District of Dodoma Region. This scheme is actually serving the area of 240 ha at present. The Mohazima sub-scheme has three intakes on the Mohazima river. These irrigation systems are developed by three big landholders and accordingly owned by them privately. All the intakes are traditional intake simply made with earth and wooden materials. The Chabi sub-scheme abstracts water from the Chabi river through two local intakes, namely; upper and lower Chabi intakes. Construction of the upper Chabi intake started in 1989. However a main canal has not been completed yet. Most problems were presence of hard rocks enroute. Once the upper Chabi becomes fully operational, water can be delivered to the Mohazima sub-scheme area. This may relieve some of farmers abstracting water from the Mohazima river.

## 2.5 Executing Agencies of the Project and Farmers' Organizations

### 2.5.1 Executing Agencies of the Project

The Commissioner of Agricultural and Livestock Development (CALD), Ministry of Agriculture and Cooperatives (MAC) is fully responsible for the overall supervision of the project implementation. At the regional level, there are two (2) cases for handling the project execution: one is by the Zonal Irrigation Office which belongs to the Assistant Commissioner of Irrigation under CALD, MAC, and the other one is by the Regional Agricultural and Livestock development Officer (RALDO) under the Regional Development Director (RDD). However, these handling systems may be amended in the near future, since MAC is now under restructuring of its organization in conformity with the structural adjustment policy of the national economy.

All of the existing irrigation systems in the project area have been operated and maintained by the farmers themselves under supporting services of the local government. These supporting services for O&M of irrigation systems are provided by the respective offices of the District Agricultural and Livestock Development (DALDO) under supervision of RALDO. In reality, however, the said services are not always adequate due to the facts that each DALDO is facing a lot of problems, i.e., lack of funds, poor knowledge and experiences of front line staff, and insufficient communication facilities between the office and on-farm sites. In addition, DALDO has only one to several irrigation officers, while limited field irrigation officer/technician below district level[1]. They also have a poor knowledge on O&M work, and accordingly, it is hardly expected to extend technical know-how to the local farmers, satisfactorily and successfully.

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1 Two irrigation technicians have been assigned to the schemes in the project area; one to Malolo irrigation scheme under TIP and the other to Mkindo irrigation scheme (Mgongola).

The office of the Regional Cooperative Officer (RCO) is responsible for undertaking the registration services of the farmers' organizations including the water users' group (WUG), as well as supporting to encouragement of their activities. The office of the District Cooperative Officer (DCO) under RCO is directly responsible for doing these services to all the farmers' organizations within the concerned district. This office has, however, only two to three assistant officers and no field staff is assigned yet so far.

### 2.5.2 Village Community

In the Study Area, the village community have been organized in each village, and functioning well with a good social norms of life, even thought the villagers consist of several tribes such as Sagara, Luguru, Goro, Nguu, Hehe, etc. Up to present, almost no problems among tribes was reported in the Study Area except such small conflicts between Massai and other tribes due mainly to the crop damages which are sometimes brought by Massai's cows.

A disagreement on land use within the village community is rather serious problem in case of Msolwa village in Msolwa scheme. Accordingly, the existing irrigation facilities, which was provided by the Government of China in 1977, have not been utilized yet up to date. In case of Malui village in Kilangali scheme, the village government was dissolved in June 1996 because of a scandalous corruption of the executive members of the village government. In these villages, it is hardly expected to establish farmers' organization functioning well.

### 2.5.3 Water Users' Group

Out of the respective 16 irrigation schemes in the Study Area, WUGs have been organized so far in 13 schemes. These WUGs are well functioning except Mvumi and Msolwa schemes. In case of Mvumi scheme, WUG has no activities, at present, because the head-works of irrigation system was completely buried under deep sediment. WUG of the Msolwa scheme is still affected under disagreement on land use in the irrigable area since 1977.

In usual case, a WUG in the Study Area takes two regular procedures for decision making, namely the "general meeting of all the members" and "executive committee (water users' committee)" which consists of 5-10 representatives who are elected by the members. In case of large scale systems, several water users' groups are organized under its WUG by each sub-village or at the secondary canal basis. In Mgeta scheme, 15 villages belonging to 4 wards, a lot of small and/or minor irrigation systems has been established individually, and accordingly, many small WUGs are organized independently. The specific conditions related to operation and management of the existing WUGs in 13 schemes are summarized as follows:

1) O&M of the Irrigation System and Water Charge

Water distribution is decided through mutual consent of farmers in the general meeting. In most cases, maintenance of irrigation facilities is done by the farmers' themselves as one of the communal work of WUG. In such Kilangali, Mgongola (Mkindo), and Mlali schemes, WUGs collect the water charges from the irrigation beneficiaries either in cash or in kind (crop production) other than the duties in communal work stated above.

