several parts of the Reserve). However, the Reserve contributes substantially to the foreign currency earning of Tanzania through income from hunting safaris and photographic tourism.

The small portion of the northern Selous Game Reserve is insider of the Ruvu River basin and it is mainly open grassland and/or open woodland. A great part of this area is an extension of the Lake Tagalala Area - an important area for rhinoceros and cheater. Other important animal species which inhabit the area include impala (*Aepyceros melampus*), buffalo (*Syncerus caffer*), wildebeest (*Connochaetes taurinus*), zebra (*Equus burchelli*) and elephant (*Loxodonta africana*). With the assistance of the Federal Republic of Germany, the management of the Reserve involves the local communities. Accordingly, buffer zones have been created implying that the coordination of planning and execution, as well as monitoring and evaluation by the different concerned institutions (the villages and wards, the district and regional authorities and Wildlife Division) at different levels.

2.4.3 Forest Reserves

There are many forest reserves with various scales in the Study Area. Almost all of these are located in the eastern part of the Ruvu River basin and around the Uluguru Mountains area at the western part of the Study Area. They represent important sites of both animal and plant biodiversity even if their primary purpose is different, e.g. water catchment, fuelwood. The most extended forest reserve is the Mkulazi Forest Reserve which is located on the north of the confluence of the Ruvu and Mgeta Rivers with some 69,000 ha, being followed by the Ruvu North, Ruvu South, Uluguru North, Uluguru South and Morogoro Fuel Forest Reserves. The forest reserves are national forests and are managed by the Ministry of Tourism, Natural Resources and Environment, Forestry Division. They are shown in Table F.6 and Fig. F.4.

2.5 Environmental Problems in the Study Area

In the Study Area, there is no serious environmental problem, but some environmental problems occurring in the Ruvu River basin are explained below:

2.5.1 Deforestation

It is said that deforestation and related phenomena which occur as a result of the deforestation such as soil erosion, river sedimentation, decrease of bio-diversity, etc. are the most significant problems of environment in the Study Area. The main reasons for deforestation are as follows: a) clearing for agriculture, b) overgrazing, c) wood-fuel harvesting and charcoal burning, d) harvesting for industrial use and e) bush fires for various reasons.

The most cases aim at clearing for unsustainable crop production and overgrazing which are both intermediate land use. Forests are being converted into marginal areas. As a result, degradation and even decertification take place.

In the Study Area, many areas were extensively burned for eradication of tsetse flies. One of the affected areas is Morogoro, where it is utilized in an unsustainable way and they are disrupting soil fertility and water supply in the surrounding areas.

Wood-fuels are the dominant source of energy in Tanzania. They account for 91% of total energy consumption, out of which household consumption alone accounts for 85%. The imbalance between wood-fuel demand and forest production, coming from over-exploitation of bushes and forests, may have such devastating impacts as the occurrence of deforestation.

Urban growth with associated charcoal demand has brought rapid deforestation in the periphery and hinterland. For example in Dar Es Salaam, the demand in 1986 was estimated at 120,000 tons and this was projected to be 260,000 tons in 1995. The sustainable supply from the surrounding woodland is estimated at 70 to 80 tones per year. This means that the tree covert in the Coast Region is being rapidly depleted.

Along the coast, mangrove forests are continually being depleted by exploitation for poles, rice cultivation and salt and lime making. Forest fires caused by bush clearing and other deliberate acts destroy large areas of woodland. For example between 1979 and 1983, about 17,000 ha of forest reserves were burned (Kamukala, 1993).

2.5.2 Soil erosion

The slopes of the Uluguru Mountains which occupy about 7% of the basin area are subjected to serious gully and sheet erosion, accentuated by population pressure, unskilled methods of farming and higher incidence of rainfall. Also, due to deforestation and poor land management which accompany the upward migration of people into steeper mountain slopes, the lower hill-slopes become impoverished or eroded. These activities have implications on the flooding and siltation in lower reaches of the Ruvu River.

2.5.3 Tsetse fly

The common varieties of Tsetse fly (*Brevipalpis, Pallidipes* and *Austeni)* are found to exist in the entire basin, except for the Uluguru Mountains area and narrow coastal belts. From the downstream area of the Ngerengere River to the surrounding area of the confluence with the Ruvu River, a number of Tsetse fly are observed comparatively. They have played a major role in the land use of the area. Tsetses carry trypanosomiasis, a kind of sleeping sickness, to which domestic stock is highly susceptible. This means that some area was not used for livestock grazing. Large areas in Africa contain no human settlements because of the tsetse fly, but recent projects to eradicate tsetses and open up these areas threaten the existence of many populations of wild animals as well as their natural habitats (TNP, 1987).

2.5.4 Sewage

At present, contamination of river water that occurs by sewage discharge without treatment into rivers doesn't become a problem in most part of the Study Area. However, through the field survey, the worsened water quality in the downstream reach of the Ngerengere River was observed in comparison with the upstream reach of Morogoro municipality. Furthermore, because of an increase of population in Morogoro and medium villages such as Ngerengere, Chalinze, Mlandizi, etc., it may become problems in relation to the river water contamination that are caused by sewage discharge from urban areas and cultivation areas, and industrial wastes into rivers.

2.5.5 Wetland

The wetlands include streams, rivers, swamps, floodplains, hot springs, fresh/saltwater lakes, deltas, salt marshes, and mangroves. These areas are essential for supporting ecological diversity, for nurturing fish population on which the poor depend on for protein, for recharging ground water supplies, for mitigating the effects of floods, for cleaning poor quality water, and many other services. Each of the protected area contains wetlands critical to that area's survival. Wetlands are prominent features and area for tourist attractions due to wildlife concentration.

The conservation of wetland ecosystems and their animal and plant life has received little attention from authorities. They are regarded as hazards, and both the agricultural and water policies of Tanzania specially call for draining wetlands for developmental purposes, particularly irrigated agriculture. They should be developed in an environmentally sustainable manner rather than draining valuable wetlands. While most valuable wetlands should be preserved, uses need to be found for less valuable ones that can sustain important ecological services. The following paragraphs describe priority issues in wetland management and possible actions for moving forward in protecting valuable functions of these unique ecosystems (WB, 1993).

3. ENVIRONMENTAL EVALUATION STUDY

3.1 Initial Environmental Examination

3.1.1 Objective

With the understanding of the importance of environmental consideration in the implementation of programs and projects to achieve sustainable development, an environmental survey is carried out at a level of master plan study. Environmental consideration is a process to study and assess potential or possible significant environmental impacts of development plan, and to propose practical measures in order to avoid or to mitigate negative impacts. This survey supports an important premise of environmental consideration that sustainable developments are achieved most efficiently when negative environmental impacts are identified and addressed at the earliest study stage. Along with these, Initial Environmental Examination is one of important methods for environmental consideration.

The Initial Environmental Examination (IEE) or preliminary environmental assessment is preliminary environmental review, and it is carried out to assess whether or not the Environmental Impact Assessment (EIA) is necessary for the development plan. Major study components of IEE include identification of project outline and site environmental condition (Project description and site description), preliminary assessment on negative environmental impacts to be caused by implementation of the plan as well as during construction stage and after completion of the plan, and evaluation on whether EIA is required in next study stage. In this water resources development plan, the basic study works for IEE were undertaken by entrusting to the Institute of Resources Assessment, University of Dar Es Salaam.

3.1.2 Institute of resource assessment

The Institute of Resource Assessment (IRA) was established as a result of realization of that nations. IRA is essentially an academic institution conducting independent research but it also provides consultancy services to the government ministries, parastatal organizations, private organizations, individuals and international organizations. The main areas of research work are the fields of a) Agricultural systems, b) Population and human settlement, c) Water resources and d) Natural resources and environment. The conclusions and recommendations of the IRA report are shown in Attachment to this Appexdix-F.

3.1.3 Environmental elements

The environmental elements for IEE have been confirmed through the screening by the preparatory study realized in October 1992 as follows:

a. Resettlement of inhabitants
b. Public health and hygienic conditions
c. Geographic and geological conditions
d. Soil erosion
e. Surface water and water quality
f. Ground water
g. Animals and vegetation

3.2 Description of the Water Resource Development Projects Taken up

3.2.1 Objective of the Development Plan

In the framework of water resources development plan in the Ruvu River basin, two Development Scenarios are established as discussed in Appendix-I of this Supporting Report. The both Development Scenarios comprise construction of reservoir type dam(s), namely the Kidunda dam in the Development Scenario-1 and the Mgeta dam/Ngerengere dam in the Development Scenario-2.

In association with the realization of those dam projects, implementation of some irrigation projects become possible as explained in Appendix-G. In addition to those dam-related irrigation projects, the Mlali Irrigation and Uluguru Mountain West Projects are taken up as the independent project from dam development for the early implementation.

The dam projects and irrigation projects taken up through the Study on the water resources development plan are summarized below;

i) Water Resources Development Project

Description	Development Scenario-1	Development Scenario-2
I. Dam Project	(1) Kidunda dam	(1) Mgeta dam (2) Ngerengere dam
II. Dam related Irrigation Project	(1) Kidunda Irrigation (2) Bagamoyo Irrigation (3) Low-lift Pump Irrigation (4) Ruvu National Youth Irritaion (5) Makurunge Irrigation	(1) Bagomoyo Irrigation

ii) Independent Irrigation Project: Mlali Irrigation and Uluguru Mountain West

3.3 Environmental Impact Evaluation

3.3.1 Environmental impacts

Impacts on the environment are divided in to two parts. One is a negative impact in the short term which is perceived at the moment of execution of the project. In this case, it is important to consider the environment in such a way as to harmonize the development activities and the conservation of the environment. Another is irreversible negative impact in the long run which is perceived after completion of the project. This may have a significant influence on the environment.

3.3.2 Prediction of environmental impacts by the development plan

Site reconnaissance and results of the basic environmental study of IRA reveal the prevention of the environmental impacts caused by the implementation of development components. It is summarized in Table F.7 with a qualitative matrix, derived from the viewpoint of IEE.

In the Table, five development components are contrasted with the environmental elements, which may be anticipated to be affected by negative impact due to the implementation of the plan. It was recognized that resettlement of inhabitants and animals and vegetation on the dam construction are the most important environmental issues.

3.3.3 Environmental screening

In order to make an indicator for assessing the proposed projects, an environmental screening format on the confirmed environmental elements was considered. While assuming an executing process of each project, the environmental screening was carried out by the Study Team's Specialist together with the Tanzanian counterpart. The format of environmental screening is shown in Table F.8.

The environmental impacts and influence on the confirmed environmental elements and some environmental problems at construction stage are summarized as follows:

(1) Resettlement of inhabitants

According to the IRA study, in the proposed project areas, no significant relocation would take place because less number of people settled in most of the project areas. However, in case of the Kidunda and Ngerengere dam projects, the four villages in the former (Bwila Chini, Bwila Juu, Kiganila and Magogoni, total population is about 6,000) and the one village in the latter (Kwaba, population is about 900) would be submerged by creation of the reservoirs.

A few portions of the Mgeta dam project area and some part of the Kidunda dam project area are consistent with the area of the Kisaki - Mvuha Buffer Zone Communal Wildlife Management Plan which is under the on-going Selous Conservation Programme, a pilot programme with the objective of enhancing conservation by broadening the participation of local people in the exploitation of their wildlife resources.

This programme is being activated by a fund of the German Foundation for Technical Cooperation (GTZ) and the management plan includes the development of a buffer zone between sixteen villages (Kisaki, Mngazi, Bwakira and Mvuha wards) and the northern Selous Game Reserve. Within these wards, land use plans have been prepared to enable farmers to utilize the land in sustainable way. According to the plan, this management plan with incentives is a positive step towards involving villagers, who live within the proximity of game reserves and parks.

However, it is important to note that this package of incentives together planned land use system may trigger changes in the settlement patterns due to land reallocation. Furthermore, land speculation and conflicts may arise in future as a result of the proposed projects in the area as more people are likely to be attracted to the area by these development projects. In some respect, it is still unclear how the proposed projects will affect the current programmes (IRA, 1993).

All land in Tanzania is owned by and vested in the State (Agricultural Policy, 1983). Following the implementation of the Tanzanian Villagization Programme, all land was divided among registered villages. When the surveying and village boundary demarcation is completed, villages will be allocated land. Title deeds will be issued to villages and all land will be allocated to institutions, enterprises or individuals. However, more than 14,400 ha in the Morogoro Region and more than 50,000 ha in the Coast Region within the basin, have already been taken by private land developers for various economic activities and they have title deeds. Further introduction of extensive irrigation farming as well as large water supply projects is likely to take away more land from the local people which may have significant negative implications on their social and economic life unless proper relocation and compensation is considered.

The basic study of the IRA has revealed that there have been some cases of relocation of people or their farms have been taken by the Government or other projects in the basin. In most cases, no compensation was given for the land forsaken mainly because the local people did not have title deeds. For example, the Kwavi pastoralistas who were relocated to give way to the projects under the National Food Company (NAFCO) and National Ranch Company (NARCO), were not compensated because they did not have title deeds for the land. On the

other hand, the Kwere rice farmers in lower Ruvu were relocated in order to implement the Lower Ruvu Water Supply Project, and a compensation was effected to farmers who had permanent crops, e.g., cashewnut trees but the method and the amount of compensation were not known.

The water resources development plan could reduce the concentration of population and their activities in the basin, and minimize environmental degradation in these areas. The irrigation development could increase employment opportunities for the people in the basin. However, these developments might attract more immigrants from outside into the basin to take advantage of employment opportunities in these irrigation farming. This would have significant impact on the environment and ecological balance of the basin since more resources would have to be utilized. While the intended development is acceptable, care must be taken to ensure that the movement of outsiders into the basin does not significantly affect the current settlement patterns and nor lead to social and environmental problems.

Consequently, the detailed investigations in just project sites and surrounding areas, especially the dam construction project areas, on settlement pattern and area, village population and family number, land allocation pattern and the holding size, land tenure and land ownership registration, household income and sources, etc., must be carried out in the future study.

(2) Public health and hygienic conditions

Infectious water related sanitation diseases are highly prevalent in the Ruvu River basin. Keeping the existing situation in mind, care should be taken by the water resources development plan not to provide conditions which will facilitate introduction of new diseases or increase incidence and prevalence of existing ones. The most common water related diseases which usually come with development of dam and irrigation projects are hereby discussed according to their transmission mechanisms.

These water related diseases are spread by insects which breed in the water or which live and bite near water. The diseases include malaria, bacroftian filariasis and onchocerciasis whose vectors are water breeders. The water resources development plan may change the environmental ecology and increase or decrease the number of suitable breeding habitant for the vectors. Malaria disease increases during the rainy seasons and it was reported to be common also in people who live in high altitudes. Bacroftian filariasis disease increases with poor sanitation related to pond water containing sewage, uncovered wet latrines, open septic tanks and overflowing sewage. Onchocerciasis or river blindness disease, if not checked by the new developments, may continuously lead to impoverishment of the villagers in the area.

It is important to do an entomological study on disease vectors, the kind of species, their biological environment and efficient ways of controlling them. This may help in assessing the impacts of the dam and irrigation projects on the health of the people. A carefully designed integrated water quality and quantity improvement project with environmental sanitation and health education will be useful.

(3) Geographic and geological conditions

A large quantity of materials such as rock, stone and soil will be necessary for dam construction and flood protection projects. These materials would be supplied from a neighbourhood of the project sites. Some range of change in land form would occur depending upon the scale of dam and flood dyke design, and an influence on the environment should be kept in mind in designing the project. The higher erosion risk results from various factors such as topography, geology, improper land use practices, etc.

