

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 I

MAIN REPORT

JANUARY, 1993

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CURRENCY EQUIVALENT

(as of July, 1997)

One U. S. Dollar (US\$ 1) = Two Hundreds Sixty Tanzanian Shilling (Tsh. 260)
= One Hundred Twenty Japanese Yen (¥ 120)



1141442 (2)

PREFACE

In response to a request from the Government of Tanzania, the Government of Japan decided to conduct a Study on the Smallholder Irrigation Projects in Central Wami River Basin and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Tanzania a study team headed by Mr. Susumu Honma, Nippon Koei Co., Ltd., five times during the study period from July 1996 to November 1997.

The team held discussion with the officials concerned to the Government of Tanzania, and conducted field survey and investigation in the study area. In succession, the team made further study and compilation of the development plan, and then, prepared this study report.

I do hope this report will contribute to promotion of the Project and to enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned to the Government of Tanzania for their close cooperation extended to the team.

January, 1998



Kimio Fujita
The President of
Japan International Cooperation
Agency

Mr. Kimio Fujita
The President for
Japan International Cooperation Agency
Tokyo, Japan

LETTER OF TRANSMITTAL

Dear Sir,


We have the pleasure to submit herewith the Study Report on the Smallholder Irrigation Development Project in the Central Wami River Basin, Morogoro Region, the United Republic of Tanzania in accordance with the terms of reference issued by your Agency.

The study on the Project was performed for a total period of 17 months from July, 1996 to November, 1997. Through this study, the Master Plan on the Project covering the representative 16 irrigation schemes was first formulated in line with the development policy of the Government of Tanzania as well as taking fully into account development needs and wishes of the beneficiary farmers. Based on the Master Plan, 4 priority development schemes were selected as the most promising model development schemes for leading an effective implementation of the total 156 traditional smallholder irrigation schemes scheduled in the National Irrigation Development Plan. The development plan proposed for the selected priority schemes was prepared with the principal aims at increasing food crop production through rehabilitation and improvement of the existing traditional irrigation furrow systems, and consequently, contributing to poverty alleviation in the rural area. "Beneficiaries' participatory approach to the project" be the basis for project implementation. The Project has been judged technically feasible, economically viable and reasonably sound in environmental impacts.

We do hope this Report will be helpful for promoting the national agriculture as well as regional socio-economic development plans conceived by the Government of Tanzania, and to be of any services to prosper the cordial relations and good-will between Japan and Tanzania.

We wish to express our hearty appreciation and gratitude to the personnel concerned of your Agency, the Tanzania Office of your Agency, the Ministry of Foreign Affairs and the Ministry of Agriculture, Forestry and Fisheries and the Embassy of Japan in Tanzania for the courtesies and cooperation kindly extended to us during our field survey and studies. Many personnel from the Ministry of Agriculture and Cooperatives of the Tanzanian Government, Morogoro region as well as the concerned district offices also attended to and assisted us during the field work at the project site. The attendants from the respective wards, village authorities and community societies also gave their valuable time for field guidance. Special thanks are mentioned to all of them.

26 January, 1998


Susumu HOMMA
The Leader of Study Team for the
Smallholder Irrigation Development Project in the Central Wami
River Basin

Photographs in Mgeta Scheme



Near Existing Intake of Mindu River



Existing Canal of Mindu System



Near Existing Intake of Mzinga River



Proposed Project Area of Mzinga System



Proposed Project Area of Mindu System

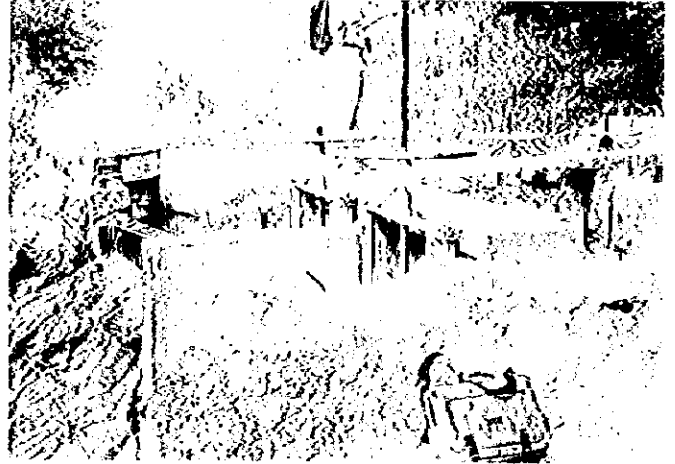


Cabbage Cultivation (just after planting)

Photographs in Mgongola Scheme



Existing Mkindo Intake Weir (downstream side)



Existing Intake of Mkindo Intake Weir



Existing Division Works in Phase II Area



Flooded Water near Mgongola River (July in 1997)

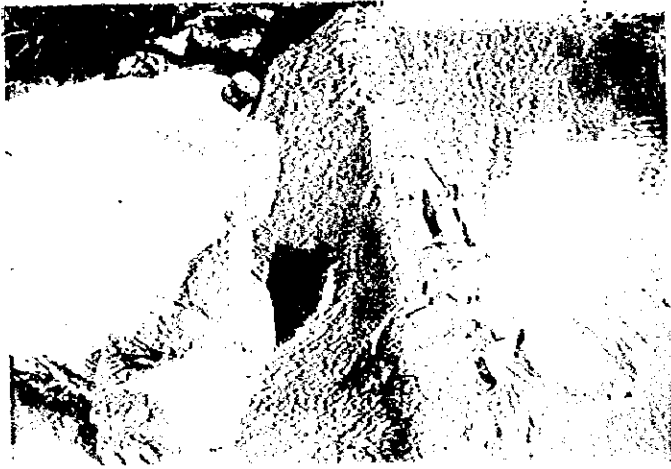


Mgongola Extension Area
(Direct sowing of paddy is carried out.)



Mgongola Extension Area
(Direct sowing of paddy is carried out.)

Photographs in Mkula Scheme



Existing Intake Weir



Intake of Existing Intake Weir



Existing Canal



Paddy Cultivation by Direct Sowing



Paddy Field after Harvesting



Flooded Condition in Paddy Field during Harvesting Season

Photographs in Mwega Scheme



Near Existing Intake Weir - A



Division Works of Canal - A



Existing Intake in Nyinga (from upstream)



Existing Canal and Onion Cultivation



Cultivation of French Beans after Harvesting Maize



Onion Cultivation after Harvesting Maize

Farmers' Participation to the Study and Development Planning



Interview with Farmers on Field



Discussion with Farmers' Group



Discussion with Womens' Group



Interview with Farmers
(Under Repairing Work on Irrigation Canal)



Public Meeting held with Farmers



Public Meeting held with Farmers

SUMMARY

PART-I. BACKGROUND INFORMATION

Chapter I. Introduction

1.1 Authority

- 01- This is the Study Report on the Smallholder Irrigation Projects (hereafter called to as the Project) in the Central Wami River Basin, Morogoro region, the United Republic of Tanzania. The feasibility study on the Project has been performed for a total 16 months from July, 1996 to October, 1997 in accordance with the Scope of Work (S/W) agreed upon between the Ministry of Agriculture and Co-operatives (MAC), the Government of Tanzania (GOT) and the Japan Inter-national Cooperation Agency (JICA) on March 19, 1996.

1.2 Historical Background of the Project

- 02- GOT has made utmost efforts to support the smallholder farmers, and has been promoting extension of irrigated farming technology since the late 1980s, as the most important subject in the agricultural sector development. MAC prepared and launched the "National Irrigation Development Program (NIDP)" in April 1994. In implementating NIDP, GOT acknowledged that the irrigation schemes selected in the Morogoro region will ensure increase of food crop production through improvement of the existing irrigation system, and consequently, contribute to the national food security and rural poverty alleviation as well as significant impacts to the other irrigation areas. Against the above background, GOT requested the Government of Japan (GOJ) on May 24, 1993, to extend technical assistance for execution of the Master Plan Study on the Central Wami River Basin, and then, Feasibility Study on the selected 16 priority smallholder irrigation projects in the said Basin. GOJ accepted to this request, and JICA dispatched a Preparatory Study Team for reviewing the proposed Project, and set up the "Scope of Work (S/W)" with GOT for extending technical assistance for the respective study and development planning for the proposed smallholder irrigation schemes on March 19, 1996.

1.3 Essential Objectives of JICA Technical Assistance Program

- 03- The main objectives of JICA technical assistance set forth in S/W are to prepare the master plan for irrigation-based agricultural development in the entire central Wami river basin with emphasis on the "farmers participatory approach", and then, to select priority-cum-model development schemes for feasibility study. It is also attached to extend transfer of technology to the counterpart personnel in the course of the above two works.

1.4 Outline of the Study Works Performed

- 04- The study works were carried out in three phases. In the Phase-I, the master plan on the Project was prepared, and out of the respective 16 irrigation schemes, such 6 representative schemes as the Mgeta, Mgongola, Mkula, Nyinga, Malolo and Mgogozi-Mwega were selected as the highest priority or the most promising model schemes. Among four schemes, the Nyinga, Malolo and Mgogozi-Mwega schemes

were taken up as a development package for rationalization approach to the irrigation water utilization since those are fed by use of the same water resource in the Mweza river, and re-named to as the Mweza scheme for feasibility study. In the Phase-II, the aerial photo-shooting and groundcontrol survey as well as aerial triangulation for the aerial photo-mapping were carried out at the project site, and successfully prepared the aerial photo-maps covering 50 km² and at the scale of 1/5,000 in Tokyo. In the Phase-III, feasibility study on the selected 4 priority schemes was carried out and the proposed development plan including such essential components as irrigation development, reinforcement of farmer's organization, strengthening of agricultural supporting services, etc. was formulated, successfully. The project implementation plan was also prepared based on the principle issue of the "farmers' participatory approach to development".

Chapter II. General Background of the Project

2.1 Socio-economic Setting of Tanzania

- 05- The total population was 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 last decade, the population increased at a rate of 2.8% a year. Majority of the rural population is belonging to agricultural sector, and a small part is engaging in the fisheries as the main means of livelihood, either in coast or in rivers, lakes or reservoir areas.
- 06- 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 about severe macro-economic imbalances due mainly to a series of external shocks, i.e. quadrupling oil prices, hazardous drought, break up of the East African Community, the Kagera War with Uganda, expansion in debt-servicing, etc. combined with poor economic management policies. Encouraging sign of economic recovery were observed during the period of implementation of the Economic Reform Program, and in fact, GDP annual growth reached at 5.5% in the years 1986 to 1990 and 4.3% from 1991 to 1996.
- 07- In Tanzania, a relative poverty line of Tsh 46,173 per capita per annum was set up at the expenditure bases to measure the level of poverty. About 59% of rural population are classified into a poverty group, and this is one of the main and pressing problems to be tackled by the Government is still valid at present.
- 08- Agriculture is the mainstay of the Tanzanian economy. It absorbed almost 84% of the employed population and generates almost 50% of GDP and 75% of the foreign exchange earnings. In the Mainland, approximately 5.9 million ha of agricultural land have been developed up to present. The agricultural land belonging to smallholder farmers (holding size at less than 2 ha) is about 4.5 million ha (or about 76% of the total agricultural land), and out of which, about 4.13 million ha are being cultivated for annual crop production. Irrigation has been provided so far for 160,000 ha (4 % of the total cultivated land). Accordingly, the agricultural production is still remain insecurity under irregular distribution of the rainfall.
- 09- In performance of Tanzania economy, the growth of agricultural GDP was rated at 4.0% in 1991, and increased to 4.4% in 1992 and 7.3% in 1993. This is generally recognized as quite satisfactory, if compared with an average population growth at

2.8% per annum for the same period. In 1994, however, the food production was about 30% decreased, since then, the national food deficit became to about 435,000 tons because of drought, and consequently, the overall performance of agricultural production was slow-downed to a serious extent.