2) By-laws and Registration of WUG

All the existing WUGs in the Study Area are not registered yet so far, nevertheless those will be possible to register as an authorized organization under the Cooperative Act No.15, 1991. Major constraints are that the member farmers of WUG have a lack of knowledge on the said registration act. It is also the disturbance that the district cooperative officers, who must have a responsibility for handling the registration of the farmers' organization, have a poor knowledge and business experiences how to encourage the member of WUG, and then, to compile appropriate conditions of WUG for successful registration, etc.

Out of 13 WUGs in the Study Area, 7 WUGs of Kilangali, Mgongola, Mlali, Mvumi, Lumuma, Ndole and Mgogozi have been instituted their own by-laws in each. Apart from their by-laws, all WUGs have a punishment rule when some one shirked the communal works and/or evaded payment of the water charges.

3) Water Right

The Regional Water Engineer is responsible for registration of the water right under the Act No.42 of 1974. All WUGs in the irrigation schemes have no official water rights, because they are not legally authorized yet. In a special exception, RALDO on behalf of Mkindo WUG in Mgongola scheme has the registered water rights for irrigation purposes. This registration has been made when RALDO was promoting Mkindo irrigation scheme as the pilot project for smallholder irrigation development in Morogoro region.

4) Activities of WUG

The farmers in such 6 irrigation schemes as Mgeta, Mlali, Lumuma, Nyinga, Malolo, Mgogozi have a long experience in irrigated farming using the traditional irrigation furrow systems. Most of their irrigation systems were constructed by the farmers themselves before the independence, except Mlali scheme which was constructed by the colonial ruler. At present, these 6 WUGs are functioning well and carried out O&M work of the facilities within their own capability. It is also recognized that WUGs in Kilangali, Mkula and Mgongola (Mkindo) schemes which are all located in the alluvial plain zone, have relatively good organizational structure although those activities are still limited to a small extent. Ndole scheme has just started in 1995, and accordingly, WUG is not yet organized completely. No practical activity is observed in 2 WUGs in Mvumi and Msolwa schemes.

### 2.5.4 Farmers' Cooperatives

In the Morogoro region, there are 3 cooperative unions relating to the agricultural marketing. Under administrative supervision of these three unions, the total 73 primary cooperative societies have been organized as of September 1996. The main objectives of these cooperative societies are to maintain the marketing of crop production and to support farm inputs supply to the farmers.

In the Study Area, there are 9 primary cooperative societies, at present. These societies were organized for the marketing purposes on both farm inputs and crop production, especially such storable crops as rice, maize, cotton, etc. Recently, however, the activities of these cooperatives have been concentrated on the marketing services mainly for cotton and coffee production. Accordingly, member farmers who benefit from the cooperative activities are prejudiced in favor of cotton and coffee cultivators. The membership of a cooperative is less than 300 farmers, while its management area covers several villages in all the cases. It seems that the service area of each

cooperative is too large if compared with their own management capability, i.e. no transportation cum communication facilities such as lorries and telephone, structural weakness, lack of operation funds for marketing of crops and farm inputs, lack of storage facilities, as a whole.

### 2.5.5 Other Organizations

In the villages within the respective scheme areas, the total 47 women's' groups have been organized, at present. The member-ship of each group is not larger than 5-20 women. Their activities are mostly nursery work on trees and afforestation, crop cultivation in the rainy season and production of local beer in the dry season.

In Mgongola scheme, there are 6 farmers' groups which are being organized under the special program for food crop production especially maize and rice that is assisted by FAO. This program provides farm inputs to the member farmers through the short term loan from the Farm Input Trust Fund as well as the technical guidance for crop cultivation technology. The short term loan is on-lent in kind with an interest of 21% per crop season.

### 2.5.6 Role of Women and Gender Groups in Irrigated Farming

In general, transportation of water and collecting of fuel wood are entrusted to women, while land clearing of field and spraying of chemicals are carried out by men's power. Other farm works are done by both men and women. It may be said that the farmers' women have played an important role in their farming and living.