(4) Soil erosion

As in general naturally steep slopes are more susceptible to soil erosion, the indication is that the larger part of the Ruvu River basin faces erosion risks imposed by topography, especially on the Uluguru Mountains. It is important therefore that, in order to ensure the sustainable farming with irrigation, management practices must incorporate appropriate soil conservation measures. If not, the soil erosion would have significant impact on the environment.

The Ruvu River basin has great potential for livestock development which is currently not fully utilized. In a few areas of high livestock concentration some signs of overgrazing are evident. Such overgrazing is likely to cause soil erosion with subsequent siltation of dams and swamps in the downstream areas.

With regards to the soil erosion, the land use practices need to be examined in the next environmental studies of the respective water resources development projects.

(5) Surface water and water quality

To maintain the environmental conditions of river, it is always necessary to discharge down the minimum river flow to the downstream reach and river mouth, in particular to safeguard the fauna and flora living and to sustain the water quality in the downstream areas. The dam project would have significant impact on the environment of the downstream surface water unless the minimum river maintenance flow is considered.

The contamination of water quality caused by river dredging and construction of river structures in the river, would lead to temporary increase of turbidity in the river water. This high turbid water may affect some kinds of aquatic weeds in the downstream reach and may damage habitant conditions of fish, and also may disturb the existing water supply system on the Ruvu.

Due to the use of agrochemicals by the improvement of agriculture with irrigation development, the draining water from the cultivated lands would be likely to be contaminated with fertilizers and pesticides which can have negative effects on aquatic organisms.

(6) Ground water

Ground water potential is rather poor in the Ruvu River basin except for limited areas. Therefore, the ground water resources are scarcely used as a source of drinking water. Presently, there is no health hazard connected to the contamination of the ground water resources (Urban Sector Engineering Project, COWI, 1992). The water resources

development plan in Ruvu River basin involves no ground water development project. Accordingly, it is considered that the environmental impact on ground water would be insignificant.

(7) Animals and vegetation

The eastern part of the Mikumi National Park and the small portion of the northern Selous Game Reserve are located inside the Ruvu River basin. Most of the Mikumi National Park portion of the basin is covered by Miombo woodland, a home of some animals. The northern part of the Selous Game Reserve is mainly open grassland and/or open woodland. A great part of this area is an extension of the Lake Tagalala area, an important area for rhinoceros and cheetah in the Reserve.

According to the IRA study, except for the wetlands as well as the areas bordering the Mikumi National Park and the Selous Game Reserve, wildlife in the Ruvu River basin is, dominated by "generalists", mainly vermin species which include baboons, monkeys, wild pigs and birds.

Other wildlife species are "specialists" being restricted to specific zones. For example, hippopotamus, bushbuck and crocodiles are confined to the river valleys. In particular, wetlands in particular are rich in varieties and numbers of birds, indicating their importance for avian life. Since most of the floodplain is not utilized for cultivation, it forms a very important refuge for these animals and birds. Most of these animals and birds would be affected, should the ecology of the floodplain change. Therefore, it is recommended to clarify the potential and biological values of wildlife in the area concerned with the water resource project in the next environmental studies of the respective water resource development project if the project may have a significant influence on the wetland.

Damming of the upper Ruvu, Mgeta and Ngerengere Rivers could lead to river-bed degradation and subsequently drain the existing swamps and wetlands, e.g. in the Dutumi - Magogoni area. Depending on the magnitude of the changes in the flooding pattern and soil moisture regime, vegetation changes would take place and affect the animal habitats and animal populations in various ways. In general, the ecology of the downstream areas would change and in particular the "specialist" species such as the giraffe, wildebeest and zebra could be affected by the hydrological and ecological changes in the area. At present, these animals inhabit in very small and limited patches in the area (Mwalyosi, 1988). The proposed projects may limit these patches further and affect these animal species negatively. In some areas to be affected, degradation of the river bed and erosion of the river bank could cause severe problems for hippopotamus and crocodiles leaving and entering the water.

A part of the reservoir area of the Mgeta dam would be probably located in the Mikumi National Park. On the other hand, the Kidunda dam would submerge a land of some 160 km^2 which include riverine forest of about 1,600 ha along the Ruvu and Mgeta Rivers, occupying a part of the Mikulazi Forest Reserve on the left bank of the Ruvu River. The forest area constitutes woodland with thicket on termite mounds and taller, dense vegetation. Buffalo, elephant, hippopotamus and crocodiles were observed during the field survey. Furthermore, there are some numbers of buffalo, hippopotamus, crocodiles and occasionally giraffes appear in the downstream reach of the Ruvu where there is potential for the irrigation development. Buffalo,

elephant, hippopotamus and crocodiles are observed therein. Therefore, it is recommended that the environmental studies to be carried out in the next prefeasibility study on the Kidunda Dam project clarify the biological values in the planned reservoir area.

The current state of knowledge regarding ecology of animals and vegetation in the Ruvu River basin is scanty or lacking. This is because detailed scientific studies have not been conducted yet. Therefore, a detailed ecological investigations must be carried out on the fields of fauna and flora for each of the project areas, especially concerning the dam project areas, in the future study stage.

It is generally accepted that the river runoff yielded in the dry period is attributable to rainfall amount during the period as well as water conservation capacity of forest area in the basin. Thus, it would be essential to conserve the existing forest area to a maximum extent so as to ensure the sufficient runoff. Although it is too hard to quantity the yield in the specific forest area existing in the Ruvu River basin in the present master plan stage, on the other hand, it is considered necessary to conserve at least the forest area in the Uluguru Mountain area to secure the stable river runoff in the lower reach as it is the largest source of the Ruvu River from the Geographical and meteo-hydrological viewpoint.

(8) Environmental problems at construction stage

When any of the projects will be constructed, some kind of environmental problems would take place. As the dam construction, irrigation development and flood control projects involve a lot of civil engineering works, in the design of the relevant structures it must be considered in such a way as not to affect the characteristics and distribution of soils as far as possible. During the construction period, air pollution, contamination of water and soil, noise and vibration and offensive odour mainly by heavy machinery for construction works would take place. The construction method should not allow the apparition of these environmental problems. Besides, the construction works must be managed in an adequate way and it would be necessary to establish a monitoring system for any possible environmental mutation.

Through the environmental screening, it was perceived that EIA is necessary in the next study stage for the project which has large negative impact on any of the environmental element and/or has small negative impact on more than half of the environmental elements as shown in Table F.9.

3.4 Conclusion

The present shortage of water and electricity supply to the Dar Es Salaam city area as well as the supply of unhygienic and unreliable water to the people in the Ruvu River basin could be resolved by formulating a comprehensive water resource development plan. As mentioned before, concerning the environmental impacts caused by the implementation of the proposed the water resources development plan, it is considered that the environment of the Ruvu River basin would be affected more or less. When implementing the plan, the possible impacts on the project areas are taken into account, together with the natural conditions and socio-economic environment of the surrounding areas of the project site. Therefore, when each of the proposed projects will be studied in the next study stage, a more detailed environmental investigation,

namely the Environmental Impact Assessment (EIA) is necessary for the following projects out of the water resources development projects (dam and irrigation projects):

i) Kidunda dam project
ii) Mgeta dam project
iii) Ngerengere dam project
iv) Kidunda Irrigation Project

It is necessary to assess the possible effects on the implementation of the plan as in detail as possible and to find possible countermeasures.

APPENDIX-F

TABLES

Table F.1 WHO AND TANZANIAN STANDARDS FOR DRINKING WATER

Constituent	Unit	WHO 1984	WHO# 1963	TTS# 1974
Toxic				
Lead (Pb)	mg/l	0.05	0.05	0.10
Arsenic (As)	mg/l	0.05	0.05	0.05
Selenium (Se)	mg/l	0.01	0.01	0.05
Chromium (Cr)	mg/l	0.05	0.05	0.05
Cyanide (Cn)	mg/l	0.10	0.02	0.02
Cadmium (Cd)	mg/l	0.005	0.01	0.05
Barium (Ba)	mg/l	-	1.00	1.00
Mercury (Hg)	mg/l	0.001	-	-
Affecting Human Health				
Fluoride (F)	mg/l	1.50	1.50	8.00
Nitrate (NO_3)	mg/l	10.0	30.0	100.0
Affecting Suitability for Domestic Use Being Organo-septic				
Colour	mg Pt/l	15TCU	50.0	50.0
Turbidity	mg SiO_2/l	5NTU	25.0	30.0
Taste		not offen.	not obj.	not obj.
Odour		not offen.	not obj.	not obj.
Salinity and Hardness				
pH		6.5-8.5	6.5-9.2	6 .5-9.2
Total Dissolved Solids	mg/l	1,000	1,500	2,000*
Total Hardness	mg $CaCO_3$/l	500	-	600*
Calcium (Ca)	mg/l	-	200	-*
Magnesium (Mg)	mg/l	-	150	-*
Sodium (Na)	mg/l	200	-	-
Sulphate (SO_4)	mg/l	400	400	600*
Chloride (Cl)	mg/l	250	600	800*
Non Toxic Metals				
Iron (Fe)	mg/l	0.3	1.00	1.00*
Manganese (Mn)	mg/l	0.1	0.50	0.50*
Copper (Cu)	mg/l	1.0	1.50	3.00*
Zinc (Zn)	mg/l	5.0	15.0	15.0*
Organic Pollution of Natural Origin				
BOD_5 (5 days)	mg O_2/l	-	6.00	6.00
Permanganate Value (Oxygen Abs. $KMnO_4$)	mg O_2/l	-	10.0	20.0
Ammonium (NH_4)	mg/l	-	0.50	-
Total Nitrogen exclusive Nitrate	mg/l	-	0.10	1.00
Bacteriological				
Coliform Organisms	each	NIL	1-3	1-3
Faecal Coliforms	each	NIL	NIL	NIL

Note) # : Water Supply Design Manual, MLWHUD, 1986
* : Tentative Figure

Table F.2 LOCATIONS OF WATER QUALITY SAMPLING

1.	Kibungo Rehabili. Gauging Station	Ruvu River
2.	Msumbisi Bridge	Ruvu - Msumbisi River
3.	Mvuha Bridge	Ruvu - Mvuha River
4.	Dutumi New Gauging Station	Mgeta River
5.	Londo Bridge	Ngerengere - Luhuga River
6.	Mindu Dam	Ngerengere River
7.	Morogoro Bridge	Ngerengere River
8.	Darajam Bridge	Ngerengere River
9.	Ngerengere Bridge	Ngerengere River
10.	Ruvu Railway Bridge	Ruvu River
11.	Umbenazomozi Bridge	Msua River
12.	Chalinze Reservoir	Msua River
13.	Nguhi NAFCO farm Intake	Msua River
14.	Upper Ruvu Water Station Intake	Ruvu River
15.	Lugoba Bridge	Mkombezi - Lufako River
16.	Masugulu Reservoir	Usigwa - Mtibwa River
17.	Lower Ruvu Water Station Intake	Ruvu River
18.	Kigongoni JICA Farm Intake	Ruvu River
19.	Dutumi Well	Ground Water
20.	Yombo Well	Ground Water
21.	Mgeta Bridge	Mgeta River
22.	Kisaki Bridge	Mgeta River
23.	Kidunda New Gauging Station	Ruvu River
24.	Utari Bridge	Ngerengere River
25.	Pangani Reservoir	Pangani River

Table F.3 LABORATORY ANALYSIS PARAMETERS

. Water Temperature	. Turbidity	. Suspended Solid (SS)
. Colour	. Odour	
. Potential of Hydrogen (pH)	. Electric Conductivity (EC)	
. Dissolved Oxygen (DO)	. Chemical Oxygen Demand (COD)	
. Bicarbonate (HCO_3)	. Carbonate (CO_3)	
. Total Nitrogen (T-N)	. Ammoniacal Nitrogen (NH_4-N)	
. Nitrite Nitrogen (NO_2-N)	. Nitrate Nitrogen (NO_3-N)	
. Total Phosphate (T-P)	. Chloride (Cl)	. Sulphate (SO_4)
. Calcium (Ca)	. Magnesium (Mg)	. Sodium (Na)
. Potassium (K)	. Total Hardness	. Salinity
. Sodium Adsorption Ration (SAR)		
. Iron (Fe)	. Manganese (Mn)	
. Boron (B)	. Fluoride (F)	
. Total Coliform	. Faecal Coliform	

Table F.4 RESULTS OF WATER QUALITY ANALYSIS OF RAINY SEASON

No.	Location Name	River Name	Tributary	Alti. m	Date	Time	Water Temp. ℃	Turbid. N.T.U.	SS mg/l	Colour mgPt/l	Odour	pH	EC(25℃) μS/cm	DO mgO2/l	CODcr mgO2/l	Bicarbonate mgCaCO3/l
1	Kibungo Rehabili. Gauging Station	Ruvu	main	200	05. 5.93	09:20	22	14	800	60	NIL	8.3	82	7.4	4.3	36
2	Msumbisi Bridge	Ruvu	Msumbisi	350	05. 5.93	08:40	23	16	500	60	NIL	8.3	280	7.0	7.2	92
3	Mvuha Bridge	Ruvu	Mvuha	130	05. 5.93	12:40	23	14	700	75	NIL	7.7	83	7.2	10.1	34
4	Dutumi New Gauging Station	Mgeta	main	130	05. 5.93	16:00	25	162	8,000	>500	NIL	7.9	160	6.9	6.5	36
5	Londo Bridge	Ngerengere	Luhuga	820	06. 5.93	13:30	24	15	300	50	NIL	8.0	138	7.4	2.6	58
6	Mindu Dam	Ngerengere	main	500	06. 5.93	16:00	27	30	100	80	NIL	7.9	180	6.1	2.1	78
7	Morogoro Bridge	Ngerengere	main	470	23. 4.93	13:50	26	200	800	475	NIL	7.6	170	7.4	9.5	66
8	Darajam Bridge	Ngerengere	main	350	23. 4.93	12:40	25	280	2,900	300	MUSTY	7.9	220	6.9	14.0	60
9	Ngerengere Bridge	Ngerengere	main	200	30. 4.93	13:50	26	>400	3,900	248	NIL	8.2	220	7.0	2.6	72
10	Ruvu Railway Bridge	Ruvu	main	20	10. 5.93	12:50	29	64	400	125	EARTHY	8.2	155	5.9	5.6	64
11	Umbenazomozi Bridge	Msua	main	320	30. 4.93	14:30	28	22	300	20	NIL	8.6	2,000	7.1	4.2	146
12	Chalinze Reservoir	Msua	-	210	23. 4.93	11:40	25	10	300	30	NIL	8.5	350	6.3	10.0	94
13	Nguhi NAFCO Farm Intake	Msua	main	20	30. 4.93	10:50	31	39	NIL	125	EARTHY	8.0	130	6.1	8.4	54
14	Upper Water Station Intake	Ruvu	main	10	23. 4.93	10:10	24	95	900	250	EARTHY	7.9	170	8.3	13.6	52
15	Lugoba	Mkombezi	Lufako	230	30. 4.93	11:40	27	30	300	25	NIL	8.6	2,800	6.6	9.1	188
16	Masugulu Reservoir	Usigwa	Mtibwa	190	30. 4.93	12:20	30	90	NIL	180	NIL	7.9	420	3.9	15.5	78
17	Lower Water Station Intake	Ruvu	main	5	28. 4.93	14:30	29	35	500	200	NIL	7.9	185	6.9	10.2	52
18	Kigongoni JICA Farm Intake	Ruvu	main	0	28. 4.93	13:20	30	36	400	225	NIL	8.0	142	7.9	7.7	50
19	Dutumi Well	(Ground Water)		140	05. 5.93	19:50	27	NIL	200	NIL	NIL	8.4	780	6.9	0.4	212
20	Yombo Lined Well	(Ground Water)		50	28. 4.93	15:30	27	118	100	490	EARTHY	8.0	170	6.7	53.5	66