- 10- The agriculture sector continues to play the most important role for maintaining the national economy. However, its productive conditions is still at the primary level and has a delicate structure against the physical constraints. Accordingly, structural improvement for further increment of agricultural production is essential and the primary subject of the agricultural sector so as to maintain the national food security conditions as well as foreign trade balance, satisfactorily.

2.2 Environmental Protection and Conservation Issues

- 11- GOT has issued the "National Conservation Strategy for Sustainable Development (NCSSD)" in 1993 and the "National Environmental Action Plan (NEAP)" in June 1994. The overall objectives envisaged in the said Plan are to ensure sustainable and equitable use of the natural resources for both present and future generations without degrading the environment.

2.3 Socio-economic Setting of Morogoro Region

- 12- Morogoro region had a population of 1.25 million as of 1990, and of which, 85% or more (approximately 1.9 million households) live in rural areas. The proximity to Dar-es-Salaam has a positive economic impact on the Morogoro region. However, the traditional smallholder farmers are the core of economic activities in the regional agriculture sector. In the region, approximately 260 thousand ha of arable land has been reclaimed for agricultural production chiefly staple food. Majority is played under rainfed conditions. It means that the regional agriculture still has a delicate-cum-weak productive structure against unfavorable climate, i.e. hazardous drought, irregular distribution of rainfall, etc. Accordingly, the unit crop yield is as low at subsistence level, at present.

PART-II. MASTER PLAN STUDY ON SMALLHOLDER IRRIGATION DEVELOPMENT PROJECTS

Chapter III. Master Plan on Irrigation-based Agricultural Development in the Central Wami River basin

3.1 Present Conditions of the Study Area

- 13- The Central Wami River Basin (the Study Area) is located about 200 km west from Dar es Salaam. The Study Area extends at the middle and upper reaches of the Wami river, including a small part of the Ruvu and Rufiji river basins. Its physiographical area is approximately 11,460 km². that is corresponding to about 15.7% of the gross extent of Morogoro region. Administratively, the Study Area belongs to three districts, i.e. Morogoro, Kilosa, and Kilombero.

(Physical Nature of the Study Area)

- 14- The Study Area has a topographic complex that is leading a variation of a micro-and/or meso-climate, hydrological features of the rivers, and consequently, an

ecology and agriculture. Namely, the Study Area could broadly be divided into four physio-graphical 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".

15- The climate conditions of this area are characterized by two distinct seasons, i.e. the dry season from June to October and the rainy season from November to May. The monthly mean discharges of the rivers largely differ each others depending on rainfall distribution, vegetation and topographic conditions in each river basin. The flow discharges of these rivers are fluctuated by the seasons, i.e. large flood on month from November to May and those reduce to small during the months of June to October. A heavy sediment-load and unstability of these river courses are one of the serious physical constraints in irrigation development in this area. In fact, the following troubles and/or damage have appeared up to present: Burying of the intake structures by sediment, difficult intake of irrigation water due to change of the river course, and crop damage by seasonal floods.

16- Most of the soils in the Study Area are relatively fertile and have sufficiently large moisture holding capacity suitable for crop cultivation and irrigation practices. With small exception, the soils developed on steep slope have a shallow effective depth, course texture, and therefore, high erodebility. About 38% of the area is covered with the forest, 30% belongs to the savanna, and 32% is agricultural land inclusive of village yards, etc. Of the total agricultural land, an estimated area of 60,000 ha is under cultivation by smallholder farmers, and greater remainder belongs to large scale state farms, i.e. sugar and sisal plantations.

(Socio-Economic Setting in the Study Area)

17- Each villages in this area consist of a few to several tribes, i.e. Sagara, Luguru, Goro, Nguu, Hehe, etc. Those inhabitants are organized into the traditional village community societies, and conduct social, cultural as well as economic activities without any hazardous conflicts between them. Nevertheless, agriculture provides employment to more than 95% of the economically active population in the villages. While the commercial and services sector do not absorb employment in a significant way.

18- The access roads to each scheme have a narrow width, and not well consolidated yet. Many of them have no river crossing structures, i.e. bridges, culverts, etc., therefore, vehicular transit is difficult during the rainy season. Each village has a primary school, dispensary, and in a part, the rural water supply system. However, all the facilities are not always functioning well due to a shortage of financial budget in most villages.

(Agricultural Setting in the Study Area)

19- The irrigated land in the Study Area is so far limited to only 8% of the total agricultural land (or about 5,000 ha). Irrigation efficiency in each scheme has recently been gone down due to mal-conditions of the existing facilities and damages by frequent occurrence of seasonal flooding during the rainy season. The great remainder is cultivated extensively for staple food production under rainfed conditions or using the seasonally flooding water.

20- The agricultural land tenure system is generally based on the land allocation within the village community society. A size of land holding per farm household is around

0.8 ha in case of the villages in Zone-I, 1.2 to 1.5 ha in Zone-II, 0.7 to 1.2 ha in Zone-III and 0.8 to 1.2 ha in Zone-IV, respectively. Out of these land holdings, an average land holding shared within the scheme area is 0.3 ha, 0.36 ha, 0.3 ha and 0.79 ha, respectively in each Zone. In Zone-I and -IV, there are no more arable land to be able to allocate for the villagers. Since then, the titles of cultivated land have been fragmented to small due to traditional inheritance through recent generation changes. Shrinkage of land holding size per farm household has, therefore, become a serious problem in this area.

- 21- In the Study Area, maize, paddy, pulse, sorghum, etc. are the dominant food crops, while vegetables, i.e. cabbage, potatoes, green peas, dry onion etc. are the essential crops for cash earnings. Especially, those vegetables are generally recognized as the principal products in the Zone-I and Zone-IV areas. In Zone-II and Zone-III areas, farmers grow paddy in the lowlying land extensively by use of the seasonal flooding, while maize, sorghum and pulse in the upland field under rainfed conditions. Double cropping of paddy under full irrigated conditions is only practiced in the existing Mkindo-Pilot scheme (60 ha).
- 22- In case of Zone-I and -IV areas, all the crops are cultivated fully by man-power. In a exceptional case in Zone-II and -III areas, some part of soil preparation is made by use of the hired tractors. Utilization of chemical fertilizers and agro-chemicals are limited only to cash crops. Since majority of farm land is not sufficiently consolidated yet so far, the production of each crop is still low at the subsistence level.

(Present Conditions of Smallholder Irrigation Schemes)

- 23- There are at least 34 smallholder irrigation schemes in the Study Area. Most of these schemes are composed of plural small irrigation furrow systems, but be commanding less than 100 ha in general. In a few irrigation schemes, the Government provided the concrete-made weir and intake facilities. While majority of irrigation schemes have only simple intake facilities made by use of the local materials. These simple intake and related structures are washed away or damaged by the seasonal flood during the rainy season every year. The repair of such damaged facilities imposes a heavy burden on the beneficiary farmers. The concrete-made weir and intakes provided by the Government are also not always functioning well due to problems in selection of the structure site and the design as well. Some of them have been, more of less, buried under sand sediment and/or damaged by flood. On the other case, serious sand sedimentation has been arisen in the upstream reaches of the weir, and thus, accelerating the river flooding. The irrigation canals are generally poor earthen-made. Since then, a large seepage losses lead very low irrigation efficiency. Drainage facilities have not been developed yet or insufficient in function in all the schemes.

(Activities of Agricultural Supporting Services)

- 24- The extension services at regional level are led by the Regional Extension Officer (REO), and at the district level, by the District Extension Officer (DEO) under supervision of REO. the Division Extension Officer (DIVEO) and Village Extension Officers (VEO) are deployed for extending technical guidance to farmers at the division and village level, respectively. At present, their extension services merely cover 29 villages out of the 44 villages in the Study Area.
- 25- In Morogoro region, there are four agricultural research centers, i.e. the Ilonga Agricultural Research and Training Institute (ARTI), KATRIN, Chollima Agro-Scientific Research Center (CSRC), and the Dakawa Research Center. These Centers are conducting the agricultural research and crop breeding works as well as training

of extension officers. As for the training services for the extension officers, the Agricultural Training Institute (ATI) and Livestock Training Institute (LITI) have also been functioning in this region. Besides, the Farm Development Center was established with grant aid of the Chinese Government in Msolwa village, and the Farmers Training Center is being under construction in Mkindo village, using the Grass-Root Fund provided by the Japanese Government.

- 26- Two national seed farms, i.e. the Kilangali Foundation Seed Farm (paddy) and Msimba Foundation Seed Farm (maize, sorghum, beans, etc.) are located in Morogoro region. However, production of certified seeds in these farms is seriously insufficient if compared with usual demand. Therefore, majority of farmers use their own seeds for crop production. Supply of the chemical fertilizers and agro-chemicals is usually very difficult due to poor trafficability of the access roads to most of the villages. It is also a serious constraint that the prices of farm inputs are high to the addition of a premium to the transportation cost. Thus at present, majority of farmers are not so easier to use such farm inputs. As for marketing of agricultural products, there is no public intervention in the marketing process. Accordingly, the prices of agricultural production are being set up at lower level through negotiation between traders and farmers from time to time.
- 27- In Morogoro, the formal lenders for the agricultural credit are the National Bank of Commerce (NBC) and the Cooperative and Rural Development Bank (CRDB). The annual interest rate charged for medium and long term credits varies from 30 to 36% per annum which lead the smallholder farmers difficult to access to those credits.

(Farmers' Organization)
- 28- In the Study Area, the Irrigation Water Users' Groups (WUG) have been organized so far in 13 irrigation schemes. All these are, however, not legally authorized yet, and accordingly, have no water rights except the Mkindo pilot scheme. In usual case, WUG takes two regular procedures for decision making, namely the general meeting of all the members and executive committee (or water users' committee) which consists of 5-10 representatives elected by the members. Water distribution schedule is decided through the General Meeting. Maintenance of irrigation facilities is done by farmers themselves as one of the communal work of WUG. In case of the Kilangali, Mgongola (the Mkindo Pilot scheme) and the Mlali schemes, WUG collects water charges from the members either in cash or in kind other than the duties paid in the said communal work.
- 29- In Morogoro region, there are three co-operative unions relating to the marketing of agricultural commodities. In the Study Area, there are nine primary co-operative societies, up to present. These co-operative societies were organized for the marketing purposes on both farm inputs and crop production. The membership in a cooperative unit is, in most cases, less than 300. These co-operatives are all not so active due to weakness of managing structure, lack of operation funds, lack of storage facilities, etc.
- 30- In the villages within the respective irrigation scheme areas, total of 47 women's groups have been organized up to the present. The membership of each group is not larger than 5 - 20 women. Their activities consist mostly of the nursery work for promotion of afforestation, crop cultivation in the farm plots allocated to the group and processing of local beer for cultural activities. As for the other organizations, there are 6 farmers' groups in Mgongola scheme. These groups were organized

under the special program assisted by FAO for food crop production increase especially maize and rice. This program provides technical guidance for crop cultivation technology as well as farm inputs to the member farmers.

3.2 Initial Environmental Examination (IEE)

- 31- The environment in the Study Area is, more or less, affected by (i) high growth rate of human and livestock population; (ii) high increase of energy consumption chiefly of the forest resources; (iii) poverty due to inactive rural socio-economy; (iv) low education level due to poverty in the rural area. These factors have been exerting a certain pressure on the natural resources, and consequently, degradation not only in the natural vegetation but also soil productivity. The said factors are also bringing the negative impacts in health and welfare risks in the rural area, contamination of water due to poor sanitation facilities, etc. Amongst the environmental parameters, it shall pay attention to (i) incremental risk of water-borne diseases; (ii) increase of biocide risks particularly on water resources; (iii) degradation of vegetation especially forests; (iv) social conflict hazard in the rural societies when the proposed development plan is implemented.