Role of Women in Farming and Living

| | Mgeta | Munyenyere | Kilangali | Mvumi | Mgongola | Mlali | Ndole | Msolwa | Mkula | Sonjo | Chabima | Lumuma | Nyinga | Malolo | Mgogozi | Chabi |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (1) Role of women in farming | | | | | | | * | | | | | | * | | | |
| - Land clearing | M | M | M | M | M | M | | M | M | M | M | M | | M | M | M |
| - Land preparation | B | B | B | B | B | B | | B | B | B | B | B | | B | B | B |
| - Seeding | B | B | B | B | B | B | | B | B | B | B | B | | B | B | B |
| - Transplanting | B | B | B | - | - | - | | - | - | - | - | - | | B | B | B |
| - Weeding | B | B | B | B | B | B | | B | B | B | B | B | | B | B | B |
| - Fertilizing | B | B | B | B | B | B | | B | B | B | - | - | | B | B | M |
| - Spraying of chemicals | M | M | M | M | M | M | | M | M | M | M | M | | M | M | M |
| - Irrigating | B | M | M | - | - | - | | - | B | - | M | M | | B | B | B |
| - Drying/bagging of products | M | B | B | B | B | B | | B | B | B | B | B | | B | B | B |
| - Harvesting | B | B | B | B | B | B | | B | B | B | B | B | | B | B | B |
| (2) Transportation of water | F | B | F | F | F | F | | F | F | F | F | F | | F | B | F |
| - Distance (km) | 1.0 | 0.5 | 2.0 | 0.5 | 0.3 | - | | 1.0 | 1.0 | 1.0 | 0.5 | 0.5 | | 0.5 | 1.0 | 0.5 |
| - Frequency (times/day) | 2 | 3 | 3 | 3 | 4 | 3 | | 3 | 3 | 3 | 3 | 3 | | 3 | 3 | 3 |
| (3) Collecting of fuel food | M | B | F | F | B | F | | F | F | F | F | F | | F | F | F |
| - Distance (km) | 2 | n.a. | 2 | 2 | 3 | 4 | | 3 | 4 | 3 | 0.5 | 2 | | 10 | 2 | 10 |
| - Frequency imes/week) | 2 | n.a. | 1 | 1 | 2 | 4 | | 2 | 2 | 2 | 7 | 3 | | 1 | 2 | 1 |

* No data.
M = Male, F = Female, B = Both
Source: Information obtained from farmers, village executive officers and village extension officers.

## 2.6 Assessment of Environmental Aspects

### 2.6.1 Water Resources and Water Quality

A number of rivers and streams are found within the Study Area, many of which disperse and peter out in swampy areas and flatter lower plain. The rivers and streams are descending with narrow valleys having rocky river beds up to the point where they enter the plains. As a result of the considerable rainfall in rainy season (March to May), many sizable water logged lands and seasonal inundated lower plains are found, though many river beds of dried are observed during dry season. The river courses in the upper part of the plains are frequently silted up.

Many of the villagers in the Study Area, who are located at low lying plains use water from irrigation canals, on the other hand those who are in hilly and mountainous areas use surface water from streams, do not have an access to safe water sources because the poor facilities and long distance to safe water sources.

The Water Utilization Act(1974) was amended in 1981 with the declaration of the Urban Water Supply Act to make adequate water pollution control. The two guidelines of the water quality; WHO Standards(WHO, 1963) and Tanzania Temporary Standard(1974), set the general standard for drinking water in Tanzania. As the results of the field survey, no constraint of water quality is found, except poor quality of some water resources for drinking purpose due to the turbidity and bacteriological contamination.

### 2.6.2 Natural Vegetation

The natural vegetation in the Study Area could be classified into the six Groups and 8 Types: Forest (Alpine Forest), Woodland (Woodland[closed], Woodland[open], Wooded Grassland), Bushland, Grassland (Dry Open Grassland, Grassland[Wetland]), Cultivated Areas (Bushland[other land]). Bushland and Shrub Thicket, Woodland (Woodland[closed], Woodland [open]) are corresponded to *Miombo* Woodland which covers totally some hundred thousand sq. km in Tanzania of under-utilized land.