No.	Location Name	NH4-N mg/l	NO2-N mg/l	Cl mg/l	SO4 mgSO4/l	Ca mg/l	Mg mg/l	Na mg/l	K mg/l	T-H mg/l	Salin.	SAR	Fe mg/l	Mn mg/l	B mg/l	F mg/l	T-C 100ml	F-C 100ml
1	Kibungo Rehabili. Gauging Station	0.070	0.024	3.5	NIL	4.4	8.4	1.7	0.35	46	0.02	0.68	0.19	0.09	0.04	1.08	3,000	1,940
2	Msumbisi Bridge	0.171	0.039	13.5	NIL	8.8	4.4	2.9	1.46	40	0.07	1.12	0.42	0.08	0.05	1.22	2,940	1,460
3	Mvuha Bridge	0.139	0.027	3.5	NIL	16.0	16.0	4.5	0.39	106	0.01	1.12	0.25	0.05	0.04	1.08	2,800	1,340
4	Dutumi New Gauging Station	0.116	NIL	1.4	NIL	16.4	9.2	8.3	2.35	79	0.03	2.31	0.75	0.17	0.06	0.65	5,380	2,500
5	Londo Bridge	0.139	0.012	2.8	3.0	14.8	6.3	5.4	0.59	63	0.02	1.67	0.52	0.12	0.05	1.00	1,400	1,140
6	Mindu Dam	0.202	0.057	16.3	5.0	10.8	10.1	9.1	2.54	68	0.03	2.81	0.28	0.14	0.04	0.96	360	240
7	Morogoro Bridge	1.000	NIL	22.0	NIL	10.8	8.9	10.6	3.13	64	0.12	3.37	1.22	0.34	0.15	0.50	4,000	2,420
8	Darajam Bridge	0.822	NIL	24.1	3.0	12.2	8.0	4.6	7.62	63	0.13	1.45	1.02	0.28	0.10	0.32	6,400	3,000
9	Ngerengere Bridge	0.640	0.055	24.1	NIL	20.0	6.4	1.4	3.32	77	0.09	0.38	0.83	0.20	0.05	0.92	1,600	750
10	Ruvu Railway Bridge	0.310	0.009	9.2	NIL	16.4	6.6	7.0	3.50	66	0.04	2.07	0.37	0.12	0.04	0.80	1,400	768
11	Umbenazomozi Bridge	0.050	0.050	3834.0	90.0	200.0	19.2	195.5	5.47	580	0.58	18.67	0.02	0.01	0.04	1.75	5,600	2,830
12	Chalinze Reservoir	0.217	0.030	32.6	7.0	36.0	NIL	19.6	7.23	90	0.12	4.61	0.05	NIL	0.18	1.24	2,875	1,500
13	Nguhi NAFCO Farm Intake	0.317	0.024	7.1	6.0	12.8	7.3	5.6	3.71	60	0.04	1.78	0.42	0.08	0.20	1.10	820	470
14	Upper Water Station Intake	0.622	NIL	14.9	2.5	25.0	18.7	8.6	3.91	140	0.06	1.85	1.05	0.53	0.05	0.76	2,100	1,000
15	Lugoba	0.008	0.084	5.7	146.0	188.0	20.3	241.5	7.23	552	1.19	23.66	0.01	NIL	0.06	2.00	3,600	1,760
16	Masugulu Reservoir	0.620	0.052	25.6	7.0	29.2	19.5	15.0	7.23	153	0.13	3.03	0.28	0.06	0.06	1.30	1,000	730
17	Lower Water Station Intake	0.335	0.339	14.2	NIL	12.0	5.4	8.6	4.11	52	0.03	2.93	0.56	0.21	0.05	1.40	860	380
18	Kigongoni JICA Farm Intake	0.470	0.036	11.4	6.0	9.2	3.4	8.9	4.30	37	0.08	3.53	0.53	0.11	0.22	1.39	700	340
19	Dutumi Well	0.038	0.024	44.0	15.0	77.2	47.9	18.6	1.46	390	0.20	2.36	0.03	0.01	0.04	1.00	10	NIL
20	Yombo Lined Well	0.930	0.024	12.8	NIL	16.0	10.2	9.7	5.67	82	0.08	2.67	0.54	0.12	0.05	1.12	5,000	2,400

Note T-H:Total Hardness, T-C:Total Coliform(35℃), F-C:Fecal Coliform(44.5℃)

Table F.5 RESULTS OF WATER QUALITY ANALYSIS OF DRY SEASON

No.	Location Name	River Name	Tributary	Alti. m	Date	Time	Water Temp. ℃	Turbid. N.T.U.	SS mg/l	Colour mgPt/l	Odour	pH	EC(25℃) μS/cm	DO mgO2/l	CODcr mgO2/l	Bicarbonate mgCaCO3/l	Carbonate mgCO3/l
1	Kibungo Rehabili. Gauging Station	Ruvu	main	200	05.11.93	13:10	29	3	NIL	13	NIL	7.2	101	8.5	2.8	50	NIL
2	Msumbisi Bridge	Ruvu	Msumbisi	350	05.11.93	12:10	27	15	10	26	MUSTY	8.1	307	8.2	4.6	160	NIL
3	Mvuha Bridge	Ruvu	Mvuha	130	05.11.93	14:30	32	2	NIL	12	CHEMICAL	7.7	106	8.8	4.0	55	NIL
21	Mgeta Bridge	Mgeta	main	1000	07.11.93	10:50	20	10	20	12	NIL	6.9	46	8.3	3.3	24	NIL
22	Kisaki Bridge	Mgeta	main	160	05.11.93	17:20	31	12	30	25	NIL	7.8	168	8.2	2.9	77	NIL
4	Dutumi New Gauging Station	Mgeta	main	130	05.11.93	15:30	33	15	30	12	NIL	7.9	183	7.2	4.3	82	NIL
23	Kidunda New Gauging Station	Ruvu	main	70	06.11.93	13:10	31	15	40	9	NIL	8.0	152	7.9	3.0	83	NIL
5	Londo Bridge	Ngerengere	Luhuga	820	07.11.93	10:20	24	8	NIL	12	NIL	7.8	152	8.2	3.0	74	NIL
6	Mindu Dam	Ngerengere	main	500	07.11.93	12:40	31	8	10	25	NIL	7.8	200	9.3	4.5	81	NIL
7	Morogoro Bridge	Ngerengere	main	470	06.11.93	18:20	26	10	10	NIL	NIL	8.1	552	7.5	4.2	119	NIL
8	Darajam Bridge	Ngerengere	main	350	06.11.93	17:20	32	8	10	26	EARTHY	8.1	458	6.5	4.6	10	NIL
9	Ngerengere Bridge	Ngerengere	main	200	06.11.93	09:40	26	8	NIL	13	NIL	8.1	495	8.0	4.0	130	NIL
24	Utari Bridge	Ngerengere	main	90	06.11.93	11:30	29	10	20	12	NIL	8.1	588	7.8	5.5	152	NIL
10	Ruvu Railway Bridge	Ruvu	main	20	09.11.93	11:10	30	24	NIL	13	NIL	7.8	175	10.0	2.9	83	NIL
25	Pangani Reservoir	Pangani	main	40	09.11.93	10:20	29	8	20	30	NIL	8.3	3,790	8.2	15.0	158	NIL
11	Umbenazomozi Bridge	Msua	main	320	06.11.93	16:50	28	12	30	12	EARTHY	8.4	4,640	6.7	11.3	463	232
12	Chalinze Reservoir	Msua	-	210	11.11.93	11:10	29	10	10	26	EARTHY	8.0	375	9.5	12.0	104	NIL
13	Nguhi NAFCO Farm Intake	Msua	main	20	11.11.93	10:20	30	24	30	15	NIL	8.1	840	7.1	5.0	150	NIL
14	Upper Water Station Intake	Ruvu	main	10	11.11.93	08:50	29	27	30	NIL	MUSTY	7.8	231	7.9	2.9	90	NIL
15	Lugoba	Mkombezi	Lufako	230	11.11.93	11:50	26	45	80	26	PEATY	8.3	8,270	4.2	19.2	657	180
16	Masugulu Reservoir	Usigwa	Mtibwa	190	11.11.93	12:30	28	40	60	30	EARTHY	7.4	450	4.5	14.2	131	NIL
17	Lower Water Station Intake	Ruvu	main	5	09.11.93	13:50	30	41	80	13	NIL	7.7	295	9.9	5.0	92	NIL
18	Kigongoni JICA Farm Intake	Ruvu	main	0	09.11.93	14:30	31	25	10	NIL	MUSTY	7.9	350	9.5	3.5	73	NIL
19	Dutumi Well	(Ground Water)		140	05.11.93	15:10	28	7	NIL	25	NIL	7.8	433	8.2	1.7	177	NIL
20	Yombo Lined Well	(Ground Water)		50	09.11.93	12:50	27	31	20	62	EARTHY	6.5	66	8.5	2.5	28	NIL

No.	Location Name	T-N mg/l	NH4-N mg/l	NO2-N mg/l	NO3-N mg/l	T-P mg/l	Cl mg/l	SO4 mgSO4/l	Ca mg/l	Mg mg/l	Na mg/l	K mg/l	T-H mg/l	Salin.	SAR	Fe mg/l	Mn mg/l	B mg/l	F mg/l	T-C 100ml	F-C 100ml
1	Kibungo Rehabili. Gauging Station	0.84	NIL	0.018	1.6	0.34	4.3	NIL	12.4	3.7	6.8	0.69	46	6.6	2.40	0.29	0.19	0.15	NIL	1,856	928
2	Msumbisi Bridge	0.84	0.024	0.018	1.8	0.25	19.1	19.5	28.8	18.0	3.8	0.30	146	6.6	0.79	0.26	0.20	0.18	NIL	1,900	980
3	Mvuha Bridge	0.84	NIL	0.017	1.2	0.16	5.0	6.0	12.0	6.1	6.4	0.33	55	6.6	2.13	0.23	0.15	NIL	NIL	1,300	600
21	Mgeta Bridge	0.84	NIL	0.021	1.2	0.16	3.6	8.2	5.2	2.7	53.0	0.87	24	2.6	26.67	0.62	0.35	0.20	NIL	400	195
22	Kisaki Bridge	1.68	NIL	0.023	1.5	0.58	5.7	NIL	14.4	3.4	31.0	0.71	50	6.6	10.39	0.08	0.04	0.18	NIL	450	202
4	Dutumi New Gauging Station	0.84	NIL	0.017	1.5	0.61	7.1	4.5	16.8	4.4	46.5	0.51	60	6.6	14.28	0.05	0.02	0.15	NIL	1,991	910
23	Kidunda New Gauging Station	2.16	NIL	0.004	1.0	0.23	6.4	NIL	18.0	7.8	18.0	1.77	77	5.2	5.01	0.01	0.01	0.20	NIL	100	56
5	Londo Bridge	0.84	NIL	0.017	1.4	0.35	2.8	1.0	13.2	7.1	28.5	0.39	62	5.2	8.95	0.40	0.23	0.15	NIL	1,220	600
6	Mindu Dam	1.68	NIL	0.018	1.5	0.18	9.9	2.8	14.8	7.1	38.0	0.38	66	6.6	11.48	0.26	0.14	0.15	NIL	154	89
7	Morogoro Bridge	2.16	0.024	0.017	1.5	0.24	104.9	1.0	32.4	17.3	82.0	0.71	152	6.6	16.45	0.61	0.01	0.18	NIL	6,010	3,000
8	Darajam Bridge	0.84	NIL	0.017	1.3	0.42	77.3	5.0	16.8	15.8	290.0	0.06	107	3.9	71.83	0.28	0.13	0.20	NIL	3,020	1,500
9	Ngerengere Bridge	5.04	NIL	0.017	1.7	0.48	80.8	2.8	30.0	13.6	97.0	1.10	131	6.6	20.78	0.52	0.28	NIL	NIL	3,130	1,860
24	Utari Bridge	21.01	NIL	0.005	1.2	1.00	103.5	10.0	36.8	18.5	79.0	0.31	168	5.2	15.02	0.01	NIL	0.20	NIL	135	72
10	Ruvu Railway Bridge	1.68	0.024	0.015	1.2	0.27	9.9	3.5	17.2	7.5	31.5	0.47	74	7.2	8.96	1.00	0.02	0.19	NIL	1,390	750
25	Pangani Reservoir	16.81	0.550	0.380	2.2	0.35	1276.2	170.0	126.0	132.5	520.0	0.04	858	8.0	45.74	0.02	NIL	0.25	NIL	697	340
11	Umbenazomozi Bridge	0.84	0.300	1.100	1.7	2.60	1251.4	23.0	104.0	90.0	790.0	0.06	630	9.3	80.21	0.60	1.60	0.25	0.85	188	100
12	Chalinze Reservoir	0.84	NIL	0.142	1.4	0.25	61.0	3.0	28.4	10.7	55.0	0.86	115	3.9	12.44	0.14	0.02	0.22	NIL	384	190
13	Nguhi NAFCO Farm Intake	0.84	NIL	0.017	1.5	0.28	204.2	15.0	58.4	37.0	110.0	7.00	298	3.9	15.93	0.03	NIL	NIL	NIL	650	380
14	Upper Water Station Intake	0.84	NIL	0.017	1.3	0.34	20.6	3.2	19.6	8.8	60.0	2.07	85	7.9	15.92	0.06	0.04	0.15	NIL	480	260
15	Lugoba	5.88	0.490	0.018	1.7	2.23	2098.6	190.0	112.0	287.0	1260.0	25.00	1,461	12.0	89.21	0.13	0.07	0.40	1.55	408	243
16	Masugulu Reservoir	1.68	0.360	0.016	1.6	0.44	56.7	9.0	28.8	12.4	70.0	0.24	123	7.2	15.42	0.15	0.09	0.20	NIL	1,370	699
17	Lower Water Station Intake	1.68	NIL	0.022	0.9	0.46	39.0	1.0	26.8	10.2	38.0	0.29	109	3.9	8.83	0.36	0.21	0.15	NIL	433	230
18	Kigongoni JICA Farm Intake	0.84	NIL	0.002	1.5	0.25	58.1	11.0	21.6	11.2	69.0	0.77	100	3.9	17.04	0.04	0.03	0.20	NIL	837	504
19	Dutumi Well	0.84	NIL	0.004	3.9	1.01	20.6	9.0	52.4	16.5	45.0	0.38	199	6.6	7.67	0.03	0.02	0.15	NIL	3	NIL
20	Yombo Lined Well	0.84	0.061	0.025	1.2	0.45	5.0	NIL	5.2	2.4	30.0	0.28	23	5.2	15.39	0.68	0.40	0.18	NIL	750	340

Note T-N:Total Nitrogen, T-P:Total Phosphate, T-H:Total Hardness, T-C:Total Coliform(35℃), F-C:Fecal Coliform(44.5℃)