(On-going Actions/Programs of the Environmental Conservation)

- 32- A few programs for environmental conservation have been conducted and attempted to contribute towards attainment of an integrated-cum-sustainable development of agriculture through coordinating amongst the efforts of all the concerned authorities, and then, to alleviate environmental problems. The Traditional Irrigation Improvement Program (TIP), Kilosa District Rural Development Program (KDRDP), Seed Distribution Services by WWF and Integrated Sustainable Agricultural Program (SAP) in the Mgeta area are the important programs for motivation of the local farmers, and hence, activation of the environmental conservation work of the rural people.

3.3 Development Potential and Constraints

(Potential for Irrigated Agriculture Development)

- 33- The land and water resources in the Study Area are appreciated as highly suitable for the objective irrigation-based agricultural development. The development plan on the respective 16 schemes formulated in NIDP is also acceptable though there is a little limitation in those resources. As far as the human resources are concerned, the labor force available in the respective schemes may not be a problem for implementing the project. Rather than the availability of labor force, however, it is essential to upgrade a quality and/or skillfulness in labor work so as to accomplish a sustainable irrigation-based agricultural production.

(Problems and Constraints to Agricultural Development)

- 34- The problems and constraints in agricultural development at present are mostly brought by serious drought and/or seasonal flooding caused by irregular distribution of rainfall, poor agricultural infrastructure, insufficient performance of extension services to farmers as well as poverty based on the traditional custom, and their multiplier effect. Therefore, in order to implement and accomplish sustainable smallholder irrigation development, improvement and/or elimination of all the problems are the crucial subject.

3.4 Basic Approach to the Project

(Policy Issued and Development Needs)

- 35- In implementation of the national socio-economic development plan, GOT has given the highest priority to the agricultural sector development with paying attention to the following issues; (i) to satisfy subsistence requirement in a large part of the country, (ii) to generate local surpluses of staple food products in order to facilitate food security at both villages and regional or national levels. In the national agricultural development plan, GOT then emphasized that a consolidation of agricultural land especially with rehabilitation-cum-improvement of the existing smallholder irrigation system is the most essential and basic strategy for attainment of the said national goals. GOT also scheduled to implement the said program based on the "farmers participatory approach to the development". On the other hand, the development needs of farmers in the Study Area are contemplated according to the wishes for improvement of the present constraints and problems on agricultural production activities. Thus, all the farmers benefiting from the existing irrigation systems attach the highest priority to "improvement of the irrigation facilities".

(Fundamental Objectives and Development Strategy)

- 36- In accordance with the political needs of GOT as well as farmers' wishes stated above, it is envisaged that the fundamental objectives and basic goal of the Project are to realize food crop production increase and its stabilization through satisfaction of agricultural infrastructure, and to ensure a sustainable agricultural development through generation of farm economy, promotion of rural poverty alleviation and conservation of the natural resources. To attain these objectives, and accomplish the goal of the Project, the following five issues are taken up as the essential strategy.

- 1) Intensification of land use and increase of agricultural production so as to generate farm income, and hence, to alleviate a rural poverty.
- 2) Rehabilitation and/or improvement of the existing traditional irrigation systems and expansion of an irrigable land as much as water resources are available, including improvement of the access road and its related structures, and provision of flood protection dikes as required.
- 3) Community development especially reinforcement of the existing water users' groups and grow up the Water Users' Cooperative Societies through education and training of the beneficiary farmers.
- 4) Reinforcement of the institutional supporting systems especially agricultural extension and farm input supply services.
- 5) Natural environmental conservation in and around the scheme areas through promotion of social- and/or agro-forestry development program.

3.5 Agriculture Development Plan

(Land Use and Crop Production Programs)

- 37- The potential net irrigable area is estimated at 4,905 ha in total covering the prospective 16 irrigation scheme areas. The proposed land use and crop production pattern are formulated for each scheme taking into account the farmers' experiences on the existing crop production and prevailing cropping pattern.

(Prospective Unit Yield and Crop Production)

- 38- The prospective unit yields of major crops are estimated referring to various records on crop experimental works as well as the actual production being obtained by aggressive farmers in the scheme areas. The prospective unit yields hereby estimated

are 5 ton/ha for paddy, 3 ton/ha for maize, 1.5 ton/ha for pulse, 15 ton/ha for dry onion and cabbage, respectively. Under the conditions with project, it could be obtainable a significant increase of crop production, i.e. 5,310 ton of maize, 23,800 ton of paddy, 1,630 ton of pulse, 17,400 ton of onion, etc.

3.6 Irrigation and Drainage Improvement Plan

(Improvement Plan on Irrigation and Drainage)

- 39- The Mgeta scheme in the Zone-I includes more than 300 of independent small- or minor-scale irrigation schemes covering approximately 2,000 ha in gross irrigable land in total. Herein the study, it has selected one existing irrigation system (5 ha) as a model development in this area, and apply a pipeline system for the main canal so far as to maintain soil erosion and land slide hazards.

As for the Mnyencye and Kilangali schemes in the Zone-II, renewal of the existing intake weirs and canal system, which have been buried due to siltation, is the essential work. To maintain sustainable irrigation development, it is also crucial to provide drainage system as well as flood protection dikes. In case of the Mgongola scheme, it is fully required to newly construct the irrigation and drainage canal system, farm road network, flood protection dikes as well as on-farm development including land leveling and establishment of farm ridges, plot by plot. For the existing Mkindo intake weir, enlargement of the intake gates is essential so as to divert sufficient irrigation water to both Mkindo pilot scheme and Mgongola extension areas.

In case of the Mlali and Mvumi schemes in the Zone-III, the existing intake weirs have been deeply buried under sand sediment. Therefore, these shall be renewed entirely. Rehabilitation of irrigation facilities as well as on-farm development are also required in these schemes. For the other schemes in the Zone-III, i.e. the Msolwa, Mkula, Chabima and Ndole schemes, rehabilitation of the existing intake weirs and irrigation canal systems shall be made together with consolidation of the on-farm works. The Sonjo scheme is practically the new development program.

In the irrigation schemes belonging to the Zone-IV, i.e. Nyinga, Malolo, Mgogozi and Chabi schemes, plural small irrigation systems have been developed and functioning for growing dry onion in the dry season. These small irrigation furrow systems shall be unified within each scheme so as to maintain a rational utilization of water resources, more efficiently. To the above end, the existing traditional intake weirs shall be replaced, and new one be created in the upper reaches of each scheme.

(Improvement Plan on Access Road)

- 40- Access roads to each irrigation scheme except the Msolwa, Mkula, and Sonjo schemes are not sufficiently consolidated yet, and accordingly, poor trafficability is one of the hazardous constraints on both agricultural and social activities in the scheme areas. Thus, herein the development plan, consolidation and/or improvement of the existing access roads including those related structures will be performed as required.

3.7 Plan of Community Development and Reinforcement of Farmers' Organization

- 41- Reinforcement of the present farmers' organizations is one of the essential subjects to efficiently perform O&M work for the agricultural infrastructure as well as to successfully maintain a sustainable development of irrigation-based agriculture in the

Study Area. Activation of the village community society is the primary basis of this approach.

(Strengthening of Existing Water Users' Groups)

- 42- In line with the "participatory approach to the development" that is the principle development issue of GOF, it is scheduled in the first place to strengthen and/or improve the existing WUG through restructuring or to organize them into the Water Users' Co-operative Society (WUCS) so as to enable farmers to successfully undertake O&M work by themselves. Access to marketing and credit services is also one of the elemental functions of WUCS. The proposed organization of WUCS constitutes of the Board Structure (Executive Committee) and several operation and management units (WUG) which will be organized by each irrigation block at the secondary canal basis or the respective villages. All the costs to be required for O&M work of the irrigation facilities will be covered by the irrigation service charges (ISC) collected from the member farmers.

(Participation of Women in Irrigation Development)

- 43- Women in the scheme areas play an important role in not only household keeping but also various activities in agriculture production as well as activities in community society. The objectives of women in development have been rightly defined by recognizing their work enabling them to develop their skills and confidence in decision making and increasing their income and employment opportunities. Thus, in the proposed irrigation schemes, it is scheduling to implement WID program with paying attention to the above objectives. An important component of the program is induction of women extension officers in DALDO office, ensuring that intensive extension and training services will reach farm women so smoothly and effectively.

(Supporting Services for O&M Work of Farmers)

- 44- Majority of beneficiary farmers in each scheme have been more or less experienced to do O&M work through operation of the existing irrigation facilities. However, as far as operation and management of WUCS are concerned, it seems that members of the existing WUG have the technical-cum-financial problems, and hence, they need technical and financial assistance from the Government especially at the initial stage of implementation.

3.8 Project Evaluation

(Economic and Financial Viability of Each Scheme)

- 45- A direct benefit of the Project is estimated to be Tsh. 2,948 million based on the prospective annual incremental production of the essential crops. The initial investment cost to be required for implementing the respective 16 irrigation schemes is estimated at Tsh 22,544 million. If an IRR of 12% is considered to be the acceptable minimum level of feasibility of the project, all the schemes except the Mgeta, Kilangali, and Chabima, are justified as highly viable both from the economic and financial point of view. The later three schemes, which have an EIRR below 12% are marginally acceptable.

(Capacity to Pay of Typical Farm Household)

- 46- The capacity to pay of the beneficiary farmers has been analyzed so as to determine whether a typical farm household can cover the amortization cost for the development fund (or replacement cost for the project facilities) and O&M cost. In case of the Chabima scheme, farmers may be able to cover the O/M cost but not the amortization cost for the development fund. The Mlali and Mgogozi-Kikalo schemes can

cover both amortization cost and O/M cost, while their income may have to bear a heavy burden to cover those costs. For the other schemes, farmers may not face such problems in covering these subject costs as the proportion of the costs relative to their income less than 20%.

3.9 Conclusion and Recommendation

(Conclusion)

- 47- According to the results of the preliminary feasibility study on the respective 16 irrigation schemes in the Central Wami River Basin, which had been taken up in NIDP, all the schemes except the Mgeta, Kilangali and Chabima schemes are evaluated as technically and economically viable and promising for development investment. Although the Mgeta, Kilangali and Chabima schemes show EIRR relatively lower than the standard rate of 12% specified by GOT, these schemes could also be acceptable if the access road to those schemes is improved/consolidated jointly under other rural development programs in the said areas.

(Recommendation)

- 48- In the Central Wami River Basin, there are many small scale traditional irrigation schemes other than the said 16 irrigation schemes. Especially in the Mkata plain which lies in the central part of the Basin, the existing traditional schemes might have huge land and water potentials for irrigation-based agriculture development. In contrast, most of the villages has no more arable land, and consequently, the holding size per farm household has been reduced to a marginal level through fragmentation of land title due to current population increase and generation change in this rural area. In order to deal with the above fact, it is to recommend that the Government shall undertake a comprehensive investigation, assessment of the land resources as well as environmental impact assessment on the Mkata plain to demarcate the possible development area for implementation of the resettlement program as it would be required in the near future.

Chapter IV. Selection of Priority Development Schemes

- 49- With due consideration of the Irrigation Development Policy issued in NIDP and also the present situations of the agricultural as well as the socio-economic setting in the respective scheme areas, the priority evaluation has been made with particular emphasis on the specific points such as technical, social, institutional, financial, economic, and environmental aspects. Apart from the priority evaluation as well as taking into account the strong intention of GOT to implement the selected schemes as a pilot project for NIDP, the priority development schemes are selected from each physiographical zone.
- 50- With all the above conditions, the four priority schemes to be subject to the feasibility study are selected from each physiographical zone (Zone-I to -IV), i.e. the Mgeta scheme (30 ha), Mgongola scheme (620 ha), Mkula scheme (149 ha) and the Mwega scheme (580 ha), respectively.