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

### 2.6.3 Source of Fuel Wood

It is estimated that fuel-wood exceed 90% of total national energy supply (Tanzania Forestry Action Plan, 1989). Long run demand of fuel wood is considered to be increased by 1.5% annum, though the annual yield from net productive forest in Tanzania is estimated at about 65 % of the total consumption volume. In addition, more than 85% of residents in urban areas use charcoals. Most of them come from the productive forest located 100-150 km far from Dar es Salaam which covers most of forest and woodlands in Morogoro Region.

Most of the inhabitants in the Study Area depend heavily on bio-mass fuel resources collected from the woodland and thicket vegetation around settlements. A few farmers, particularly living in hilly lands, produce charcoal. Depletion of woodland is therefore already a problem around settlements in the Area.

Many households collect fuel-wood as far as 3 to 7 km from the their homes with collection frequency of twice to three times every week spending 4 to 6 hours per one collection. The fuel-wood consumption is estimated at around 3.6t per family/an or 6 $m^3$ per family/an. The total wood requirement for domestic consumption is estimated at 1.5 to 2.0 $m^3$ per cap./year including other purposes, i.e. construction, facing etc.

### 2.6.4 Wildlife and Fisheries

Wildlife within the Central Wami River basin and its surroundings is dominated as "generalist". They are mainly vermin species which include baboons, monkeys, wild pigs, and birds, except for the areas bordering the Mikumi National Park Udzunguwa National Park and the Selous Game reserve which is bordering of some proposed Project Areas. Other wildlife species are denominated as "specialist" being restricted to specific zones. The wetlands in particular are rich in varieties and number of animals of specialist and birds, including avian life. Swamp and flooded land which are not utilized for cultivation, form a very important refuge for these animals and birds. Thus, most of wildlife would be affected by the swamp and flooded land changes.

According to available literature, important species are Red Colobus Monkey, Buffalo Dikidiki, Bush buck, Duiker, Eland, Hartebeest, Impala, Antelope, Rudock Steenbok, Warthog, Wildebeest, Ducks Geese, Franklin, Guinea Fowls, Dove Pigeon. Additionally, some crop damages by wild animals (specially during dry season) are reported, specially in the areas located on bordering of National Park.

Fisheries resources are widely found in the Wami river and its associated swamps /tributaries. The preliminary list of the species inhabiting in the main streams and rivers throughout the Area includes *Ilapia* and *Clarias*, *Bagnis*, *Sistichodus*, *Citharinus*, *Eutropicus*, *Schilbe*, *Alestes*, *Mormyrus*, *Lases*, *Synodontis*, *Barbus*, *Hydrocinus*, eels, trouts and shrimps are observed. However, almost all the local communities consume fish but the commercial fishing is not common, though some small fish farming is being carried out.

### 2.6.5 Livestock and Pasture Land

Population density of cattle in the Region is estimated at 10.8 head/$km^2$ (11.5 ha/head) based on the number of cattle (National Sample Census of Agriculture 1993/94) and total range area of 30,000 $km^2$(Morogoro Region Statistical Abstract, 1993). The population growth rate of cattle in Tanzania is estimated at 15%.

The range within the Area is considered to be classified as Zone III (Dry- sub-humid to semi-arid) to Zone IV (Semi-arid) of Eco-climatic zones of East Africa (Pratt et al., 1966). Woodland and wooded grassland to bush/shrub grassland are the natural vegetation in the Zones. The ratios of livestock carrying capacity under subsistence pastoralism can be obtained at 1.6 ha per head in Zone III and 4.0 ha per head in Zone IV(Pratt, 1968). On the other hand, as suitable land for cattle grazing is estimated at 16,436 $km^2$ within the Region (MAC, 1986/87), the carrying capacity of range-land is around 500 thousand animal units equivalent, assuming the capacity of 3 ha per head. Thus, the potential for additional cattle keeping in the Region is not considered to be enough.

The diseases of cattle in the Study Area could be grouped as general diseases, tick-borne disease, trypanosomiasis, calf disease, skin disease, and helminths. In the Study Area, the common varieties of Tse-tse flies (*Brevipalpis*, *pallidipes* and *Austeni*) which spread Trypanosomiasis, are found and Tse-tse infected land of the Morogoro Region is estimated at 23,053 $km^2$ (MAC, 1986/87). Traditional Tse-tse control has been based

on bush-control operation which is carried out by creating belts of open country and control of wildlife, to eliminate reservoirs of infection and to prevent spread.