Table F.6 LIST OF FOREST RESERVES

Bagamoyo Region	
Mangroves Forest Reserve	1,499 ha
Kikoka Forest Reserve	1,655 ha
Ruvu North Forest Reserve	31,930 ha (some parte)
Ruvu South Forest Reserve	35,500 ha (some parte)
Simbo Forest Reserve	591 ha
Morogoro Region	
Bunduki I-III Forest Reserve	111 ha
Chamanyani Forest Reserve	796 ha
Dindili Forest Reserve	1,007 ha
Kasanga Forest Reserve	70 ha
Kilengwe Forest Reserve	995 ha
Kimboza Forest Reserve	386 ha
Kitulanghalo Forest Reserve	2,638 ha
Mhangala Forest Reserve	35 ha
Mindu Forest Reserve	2,285 ha
Mkulazi Forest Reserve	68,627 ha
Mkungwe Forest Reserve	1,967 ha
Morogoro Fuel Reserve	12,950 ha (some parte)
Mvuha Forest Reserve	852 ha
Nguru ya Ndege Forest Reserve	2,407 ha (some parte)
Nyandiduma Forest Reserve	48 ha
Pangawe East Forest Reserve	769 ha
Pangawe West Forest Reserve	184 ha
Ruvu Forest Reserve	3,094 ha
Shikurufumi Forest Reserve	260 ha
Uluguru North Forest Reserve	8,357 ha
Uluguru South Forest Reserve	17,293 ha
Vigoregore Forest Reserve	921 ha
Vigoza Forest Reserve	26 ha

Source: Forest Catchment Office

Table F.7 MATRIX OF ENVIRONMENTAL IMPACTS

(Impacts caused to the Environment by the Development Component)

Developmental Component / Environmental Element	a	b	c	d	e
A. Socioeconomic Environment					
1. Resettlement	++		+		(++)
2. Economic Activities					
3. Transportation and Public Facilities					
4. Disintegration of Communities					
5. Archaeological Remains and Cultural Assets					
6. Water or Common Rights	+	+	+		(+)
7. Health and Sanitation	+		+		(+)
8. Wastes	+		+		(+)
9. Disaster Potentiality	+	+	+	+	+
B. Natural Environment					
10. Geography and Geology	+			+	(+)
11. Soil Erosion	+		+		(+)
12. Ground Water					
13. Rivers and Lakes	+	+	+	+	(+)
14. Coast and Sea					
15. Fauna and Flora	++		+	+	(+)
16. Meteorology	+				(+)
17. Landscape	+		+	+	+
C. Environmental Problems					
18. Air Pollution	+	+	+	+	+
19. Water Contamination	+		+	+	+
20. Soils Contamination	+		+	+	(+)
21. Noise and Vibration	+	+	+	+	+
22. Ground Subsidence					
23. Offensive Odour	+	+	+	+	+

Note)

++ : Environmental element of large impacts and necessity of some countermeasure.

\+ : Environmental element of possible large impacts due to the project scale and site condition.

Developmental Component :

a. : Dam Construction
b. : Water Supply
c. : Irrigation Development
d. : Flood Protection
e. : Hydropower Development

( ) means with Dam Construction

Table F.8 FORMAT OF ENVIRONMENTAL SCREENING

1. Resettlement

By an execution of the proposed project, will the project induce a large scale resettlement of inhabitants ? or by the involuntary resettlement with the dam construction project, will the project significantly affect existing social life of inhabitants, in and around the project site, such as daily human life, economic activities, transportation, community, institution, customary, etc. ?

2. Health and Sanitation

By an execution of the project, will the project significantly affect the health situation of inhabitants ?, or induce water related diseases ?

3. Geography and Geology

By an execution of the project, will the project significantly affect geography or geology of the area as a result of change of land forms, in and around the project site ?

4. Soil Erosion

By an execution of the project, will the project significantly induce soil erosion, land devastation, deterioration of soil fertility, etc. ?

5. Surface Water

By an execution of the project, will the project significantly affect run-off condition and water quality of surface water of rivers, reservoirs and swamps ?

6. Ground Water

By an execution of the project, will the project significantly affect run-off condition, change of the water level and water quality of ground water ?

7. Animals and Vegetation

Are any habitants for rare species of animals / any growing areas for rare species of vegetation or ecologically sensitive areas in the project site ?, or are any valuable areas for sustainable utilization of plants in the project site ?, or are any valuable area for protection and preservation of fauna / flora allocated in the project site ?

Overall Evaluation

Is a study of the Environmental Impact Assessment (EIA) necessary for this development project ?

Table F.9 RESULT OF ENVIRONMENTAL SCREENING

Project Name	Environmental Element							
	a	b	c	d	e	f	g	EIA
(1) Kidunda Dam Project	+	+	+	+	+	-	+	Y
(2) Mgeta Dam Project	-	+	+	+	+	-	+	Y
(3) Ngerengere Dam Project	+	+	+	+	+	-	+	Y
(3) Lower Ruvu Schemes-1 and -2	-	-	-	-	+	-	-	N
(4) Upper Ruvu Scheme	-	-	-	-	+	-	-	N
(6) Bagamoyo Irrigation Development	-	+	+	-	+	-	-	N
(7) Low-lift Pump Irrigation Project	-	+	+	-	+	-	-	N
(8) Makurunge Irrigation Project	-	+	+	-	+	-	-	N
(9) Ruvu National Youth Irrigation Project	-	+	+	-	+	-	-	N
(10) Kidunda Irrigation Project	+	+	+	-	+	-	+	Y
(11) Ngerengere Irrigation Project	+	+	-	-	+	-	+	Y
(12) Uluguru Mountain East Project	-	-	-	+	-	-	-	N
(13) Mgeta Plain Mvuha Irrigation Project	+	+	-	-	+	-	+	Y
(14) Mgeta Plain Irrigation Project	+	+	+	+	+	-	+	Y
(15) Mlali Irrigation Project	-	+	-	-	+	-	-	N
(16) Uluguru Mountain West Project	-	-	-	+	-	-	-	N

Notes
- + : Negative impact
- - : No or very small influence
- Y : EIA is necessary
- N : EIA is unnecessary

Environmental Element
- a. : Resettlement of Inhabitants
- b. : Public Health and Hygienic Conditions
- c. : Geographic and Geological Conditions
- d. : Soil Erosion
- e. : Surface Water
- f. : Ground Water
- g. : Animals and Vegetation
- EIA : Environmental Impact Assessment