PART-III FEASIBILITY STUDY ON PRIORITY DEVELOPMENT SCHEMES

Chapter V. Present Conditions of Priority Scheme Areas

5.1 Physical Nature of Priority Scheme Areas

- 51- The Mgeta and Mgongola schemes are belonging to Morogoro district, and located respectively at 50 km south-east and 90 km north from Morogoro city, the capital of Morogoro region. The Mkula scheme belonging to Kilonbero district is located at the southern most part of the Central Wami River Basin (about 180 Km from Morogoro city), while the Mwega scheme belonging to Kilosa district is at the west most area (220 Km from Morogoro city).
- 52- The Mgeta scheme composing of small- and micro-scale irrigation systems lies on a steep mountainous slopes having more than 1/3 gradient, and has a delicate natural environment, i.e. soil erosion, land sliding, etc. in the present agricultural activities. The Mgongola scheme is extending on a part of the seasonal flood plain that has an average slope at 1/500, while rich in micro-relief. The scheme area is habitually affected by the seasonal flooding and inundated at 40 to 100 cm water depth during the rainy season. In case of the Mkula scheme, the arable land lies on the fan-formation (1/200 gradient on an average) developed at the foot of mountain ranges. At the lower reaches of this area, the land is also affected by the seasonal flooding during the rainy season every year. The Mwega scheme is located on a riverine terraces narrowly developed along the Mwega river. The soils in these scheme areas are relatively fertile and have moderately high water holding capacity except in a part having a coarse texture and rough soil structures.
- 53- The climatic conditions in the scheme areas are characterized by two distinct seasons, i.e. dry season from June to October and the rainy season from November to May. Although the rainfall distribution pattern is almost the same among the selected scheme areas, the annual mean rainfall in each scheme area largely varies like as 2,190 mm in the Mgeta, 1,310 mm in the Mgongola, 1,400 mm in the Mkula and 360 mm in the Mwega schemes. The other climatic parameters observed are also the same at each scheme except the Mgeta scheme, namely 30°C and 18.7°C for the maximum and minimum air temperatures respectively, 80% for the relative humidity, 5 mm/day for the evaporation and 7 hr/day. for sunshine hour. In case of the Mgeta scheme area, the maximum and minimum air temperature are at 23.5 and 15°C respectively. The sunshine hour is at 5 hr/day.
- 54- The river flow usually increases from October and reaches at the peak in April, then decreases until September. The seasonal discharges in April estimated based on a 5-year return period are at 6.3 m³/sec. for the Mkindo river, 0.6 m³/sec. for the Mkula river and 31 m³/sec. for the Mwega river, while the discharges in September are at 0.75 m³/sec., 0.04 m³/sec. and 0.7 m³/sec., respectively. Besides, the maximum flood discharges based on a 50-year return period in each river are at 114 m³/sec. in the Mkindo river, 59 m³/sec. in the Mkula river and 99 m³/sec. in the Mwega river.

5.2 Present Setting of Socio-Economy

- 55- The village is the smallest unit of the public administrative structure. In the four scheme areas, there are 8 villages. The village council is the managing function. Its members are elected by the villagers, and varies from 16 to 25 depending on the po-

population of each village. Revenue of the village council is basically the levies and taxes, i.e. the development levy, traded crops levy, and local brew tax.

- 56- The total population of all four schemes is estimated about 45,030, of which 29,350 is inhabited in the Mgeta, 8,470 in the Mgongola, 2,940 in the Mkula, 4,270 in the Mwega schemes, respectively. The household is about 8,650 in total. The family size is estimated at 5.2 persons per household on an average. Most of the farmers have completed the primary level or at least had some years of primary schooling. However, those who have gone to the secondary level of education are few in each village.
- 57- All the schemes except the Mkula scheme have certain distance from the main highways. The conditions of these access roads are still not sufficiently consolidated yet, and accordingly, vehicular traffic is very difficult. Recently, in some villages, the rural water supply system has been provided, but those have not enough capacity to feed water for all the villagers. Fetching water is a hard work for women. Even though the transmission line runs near by some villages, no distribution lines are not networked yet so far. Thus, the rural electrification is not progressed in the respective scheme areas. Most of the villages have a dispensary. However, these facilities do not meet the minimum requirement recommended by WHO.
- 58- At present, almost 95% of the economically active population in the villages are engaged in agricultural-based activities. In the villages, there are small-scale processing factories, i.e. rice and maize mills, simple brewing by the women's groups, etc. The local brewing is the important income source of women as well as the stable revenue source of the village government.

5.3 Present Conditions of Agriculture in the Scheme Areas

- 59- Farm land in the Mgeta scheme (30 ha) has been reclaimed in terrace forms, and all cultivated with upland crops. At present, almost half of the land is being irrigated, while the remaining half is still under rainfed conditions. In case of the Mgongola scheme (620 ha), all the land has been used for paddy cultivation. The irrigated paddy field is so far only 60 ha in the Mkindo pilot scheme. In the Mkula scheme (149 ha), almost 60% of the land is categorized as the paddy field, and the remaining 40% as the upland field. A benefited land by the existing irrigation furrow system is limited only to one ha or around. As for the Mwega scheme (580 ha), some 30% of land is classified into the paddy field and 70% into the upland field. Of these land, approximately 95% is benefiting by the existing irrigation furrow systems.
- 60- The land tenure system in the scheme areas are based on the cultivation right to be inheritance to the villagers under the land allocation administered by the village council. The average farm size per household in each scheme area is as shown below:

Particulars	Mgeta	Mgongola	Mkula	Mwega
Average holding Size	0.80	1.62	1.29	1.28
Inside scheme	0.30	0.36	0.30	0.79
Outside scheme	0.50	1.26	0.99	0.49

Recently, the farm size per household is gradually reducing to a marginal level due to fragmentation of land title through the current generation changes. This fact is one

of the hazardous problem especially in the Mgeta scheme.

- 61- In the rainy season, paddy is predominantly grown in the lowlying flood area, while maize and pulse in the upland field in all the schemes. In the dry season, vegetables and pulse are cultivated as the essential cash crops. In case of the Mgeta scheme, such vegetables as cabbage, potatoes, green peas etc. are cultivated as the principal products, while dry onion as the same in the Mwega scheme. In the Mgongola scheme, farmers grow only paddy in the rainy season using the seasonal flood water, while in the dry season, the land is left fallow from crop production and extensively use for cattle grazing. Double cropping of paddy under fully irrigated conditions is only practiced in the Mkindo pilot scheme (60 ha). In the Mkula scheme, farmers grow maize and pulse twice a year blessing with the natural soil moisture supplied from shallow groundwater. All the crop farming is practiced by family labor and/or mutual-help arranged within the village community society, except some part of soil preparation that is made by use of the hired tractors in case of the Mgongola and Mkula schemes. Other than the cash crops, no chemical fertilizers and agro-chemicals are used in common. Seeds are prepared by farmers themselves using a part of the former products.
- 62- The farm land is so far not yet consolidated, satisfactorily and sufficiently. Poor farming technology and supply system of farm inputs are also the constraints in the present crop production. Consequently, the unit yield as well as quality of each crop production are still low at the subsistence level.
- 63- With exception of the Mgeta scheme, the net reserve in farm economy does not sufficiently cover the capital cost to be required for crop operation in the next year. In fact, majority of farmers must resort to some form of informal financing and/or the off-farm income to cover the said gap. The major sources of off-farm income is of a petty business, i.e. sales of agricultural production in the local market, processing of local brew, and remittance from the relatives. In the farm economy, food is the main expenditure in all the schemes, that is ranged from 43% to 52%. Clothing expenditures share in total expenditure varies from 19% to 26%. Education expenditures have a share from 9% to 11%. Medical expenses share varies from 15% to 10%. Petty and leisure expenditures represent 1% to 6% of total expenditures.

5.4 Present Condition of Irrigation Schemes

- 64- The small irrigation furrow systems in the Mgeta scheme are composed of the free flow type and simple intakes and earth canals without provision of lining and any related structures. The soil erosion in the canals is one of the hazardous problems. In the Mgongola scheme, irrigation is practiced only in the Mkindo pilot scheme (60 ha) at present. The greater remainder is, therefore, subjected to newly develop the irrigation system. In case of the Mkula scheme, the irrigation practice is limited to only 1 ha or around since the existing facilities are not functioning well and need structural improvement and/or rehabilitation entirely. The Mwega scheme consists of three sub-schemes with adjoining land namely the Nyinga, Mgogozi-Mwega, and Malolo sub-schemes. All these sub-schemes abstract irrigation water principally from the Mwega river. A free intake serving the Mgogozi-Mwega area was completely washed away by flood in 1995 and it led the area into acute water shortage. This situation has been partly improved by supplying the irrigation water from the third Nyinga intake through the aqueduct constructed in 1996. In Malolo

area, there are two concrete-made intakes on the Mwega river. Since these intake weirs are the fixed type, sand sedimentation is proceeded to a serious extent and forms a shallow bottom in the upper reaches of the river. Consequently, it brings frequent flooding in the farm land during the rainy season, while much disturbs an efficient irrigation in the dry season.

5.5 Agricultural Supporting Services and Farmers' Organizations

- 65- In Morogoro region, institutional re-organization in respect to the agricultural extension services is now under progress in line with the national administrative restructuring policy. In this, the regional government has been undertaking the training and education program particularly for DIVEO and VEO so far as to strengthen the agricultural extension services in the village areas. Recently, DIVEO has been assigned in each division respective to the selected scheme areas. VEO has also assigned for each villages except Mgogozozi village in the Mwega scheme. Under technical supervision of DIVEO, they are extending the technical extension services to farmers. However, it is necessary to re-train or educate them, since majority of VEO does not familiar with a technology on irrigated farming, up to present.
- 66- At present, the institutional agricultural credit service is available in the FAO Special Program on Food Production. However, in the scheme areas, farmers in Mkindo and Henbeti villages in the Mgongola scheme only have a opportunity to participate at this moment, since the Program is still under the pilot stage.
- 67- In the respective scheme areas, there are two primary cooperative societies, i.e. Twalangize Cooperative Society (less than 300 membership) in Mgeta scheme and Dizingwi Cooperative Society (about 40 members) in Mgongola scheme. Both cooperatives have been registered and authorized under the Cooperative Act. No. 15, 1991. At present, these cooperatives are being affected by such problems as lack of funds for marketing of crops, lack of storage facilities, etc.
- 68- The water users' groups (WUG) have been organized in each scheme. WUG is managed by the executive committee (water users' committee) which consists of 5 to 10 members. In the Mwega scheme, there are several irrigation systems and each one commands relatively large irrigable area, therefore, the number of sub-WUG have been organized at the sub-village or irrigation area at the secondary canal basis. Generally, the schedule of seasonal water distribution is determined through the general meeting of WUG. Maintenance of the facilities is done by the communal work of the members. It is appreciated that the said communal O&M work is functioning well. Recently, two WUGs have planed to collect an irrigation service charge (ISC) from the member farmers other than their participation to the communal O&M work. In case of the Mkindo WUG, ISC is charged at Tsh. 1,000/year/acre since 1994/95 crop season. Out of 96 member farmers in total, 85 farmers paid ISC to WUG as of August 1997. Now, WUG intend to change the payment system from "cash" to "in-kind" and its rate to one paddy bag (70 kg) per year per acre. All the existing WUG except Mkindo WUG in the respective schemes did not aquire the water rights for their schemes because they are still at the primary based organization and not legally authorized yet by the Government.
- 69- In the scheme areas, the total 13 women's groups have been organized under foreign aid assistance programs or the communal development program of village governments and/or by women themselves. The membership of a group is not larger than

20 women. Their activities are mostly crop cultivation in the rainy season and processing of local brew in the off season. In case of the Mgongola scheme, there are several farmers' groups which are being organized under FAO Special Program for promotion of food production increase especially maize and rice.