### 2.6.6 Area for Natural Conservation

In and around the Study Area, there are two National Parks; Mikumi and Udzungwa N.P., Selous Game Reserve, Kilombero Game Controlled Area and Mkata Game Open Area. In the southern part of the surroundings of the Study Area covering the upper parts of the catchment of Rudete and Msagere Rivers (tributaries of Ruvu River) and Mkata River (upper part of Wami River Basin); Udzungwa N.P. around the south-western part covering West Kilombero Scarp; Kilombero G.C.A. on the southern part of the Area located on Msolwa Plain; Mkata G.O.A. on the southern margin of Mkata Plain borders on Mikumi N.P. in West.

There are many forest reserves with various scales in the Region, most of which are located in hilly to mountainous areas, having a total area of 3,626 $km^2$ in the three districts within the Study Area. The most extended forest reserves in each district are Mkulazi Forest Reserve (68,627 ha) in Morogoro District, Ukwiva Forest Reserve (54,635 ha) in Kilosa District and Udzungwa Scarp Forest Reserve (20,720 ha) in Kilombero District.

### 2.6.7 Public Health Services and Diseases

(1) Health Service

Regional and District Hospitals have better facilities and more skilled personnel and better quality of diagnosis than Dispensaries and Health Center. However, it is obvious that the health service facilities in the Area fall short of WHO recommended minimum requirement sets. Considering the conditions of poor water supply and high risk of water-bone/vector-bone diseases, it is estimated that the improvement of the service level is an urgent requirement.

(2) Morbidity Pattern

Diarrhea, meningitis and rabies are top three diseases which under the obligation to be reported. The top position held by malaria in the out-patients morbidity figures and occupies the first position of frequency in diagnosis and treatment in the Region and in all health institutions of the Area. Diarrhea, skin diseases and diseases of intestinal worms occupy the second to fourth positions in frequency of diagnosis in most of health institutions. In addition, the reported cases of other vector-bone diseases such as schistosomiasis, are not considered to be low level, because more than 10,000 cases in the Region have been reported in 1992 and 1995.

(3) Water-bone Disease

Malaria and schistosomiasis are vector-bone diseases, being transmitted by mosquitoes and snails respectively. Adult mosquitoes require water for breeding and snails transmitting schistosomiasis are dependent on freshwater for both survival and multiplication. According to the Assessment Study, the transmission potentials of malaria and onchocerciasis are estimated at high level and that of schistosomiasis is at a moderate level.

Thus, it is obvious that the high risk of water-bone/vector-borne diseases is

universal. The control of such kind of risk is emphasized for risks associated with environmental sanitation, provision of household latrines, proper method of waste disposal and vermin and insect control.

### 2.6.8 Fertilizers and Pesticides

The annual unit input amounts of chemical fertilizers to farm lands is theoretically estimated at 13 kg/ha. However, the use of artificial fertilizers such as chemical fertilizers, was very unpopular in farmlands except a few upland farming fields. Thus it is considered that inputs of chemical fertilizers are concentrated on specific upland crops farming lands. The use of pesticides is on a very limited range and total distributed amounts in the Region is recorded at 890 tones of solid type and 444,000, liters of liquid type (Tropical Pesticides Research Institute, 1991).

Thus, the consumption of agro-chemicals in the Study Area is estimated to be at a very low level and their negative impacts on the environment are assessed as very small at present. On the other hand, the pesticides registered in Tanzania through Tropical Pesticide Research Institute are classified four categories; General Use for 5 years (Full Registration), General Use for 2 years (Provisional Registration), Restricted Registration and Experimental Use Only.

### 2.6.9 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

### 2.6.10 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, Seed Distribution Services by WWF and Integrated Sustainable Agricultural Program in Mgeta area are considered as important components of the actions for the environmental conservation.