APPENDIX-F

FIGURES

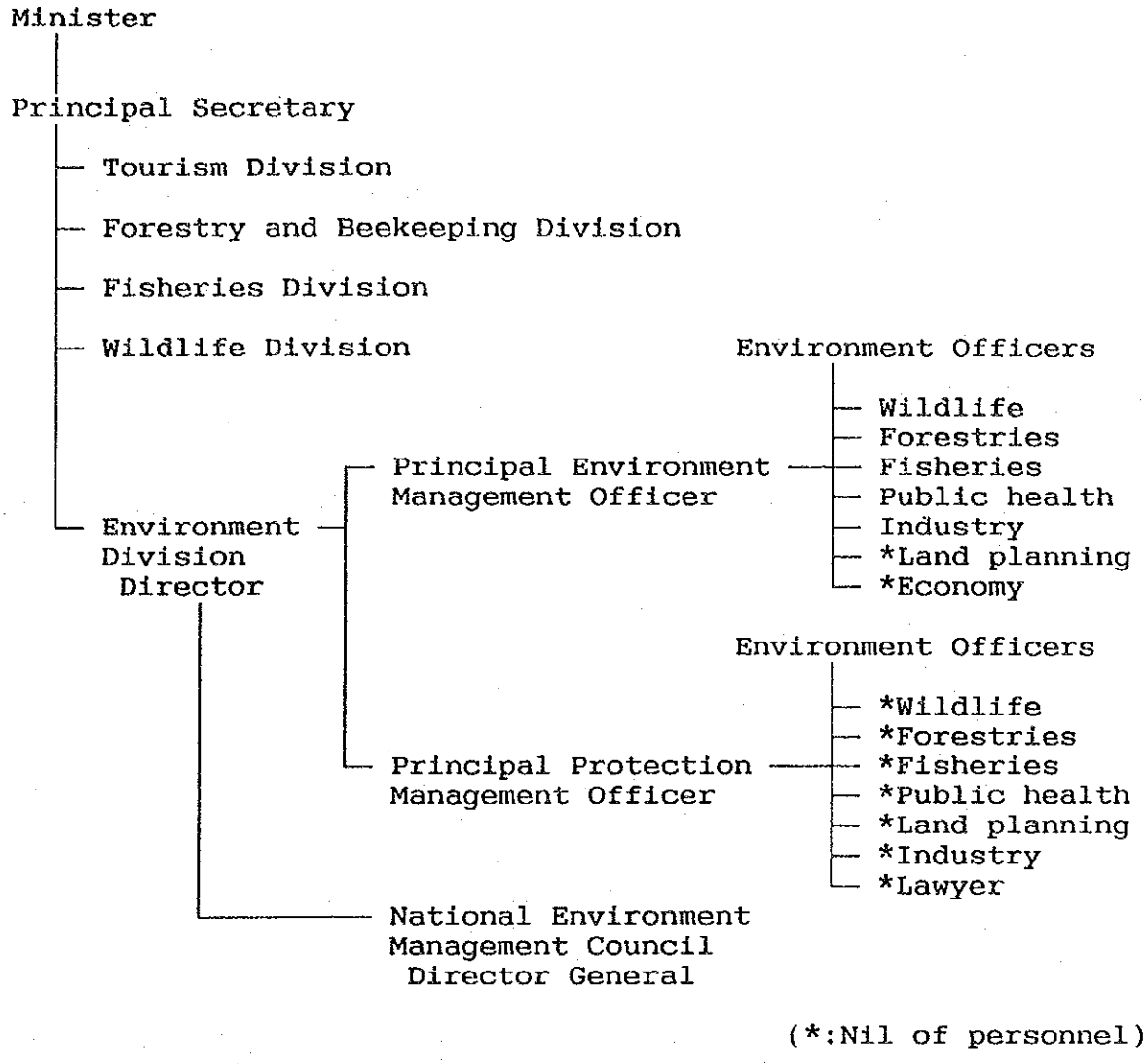

Fig. F.1 ORGANIZATIONAL CHART OF MTNRE AND ENVIRONMENT DIVISION

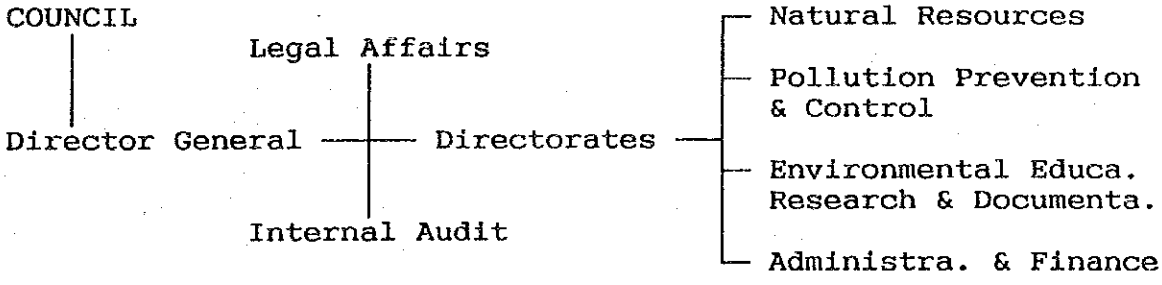

Fig. F.2 ORGANIZATIONAL CHART OF NEMC

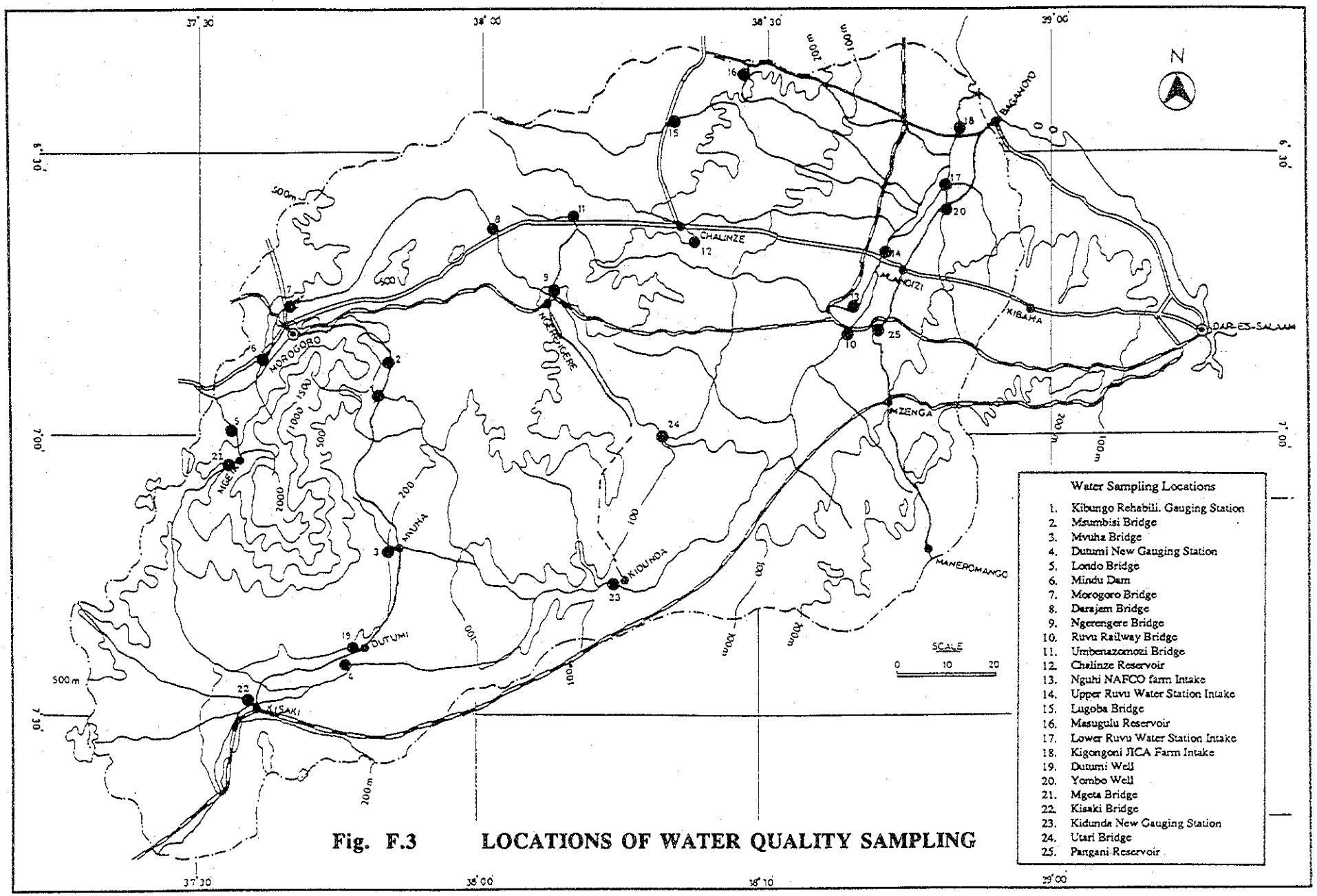

Fig. F.3 LOCATIONS OF WATER QUALITY SAMPLING

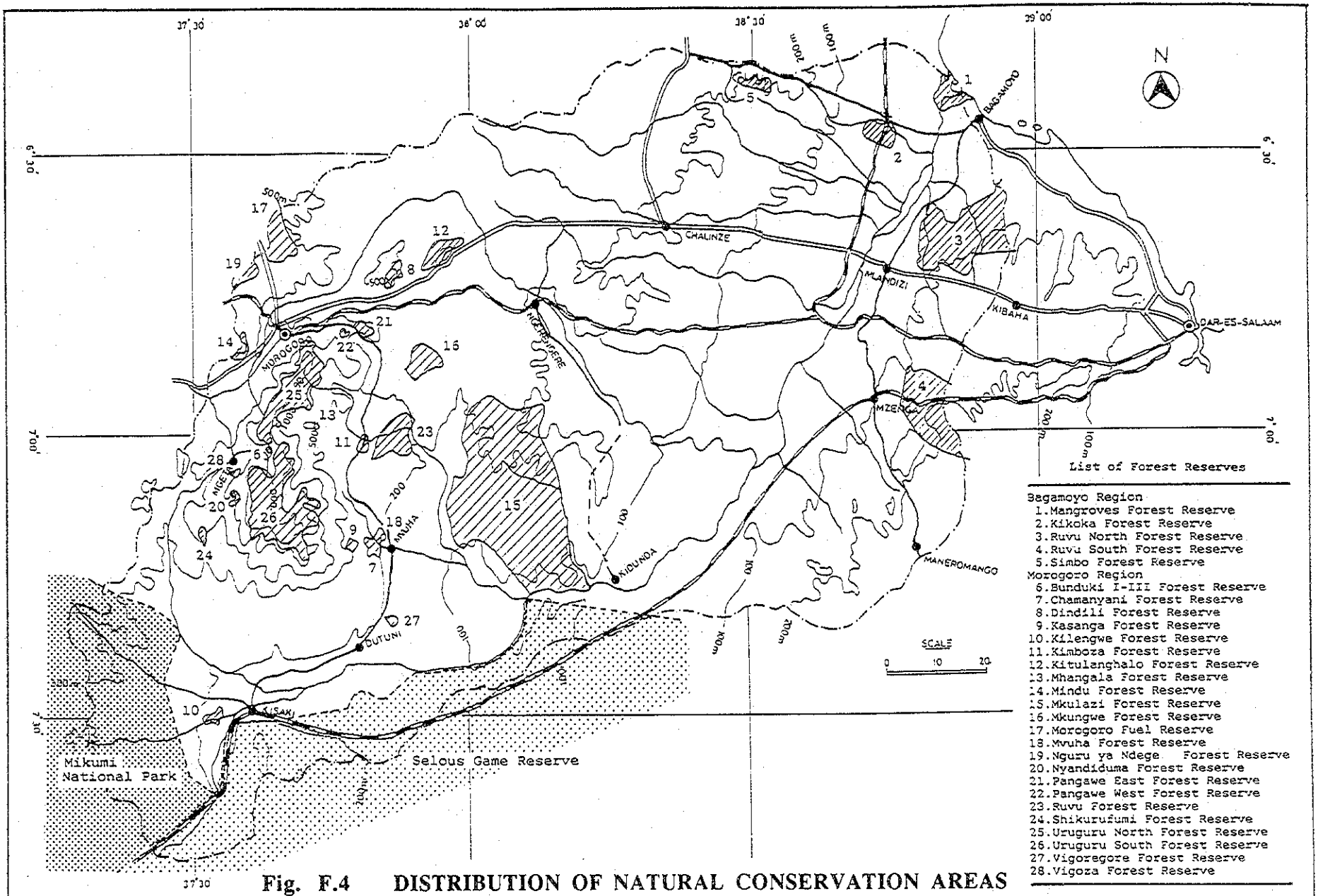

Fig. F.4 DISTRIBUTION OF NATURAL CONSERVATION AREAS

ATTACHMENTS TO APPENDIX - F

CONCLUSION AND RECOMMENDATION OF IRA'S REPORT

CONCLUSION AND RECOMMENDATION OF IRA'S REPORT

A. General Conclusions

Great potential exists in the Ruvu River basin for water resource development (for domestic/industrial water supply, irrigation and hydroelectric supply). At present, water and land resources in the basin are utilized at a limited scale.

The present shortage of water and electricity supply in the Dar Es Salaam city area as well as the supply of unhygienic and unreliable water to the people in the basin could be resolved by formulating a comprehensive water resource development plan in the Ruvu River basin. As long as such a plan incorporates social, ecological and environmental issues at all the stages of project formulation, design and implementation, the positive implications are likely to outweigh the negative ones.

B. Specific Conclusions

1. Serious and extensive soil erosion resulting from activities of the local people has taken place, and will be the major problem within the Uluguru Mountains due to deforestation and poor land management which accompany the upward migration of people into steeper mountain slopes as the lower hill-slopes become impoverished or eroded. These activities have implications on the flooding and siltation in lower reaches of the Ruvu River.

2. The soils of the Ruvu River basin have not been adequately studied and documented. As the character of soils will to large extent determine land use practices in the basin, the present lack of detailed information about this important resource is a major factor which will affect development planning in the basin.

3. The Ruvu River basin is well endowed with forest resources. The Uluguru evergreen montane and lowland forests and some of the remaining coastal forest remnants are important catchment forests from which the Ruvu River originates and on which the City of Dar Es Salaam is dependent with respect to its water supply. These forests contain some of the rare endemic plant species and are therefore important biological and ecological centres at the local, national and international level. The sustainability of any water resource development project in the basin will depend on the effective conservation and/or management of these catchment forests.

4. Except for the small portion of the Mikumi National Park and the Selous Game Reserve, wildlife is not a very important resource in the basin, except vermin. Water resources development in the basin will therefore have minimum effects on wildlife.

5. Fisheries are not developed in the Ruvu River basin, but potentially it is an important economic and social activity. Depending on the magnitude of the water

resources development activities and the resultant changes on flooding regime as well as the resultant physical impacts on the river bed and river bank, fish and fisheries could be affected negatively by the planned development. Although these impacts could be minimized by introduction of aquaculture, fish farming is very new in the area so that, it will become expensive as very few local and traditional fish species are adaptable to aquaculture.

6. Generally, the economy of the people in the Ruvu River basin is relatively poor, and is mainly based on agriculture using traditional farming systems. Although rain-fed cropping predominates, potential for irrigation farming is high. Implementation of water resource development programme in the basin would improve rice production in particular since the scope for expansion of production of the crop exists. However, expansion of irrigated agriculture will have to take into consideration the water requirement for other various purposes, e.g. hydroelectric power production, industrial activities and domestic water supply.

7. Development of irrigation agriculture would involve the use of expensive chemical fertilizers, herbicides and insecticides with detrimental effects on the soil and aquatic environmental quality.

8. Infectious diseases are highly prevalent and endemic in the Ruvu River basin. Water-related and non water-related epidemic diseases occur indicating existence of poor health status caused by poor sanitation practices, low health awareness, use of contaminated water supply, and other factors. Implementation of water-related development projects in the basin could provide conditions which will facilitate introduction of new diseases or increase incidence and prevalence of existing ones.

C. Recommendations

1. In view of the uncontrolled soil erosion especially on the eastern side of the Uluguru Mountains, any efforts to clear more forests for whatever purpose measures must be discouraged by the relevant authorities.

2. Appropriate soil conservation and management programmes should be constituted in the Uluguru Mountains as well as the rest of the basin.

3. Detailed studies must be made on existing soil types, their capability, suitability and distribution in order to determine appropriate land use practices in the basin.

4. To sustain the water-related development projects in the Ruvu River basin, the planned master plan should incorporate effective conservation and/or proper management of the alpine/montane and lowland forests as well as the costal remnant forest in the catchment areas.

5. In order to minimize the negative impacts of implementation of water-related development projects on wildlife in the basin, especially in the Mikumi National

Park and Selous Game Reserve, the planned programmes should give full support to, or improve upon the current programmes which involve the villagers adjacent to the conservation areas in wildlife conservation and management.

6. The planned water resource development programmes in the Ruvu River basin should as far as possible ensure the maintenance of traditional floodplain and estuarine fisheries with minimum negative impacts.

7. The change to modern irrigation farming under the planned water resource development programme in the Ruvu River basin should be done slowly by stages in order to train and allow the local people to adapt to the new technology and the associated economic implications.

8. The planned development programme would have to introduce an effective integrated programme from the beginning to monitor environmental changes (including health) so as to introduce intervention measures to arrest undesirable trends.

9. As far as control of diseases which are transmitted by human biting insects is concerned, planned development programme should undertake a study on population dynamics of breeding sites and activities of the insects so as to ascertain cytologically their specific identifies for control measures.

10. Detailed studies must be carried out to establish the projected future water demands for domestic water supplies, livestock, irrigation, hydropower and Dar Es Salaam city. Monitoring programme should be done basin-wise to avoid misuse or abuse.

11. In order to minimize water pollution and avoid poisoning of aquatic life, livestock and human beings, agrochemicals should be applied very sparingly on vegetables, fruits and coffee, particularly within the Ruvu River basin. Application of agrochemical should be accompanied by user education.

CONCEIVED ENVIRONMENTAL ISSUES ON THE KIDUNDA DAM PROJECT

CONCEIVED ENVIRONMENTAL ISSUES ON THE KIDUNDA DAM PROJECT

The reservoir area of the planned Kidunda Dam is located north of the Selous Game Reserve adjoining it, one of the largest wildlife areas left in the world. While the Selous Game Reserve occupies approximately an area of around 50,000 km^2, an area to be submerged by the Kidunda Dam is estimated to be as rather small as around 12 km^2, based on the 1 to 50,000 scaled topographic maps. (Likewise, the reservoir area of the Kidunda Dam is about 140 km^2, which is equivalent to about 0.3 % of that of the Selous Game Reserve. Accordingly, the creation of the Kidunda Dam-reservoir would not have any direct adverse effect on the existing Selous Game Reserve taking into account the very small area of the Reserve to be submerged by creating the reservoir. On the other hand, the following issues in relation to the reservoir area are envisaged through the present field investigation;

(1) The Kidunda Dam-reservoir will submerge some parts of areas where the land uses plans are established under the on-going Selous Conservation programme (SCP) of the GTZ (hereinafter referred to as the SCP plan). In principle, the SCP plan aims to control the commercial poaching for ivory and rhino horn by setting up the buffer zones to demarcate the areas of human activities and wildlife. The SCP plan set up the buffer zones not only in and around the two dam sites, namely the Kidunda and Mgeta dam sites, but also in other areas.

(2) About 6,000 people live in the planned Kidunda reservoir area.

During the field investigation, therefore, the Study Team attempted to collect as much data and information concerned with the above issues as possible through the unofficial meeting with staff of the SCP office. Consequently, it was foreseen that the following environmental issues might take place in case of the realization of the Kidunda Dam:

i) Resettlement of people living in the planned reservoir area
ii) Adverse influence on ecosystem of the Selous Game Reserve
iii) Adverse influence on wet lands and wildlife in the planned reservoir area

The overall views on the aforesaid environmental issues, which were verbally expressed in the unofficial meeting held among the concerned personnel during the field investigation, are tabulated in Table-B of the next page.

In the present Study, the environmental survey was preliminarily conducted at a level of the initial environmental examination (IEE) for the entire Ruvu River basin with a catchment area of about 18,000 km2, and it did not comprise the specific environmental impact assessment (EIA) on the Kidunda dam project. Therefore, this Final Report recommends to carry out a prefeasibility study on the Kidunda dam project, in which the importance is to be placed on the clarification of the aforesaid environmental issues conceived at this stage as well as the geological ones at the proposed dam site.

It is hoped that the subsequent environmental impact assessment shall be conducted keeping close participation and coordination with organizations presently having activities in the basin. In case it is found out that construction of the Kidunda dam will create a great adverse influence on the environment, the Development Scenario-2 (the Mgeta Dam and Ngerengere Dam) should be proceeded instead of the Kidunda Dam in order to cope with the future water demand in Dar Es Salaam city.

Table-B OVERALL VIEWS ON THE KIDUNDA DAM PROJECT

Item	Staff of SCP	Counterpart of MWEM	JICA Study Team
i) Resettlement of people in the planned Kidunda reservoir area	At present, about 6,000 people live in the planned Kidunda reservoir area. It seems very difficult to resettle those people in other areas.	The Government has an experience in doing the resettlement of people to date. It is considered that this matter is not critical issue for realization of the Kidunda Dam Project.	The Study suggests to resettle the people in the Kidunda Irrigation project area with a very sparse population density, which is located downstream of the proposed Kidunda dam site, as well as to implement the Kidunda Irrigation Project in parallel with the Kidunda Dam Project. Thus, it is expected that the people who are performing the traditional farming are expected to gain a lot of benefits from those projects.
ii) Influence on ecosystem of the Selous Game Reserve	The ecosystem of Selous Game Reserve (SGR) is not independent of the other areas than the SGR area, but it has a linkage with the surrounding areas in terms of the ecosystem . In particular, the Kidunda reservoir area constitutes very important migration routes of wildlife in the Reserve. (This means that wildlife in the Reserve move periodically form the Reserve to the surrounding areas.) Therefore, there is a fear that the creation of the Kidunda reservoir will interrupt the movement of wildlife in the Reservoir, leading ultimately to destruction of the existing ecosystem.	This issue needs to be clarified through the detailed environmental survey in the subsequent prefeasibility study on the Kidunda Dam Project.	During the field investigation, it was confirmed that wildlife such as crocodiles and hippos dwell along the Ruvu River and it was reported that a lion appeared in the bush area near Bagamoyo. In this respect, it could be said that the entire Ruvu River basin is influenced by the ecosystem of the Selous Game Reserve. Since the detailed data related to influence on the ecosystem were not available at any organization concerned during the field investigation, it is considered essential to carry out the environmental assessment study in order to clarify this matter, the intervention with the SCP plan in the reservoir area, other adverse influences on the surrounding areas by construction of the Kidunda Dam, and the possibility to minimize those adverse effects by means of scale-down of the reservoir area.
iii) Extinction of wet lands	There are very unique wet lands in the planned Kidunda reservoir area. Besides, the wild dogs which are very precious animals dwell in the reservoir area.	There are a lot of wet lands in the Selous Game Reserve, especially in the Rufiji basin. For the time being, it is very difficult to understand the reason why the reservoir area located outside the SGR area is very important wet lands. In addition, it is informed that a lot of wild dogs live in the SGR area. Therefore, this issue should be clarified through the environmental impact assessment (EIA) study in the subsequent prefeasibility study as proposed by the JICA Study Team.	It is necessary to await the results of the EIA in the subsequent prefeasibility study in order to assess whether or not this matter is critical issue. (The EIA would also examine the possibility to migrate the wildlife in the reservoir into the SGR area.) On the other hand, it is noted that the planned reservoir area dose not form the wet lands throughout a year, but only during the wet season.
Others	The SCP plan has been implemented since a long time ago. The planned Kidunda reservoir area is one of the major planning areas of the SCP. We have an intention to participate in the EIA on the Kidunda Dam Project.	It is too hard to abandon the Project at this stage, because the investigation thereon has been performed since 1960's. We hope eagerly to carry out the detailed environmental survey on the Kidunda Dam Project in the next prefeasibility study.	Since it is found out as a result of the Study that the Kidunda Dam Project is blessed with the distinguished economic viability, it is too early to abandon the Project at this stage. Hence, we recommend to carry out the prefeasibility study thereon focusing on the EIA and geological investigation of dam site, and the successive study on the Development Scenario-2 (Mgeta and Ngerengere Dams) should be proceeded if it is concluded by the prefeasibility study that there are the critical problems on the Kidunda Dam Project in terms of the environment and/or the geology of dam foundation. Since it is forecast that population of the Dar Es Salaam city will continue to increase remarkably from now on, it is considered necessary to proceed with the water resources development at an earlier stage in order to cope with the future municipal water demand. Although the Rufiji basin is an alternative for the water resources development, a huge amount of investment cost would be required to construct the water conveyance facilities from the river to the city, whose length is approximated at 150 to 200 km depending on the selected route.