5.6 Environmental Impact Assessment (EIA)

- 70- Majority of inhabitants in the scheme areas use the domestic water from the irrigation canals or river streams. A shallow ground water is also available but it is used only a limited part, at present. The quality of these water resources is not always capable for drinking purpose. Treatment of water against turbidity and bacteriological contamination is one of the essential subject to the rural development.
- 71- Malaria is the most hazardous diseases in the scheme areas. It is also remarkable that a morbidity at more than 10,000 cases is observed on the water/vector-borne diseases, i.e. Onchocerciasis and Schistosomiasis in the region during 1992 to 1995. Thus, it shall pay attention to the said diseases, and promote to improve the rural sanitation facilities, household latrines, waste/disposal facilities as well as precise control of vermin and insects so as to secure the rural health environment, satisfactorily. The negative impact to be caused by utilization of the farm inputs might be limited to a small extent in case of development of the respective schemes. To utilize the agro-chemicals, it shall precisely refer to the specific guideline issued by the Tropical Pesticides Research Institute.

Chapter VI. Basic Approach to Development Planning on the Priority Schemes

- 72- The proposed development plan of each priority scheme areas has been formulated in line with the fundamental objectives and basic strategies as per stated in the preceding Section 3.4, Chapter III.

Chapter VII. Irrigation-based Agricultural Development Plan on the Priority Schemes

7.1 Demarcation of Irrigable Area

- 73- The subjected development area demarcated based on the development potential assessed on the land and water resources is 1,379 ha in total for all four schemes, and it is broken-down to 30 ha, 620 ha, 149 ha and 580 ha respectively for the Mgeta, Mgongola, the Mkula and Mwega schemes. As for the proposed land use of each scheme area, the following land development and/or consolidation has been planned: Full use of 30 ha as upland field (Mgeta scheme); 620 ha be fully developed as paddy field (Mgongola scheme); consolidation of 100 ha paddy field and 49 ha upland field (Mkula scheme); while 240 ha paddy field and 340 ha upland field (Mwega scheme), respectively.

7.2 Agricultural Development Plan

- 74- In the crop production plan, maize and paddy are selected as the staple food crops, while pulse and vegetables as the economic crops. The existing cropping pattern, which is being already familiar with the local farmers and smoothly operating under the local climate, shall be the basis for intensification and diversification of the crop

production.

- 75- In all the scheme areas at present, majority of crops are grown so extensively without application of such farm inputs as chemical fertilizers, agro-chemicals, certified seeds as a whole. Herein the plan, it is scheduled to introduce high yielding varieties of each crop as well as proper farming technology especially for efficient utilization of farm inputs through joint assistance program among the agricultural extension services, agricultural credit, and research and training, etc. so far as to promote incremental crop production to an economically reasonable level.
- 76- In each scheme area, eager farmers have already been experienced higher level of crop yields even under the present conditions. Thus, it could be possible to accomplish a large increment of crop production. The crop production with the Project is expected about 2,890 tons of maize, 6,390 tons of unhusked rice, 90 tons of pulse, 3,490 tons of dry onion, etc.

7.3 Irrigation Development Plan

(Layout of Irrigation Development Schemes)

- 77- The layout of irrigation development schemes has been made taking such essential components as rehabilitation and/or improvement of the existing irrigation system, drainage improvement, on-farm development inclusive of farm plot consolidation work and flood protection for farm land conservation as well as improvement of the farm road and access road. The works conceived herein the layout are broadly divided into two schedules, i.e. rehabilitation and/or improvement of the existing facilities and a new construction or expansion of structural function of the existing facilities.

In the Mgeta scheme, rehabilitation of the existing intake-weirs and introduction of pipeline system instead of the existing main canal system are the key work. As for the Mgongola scheme, most part of the work shall be performed as new irrigation scheme that is including establishment of irrigation and drainage systems entirely from the main canal until field ditches, farm road network, on-farm development, flood protection dikes, etc. The intake gates of the Mkindo intake weir and head-race canal shall be subject to enlargement on the above concern. The same works exclusive of the flood protection dikes shall be applied to the Mkula scheme. In case of the Mwega scheme, rehabilitation of all the existing facilities and those related structures shall be the bases for ensuring an efficient operation of the irrigated farming. To rationalize irrigation water utilization, all the existing intake weirs shall be replaced, and a new intake weir be constructed at the upper-most reaches of this scheme area. River improvement is also made so as to release seasonal flooding water, safely and effectively. Improvement of the access road including the bridge on the Mwega river is also essential to maintain efficient-cum-sustainable operation of the development scheme.

(Preliminary Design of Irrigation Facilities)

- 78- The intake weirs subject to both rehabilitation (the Mgeta, Mgongola and Mkula scheme) and new construction (the Mwega scheme) have been designed referring to the maximum flood discharges and useful water in the critical dry season estimated based on 50- and 5-year return period, respectively. In the Mgeta scheme, both Mzinga and Mindu intake weirs will be reinforced by means of wet masonry method.

In case of the Mkindo intake weir of the Mgongola scheme, lowering of the floor level of existing inlet as well as widening of intake gates will be made to intake irrigation water, sufficiently. The Mkula intake weir will also be improved with provision of protection measures against water leakage in the weir bottom. Reinforcement of intake structure is also essential work on this concern. The proposed Mwega intake weir is a new work in the Mwega scheme.

- 79- The proposed canals will be of trapezoidal cross section type in principle. The main and secondary canals will be lined with concrete. Others will be of earth type. In the case of lined canals, the design canal velocity should be as fast as possible provided that the canal velocity be less than 70 % of the critical velocity. As for earth canals, the design permissible canal velocity is set at 0.9 m/sec, while at 1.2 m/sec for drainage canals, since the design flood discharge has only a 10- year probability.
- 80- Various kinds of structures such as turnouts, checks, drops, culverts, cross drains, and side spillways will be provided on the main and secondary irrigation canals. Drop structures and road crossing culverts will be provided on drainage canals. To the proposed Mzinga pipeline system, float valves and outlet valves will be provided at 5 points and at 13 points, respectively. For the Mindu canals, number of drops will be set up so as to dissipate hydraulic energy. In the Mkula secondary canal-2, which will have dual functions for irrigation and drainage works, check-cum-drop structures will be provided. These drop structures will have a safety function for spill out an excess water to the downstream even if the check is completely closed with logs. In the Mwega scheme, aqueducts will be provided at the points where the secondary canals cross the Mwega river and the Kikalo river. Also, cross drain structures or siphons will be provided on the canals in order to safely release flood water coming from the hilly area across the main canal or secondary canals.

(Road)

- 81- In the Mgongola scheme, the farm road network will be provided to support agricultural production as well as socio-economic activities within the scheme areas. Besides, the access road to the intake weir site be improved for maintaining operation of the head-works. As for the Mwega scheme, it has also scheduled to consolidate the existing access road connecting with the national high-way and the villages in the scheme area. The existing bridge on the Mwega river will also be renewed in this plan. All the above roads be paved by use of laterites.

(Flood Protection Dike and River Improvement)

- 82- In the Mgongola scheme, flood protection dikes will be constructed along the Dizingwi and Mkindo river. Width of both rivers will be kept 100 m out-side of the embankment. The Dizingwi river will also be deepened about 1 m for the river section from the bridge on the road B-127 until 1 km downstream so as to improve drainage conditions in and around the irrigable area. The Mwega river will also be enlarged its flood way to 10 m wide and 1 m deep for the river section about 1.9 km long at the site from 400 m downstream point to 1.5 km upstream point from the lower-Nyinga intake to release flood water of 10-year probability, smoothly.

(On-farm works)

- 83- As for the Mgongola scheme, the present rainfed paddy fields of about 510 ha in net will be reshaped by leveling so as to remove the micro relief. Both field ditches and farm ridges have to be also constructed. These minor works including final leveling are expected to be carried out by beneficiaries in all the schemes.

(Operation and Maintenance)

- 84- The main and secondary canals generally convey water on a 24-hour basis, while water will be diverted continuously without rotation in principle from the main and secondary canals to tertiary canals. When river water is insufficient for irrigation water demands due to drought, a rotational irrigation water supply should be carried out among all the tertiary blocks. The maintenance work on irrigation and drainage facilities will be performed by the specific two schedules, i.e. "regular maintenance, time to time" and "periodic maintenance during the off-irrigation period".

7.4 Reinforcement Plan on Institutional Supporting Services and Farmers' Organization

(Organization and Function of WUG)

- 85- To organize WUG, two types of organization structure, i.e. Type-A (in case less than 100 members; the Mgeta scheme) and Type-B (in case over 100 members; the Mgongola, Mkula and Mwega schemes) are conceived herein the plan. Both types have almost the same structure, except that Type-B will have the sub-groups as the operation and management units to be organized at each secondary irrigation blocks or each village bases. The structural function of WUG is of the general meeting, executive committee and auditing, and under those management, all the member farmers will participate to O&M work, marketing of agricultural commodities, access to the agricultural credit, group activities of women, etc. The financial budget be covered by the annual member fees, while the cost to be required for O&M work be covered by the irrigation service charges (ISC).

(By-laws of WUG)

- 86- In the articles and/or by-law of WUG, it is essential and crucial to enact the following conditions; (i) compulsory participation of irrigation beneficiaries into WUG, while be irrespective of their gender, (ii) members' duties for payment of ISC, (iii) punishment rule, etc. Immediately after establishment of WUGs, these shall be enrolled for public authorization as the Water Users' Co-operative Society (WUCS), and acquire the water right for irrigation development.

(Women's Participation in Development)

- 87- Under implementation of this Project, it could be ensure activation of crop production-based business, i.e. marketing of agricultural commodities, post-harvest services, community services especially in management of WUG, etc. Accordingly, women in the scheme areas will have an opportunity to involve these activities. As for women's participation in this Project, it is proposed to organize women into voluntary groups to deal with (i) appointment of women's leaders in the executive committee of WUG in order to encourage greater participation of women in public affairs; (ii) establishment of women's group and encouragement of value-added processing of crops, etc. A representative of the women's group joins the executive committee as its member, and participates in all the managing services of WUG.

(Co-operative Approach to Marketing of Agricultural Commodities)

- 88- To arrange smooth supply of farm inputs at reasonable prices, it is proposed to organize a cooperative-based procurement system through application of the group loan of WUG. For selling the agricultural products, it is also proposed to introduce "cooperative shipping system". After harvesting, the products are collected at the storage facilities of WUG for waiting to be either delivered to the traders or to be picked up by them. The product selling prices are negotiated between WUG and the traders. WUG takes the money from the total selling amount for repayment to the

bank, then the members take the balance.

(Agricultural/Rural Credit Facilities)

- 89- At the initial stage of the project implementation, most of farmers need a considerable amount of loan for not only purchasing farm inputs, farming implement but also preparing the capital fund for farming operation. In reality however, no institutional credit facilities are available in and around the respective scheme areas, at present. To overcome such situation, it is proposed to establish the following three credit systems within the function of WUG, i.e. "Group Loan System" to access to the bank loan services, and "Revolving Fund Loan System" and "Mutual Aid Credit System".

(Training Program for Extension Officers and Farmers)

- 90- All WUG in the schemes should be strengthened through a forced training program. The training program be also extended to DIVEO and VEO as well as irrigation technicians so as to deepen their technical knowledge and skillfulness on irrigation management in addition to the specialized technology on farm management. The training program proposed above shall be executed in close coordinating with the on-going programs which are being supported by FAO, the World Bank, etc. Besides, it shall also be scheduled to provide special training to VEO and irrigation technicians. The follow-up training for WUGs' staff is also essential and crucial so far as to maintain a sustainable activities of WUG.