# CHAPTER III. DEVELOPMENT POTENTIAL AND CONSTRAINTS

## 3.1 Development Potential for Irrigated Agriculture

### 3.1.1 Land Resources

The land suitability evaluation for irrigated farming is made according to the specific criteria for both lands respectively for paddy and up-land crop cultivation. To prepare this criteria, the rated conditions on requirements as well as limitations for irrigated farming are basically referred to the "Guidelines for Land Evaluation for Irrigated Agriculture" prepared by FAO (1985) and the "Tanzanian System for Paddy Irrigation", and adjusted according to the practical information on the lands and agricultural aspects observed in the Study Area. The essential factors are of (a) agronomic aspect, i.e. "conditions of the rooting zone including soil texture quality, effective soil depth and gravel and/or stony conditions", "soil fertility", "irrigability and drainability" and "frequency of seasonal flooding"; (b) farm management aspect, including "accessibility to the field" and "tillability"; (c) engineering aspect, i.e. "necessity of land grading" and "requirement of drainage improvement and flood protection which lead to extend certain large investment for the development"; and (d) conservation and environmental aspect such as "salinization hazard", "influence and/or change of hydrological regime" and "soil erosion".

Development Potential of Land Resources by Schemes

| Name of Schemes | Land Resources (Arable Land) (ha) | Land Suitability Classes Paddy Field (Grade) | (ha) | Up-Land Field (Grade) | (ha) | Remarks (Special Needs) |
|---|---|---|---|---|---|---|
| Zone-I: | | | | | | |
| Mgeta Scheme | ^2,000 | IV | 2,000 | III | 2,000 | Protection of soil erosion, soil fertilization |
| Zone-II: | | | | | | |
| Manyenyere Scheme | 1,300 | III | 460 | III | 300 | Consolidation of field, flood protection |
| Kilangali Scheme | 720 | III | 720 | III | 60 | Consolidation of field, flood protection |
| Mgongola Scheme | 830 | III | 620 | III | 60 | Consolidation of field, flood protection |
| Zone-III: | | | | | | |
| Mlali Scheme | 80 | II | 80 | II | 80 | Consolidation of field, flood protection |
| Mvumi Scheme | 330 | II | 330 | II | 70 | Consolidation of field, drainage improvement |
| Msolwa Scheme | 400 | II | 400 | I | 250 | Consolidation of field, drainage improvement |
| Mkula Scheme | 400 | II | 400 | I | 130 | Consolidation of field, drainage improvement |
| Sonjo Scheme | 600 | II | 600 | I | 280 | Consolidation of field, drainage improvement |
| Zone-IV: | | | | | | |
| Chabima Scheme | 15 | III | 15 | III | 15 | Consolidation of field, drainage improvement |
| Lumuma Scheme | 480 | III | 340 | II | 440 | Rationalization of furrow system |
| Ndole Scheme | 100 | III | 100 | II | 100 | Consolidation of field, soil fertilization |
| Nyinga Scheme | 100 | II | 20 | II | 80 | Rationalization of furrow system, soil fertilization |
| Malolo Scheme | 500 | II | 60 | II | 440 | Rationalization of furrow system, soil fertilization |
| Mgogozi Scheme | 200 | II | 20 | III | 200 | Rationalization of furrow system, soil fertilization |
| Chabi Scheme | 340 | II | 20 | II | 320 | Rationalization of furrow system, soil fertilization |

### 3.1.2 Water Resources

An available water in each scheme is determined with due consideration of the existing water rights. The following Table shows the discharges to be useful in the critical dry season at the 1/5 probability.

Development Potential of Water Resources by Schemes

| Name of Schemes | | Dry Season Discharges at 1/5 Probability | | | Existing Water Right ($m^3$/sec.) | Minimum Water to be Useful ($m^3$/sec.) |
|---|---|---|---|---|---|---|
| | | Respective River | July ($m^3$/sec.) | September ($m^3$/sec.) | | |
| Zone-I | Mgeta Scheme | Small streams | - | - | none | - |
| Zone-II | Manyenyere Scheme | Myombo | | | | |
| | Kilangali Scheme | Myombo | 2.6 | 1.2 | - | 1.2 |
| | Mgongola Scheme | Mkindo | 1.5 | 0.9 | - | 0.9 |
| Zone-III | Mlali Scheme | Mlali | 0.02 | 0.02 | - | 0.02 |
| | Mvumi Scheme | Kisangata | 1.3 | 0.8 | 0.06 | 0.7 |
| | Msolwa Scheme | Msolwa | 0.28 | 0.11 | 0.30 | - |
| | Mkula Scheme | Mkula | 0.17 | 0.07 | - | 0.07 |
| | Sonjo Scheme | Sonjo | 0.44 | 0.18 | - | 0.18 |
| Zone-IV | Chabima Scheme | Chabima | 0.01 | 0.01 | - | 0.01 |
| | Lumuma Scheme | Lumuma | 0.38 | 0.24 | 0.12 | 0.24 |
| | Ndole Scheme | Ndole | 0.08 | 0.06 | - | 0.06 |
| | Nyinga Scheme | Mwega | | | | |
| | Malolo Scheme | Mwega | 1.6 | 1.2 | - | 1.2 |
| | Mgogozi Scheme | Kikalo | 0.04 | 0.03 | - | 0.03 |
| | Chabi Scheme | Chabi | 0.16 | 0.11 | - | 0.11 |
| | | Mohazima | 0.24 | 0.17 | 0.53 | - |