Note : All the views above were expressed verbally by the concerned personnel in the unofficial meeting.

APPENDIX-G

AGRICULTURE

APPENDIX - G
AGRICULTURE

Table of Contents

1	AGRICULTURE IN TANZANIA	.....	G - 1
	1.1 General	.....	G - 1
	1.2 National Development Plan	.....	G - 2
2	CURRENT SITUATION OF AGRICULTURE	.....	G - 2
	2.1 Population	.....	G - 2
	2.2 Soil	.....	G - 3
	2.3 Present Land Use	.....	G - 5
	2.4 Present Cropping Pattern	.....	G - 6
	2.5 Present Farming Practices	.....	G - 7
	2.6 Crop Yield and Production	.....	G - 8
	2.7 Irrigation and Drainage System	.....	G - 11
	2.8 Livestock Farming	.....	G - 15
	2.9 Forest	.....	G - 19
	2.10 Fishery	.....	G - 20
3	PROSPECTIVE AGRICULTURAL DEVELOPMENT PLAN	.....	G - 25
	3.1 Basic Concept for Agricultural Development	.....	G - 25
	3.2 Assessment of Land Resources	.....	G - 26
	3.3 Possible Agricultural Development Project Plans	.....	G - 27
	3.4 Priority Ranking Study	.....	G - 33
	3.5 Agricultural Development Scenario	.....	G - 39

List of Tables

Table No.	Title	Page
Table G.1	Irrigation Area in Tanzania	GT - 1
Table G.2	Existing/Proposed/Abandoned Agricultural Projects/Farms	GT - 2
Table G.3	Registered Water Rights in the Ruvu River Basin	GT - 3
Table G.4	Data on Livestock in Bagamoyo District	GT - 4
Table G.5	Data on Livestock in Bagamoyo and Kibaha District	GT - 4
Table G.6	Data on Livestock in Morogoro District	GT - 5
Table G.7	Wood Consumption in the Ruvu River Basin	GT - 5
Table G.8	Summary Table of Agricultural Project	GT - 6
Table G.9	Traditional Irrigation System in the Uluguru Mountain West	GT - 7
Table G.10(1)	Irrigation Water Requirement of Paddy in the Lower Ruvu Basin	GT - 8
(2)	Irrigation Water Requirement of Maize in the Lower Ruvu Basin	GT - 8
(3)	Irrigation Water Requirement of Paddy in the Middle Ruvu Basin	GT - 9
(4)	Irrigation Water Requirement of Maize in the Middle Ruvu Basin	GT - 9
(5)	Irrigation Water Requirement of Cotton in the Mgeta Plain	GT - 10
(6)	Irrigation Water Requirement of Paddy in the Mgeta Plain	GT - 10
(7)	Irrigation Water Requirement of Maize in the Mgeta Plain	GT - 10
Table G.11	Unit Direct Construction Cost and Material Cost	GT - 11
Table G.12	Summary of Construction Cost of Irrigation Project	GT - 12
Table G.13	Calculation of Incremental Benefit by Project	GT - 13
Table G.14	Weight Table for Priority Study	GT - 14
Table G.15	Priority of Agricultural Project in the Ruvu River Basin	GT - 15

List of Figures

Fig. No.	Title	Page
Fig. G.1	Location Map of Pits and Auger Holes for Soil Survey	GF - 1
Fig. G.2	Present Cropping Calendar (1/4) Bagamoyo	GF - 2
	Present Cropping Calendar (2/4) Mkuyuni	GF - 3
	Present Cropping Calendar (3/4) Mgeta Plain	GF - 4
	Present Cropping Calendar (4/4) Uluguru West	GF - 5
Fig. G.3	Location Map of Existing/ Proposed/Abandoned Projects/Farms	GF - 6
Fig. G.4	Location Map of Potential Area for Agricultural Development and Proposed Project Area	GF - 7
Fig. G.5	General Layout Map of	
	(1) Bagamoyo Irrigation Development and Makurunge Projects	GF - 8
	(2) Low-lift Pump Irrigation Project	GF - 9
	(3) Ruvu National Youth Irrigation Project	GF - 10
	(4) Kidunda and Ngerengere Irrigation Projects	GF - 11
	(5) Mgeta Plain Irrigation Project	GT - 12
	(6) Mlali Irrigation Project	GT - 13
	(7) Uluguru Mountain West and East Projects	GT - 14
Fig. G.6	Proposed Implementation Schedule of Irrigation Project by Scenarios	GF - 15

Reference

Table of Reference ..... GR - 1

APPENDIX - G

AGRICULTURE

1. AGRICULTURE IN TANZANIA

1.1 General

Total land area of United Republic of Tanzania is approximately 94.5 million hectares of which 40 million hectares are estimated to be arable. The cultivated land area is estimated at only 5.24 million hectares*1 or 5.5% of the total land. Of the remaining land area, forest area accounts for 42.3 million hectares and glass land area for 35 million hectares.

African cultivation, so-called shifting cultivation, dominates in major part of the farming areas. Farming technics are still at primitive level. Yields of crops are low and much affected by rainfall. Actually irrigated areas are very limited to some 67,000 hectares including both modern and traditional irrigation systems*2 as shown in Table G.1.

Maize is a primary staple food in Tanzania. The total cultivated area of maize reaches approximately 180 million hectares or 34 % of total cultivated area in 1990/91. Cereals such as sorghum and millet are also important with cultivated area of 83 million hectares as shown below:

Area, Production and Yield per Hectare of Principal Crops (Tanzania Mainland)

Unit : Area - 1,000 hectares
Yield - tons/hectare
Pro. = Production - 1,000 Metric tons

Crop	1989/90			1990/91			1991/92			Average**		
	Area	Yield	Pro.	Area	Yield	Pro.	Area	Yield	Pro.	Area	Yield	Pro.
Maize	1631	1.37	2227	1848	1.26	2332	1908	1.17	2226	1796	1.26	2262
Sorghum*	487	1.10	537	856	0.88	750	683	0.86	587	827	1.08	765
Millet *	145	1.08	157		N.A.		309	0.85	263			
Paddy	289	2.54	736	369	1.10	406	307	1.28	392	322	1.59	511
Wheat	52	2.04	106	50	1.66	84	44	1.46	64	49	1.73	85
Cassava	590	2.93	1731	604	2.59	1566	684	2.60	1778	626	2.70	1692
Sweet Potato	307	3.25	996	232	1.25	291	168	1.30	257	236	2.18	515
Pulse	580	0.66	384	565	0.75	425	585	0.53	312	577	0.65	374
Banana (Plantations)	226	3.64	823	252	2.97	750	265	3.00	794	248	3.18	789

* : Data for Sorghum in 1989/90 and 1990/91 include Millet.
**: Data for average of Sorghum including Millet.
N.A. = Not available
Data Source : Basic Data Agriculture & Livestock Sector 1986/87 - 1991/92, Ministry of Agriculture, May 1993.

Agriculture of Tanzania is characterized by paddy cultivation. Tanzania has biggest paddy cultivated area among the East African countries except Madagascar and has vast potential for paddy cultivation in the Rufiji, Wami, Ruvu River basins, etc.

*1 : Statistic Data 1989, FAO
*2 : Irrigation department, Ministry of Agriculture, Feb. 1992

In spite of the huge agricultural potential, Tanzania has faced chronic food shortage problem. In order to solve the food shortage problem, major staple crops such as maize, rice and wheat, have been imported. The total volume of imported food has amounted to range from 50,000 to 300,000 metric tons.*3

1.2 National Development Plan

The " Long Term Perspective Plan 1981-2000" was prepared as a national development plan in 1981. Since 1989/90, Tanzania has been changing her economic policy introducing a free marketing economic system. In this situation the perspective plan in various economic sectors will require some modification. However, the basic concepts will not be changed drastically because of its essential feature. The aims of the long-term development plan in agriculture, livestock, forestry and fishery sectors are summarized below.

Long Term Perspective Plan 1981-2000

The agriculture and livestock development programme will aim at :

(a) attaining self-sufficiency in the production of basic food stuff requirement;

(b) increasing agricultural diversification;

(c) providing raw material requirement for industries as much as possible;

(d) production for export; and

(e) deriving increased gains from livestock resources. This will call for more attention to the development of livestock than has been the case previously.

2. CURRENT SITUATION OF AGRICULTURE

2.1 Population

The project area spreads over the Morogoro and Coast Regions. The population in the project area is estimated at 609,595 as of 1988. The average growth rate is about 3.5%. Total number of household is estimated at about 124,000 as shown below;

*3; source: Tanzania Economic Trends Vol.4 No.2, July 1991.

	Population	Household
Total of the Project Area	609,595	123,963
Morogoro Region	428,565	80,861
Morogoro Rural	310,972	58,674
Morogoro Urban	117,593	22,187
Coast Region	181,030	43,102
Bagamoyo	89,201	21,238
Kibaha	59,199	14,095
Kisarawe	32,630	7,769

Source: Population Census 1988, Regional Profile

The average population density in the Project area is as sparse as 34.4 persons per km^2. The data on average size of agricultural household and farm labour force are not available in the Census.

2.2 Soil

2.2.1 Selection of soil survey area

Prior to selection of soil survey areas, the Study Team reviewed the existing data including, "An Outline Plan for Development of the Ruvu River by FAO 1961", "Coast / Dar Es Salaam Regions Master Plan by CIDA 1979", "Soil, Physiography and Agro-ecological Zones of Tanzania by FAO 1984" and "Farm Development Using Aerial Photo Interpretation in the Ruvu River Basin, Bagamoyo by MWEM 1986". As a result of the reviewal study, the following five areas were selected as priority areas for the soil sampling survey in order to carry out the soil analysis;

- Lower Ruvu Valley

  Makurunge area in Mwanbo Division of Bagamoyo District
  Station Ruvu area in Ruvu Division of Kibaha District
  Matima area in Matima Division of Kibaha District

- Middle Ruvu Valley

  Kidunda area in Ngerengere Division of Morogoro Rural District

- Mgeta Plain

  Bwakira-chini area in Bwakira-chini Division of Morogoro Rural District

2.2.2 Soil survey

The soil survey aims at identifying major soil groups and their distribution in the Ruvu River basin to evaluate the endowed land resource, and also examining the suitability of each soil group for irrigation through the review of the previous studies and present investigation result. The soil profile observation and soil sampling survey were carried out during the early April to May in 1993. A total of 25 sampling pits including auger holes were dug to examine the

suitability for the agricultural purpose. The soil profile observation was made applying the standard of national soil service of Tanzania. Major observation items were as follows;

- Land form
- Site characteristics
- Ground water level
- Surface characteristic
- Soil erosion
- Parent material
- Flooding/Ponding
- Vegetation type
- Drainage class
- Land use and cropping pattern

Location of those pits and auger holes sites are given in Fig G.1. In parallel with the soil profile observation, soil sampling was made by each soil depth. A total of 118 soil samples were collected and they were laboratory-tested for ten (10) items listed hereunder. In addition to the aforesaid soil survey, the water quality analysis was also made for seven (7) samples collected from those test pits and rivers to clarify the saline condition.

1) PH
2) EC (Electrical Conductivity)
3) CEC (Cation Exchangeable Capacity)
4) S.A.R. (Sodium Absorption Rate)
5) Total Nitrogen
6) CaCO3
7) Available Phosphorus
8) Particle Size Distribution
9) Exchangeable Cations (Mg++, Ca++, K+, Na+)
10) Organic Carbon

2.2.3 Characteristics of soils

The results of field investigation and laboratory test show the following characteristics of soils in the Ruvu River basin.

Lower Ruvu Valley

In this area, alluvial clayey soils are dominant being transported from the tributaries of the Ruvu River.

The depth of the top soils and effective soils are good enough for agriculture. The soil reaction is weak and suitable for most crops. The electrical conductivity is low and this indicates that soils are almost free from salinity problem. Sodium adsorption ratio is also low with less than 6 implying absence of sodicity hazard. The cation exchangeable capacity ranges from medium to very high. This indicates that the soil is very fertile and suitable for rice cultivation.

Middle Ruvu Valley

The soil survey for this area was not carried out due to flood and heavy rain during the field survey.

According to the geological map prepared by FAO, report No.1316, the outsides of both right and left banks of the valley are covered by alluvium and clayey deposits.

Mgeta Plain

The soil texture of the upper part of this area are classified to be sand, sandy clay and sandy clayey loam whereas the lower parts of the area are covered by clay and clay loam. Except for some northern part of Gombo village, PH and EC values are low and S.A.R. values are generally medium. These soil characteristics indicate that the soils are suitable for most crops. Salinity and sodicity problems are also absent. Soil fertility is high especially in the lower part of the area.

The soil in the northern part of Gombo village shows that sodium adsorption rate is over 12 at many sites. Therefore these areas covering approximately 1,700 hectares in total should be excluded from the priority area for agricultural development.

2.3 Present Land Use

The land use was investigated to set up a broad inventory of natural resources potential and to assess land use in relation to water resources development in the Ruvu River basin. The Study Area covers the Ruvu River basin of about 17,700 km^2.

The principal types of vegetation in the basin are (a) Mangrove forest, (b) Thicket, (c) Woodland, (d) Tropical Evergreen and Sem-deciduous forest, (e) Mountain forest, (f) Mountain heath-land, and Vegetation induced by the cultivation.

(a) Mangrove forest occupies a small area of about 2 km^2 at the mouth of the Ruvu River. This forest is the Government's reserve, and is mainly exploited for local use.

(b) Thicket is scattered over the entire basin up to an area of 600 m in altitude, and it has not much economic importance. The chief species are wild kapok and gum copal.

(c) Woodlands ocupy about 14,200 km^2 or 80 % of the basin area. Out of the total woodland, an area of about 800 km^2 belongs to the Central Government Reserve.

(d) Tropical Evergreen and Semi-Deciduous Forest lie along with river streams, and also at places above 1,000 m where annual rainfall exceeds 1,000 mm. The major species are mvule, mahogany, albizzia and sterculia. They provide valuable timber both for internal and export uses.

(e) Mountain forest and Mountain heath-land are composed mainly of Podocarpus and Camphorwood. They lie in closed and inaccessible areas, usually at places above 1,000 m in altitude and provide good protection against erosion.

The forest area totals about 4,000 km^2 in the Ruvu River basin, of which the Government's reserve accounts for approximately 2,800 km^2.

The steeper slope areas of the Uluguru Mountains which occupy about 1,200 km^2 or 7 % of the basin area are subject to serious gully and sheet erosion. Some of these areas are under the occupation of the Waluguru tribesmen.

The drainage area of about 11,600 km^2 is drained by the Ruvu mainstream and its major tributaries, comprising the Mvuha, the Mgeta, the Ngerengere and the Msua Rivers, and some 1,800 km^2 is used for scattered cultivation at present.

Approximately 900 km^2 is estimated to be utilized for town, villages, road, buildings, etc.