7.5 Environmental Conservation / Protection Plan

(Mitigation of Water-borne Diseases)

- 91- To eliminate and/or mitigate influence of water-borne/vector diseases from the scheme areas, the following three counter measures are proposed as the most effective and easy ways for undertaking by the local people, namely, "precise cleaning of the irrigation and drainage canals and drying up of the canal bottom periodically", "consolidation of the sanitation facilities in the village areas", and "utilization of the agro-chemicals for directory controlling the vectors and intermediate hosts habitat immediately after drained out the irrigation water from both canals and field plots".

(Agro-chemical impacts and water contamination)

- 92- As for the water contamination problems due to utilization of fertilizers and agro-chemicals, it is essential to prepare a standard guideline and advice farmers how to use agro-chemicals, safely and satisfactorily. It is also essentially needed to organize farmers into the plant protection communal groups with in WUG, and then, operate group-based plant protection and sanitation control in the respective scheme areas. Leading such communal work is the essential bases not only for encouraging participation of farmers in the project, but also promoting a sustainable agricultural development.

(Deforestation and degradation of vegetation)

- 93- To properly maintain the present forest and vegetation against the negative impacts caused by fuel wood collection, it is necessary to make precise and fair demarcation and allocation as well as limitation of the development area on the open forest, and set up by-law for collection of fuel wood. Afforestation program is the most essential and practical way for conservation of the vegetation and then forest resources.

(Social conflict in land and water utilization)

- 94- To eliminate the social conflicts on land and water utilization, it is essential to en-

force the village act, and more over, empowerment of the leadership of the village community societies.

(Monitoring Action Plan)

- 95- Monitoring of the project implementation is essential to verify whether any counter measures are effective or not for mitigation or elimination of environmental negative impacts. The proposed monitoring action plan includes "compilation and analysis of the data observed and preparation of periodical reports", "evaluation and identification of unexpected environmental effects" and "formulation of counter-measures to mitigate the unexpected negative effects if any arisen."

Chapter VIII Evaluation of the Proposed Development Plan

(Cost Estimate)

- 96- The project cost has been estimated making reference to the standard costs/prices applied to the current implementation of public works by the Regional Engineers Office in Morogoro, National Construction Council as well as the cost performance observed by the general contractors in the current works in Tanzania. The estimation includes the physical contingencies (10% of direct construction costs), and price contingencies (3 % for the foreign and 17 % for local currency portions). The total cost to be required for implementing the selected four schemes is at Tsh. 8,560 million (or equivalent to about US\$ 13.8 million). The break-down of the cost for each scheme is as shown in the following Table.

Project Cost by Priority Development Schemes

Name of Schemes	Scheme Area (ha)	Total Development Cost		Total Development Cost per ha	
		(Tsh. million)	(eqv. US\$ thousand)	(Tsh. thousand)	(eqv. US\$)
Mgeta	30	156	252	5,200	8,400
Mgongola	620	3,839	6,192	6,192	9,987
Mkula	149	619	998	4,154	6,698
Mwega	580	3,947	6,369	6,805	10,981
Total	1,379	8,561	13,811	6,208	10,015

(Operation and Maintenance Costs)

- 97- O&M services for irrigation facilities will be performed mostly by labour work of the beneficiary farmers under management of WUCS since majority of facilities and structures are so simple. Thus, the annual O&M cost to be required is limited only to the gate structures in the intake-weirs, division-boxes, etc. A replacement cost will also be required for such structures. To meet these costs, it is scheduled to collect SIC from all the beneficiary farmers. SIC estimated for each scheme is as summarizing in Table below. SIC hereby proposed is considered to be reasonable as justified in the following Capacity to Pay analysis

Irrigation Service Charges by Scheme (Unit: Tsh./ha)

Particular	Mgeta	Mgongola	Mkula	Mwega
Irrigation Service Charges	10,280	18,240	10,710	8,014

(Project Benefits)

- 98- The project benefit will primarily accrue from increment of crop production as a joint effects in a stable irrigation water supply with proper O&M work, improvement of irrigated farming practices with provision of adequate agricultural supporting serv-

ices. The prospective benefit in each scheme is as shown below:

Scheme	Mgeta	Mgongola	Mkula	Mwega
Benefit	14.57	472.21	73.14	448.80

(Economic and Financial Evaluation)

- 99- The economic and financial viability of the Project has primary been evaluated by means of analyses on the economic and financial internal rate of return (EIRR and FIRR).

Particular	Mgeta	Mgongola	Mkula	Mwega
Economic IRR	11.0	15.3	13.1	15.2
Financial IRR	9.0	13.4	11.3	12.6

If compared with the standard EIRR at 12% for assisting a feasibility of agricultural development project that is specified by GOT, Mgongola, Mkula, and Mwega schemes could be appreciated as economically viable and highly promising schemes for development investment. In the case of Mgeta, its EIRR is meagerly lower than that of the standard line but it might be acceptable as a promising scheme for model development in the mountainous zone.

(Capacity to Pay in Farm Economy)

- 100- As shown in the Table below, the Project will bring about a net profit more than Tsh 134,000 per farm household that is almost two times of the present income level in case of Mgeta, while 40 times in case of Mgongola scheme. The net income hereby expected would allow the farmers to have funds to cover the capital for crop operation in the next year. Moreover, the farmers could cover the charges for O&M works on the irrigation facilities as well as annuity cost for amortizing the initial investment fund for project implementation, and enable to obtain net reserve thereafter deducting all the duties.

Particulars	Mgeta	Mgongola	Mkula	Mwega
a. Average Land Holding Size (ha)	0.30	0.36	0.30	0.79
b. Gross Farm Income	333	497	308	1,178
c. Annual Production Cost	78	150	106	334
d. Net Farm Income	255	347	202	844
e. Income Tax	6	7	7	12
f. O&M Cost	3	7	4	15
g. Amortization Cost	70	102	57	188
h. Net Profit				
In case: ="d.-(e.+ f.)"	245	334	191	817
In case: ="d.-(e.+ f.+ g.)"	175	232	134	629

(Viability Assessment from Other Aspects)

- 101- GOT and village community in each scheme have the basic function to implement the Project though structural reinforcement is required. Thus, the development capability of each scheme is considered to be generally acceptable from the institutional and organization viewpoints. It is also appreciated that the traditional village com-

munity being organized in each scheme area is well functioning to manage farmers' activities. In most scheme area, the local farmers have, more or less, experienced in the irrigated farming since certain long time ago, and accordingly, acknowledge whether irrigation development is required or not. Therefore, from the technical viewpoint, the farmers' participatory approach to the project implementation could be maintained without serious problems.

The initial environmental examination pointed out that the Project would bring such misgivings as "influence of water-borne diseases", "water contamination by use of chemical fertilizers and agro-chemicals", "degradation of vegetation due to increment of fuel wood consumption" and "social conflicts on utilization of the land and water resources". However, it could be satisfactorily managed and minimize these negative impacts since all of the proposed schemes are small in development scale.

Chapter IX Implementation Plan of the Project

9.1 Project Implementing Agency

- 102 The Agriculture and Livestock Development Division (ALDD) in the Ministry of Agriculture and Cooperatives (MAC) is the supervisory agency of this Project. ALDD coordinate all the activities of the concerned Government agencies and regional administrative authorities in respect to this project implementation. At the regional level, the Zonal Irrigation Office in Morogoro under technical supervision of the Department of Irrigation (DOI) of ALDD will have direct responsibility for the project implementation. The Zonal Irrigation Office (ZIO) will undertake not only engineering works but also the public arrangement in line of the basic policy on "farmers' participatory approach" so as to guide the local farmers for full understanding about this project and then adjust the development plan for more practical way. To maintain smooth implementation of the project, ZIO shall keep close coordination with the regional and district offices concerned.
- 103- In the regional level, the agricultural supporting services is being handled by the office of Regional Agricultural and Livestock Development Officer (RALDO) under technical and administrative supervision of ALDD. At the district level, the office of the District Agricultural and Livestock Development Officer (DALDO) is responsible for extending the supporting services to the farmers in each district. In the region, GOT is now under re-structuring of the regional government organization. Through this, GOT intend to strengthen the district government authorities through re-staffing from the region agencies/authorities concerned, and transfer the responsibility for implementing the rural development programs from the regional government.

9.2 Schedule on the Engineering Works

(Construction Schedule)

- 104- Construction schedule has been formulated for all 4 schemes as a package. The overall construction time schedule includes one year for the survey and detailed design and tender arrangement for procurement of a competitive contractor, and three years using two dry seasons for completion of the construction works (see Figure: Construction Time Schedule attached hereto). On this schedule, it has been conceived that the minor works, i.e. construction of field ditches and farm ridges, final leveling of the farm plots, etc. shall be undertaken by the beneficiary farmers themselves under

technical supervision of ZIO.

(Establishment and Growing-up of WUCS)

- 105- Structural improvement and re-establishment of WUGs shall be scheduled in parallel with the construction work. In the course of this program, the beneficiary farmers could acquire necessary technology for O&M works as well as experience through practically engaging in the construction work as well as the technical guidance to be provided by the executing agency. At the first, the village governments will organize "land allocation committee" for the implementation of land re-allocation and "ad-hoc committee" for establishment of WUG in the schemes. Both committees shall consist of representatives of the village government as well as the existing WUGs. DALDO and the concerned ward government shall support to activities of both committees.

The ad-hoc committee should take all necessary arrangement and set up WUGs at least three months before completion of the construction works. The training to WUGs should be commenced immediately by the DALDO. Then after completion of the construction works, WUG commence O&M work by its-self, and DALDO extend necessary supporting services through VEO and irrigation technician attached to each scheme. DALDO also have to take periodical monitor and evaluate the activities of WUGs, and will settle problems of WUGs if any arisen and/or provide follow-up training to WUGs as required.

(Strengthening Program of the Extension Services)

- 106- To strengthen the existing extension service function, DALDO should has the initiative for implementing the training program for VEO and DIVEO during the construction stage as well as the post-construction stage. To this, DALDO shall keep close coordination with the existing training authorities and the agencies of the ongoing training programs. To satisfactorily maintain coordination amongst all the concerned agencies and authorities, it is proposed to organize an "Agricultural Coordinating Committee" in the respective three districts. The representative of farmers should join to this Committee, accordingly. The implementation schedule on the training program is as shown in Figure attached hereto.

Chapter X. Conclusions and Recommendations

10.1 Conclusions

- 107- The present feasibility study revealed that the Project consisting of the four priority development schemes is technically feasible and economically viable. From the institutional and organization, social and environmental aspects of viewpoints, it is also justified that the Project is sound as a whole. Execution of the Project could accomplish the following principle objectives and goals: (i) stabilization and large increase in agricultural production, and (ii) ensuring generation of farmer's income and growing out of poverty.

Through the farmers' intention survey and the public meetings held in each scheme area, the following conclusions were obtained: (i) most of farmers are sufficiently motivated to participate in the project implementation and strongly desire to materialize the subjected development, (ii) majority of farmers have a capability for doing O&M work by themselves, although technical support and guidance are required at the initial stage of the project implementation. It is also highly expected that a large

impact of the Project would extend to other smallholder irrigation schemes not only in Morogoro region but also the similar schemes in the entire country.

Judging from the above conclusions and development needs, it is recommended to implement the Project as early as the financial budget become available.