As seen in the above Table, it has no useful water in the dry season in both Msolwa river and Mohazima river in Chabi scheme if deducting a quantity of water authorized in the existing water rights which are owned by other fields, although some water is being utilized by farmers in the said scheme areas. Thus, to implement the irrigation development in these schemes, adjustment of the existing water rights is essentially needed.

The Mgeta scheme depends irrigation water on numerous small tributaries of the Mgeta river. There is no conflict to utilize water flowing these small streams, since the Mgeta river flows plenty of water throughout a year without uitlization.

The Miyombo river, which contributes to Manyenyere and Kilangali schemes joins to the Mkata river at about 12 km downstream after Kilangali intake. The Mkata river is the largest tributary of the Wami river and plenty of water throughout a year owing to the contribution of the Mkondoa and other rivers than the Miyombo river. Thus, it seems to be no problem even if almost all the water resources of the Miyombo river are used for the irrigation of Manyenyere and Kilangali schemes.

Mgongola and Mvumi schemes have the same situation on the river water use as Manyenyere and Kilangali schemes. The Mkindo river, which is a water source of Mgongola scheme joins into the Wami river soon after the Mgongola scheme area. The Kisangata river, which is a water source of Mvumi scheme joins into the Mkata river soon after passing the Mvumi scheme area. The Mkata river and the Wami river main stream are plenty of water throughout a year. Therefore it is judged that all these schemes can use almost all the water resources of their respective rivers.

The Mlali river has been serving the Mlali scheme since 1950s. This situation will not be changed in future.

The Mkula river joins into the Sonjo river at 1 km downstream of the existing headworks of the Mkula scheme. Then the Sonjo river joins into the Msolwa river at the point located in the Kilombero Game Controlled Area. These rivers can totally serve to Mkula and Sonjo Schemes, respectively, because of no water users in the downstream. However as for the Msolwa river, Kilombero Sugarcane Plantation has a water right of 0.30 $m^3$/sec, and thus adjustment of water resources including review of the existing water right is required for the irrigation development of the Msolwa scheme.

As for Chabima and Ndole schemes, they are served by the Chabima river and the Ndole river which join into rather big rivers namely the Chogwe river and the Mkundi river immediate after the scheme areas, respectively. These Chogwe and Mkundi rivers have abundant water throughout a year. Thus almost all water resources of the Chabima and Ndole rivers can be used for the schemes, respectively.

The Lumuma river's water resources have been totally utilised for irrigation of cultivation area in the Lumuma river basin in the dry season. Such a situation will not be changed in future.

The Kikalo river, which is a water source of Mgogozi Kikalo sub-scheme flows into the Mwega river at the point between Nyinga scheme and Malolo scheme. Also, the Chabi river, which is serving Chabi scheme flows into the Mwega river at the downstream after Malolo scheme. All water resources of these rivers can be utilised for these Mgogozi Kikalo and Chabi schemes, since no other users before confluence to the Mwega river exist and the Mwega river is plenty of water. The Mohazima river, which is serving for both Mohazima sub-scheme of the Chabi and ILO scheme in Dodoma region flows into the Mwega river at the downstream after Malolo scheme. All water resources of the Mohazima river can be utilised for both schemes, but the water right of which amount is 0.53 $m^3$/sec has been granted to ILO scheme in Dodoma region. Thus in case that the irrigation development in Chabi scheme is implemented utilising the water resources of the Mohazima river, adjustment of water allocation including the review of the water right is essentially required.

The Mwega river, which is serving Nyinga and Malolo schemes, and Mgogozi Mwega sub-scheme has no water users in the downstream reaches after Malolo scheme and joins into the Great Ruaha river at about 20 km downstream from the Malolo scheme. The Great Ruaha has abundant flow even in the dry season having a huge catchment area in comparison with that of the Mwega river. Thus, almost all the water resources of the Mwega river can be exclusively utilised for Nyinga and Malolo schemes, and Mgogozi Mwega sub-scheme.