The present land use in the Ruvu River basin is summarized as follows;

	(Unit: km^2)
Entire area	17,700
Forest	4,000
- forest reserve	2,800
- forest no-reserve	1,200
Steeper slope area	1,200
Drainage area	11,600
- floodplain	9,800
- arable land	1,800
Town,Village,Road,etc.	900

2.4 Present Cropping Pattern

Owing to the relatively mild climate, various kind of crops such as wheat, maize, paddy, cassava, vegetables, orange, coffee banana, pineapple, etc, have been introduced in the Langali areas, western side of Mt.Uluguru, Bwakira-chini area in the Mgeta Plain, and Mkuyuni area in the upper Ruvu. Whereas, in the lower basin between the Ruvu station and Bagamoyo areas, a few kind of crops such as paddy, maize and cassava are cultivated in the floodplain with the traditional farming practices on a small scale. Current cropping calendars prevailing in Langali, Bwakira-chini, Mkuyuni and Bagamoyo are tabulated below:

Location/Crops	Sowing	Harvesting
Langali		
Maize (rainy season)	March	June
Maize (dry season)	Aug./Sept.	December
Vegetables	Jan./Feb.	Jul./Aug.
Coffee	May/Aug.	
Bwakira-chini		
Wheat	Feb./Mar.	Aug./Sept.
Paddy	Nov./Dec.	Apr./May
Maize (rainy season)	March	June
Maize (dry Season)	Aug./Sept.	December
Coffee	May/Aug.	
Mkuyuni		
Maize (rainy season)	March	June
Maize (dry season)	September	January
Paddy	Nov./Dec.	Apr./May
Cotton	January	June
Vegetables	Jan./Feb.	Jul./Aug.
Cassava	Mar./Apr.	Oct./Nov.
Orange	May/June	
Coffee	May/Aug.	
Bagamoyo		
Maize (rainy season)	March	June
Maize (dry season)	September	January
Paddy	Jan./Feb.	Jun./July
Cassava	Mar./Apr.	Oct./Nov.

Note : Present cropping patterns in the Ruvu River basin are illustrated in Fig. G.2.

2.5 Present Farming Practices

2.5.1 Small Scale Farming

Peasant cultivation techniques are based on manual with simple hoe. Animal power and tractors are generally not suited to small scale farming in the basin. The present farming practices with regard to the major crops such as cassava, maize and paddy are summarized as follows;

Cassava: Planting of cassava takes place in October to November or February to April with rain. Propagation of cassava is made by means of stem cutting. There are two varieties; sweet varieties, in which the cyanogenic glucoside is restricted to the outer layer of the tubers and the bitter varieties which contain the glucoside throughout the tuber. The sweet varieties are less commonly grown having disadvantage of being devastated by wild pigs and porcupines. For this reason, the bitter varieties are widely grown, even though the preparation for eating is more labour-consuming.

Maize: Maize cultivation is mainly on small holdings, more often as a mixed stand entirely under rainfed conditions except for the Ruvu floodplain, where the flood condition determine the extent grown and the sowing time. Timely sowing under rainfed conditions is considered as a critical factor in the Ruvu River basin. In general, the second half of March is the advisable planting time. The individual plot size cultivated with maize ranges from 0.1 to 0.5

ha, mostly in a mixed stand with recently planted cassava, or with millet, sorghum, and often with rice in the floodplains.

Rice: Nearly all of the rice, except Bagamoyo Irrigation Development Project, is sown directly in the field after plowing, which is usually done in the dry period. Germination depends largely on available moisture and the water level in the field. There is no control over this factor in the floodplain at present. In the Ruvu River basin, the medium textured, sandy loams of the river banks are preferred to the clays of depression areas. In the floodplain, sowing takes place during January and February, before the flood water becomes a threat. Rice is often inter-planted with maize and is harvested in June when the water begins to recede.

2.5.2 Large Scale Farming

Ruvu Rice Farm Ltd: Although the Study deals primarily with small scale agriculture, it should be noted that there is also some large scale farming and ranching in the basin. The rice cultivation method in the Ruvu Rice Farm Ltd (NAFCO RUVU) is summarized as follows. The Ruvu Rice Farm was originally developed for rice production with an extent of 750 ha under surface irrigation by pumping water from the Msua and Ruvu Rivers.

Before sowing, the land is plowed once, harrowed twice and levelled. These operations are performed between September and December. Sowing commences in February. The direct sowing is made at the rate of 150 to 175 kg paddy seed by using seed drills mounted on wheeled tractor. Rice varieties planted in Ruvu Rice Farm at the moment are Subermati from India, Katrin and a local variety called Super.

Ronstar 25 EC and Stam are pre and past emergence herbiciedes applied at the respective rates of 5 and 12 litters per ha. Recently Satunil is used as a pest emergence herbicide. Hand weeding is also practiced to remove the other weed generations and the wild rice which are not controlled by these herbicides. There are two species of wild rice: Oryza punctata and Oryza lengistaminata. O.punctata is annually propagated by seed, while O.lengistaminata is perennial and is propagated by seed and roots. The wild rice is the major cause of the low yields in the Ruvu Rice Farm at present.

Triple super phosphate (TSP) is incorporated into the soil prior to germination of the crop at the rate of 125 kg per ha after every two years. Two splits of Urea are applied 30 days after germination and booting stage. Nitrogen is applied at the rate of 100 kg per ha. Pest has more economic importance than diseases at the Ruvu Rice Farm so far. Major pest problems are caused by armyworm, rice leaf rollers, rice skippers and birds called Quelea-quelea.

Harvesting of paddy is done by using combine harvesters and commences in June to August depending on the planting times and planted areas.

2.6 Crop Yield and Production

2.6.1 Major crop production in Coast and Morogoro region

Farmers of the Coast Region are primarily subsistence producers. Every household gives the priority to crops such as cassava, maize and rice to meet its food requirements. Cash crops,

important for buying consumer goods, including cashew, sesame, cotton and citrus, are produced in addition to the subsistence crops. The average cultivated area and production of these crops from 1985/86 to 1990/91 are as follows;

Average Cultivated Area and Production in the Coast Region

(Unit:1,000 ha, tons)

	Cassava	Maize	Rice	Cashew	Sesame	Cotton
Area	45.1	15.6	24.4	3.0	2.0	2.1
Production	202.4	19.1	34.9	4.1	0.5	2.5

Surplus food crops such as rice and cassava are marketed.

The Morogoro Region lies within an altitude of 400 to 2,650 m of the mountainous areas. Soils consist of fertile sandy loam and loamy clays. Annual average rainfall reaches 800 to 1,000 mm in the lowland. It increases up to over 1,500 mm in the mountainous areas. Due to its fertile soils and wide range of altitudes, a considerable number of crops are grown in the Region. Sisal, the major cash and export crop, is grown in large-scale plantations. Coffee and cotton are grown on a limited scale by smallholders. Major food crops comprise maize, paddy rice, cassava and sesame, etc.

The Region is also one of the major suppliers of fruits and vegetables to the Morogoro and Dar Es Salaam urban centers. The Region, which is blessed with favorable climate and fertile soils, is attracting an increasing number of farmers from other densely populated areas.

Average crop cultivation area and production from 1985/86 to 1990/91 in the Morogoro Region are summarized as shown below;

Crop Cultivation Area and Production in the Morogoro Region

(Unit: 1,000 ha, tons)

	Maize	Paddy	Cassava	Sesame	Sisal	Coffee
Area	86.8	50.6	20.1	3.5	4.5	2.6
Production	115.8	92.7	69.3	4.6	456.4	0.2

2.6.2 Crop yield and production in the Ruvu river basin

At present, no statistical data of crop yield and production are available on the Ruvu River basin. Unit yield and crop production were estimated for the major crops on the basis of the data provided by the Ward and District Extension Offices, information collected from the village offices and local farmers and the field data obtained by field investigations as tabulated below;

Unit yield of each crop

(Unit: tons/ha)

Major crops	Ruvu Basin	National Average (1985/86-1991/92)
Cotton	1.6	0.48
Rice	2.5 to 2.7	1.49
Maize	1.4 to 3.6*	1.42
Vegetables	3.0 to 25.2**	
Cassava	2.3 to 7.3***	2.25
Wheat	3.0 to 3.1	1.62
Orange	25.4	
Coffee	1.2 to 1.3	0.20
Banana	24.9	
Pineapple	24.8	

In the above table, unit yield of 3.6 tons per ha of maize with "*" is the records in Langali and Mkuyuni areas. 25.2 tons per ha of Vegetables with "**" is an average unit yield of Langali area located at the western part of the Uluguru Mountain. 7.3 tons per ha of cassava production is yielded in the Yombo and Ruvu Station areas covered by fertile soils in the lower Ruvu River basin. Unit yields of cotton, coffee and wheat in the upper Ruvu River basin are very high in comparison with the national average values.

Crop Cultivation Area by Crop Season and Location

(Unit: 1,000 tons)

Crops/ Season	Uluguru western Langali	Mgeta Plain Bwakira	Upper Ruvu Mkuyuni	Middle Ruvu Mkulazi	Lower Ruvu Yombo	Total
Rainy season:						
Wheat		6.2		2.0		8.2
Cotton		3.5	2.7	1.0		7.2
Rice		3.5	6.3		2.6	12.4
Maize	5.3		7.0		0.6	12.9
Vegetables	5.9		1.7			7.6
Cassava		3.6			2.2	5.8
Total	11.2	13.2	21.3	3.0	5.4	54.1
Dry season:						
Beans	7.6	2.7	3.9			14.2
Soybeans		1.4				1.4
Maize	2.3		3.5		0.3	6.1
Cassava			3.6		2.2	5.8
Pineapples			0.1			0.1
Total	9.9	4.1	11.1		2.5	27.6
Perennial:						
Orange			1.8			1.8
Coffee	1.7	1.4	9.7			12.8
Banana				0.7		0.7
Total	1.7	1.4	11.5	0.7		15.3

As shown in the above table, the cultivated area is about 97,000 ha in the entire Ruvu River basin as of 1992. Out of the total cultivated area, about 54,000 ha or 56 % of the cropped area is under cultivation of such crops as wheat, cotton, rice, maize, vegetables and cassava in the rainy season. About 27,600 ha or 28 % of the total cropped land is used for cultivation of beans, soybeans and cassava in the dry season. The remainder of about 15,300 ha or about 16 % is used for perennial crops such as orange, coffee and banana.

Based on the present cultivated area and unit yield of crop, the crop production is estimated as follows;

(Unit: 1,000 tons)

Crops/ Season	Uluguru western	Mgeta Plain	Upper Ruvu	Middle Ruvu	Lower Ruvu	Total
Rainy season:						
Wheat		18.7		6.1		24.8
Cotton		5.7	4.3	1.6		11.6
Rice		8.9	16.7		5.8	31.4
Maize	19.1		25.2			44.3
Vegetable	147.8	5.1				152.9
Cassava			8.3		16.1	24.4
Dry season:						
Beans	4.9	1.8	2.5			9.2
Soybeans		0.9				0.9
Maize	8.3		12.6		1.3	22.2
Pineapples			2.4			2.4
Perennial:						
Orange			45.8			45.8
Coffee	2.1	1.8	12.4			16.3
Banana			17.4			17.4

As far as crop products on the volume basis are concerned, the largest one is 152,900 tons of vegetables, followed by 66,500 tons of maize, 45,800 tons of orange, 31,400 tons of rice, 24,800 tons of wheat, etc. in the Ruvu River basin.

2.7 Irrigation and Drainage System

2.7.1 Existing irrigation system

Irrigation and drainage systems exist in the lower Ruvu and western slope of the Uluguru Mountains (Uluguru West or Traditional Irrigation). Irrigation water amount supplied to sisal and other estates is negligible small because of scale-down of their production. The farmers in the middle and upper Ruvu areas rely on unstable rainfall.

Existing irrigation methods in the basin are broadly divided into two types, namely, modern irrigation by pumping in the low-lying area and traditional irrigation in the Uluguru Mountain areas.

Modern irrigation and drainage system in the Lower Ruvu Valley

There are 17 numbers of existing, abandoned and proposed agricultural development project/farms between the Ruvu town and the Ruvu River mouth. Irrigation farming has been attempted in some projects/farms as stated below. The list of these projects/farms and their locations are shown in Table G.2 and Fig. G.3, respectively.

Modern irrigation method using pumps with flood protection dike system was introduced to Kivungwi area in middle of 1960's establishing NAFCO farm of 750 hectares under the Chinese assistance. In early 1970's pumping irrigation schemes, namely, the Ruvu national service rice irrigation and the Makurunge projects were constructed by the Government.

Private company, the Matusita farm, attempted a pumping irrigation farming at a location just upstream of the Makurunge scheme in 1980's.

At present, the Makurunge and the Matusita farms are abandoned and cultivation in the Ruvu national service rice irrigation project has been suspended since 1989. Cultivated land area in NAFCO farm was also reduced to some 150 hectares in 1988/89 crop season. The main causes of these failures are summarized below.

Makurunge project
- lack of involvement of farmers in the project planning stage resulted in no contribution of farmers to operation and maintenance of the irrigation facilities
- lack of spare parts of pump equipment
- lack of fund to complete construction of irrigation and drainage facilities

Matusita farm
- lack of farming and management skills resulted in low yield
- flood damage to cash crops, especially vegetable cultivation

Ruvu rice irrigation project
- shifting of river channel resulted in insufficient water supply
- lack of fund to complete construction of irrigation and drainage facilities
- collapse of flood protection dike due to insufficient compaction and unsuitable construction material resulted in high maintenance cost and small profit

NAFCO farm
- lack of spare parts of agricultural machineries and pump equipment
- deterioration of irrigation and drainage facilities

Since 1987 the Bagamoyo Irrigation Development Project (BIDP) has been operated on an experimental basis for 8 hectares with joint effort of the Tanzanian Government and JICA. The aim of the experimental farm is training of farmers in irrigated paddy farming. At present, a total of 70 farmers have been trained. In 1992/93 crop season, 17 farmers were selected from approximately 300 applicants for the training.

Average yields of trainees were 5.0 tons/ha of rainy season paddy and 4.8 tons/ha of dry season paddy in 1992, respectively. This is a reason why the BIDP project raises local interest by irrigation not only in adjacent areas but also in other basins of the Coast Region. In a full development stage, BIDP has a plan to irrigate an area of 1,000 hectares by gravity system.

In addition to these irrigation schemes, Kigongoni prison farm possesses small scale irrigation area of 20 hectares by gravity system utilizing their own reservoir on a tributary of the Ruvu River. Irrigated cultivation is not practiced in other existing private farms and PAC Masuguru farm.

Villagers along the river basin also cultivate paddy supplying supplemental water manually from ponds scattered in the floodplain. The villagers in Kitonga have strong intention of small-scale pumping irrigation farming using the ponds.

Following table shows a summary of the existing and potential areas of agricultural development in the lower Ruvu.

Ownership	Area		Irrigated Area		
	Potential (ha)	Planted (ha)	Designed (ha)	Actual (ha)	Future plan (ha)
Public	9,300	3,900	1,045	197	2,400
Private	7,550	30	-	-	220
Village	2,400	2,400	-	-	2,400
Total	19,250	6,330	1,045	197	5,020

Traditional irrigation and drainage in the Uluguru Mountain West

Irrigation in this area has been voluntarily commenced by the local people since 1960's. There exist 68 traditional unlined irrigation canal systems with total length of 170 km in Mgeta division. These systems irrigate some 2,000 hectares of vegetable farms in dry season. Each farmer owns 0.18 to 0.24 hectares of farm plot and cultivates vegetables throughout the year.