10.2 Recommendations

(Phasing of the Project Implementation)

- 108 As explained in Chapter IX, it is planned that the Project consisting of the four priority irrigation schemes be implemented in one package and during a period of four years under the condition that GOT arranges all necessary capital funds either applying the foreign aid or its own budget. In case, if budgetary arrangements have some difficulty, it is recommended to adopt a stagewise implementation of the four schemes according to an available fund. To implement the Project by stagewise schedule, it is suggested to put the highest priority for Mwega scheme, and then, forward in turn to Mgeta, Mgongola and Mkula schemes taking into account a magnitude of irrigation requirement as well as urgency for implementation.

The Mwega scheme is located in the semi-arid zone, where irrigation development is indispensable for agricultural production activities. In addition, the arable land in the area is limited to only in the narrow riverine terrace. Since the land holding size per farm household is becoming small due to fragmentation of the land titles through the current generation changes, further intensification of land use and diversification of the crop production are essentially needed. To deal with the said situation, and hence, to maintain a sustainable economic development of the smallholder farmers, an improvement of the existing irrigation facilities is prerequisite subject. In other word, it is noted that the farmers in the scheme area have a long experience in irrigated farming and O&M work of irrigation facilities, and have a positive attitude towards realization of financial self-reliance for maintaining sustainability of their agricultural-based livelihood.

As for the Mgeta scheme, the designed area is quite small in this planning because this scheme was selected as a development model in the area which has various problems such as soil erosion, land slide due to inappropriate irrigation systems constructed on sloped land. In view of the environmental conservation in the area, it can be concluded that the implementation of the Mgeta scheme is of paramount urgency among the four schemes.

The Mgongola as well as Mkula schemes have no difficulty from the technical viewpoint, but a sensitive issue still remains in their implementation, that the reallocation of the irrigable lands. Because the lands to be developed newly by the schemes occupy a large portion of the total development area, it is necessary to re-allocate those lands in accordance with the policy that development fruits should be distributed to farmers equally and as many as possible. Although this land re-allocation may be possible in both schemes, because over 90% of farmers have agreed with the allocation plan so far, it is recommended to proceed with adequate preparatory works like public meetings to set farmers' consensus before the commencement of the schemes.

(Institutional Aspects)

- 109 In order to achieve successful and effective implementation of the Project, it is recommended that GOT shall satisfy the following conditions prior to commence the proposed development plan.

- 1) It is essentially needed to deploy further technical staff into the ZIO and DALDO offices in the respective three districts. An additional staff to be required for these offices concerned is estimated to be 10 officers including socialist and agro-economist for ZIO, irrigation engineers and expert for institutional credit services for DALDO office, and irrigation technicians, extension officers for DALDO offices. In addition, it is also necessary to assign several specialist/experts for extending the technical guidance and training services to officers/engineers as well as WUG/WUCS and farmers. The experts required for the said purposes are: i) O&M (including maintenance of irrigation facilities) expert, ii) Institutional Expert, and iii) Agronomist/Extension Expert.
- 2) At present, GOT has a plan for restructuring of the regional government. According to this plan, the Morogoro regional government will be simplified in its organization and staffing, and the district governments will be strengthened. In implementation of this Project, DALDO and DCO will have to be the direct responsibility for supporting to WUG/WUCS and farmers. It is, therefore, recommended to accelerate the present restructuring program and strengthen the supporting function for efficiently implementing the Project.
- 3) In case of Mgongola and Mkula schemes, re-allocation of the irrigable land is one of the crucial subject. In fact, more than the total farmers in both scheme areas desired land re-allocation in accordance with the development policy representing that a benefit to be obtainable from the agricultural development should be shared equally and fairly as many farmers as possible. The land allocation sometimes leads misgivings of delicate social conflicts once missing a reasonable way. It is, therefore, recommended that both regional and district governments shall take care of this matter and extend necessary support to the village authority and community societies as well as farmers so far as to perform the said land allocation satisfactorily and successfully.

Table 1 (1/2) Present Features of Irrigation Schemes

	ZONE-I MOUNTAINOUS ZONE	ZONE-II ALLUVIAL PLAIN ZONE			ZONE-III PIEDMONT PLAIN & FAN ZONE			
	1	2	3	4	5	6	7	8
Name of Scheme	Mjeta	Manyenyere	Kilangali	Mgongola	Mafi	Mvumi	Msolwa	Mkufa
District	Morogoro	Kilosa	Kilosa	Morogoro	Morogoro	Kilosa	Kilombero	Kilombero
Villages Concerned	13 of villages concerned	Tindiga Malui Kivungu	Kilangali	Mkindo	Miali Kipera	Mvumi	Msolwa	Mkufa
Altitude (above sea level)	800-2,000	440	430-450	345-365	550-590	400-460	280-300	278-300
River Basin	Ruvu	Wami	Wami	Wami	Ruvu	Wami	Rufiji	Rufiji
River	Small streams of Mjeta river	Miyombo	Miyombo	Mkindo	Mafi	Kisangata	Msolwa	Mkufa
50 year Probable Flood Discharge (m ³ /sec)	—	34	35	112	64	244	97	59
Flood discharge in average year (m ³ /sec)	—	15	17	37	18	31	14	8
Flooding	none	Every year	Every year	Every year	A part of downstream	Every year	A part of downstream	Shallow water stagnant due to poor drainage
Annual Mean Rainfall (mm)	2,190	830	830	1,300	900	780	1,430	1,430
Soil	Cambisols	Fluvisols	Fluvisols	Fluvisols	Fluvisols	Fluvisols	Fluvisols	Fluvisols
Arable Land								
Irrigated area (ha)	1,600	290	65	40	2	8	0	1
Rainfed land (ha)	3,100	750	305	540	58	252	320	160
Major cultivated crops								
Rainy season	Pulse, Maize	Pulse, Maize, cotton, Sorghum, Sunflower	Pulse, Maize, Sorghum, Sunflower	Pulse, Maize, Paddy, Cotton	Paddy, Maize, Sorghum	Paddy, Maize, Sorghum, Cotton	Paddy, Maize, Sugarcane	Paddy, Maize, Sugarcane
Dry season	Pulse, Vegetables	-	-	Paddy	Tomato	-	Maize, Sugarcane	Maize, Sugarcane
Cultivated Land								
Rainy season (ha)	1,600	400	145	580	60	138	320	161
Dry season (ha)	1,600	0	0	40	22	0	120	51
No of Farm Household (no.)	5,870	1,907	434	1,894	1,148	1,863	500	490
Population in Villages Concerned	29,350	11,440	3,040	8,473	5,736	7,448	2,996	2,944
Water Management Society	Existing in some systems	No	Exist.	Exist.	Exist.	No	Exist but not active	Exist but not active
Major Irrigation Facilities				In Mkindo Irrigation Scheme				
Constructed Year	—	in 1970s	in 1970s	in 1980s	in 1950s	in 1970s	in 1970s	in 1980s
Head works								
Type of weir	Traditional free	Fixed weir (Concrete-made)	Fixed weir (Concrete-made)	Fixed weir (Concrete-made)	Stop-log (Concrete-made)	Fixed weir (Concrete-made)	Fixed weir (Wet stone masonry)	Fixed weir (Concrete-made)
Type of intake	Free Intake	Gate Inlet	Gate Inlet	Gate Inlet	Gate Inlet	—	Free Intake	Gate Inlet
Condition	Many intakes	Buried with sediment	No gates	Gate not well working	Buried with sediment	Buried with sediment & abandoned	Gate broken, Deteriorated	Much leakage through weir
Major Irrigation Canal								
Type	Earth	Earth	Earth	Partly lining/stone masonry	Partly lining	Earth	Partly lining/stone masonry	Flume made masonry
Condition	Good + poor	Poor	poor, under construction	Partly deteriorated and much leakage	Sediment in upstream	ruined	Partly deteriorated and much leakage	Eroded and leakage, no function in downstream
Major Drainage Canal								
Type	—	—	—	Earth	Earth	—	—	—
Condition	—	—	—	Buried with sediment	Buried with sediment	—	—	—
Related Structure	—	—	Diversion works	Siphon, Cross culvert, Diversion works	Drop	—	Cross culvert, Aqueduct, Drop	Cross culvert, Diversion works
Condition	—	—	marginal	marginal	marginal	—	marginal	marginal
Access Road								
Trunk road	A-7	B-127	B-127	B-127	A-7	B-127	B-127	B-127
Distance from trunk road (km)	35	20	15	Nearby	10	5	Nearby	Nearby
Condition	Marginal (Mountain road, steep slope partly, Exposed rock)	Poor (Difficult travelling in rainy season)	Marginal (Difficult travelling in rainy season)	-	Good	Marginal	-	-

TABLE 1 (2/2) Present Features of Irrigation Schemes

	ZONE-III		ZONE-IV VALLEY AND RIVERINE TERRACE ZONE					
	9	10	11	12	13	14	15	16
Name of Scheme	Sonjo	Chabima	Lumuma	Ndole	Nyirga / Mgogozzi-mwega	Malolo	Mgogozzi-Kikalo	Chabi
District	Kilombero	Kilosa	Kilosa	Morogoro	Kilosa	Kilosa	Kilosa	Kilosa
Villages Concerned	Sonjo	Chabima	Mswero Idole Mkunghulu	Ndole	Malolo	Malolo	Mgogozzi	Chabi
Altitude (above sea level)	280-300	660-680	800-900	740-800	580-610	580-640	580-640	560-620
River Basin	Rufiji	Wami	Wami	Wami	Rufiji	Rufiji	Rufiji	Rufiji
River	Sonjo	Chabima	Lumuma	Ndole	Mwega	Mwega	Mgogozzi, Mwega	Chabi, Mohazima
50 year Probable Flood Discharge (m ³ /sec)	154	16	161	33	99	117	8/113	33-50
Flood discharge in average year (m ³ /sec)	22	8	12	16	14	17	1/16	3/5
Flooding	A part of downstream	None	Rarely occurred	None	Every year	Every year in upstream	Erosion in upstream, flooding in downstream	Scarcely none
Annual Mean Rainfall (mm)	1,430	1,050	1,050	1,300	360	360	360	360
Soil	Fluvisols	Cambisols	Fluvisols	Cambisols	Fluvisols	Fluvisols	Fluvisols	Fluvisols
Arable Land								
Irrigated area (ha)	0	1	380	8	110	337	100	270
Rainfed land (ha)	480	9	0	72	56	48 (poor irri.)	0	0
Major cultivated crops								
Rainy season	Paddy, Maize, Sugarcane	Maize	Paddy, Pulse, Maize	Pulse, Maize	Paddy, Maize	Paddy, Pulse, Maize	Maize	Pulse, Maize
Dry season	Maize, Sugarcane	Pulse	Onion	Maize, Pulse	Onion, Pulse	Onion, Pulse	Onion, Pulse	Onion, Pulse, Maize
Cultivated Land								
Rainy season (ha)	350	10	380	80	92	384	100	270
Dry season (ha)	150	-	280	8	166	200	30	200
No. of Farm Household (no.)	253	140	777	260	50	475	211	180
Population in Villages Concerned	1,774	700	5,440	1,043	200	3,800	1,265	1,076
Water Management Society	No.	No.	Exist	Exist	Exist	Exist	Exist	Exist
Major Irrigation Facilities	No exist							
Constructed Year	-	in 1985	in 1940s	in 1995	-	in 1972	-	in 1980s
Head works								
Type of weir	-	Fixed weir (Wet stone masonry)	Traditional free	Fixed weir (Wet stone masonry)	Traditional free	Fixed weir (Concrete-made)	Traditional free	Traditional free
Type of intake	-	Gate Inlet	Free Intake	Gate Inlet	Free Intake	Free Intake	Free Intake	Free Intake
Condition	-	Abandoned	Damaged every rainy season	Good, newly constructed	Damaged every rainy season	No discharge control st and heavy siltation	Damaged every rainy season	Damaged every rainy season
Major Irrigation Canal								
Type	-	Earth	Earth	Earth	Earth	Earth	Earth	Earth
Condition	-	Ruined	Good	Deep soil erosion	Good	Marginal	Poor	Poor
Major Drainage Canal								
Type	-	-	-	-	-	-	-	-
Condition	-	-	-	-	-	-	-	-
Related Structure	-	Fish pond	Cross culvert Diversion works	Diversion works	-	Cross culvert & drop	-	Aqueduct
Condition	-	abandoned	poor	marginal	-	poor	-	Leaked
Access Road								
Trunk road	B-127	B-127	Kidate Railway Station	B-127	Starting from Malolo village	B-127	Starting from Malolo village	Starting from Malolo village
Distance from trunk road (km)	Nearby	21	10	37	9	29	6	5
Condition	-	Very poor (Difficult travelling in rainy season) (steep slope partly)	Marginal (steep slope partly, Exposed rock)	Poor (Steep slope partly, Exposed rock)	Marginal (Steep slope partly)	Good	Marginal	Marginal
						Eroded, muddy, Upper part of bridge flushed (between Malolo and Chabi/Mgogozzi)		