### 3.1.3 Human Resources

The following Table indicates the agricultural population, numbers of the farm households, average family size and working population in the respective schemes based on the basic information obtained through farm economic and sociological surveys as well as hearing with the representatives of each villages.

According to the results of the farm economic survey, the main workers of a farm household is mainly husband and wife, while the field work is supported by the youth who are aged over 15 years old. Namely, most of the farm operation is being done by the available family labor force. As for the labor peak at the most busy crop season, farmers are helping each other. If short in labor force, they might adjust the working duration to a certain extent. In the exceptional cases in such Chabi, Malolo, Mgogozi and Lumuma schemes where the farmers has developed the traditional irrigation furrow and intensified the crop operation for production of dry onion, beans, etc., farmers employed the seasonal labor from out side of the villages.

Agricultural Population, Farm Households, Family Size and Working Population in the Respective Schemes

| Name of Schemes | | Numbers of Villages | Total Population | Numbers of Farm Households | Family Size (person/family) | Working Population |
|---|---|---|---|---|---|---|
| Zone-I | Mgeta Scheme | 15 | 29,350 | 5,800 | 5 | 13,340 |
| Zone-II | Manyenyere Scheme | 3 | 11,440 | 1,910 | 6 | 4,390 |
| | Kilangali Scheme | 1 | 3,040 | 430 | 7 | 990 |
| | Mgongola Scheme | 3 | 8,470 | 1,690 | 5 | 3,890 |
| Zone-III | Mlali Scheme | 2 | 5,740 | 1,150 | 5 | 2,650 |
| | Mvumi Scheme | 1 | 7,450 | 1,860 | 4 | 3,910 |
| | Msolwa Scheme | 1 | 3,000 | 500 | 6 | 1,150 |
| | Mkula Scheme | 1 | 2,940 | 490 | 6 | 1,130 |
| | Sonjo Scheme | 1 | 1,770 | 250 | 7 | 580 |
| Zone-IV | Chabima Scheme | 1 | 700 | 140 | 5 | 320 |
| | Lumuma Scheme | 3 | 5,440 | 780 | 7 | 1,790 |
| | Ndole Scheme | 1 | 1,040 | 260 | 4 | 550 |
| | Nyinga Scheme | 1 | 470 | 118 | 4 | 250 |
| | Malolo Scheme | 1 | 3,800 | 480 | 8 | 1,100 |
| | Mgogozi Scheme | 1 | 1,000 | 143 | 7 | 330 |
| | Chabi Scheme | 1 | 1,080 | 180 | 6 | 410 |

It seems that the present holding size per household might be rather lager if compared with the family labor force. Thus, to promote an intensive farming and/or crop diversification under the conditions with the proposed irrigation development, it shall organize youth into working groups either in-household or in-community in each village. As seen in the above Table, it could be expected large labor force in near future when the young is aged to over 15 years old.

On the other hand, it is essentially needed to up-grade a quality and/or skillfulness of labor force so as to accomplish the sustainable irrigation based agricultural production. At present, all villages in the Study Area have access to primary education and the schools are located in or near the villages. However, the physical conditions are usually not adequate and there is a notorious lack of teaching materials. This in turn negatively affect the level and quality of education received by the students. Farmers also need to be advised on cultivation techniques and systems, and accordingly, it is essential and the important role that the extension officers must play in the development of human resources. In reality, however, majority of extension officers in the Study Area do not have adequate working conditions or training services which leads to an unsatisfactory performance of the technical extension services for farmers. The government should pay special attention to this fact and strengthen the extension service function.

## 3.2 Problems and Constraints to Agricultural Development

The present problems and constraints to the agricultural development is being mostly brought by serious drought and/or seasonal flooding caused by irregular distribution of rainfall, poor agricultural infrastructure, inactive extension services to farmers as well as poverty based on the traditional custom, and those multiplier effect. Therefore, in order to implement and accomplish a sustainable development, improvement and/or elimination of all the constraints is the crucial subject. To apply the farmers' participatory approach to this Project in accordance with the principle development policy of the Government, it is also essential to up-grade the farmers' skill as well as to organize the farmers' societies, i.e. water users' co-operative through reinforcement and activation of the village community.