Table 2 (1/2) Project Features of Irrigation Schemes

	ZONE I MOUNTAINOUS ZONE	ZONE-II ALLUVIAL PLAIN ZONE			ZONE-III PIEDMONT PLAIN & FAN ZONE				
		1	2	3	4	5	6	7	8
Name of Scheme	Mgela	Manyenyere	Kiangali	Mgongola	Mlafi	Mvumi	Msolwa	Mkula	
Net Cropping Area (ha)	30	1,040	370	620	60	260	320	143	
Planned Major Crops	Rainy season	maize, pulse	paddy	paddy	paddy	paddy	paddy, maize	maize, paddy	paddy, maize
	Dry season	cabbage, potato, vegetables	paddy	paddy	paddy, cereals, vegetables	tomato	paddy, pulse	maize, pulse	maize, pulse, vegetables
River Name of Irrigation Water Sources	Mzinga, Mndur	Miyombo	Miyombo	Mkindo	Mlafi	Kisangata	Msolwa	Mkula	
Available Water Resources in Drought Year of 5 Year Return Period	-	1.2 - 2.6		0.9 - 1.5	0.02 - 0.02	0.8 - 1.3	0.11 - 0.28 (No water after deducting amount granted by water right)	0.07 - 0.17	
Adjustment for Water Allocation	Not necessary	Adjustment is required between Manyenyere and Kiangali Schemes		Not necessary	Not necessary	Not necessary	Adjustment is required with water users in the downstream	Not necessary	
Estimated Irrigable Area	Rainy season	30	1,040	370	620	60	260	320	143
	Dry season	30	690	160	620	30	260	240	143
Irrigation and Drainage Development Plan									
Head works	Const. of permanent st. at current intake points	Reconstruction of weir and intake	Reconstruction of weir and intake	Improvement of intake structure	Construction of intake only at upstream of existing	New Const. of all the facilities, weir and intakes	Improvement of existing weir	Improvement of existing weir, protection against water backflow	
Type of Weir	Fixed weir	Stoplog gated type	Stoplog gated type	Fixed weir	-	Stoplog gated type	Fixed weir	Fixed weir	
Intake	Stone masonry Concrete made	Steel gated inlet	Steel gated inlet	Steel gated inlet	Steel gated inlet	Steel gated inlet	Steel gated inlet	Steel gated inlet	
Irrigation and Drainage Facilities	Improvement of existing trunk systems	Improvement and extension	Improvement	Reconstruction and new construction	Improvement and extension	Newly construction	Improvement and extension	Improvement and extension	
Major Irrigation Canals	Pipeline or Lining (planting cobble stone)	Existing canal improve 7.5km with lining and 9.5 km as earthen canal	Existing canal improve 3.5km with lining and 4 km as earthen canal	New const. of lining canal 10.6 km & earth canal 12.3 km	New const. of lining canal 0.25km & improve canal 1.4 km with lining	New construction of lining canal 7km	Heighten 1.3km & const 3.8 km with lining	Reconst. 0.7km New lining 0.9 km. Earth canal 19.1km	
Major Drainage Canals	-	Construction of earth drain 25km & improve Kidaga furrow	Construction of earth drain 16km	Construction of earth drain 13 km	Construction of earth drain 3km	Construction of earth drain 3.3km	Construction of earth drain 5km	Construction of irrigation cum drainage canal 3 km	
Flood Protection Dike River Improvement	-	Construction of 7.5 km long	Construction of 5.5 km long	Construction of 10.2 km long River Improv. 1 km	Construction of 1.4km long	Construction of 8.5 km long	Construction of 1.2 km long	-	
Farm Road	-	Construction 16km long	Improvement 8.5 km long	Construction 9.5 km long	Improvement 1.5km including newly construction	Construction 3km long	Land leveling 200 ha & construction of field ditches for 260 ha	-	
On-Farm Development	-	Land leveling & construction of field ditches	Land leveling & construction of field ditches	Land Reshap 511 ha	Construction of field ditches	Land leveling 200 ha & construction of field ditches for 260 ha	Land leveling 120 ha & construction of field ditches for 329 ha	Construction of field ditches for 143 ha	
Improvement Works of Access Roads	-	Embankment & side ditches about 4.5 km Provision of some cross drains	Embankment & side ditches about 5.0 km Provision of some cross drains	-	-	-	-	-	
Enhancement of Community and Farmer's Group	Establishment of Water User's Group, Farmers Own Management of Facilities, Enhancement of Supporting Services on O&M, Promotion of Women participation on Irrigation Activities								
Irrigation and Drainage Development Cost (mil. Tsh.)	156	6,059	2,376	3,839	222	1,597	953	943	
	exchange to Yen (mil. Yen)	30	1,120	433	743	41	295	176	174
Access Road Improvement Cost (mil. Tsh.)	-	187	212	-	-	-	-	-	
	exchange to Yen (mil. Yen)	-	35	39	-	-	-	-	
Economic Evaluation									
Economic Internal Rate of Return (%)	11.0	12.2	10.0	16.7	15.3	13.6	15.0	13.8	
Financial Internal Rate of Return (%)	9.0	12.0	9.2	13.4	10.2	10.6	14.7	11.3	
Selection of Priority Development Schemes	Selected			Selected				Selected	

Table 2 (2/2) Project Features of Irrigation Schemes

	ZONE-III FLEDMONT PLAIN & FAN ZONE 9	ZONE-IV VALLEY AND RIVERINE TERRACE ZONE							
		10	11	12	13	14	15	16	
Name of Scheme	Sonjo	Chabima	Lumuma	Ndole	Nyinga Mgogozzi Mwega	Malolo	Mgogozzi-Kikalo	Chabi	
Net Cropping Area (ha)	480	10	380	80	195	385	100	270	
Planned Major Crops	Rainy season	paddy, maize	maize	maize, beans, paddy	maize, beans	maize, paddy	maize, paddy	maize, beans	maize, beans
	Dry season	maize, beans	beans	onion	maize, beans	onion, maize, pulse	onion, maize, pulse	onion	onion
River Name of Irrigation Water Sources	Sonjo	Chabima	Lumuma	Ndole	Mwega		Kikalo	Chabi, Mohazima	
Available Water Resources in Drought Year of 5 Year Return Period	0.18 - 0.44	0.01 - 0.01	0.24 - 0.38 (Available w resources for crop area of 1140 ha in whole Lumuma Rbasini)	0.06 - 0.08	1.2 - 1.6		0.03 - 0.04	0.17 - 0.24 (zero after deduct amount of water right) 0.11 - 0.16	
Adjustment for Water Allocation	Not necessary	Not necessary	Not necessary	Not necessary	Not necessary	Not necessary	Not necessary	Adjustment is required with Dodoma side	
Estimated Irrigable Area	Rainy season	480	10	380	80	196	384	100	270
	Dry season	380	10	380	80	196	384	50	270
Irrigation and Drainage Development Plan									
Head works	New Const. of all the facilities: weir and intakes	Improvement of existing damaged weir	Unifiration of existing intakes	As it is present	Unify to one new intake		Repairing weir and const. of intake	Const of permanent weir and intake at upper Chabi	
Type of Weir	Fixed weir	Fixed weir	Fixed weir type 1 Sluipg gated type 2	-	Fixed weir		Fixed weir	Fixed weir	
Intake	Steel gated inlet	Steel gated inlet	Steel gated inlet	-	Steel gated inlet		Steel gated inlet	Steel gated inlet	
Irrigation and Drainage Facilities	Newly construction	Newly construction	Newly construction of main canals	Improvement and extension	Newly construction of main and secondary canals		Newly construction of main canals and improvement	Improvement and extension	
Major Irrigation Canals	Construction of lining canal 6.5km and other canals	Construction of earth canal 1km	Construction of lining canal 21km & night storage ponds	Lining 3km	Main/lining : 13.4 km Secondary : 6.2 km		Construction of lining canals 4 km and night storage ponds	Construction of 4km and improve 3.5km with lining	
Major Drainage Canals	Construction of earth drain 4km	-	-	-	Drainage : 0.7 km		-	-	
Flood Protection Dike	Construction of 2.4 km long	-	-	-	River improvement : 1.9 km		-	-	
Farm Road	-	-	-	Construction : 2km long	-	-	-	-	
On-Farm Development	Land leveling 260 ha & construction of field ditches for 430 ha	Construction of field ditches for 10 ha	-	Construction of field ditches for 80 ha	-	-	Construction of field ditches 3 km	Construction of field ditches 11 km	
Improvement Works of Access Roads	-	Embankment about 2 km Rock cutting & filling about 0.5 km	Provision of some cross drains Improvement of alignment & embankment about 0.5 km	Surface improvement about 3 km Provision of 7 cross drains Construction of 10 m superstructure Provision of fashion	Improvement : 1 km (Malolo - Chabi) Bridge : 1 place Improvement : 5 places (Malolo road)		Provision of submergible concrete slabs at stream-crossing points Embankment about 1 km Construction of a bridge across Mwega river		
Enhancement of Community and Farmer's Group	Establishment of Water User's Group, Farmers Own Management of Facilities, Enhancement of Supporting Services on O&M, Promotion of Women participation on Irrigation Activities								
Irrigation and Drainage Development Cost (mil. Tsh.)	1,551	38	1,472	234	3,717		335	705	
exchange to Yen (mil. Yen)	287	7	272	43	719		62	130	
Access Road Improvement Cost (mil. Tsh.)	-	61	41	169	233		Package Rehabilitation Cost among Malolo, Mgogozzi, Kikalo, and Chabi : 111		
exchange to Yen (mil. Yen)	-	11	8	31	45		Package Rehabilitation Cost among Malolo, Mgogozzi, Kikalo, and Chabi : 21		
Economic Evaluation									
Economic Internal Rate of Return (%)	16.4	11.6	17.3	15.9	15.4		15.9	28.7	
Financial Internal Rate of Return (%)	15.9	10.2	13.6	14.9	12.6		12.7	24.5	
Selection of Priority Development Schemes	Selected								

**THE SMALLHOLDER IRRIGATION PROJECTS
IN
CENTRAL WAMI RIVER BASIN, MOROGORO**

MAIN REPORT

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- Attachment-1. Scope of Work for the Study
- Attachment-2. Minutes of Meeting for Inception Report
- Attachment-3. Minutes of Meeting for Progress Report - II
- Attachment-4. Minutes of Meeting for Interim Report
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ANNEXES

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- Division -2. Development Plan of Mgeta Scheme, Morogoro District
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- Division -5. Development Plan of Mwega Scheme (Malolo, Nyinga and Mgongozi-Mwega Complex-Schemes), Kilosa District

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.)