Irrigation canals, originated from permanent streams, convey irrigation water to each farm plot running along contour lines and crossing gullies for 2.5 km on an average. Canals are maintained and operated by farmer users' groups. However, their maintenance activities are limited to minor works such as canal re-excavation after rainy season, protection of intakes and leakage portions of canals by stones with clay bondage due to lack of budget, proper material and technical skills.

2.7.2 Water rights

Water rights registered for agricultural purposes total 43 nos. with total water amount of 4.5 m^3/sec as listed in Table G.3. As for the lower Ruvu, a total of 4 nos. with water amount of

1.0 m^3/sec are registered. However, the total amount of registered water rights dose not necessarily coincide with the agricultural requirement. For the proper management of the water resources, water measuring system, registration system and registered water amount should be reviewed and adjusted.

2.7.3 Problems identified

Lower Ruvu Valley

- Excessive floods

Excessive floods cause damage to paddy cultivation and some irrigation facilities. On the contrary, normal floods bring fertile soil from upper stream of the Ruvu River. Mitigation of excessive floods will be necessary to attain the low cost and effective irrigation development.

- Lack of farmers' knowledge on irrigation

Farmers in the lower Ruvu basin are lacking of knowledge on irrigation. The irrigation project could not succeed without training of farmers in irrigation farming and without establishment of well organized farmer users' group for future operation and maintenance activities required. The BIDP has been tackling on this problem through giving training to farmers on an experimental basis for these 6 years. This experimental farm is scheduled to be expanded to the pilot farm of 100 hectares which is under construction with the local budget and JICA assistance.

Middle Ruvu Valley

- Wildlife

The potential agricultural area in the right bank of the Ruvu River is adjacent to the Selous Game Reserve. It is forecast that agricultural production will be damaged by wildlife, harmful insects and diseases.

- Excessive floods

Excessive flood habitually occurs seriously in this area. Mitigation of excessive floods will be essential in case the agricultural development is contemplated in this area.

- Poor accessibility

There is no jeepable road in the agricultural potential area of the middle Ruvu. Even trunk road between Ngerengere to Mkulazi, headquarters of the ward which covers the potential area, is not passable in rainy season. Road improvement and construction of new road networks in the potential area will be necessary.

- Sparse population and insufficient infrastructure

Total population in the potential area was only 5,177 in 1988 census. Settlement program with sufficient basic infrastructure in line with agricultural development will be indispensable.

- Lack of farmers' knowledge in irrigation

No irrigation activities have taken place in this area. Thus, training of farmers will be also required in this area.

Upper Ruvu Basin

- Lack of potential area

The upper Ruvu area plays the role of a fruit basket for Dar Es Salaam. From climactic, ecological and engineering points of view, there is no room for extension of irrigation area.

Mgeta Plain

- Poor accessibility

Although this area has dense population, the road condition between Morogoro municipality to Kisaki railway station is hardly passable in rainy season.

- Lack of infrastructure

Basic social infrastructure such as dispensaries, schools and drinking water supply facilities are not sufficiently provided or deteriorated seriously. In order to activate farmers, infrastructure improvement program will be necessary.

Western slope of the Uluguru Mountains (Mgeta division)

- Soil erosion

In the long history of cultivation in this area, forests have been cleared and steep slopes have been utilized for vegetable cultivation. Intensive rainfall in rainy season causes soil erosion in farm plots and gully erosion in natural streams. These erosion problems result in siltation problem in the downstream area. Soil conservation program will be crucial in this area.

2.8 Livestock Farming

2.8.1 General condition in Tanzania

Livestock farming is a common basic agricultural activity since long ago. Traditionally landowners and individual farmers have raised various kinds of livestock such as cattle, goats, sheep, poultry, etc. Those livestock products, such as meat, milk, butter and hen eggs, are being mostly consumed by 25 million people providing important animal fat and protein to their diet.

However, livestock farming is mostly run by private business and individuals by utilizing abundant grass land sparsely populated without fixed pasture land surrounded by fences. In same cases of remote areas, livestock farming is carried out under a nomadic system like Arabians. The wide land of Tanzania with an area of approximately 950,000 km^2 allows such free grazing system until now. However, such free grazing method gradually devastates the

natural grass lands and becomes a constraint due to deforestation which is unfavorably needed for supplying lumber and fuel wood. Over-grazing also will cause heavier erosion of soil and higher evapotranspiration from ground surface, thus finally making land, soil and water conservation difficult. It is feared that desertification of the present green land would be accelerated in long future.

On the other hand, nomadic system does not contribute to food grain production because those people normally do not settle at fixed places and they do not cultivate any crop. The food self-sufficiency is one of the most important national economic development policies of the Government. In spite of much effort paid by the Government to increase the food grain production about 40 million US$ equivalent of food grains are still imported annually, which mainly consist of rice and wheat flour.

Thus the Government is trying to establish such settlement programme for those nomade to conserve land, soil, water and good vegetation as much as possible.

2.8.2 Present livestock production in Tanzania

Unfortunately no detailed national livestock statistics are available except one estimated by FAO. The FAO's Production Yearbook shows the estimated livestock and products as below;

Estimated Number of Livestock

(Unit: 1,000 heads)

	1987	1988	1989	1990	1991
Cattle	13,000	13,500	12,960	13,050	13,140
Goats	6,550	6,600	8,260	8,530	8,810
Sheep	4,500	4,700	3,540	3,560	3,560
Pigs	182	184	280	281	282
Asses	171	172	-	-	-
Chicken	29,000	30,000	18,000	19,000	20,000
Duck	3,000	3,000	1,000	1,000	1,000

As far as above table shows, it seems that the number of cattle under breeding is sufficient for supplying meat and other dairy products. However, it seems that other livestocks are still insufficient for the whole domestic consumption. Pigs may have same maximum limit because of high Moslem population which is said to be about half of 25 million people. It seems that the present number of pigs is far less than such limit. Chicken is far less than the market demand of meat and eggs.

The following table shows the FAO's estimates of livestock products:

(Unit: 1,000 tons)

Products	1987	1988	1989	1990	1991
Beef and veal	160	162	194	195	197
Goats' meat	18	18	21	21	22
Mutton and lamb	12	13	10	10	0
Pork	5	5	8	8	8
Poultry meat	27	28	23	24	25
Other meat	13	13	11	13	13
Total	235	244	267	271	275
Cows' milk	440	448	457	459	463
Goats' milk	63	63	79	82	85
Butter	3.9	4.0	4.1	4.2	4.3
Hen egg	59.6	61.6	36.0	38.0	40.0
Other egg	3.0	3.0	1.2	1.3	1.4
Honey	13.0	13.5	14.0	14.5	15.0
Cattle hide	32.6	33.1	39.4	39.7	40.0
Sheep skin	3.1	3.2	2.4	2.5	2.6
Goat skin	3.8	3.8	4.3	4.5	4.6

According to the trade statistics' negligible quantity of meat is imported or exported. Therefore almost all of the above products are consumed by 25 million people. Then the meat intake corresponds to about 30 gram per capita per day. In addition average fish meat intake is about 19 gram and egg intake amounts to about 6 gram per capita per day. The total animal food intake becomes 55 grams per capita per day which is not so sufficient but still at fairly good level among other developing countries.

In addition the FAO's estimate on the livestock products seem to be very conservative if compared with the total number of livestock. This fact implies that private home consumption may be very common in local areas. Therefore from the point of view of animal fat and protein intake on an average there seems no serious shortage problem except wide gaps between rich and poor people.

However in recent years the export bovine hide was rapidly increased from that in 1987 as shown in the following table;

Export of Livestock Products in Value

(Unit: Million Tshs.)

Commodity	1981	1982	1983	1984	1985	1986	1987	1988	1989
Bovine hide									
dry	3.7	2.8	0.4	7.4	13.1	14.3	60.3	145.3	250.6
wet	4.9	4.3	7.4	12.7	7.5	5.3	20.0	60.9	67.4
Goats' skin									
wet	12.4	10.2	5.2	6.5	4.8	2.0	0.0	5.5	5.5
Total	21.0	17.3	13.0	26.6	25.4	21.6	80.3	211.7	323.5

Therefore from the point of view of export promotion the cattle breeding will play an important role to earn foreign currency.

2.8.3 Present livestock production in the Ruvu River basin

Table G.4 shows statistics on number of livestock in 1984 to 1990, livestock products and consumption of animal food per capita per year in 1984 to 1988 in the Bagamoyo District, the Coast Region. From the Table, it can be estimated that an annual increase of number of cattle in Bagamoyo District was about 3.2 % during the past six years. In case of chicken meat product, an annual increase rate was about 3.3 % in the same six years. Based on the animal food consumption per capita per year, animal food consumption per capita per day is estimated as shown below;

Animal consumption per capita per day in Bagamoyo District

Commodity	1984	1985	1986	1987	1988
Total meat	0.7	5.2	3.4	3.2	2.9
Egg	5.5	0.5	4.1	3.9	3.1
Total	6.2	5.7	7.5	7.1	6.0

As far as above figures show, an average animal food consumption per capita per day in the Bagamoyo District is considerably lower than those of the national level.

Only limited information is available regarding livestock breeding in the Ruvu River basin. Table G.5 shows the present situation of the livestock grazing in the Ruvu River basin in Bagamoyo and Kibaha Districts. The increase rate of number of cattle in the basin is lower than that of entire Bagamoyo District.

Table G.6 shows the livestock grazing in the District of Morogoro Rural in the 1984 census. As seen in the Table, Kingolwira, Melela, Mlali, Kidugalo and Tununguo villages are producing large number of cattle . These villages are well known as the traditionally cattle producing villages in Morogoro Rural, with free grazing method enforced by the Masai people.

2.8.4 Livestock facilities

Existing livestock facilities in the Coast and Morogoro Regions are tabulated as follows;

Existing Livestock Facilities

Facilities	Morogoro	Coast
Slauterhouse	1	1
Hide Banda	1	0
Dips	5	22
Veterinary	0	6
Spray races	2	6
Bull center	0	1
Trial plot for pasture	0	1

Total 22 dips and 6 veterinary centers exist in the Coast Region, of which only two dips are operating at present. Other 20 dips and 6 veterinary centers require rehabilitation.

There are 6 spray races in the Coast Region but these spray races belong to parastal organizations. In the Morogoro Region, no veterinary and bull centers exist so that offices in charge are requested to provide those centers at proper locations therein.

2.9 Forest

2.9.1 Present conditions

The following table shows the forest reserve areas and forest non-reserve areas in the Coast and Morogoro Regions;

District	Forest reserve area (ha)	Forest non-reserve area (ha)
Bagamoyo	34,913	Unknown
Kibaha	52,634	22,273
Kisarawe	14,796	Unknown
Morogoro	181,000	1,744,000
Total	283,343	(1,766,000)

Forest is the second land use in terms of land area in the above Districts. More than 20 % of the total surface of the above four Districts is officially designated as forest reserve and forest non-reserve for commercial and domestic use. The forest reserves are managed by the Forestry Division of the Ministry of Tourism, Natural Resources and Environment and the forest non-reserves are under the jurisdiction of the District Counsel. Charcoal, firewood, logs and building poles are being produced by the wood merchants who are approved by the District Counsel .

2.9.2 Forest production

Table G.7 shows a tendency of the forest productions in the Districts of the Ruvu River basin for the period from 1985/86 to 1991/92.

According to the District Natural Resource Officer, about 15 years ago, the area between Mdaula village, Chalinzi Ward in the Coast Region and Kwembe village, Kibamba Ward in the Dar Es Salaam Region was covered by thick forest, but today the trees had been eliminated by timber and charcoal traders. However, Bagamoyo, Kibaha and Kisarawe Districts in the Coast Region will continue to be a major source of charcoal, firewood and house building poles for the Dar Es Salaam.

The charcoal and firewood productions in the Coast Region show a tendency to move the producing areas from the Kibaha area to the accessible forested areas of the Bagamoyo and Kisarawe Districts. If indiscriminate felling of trees is not arrested, these areas would turn into a gully wasteland like Mdaula and other villages in the vicinity. A lot of the forest reserves and forested areas are in need of afforestation. The Regional Natural Resource Office of the Morogoro Region has its own tree seedling nursery. This office supplied the tree seedlings to the villages and Wards in its jurisdiction for the period from 1981/82 to 1988/89. In 1989/90, this service was stopped due to lack of fund, and the seedling raising was restarted in 1992/93

but apparently the supply of seedling was inadequate to meet present requirement of villagers and reserves.

Production of tree seedlings in the Regional Natural Resources Office in Morogoro is as follows;

Year	No. of seedling
81/82	277,800
82/83	175,400
83/84	85,000
84/85	167,600
85/86	117,600
86/87	95,500
87/88	70,000
88/89	156,000
92/93	15,000

Source: Natural Resources Office in Morogoro.

2.10 Fishery

2.10.1 Present condition of fishery in Tanzania

(1) Production

The fishery in Tanzania is still in a primitive stage without much pisciculture but being mainly of catching fish from natural water bodies. The following table shows the annual catch records:

(Unit : ton)

	1987	1988	1989
A. Major fresh water (Sub-total):	297,494	331,013	318,576
Lake Victoria	159,915	218,443	207,456
Tanganika	93,729	62,736	59,494
Nyasa	30,009	37,055	34,525
Rukwa	8,120	5,683	8,941
Nyumba ya Mungu Dam	2,177	3,511	3,856
Mtera Dam	3,361	3,512	4,304
Industrial fish	183	74	-
B. Minor fresh water (Sub-total):	5,938	12,746	10,936
Arusha Region	1,018	4,285	1,115
Dodoma Region	1,311	974	1,404
Singida Region	2,136	-	5,311
Morogoro Region	685	2,721	2,184
Coast Region	350	1,737	516
Other Regions	438	3,029	406
C. Marine Water (Sub-total):	38,790	49,059	47,145
Coast Region	11,402	11,950	10,998
Dar Es Salaam	6,352	14,002	15,256
Others	21,036	23,107	20,891
Total	342,222	392,818	376,657

Source: "Agricultural statistics 1989" President's Office, Planning Commission, June, 1992

From the above table it is clearly seen that:

a. The fish consumption rate per capita in 1988 is as low as about 17 kg/cap./year leaving much latent demand unsatisfied.

b. Marine fish catch in Indian Ocean occupies in 1988, only 49,059 tons accounting for only 12.5% of the total catch of 392,818 tons. The fresh water fish catch mainly depends on over 10,000 fish ponds and many available lakes of large to medium size. Fishing is hardly conducted in rivers or fish ponds on a commercial base.

c. At present there is no fish feed industry.

(2) Marketing

No special market exists in the country especially for fresh water fish. Fishes are auctioned at the river and lake sides without marketing and storage facilities.

(3) Training and research

There are 3 fishery training institutes in the country:

Nyegezi	2 years certificate course
Kunduchi	2 years diploma course
Mbegani	specialized courses such as: - Marine engineering

- Boat building
- processing (fish).

Other minor training centers for fishermen existed at Liuli in Songea, Pangani in Tanga, Mara and Zamzibar, and most of them were abandoned.

Fishery research main center under TAFIRI (Tanzania Fishery Research Institute) is located at Kunduchi with sub-stations in Kigoma, Kyela, Mwanza and a very small station in Mara. In these centers, following 3 major programmers funded by external organizations are studied:

Lake Tanganika : the programme is to assess the fish resources in the lake and to come up with the recommendable annual catch in the area. This programme has been financed by FINDA (Finland Development Agency). It is an international research programme cooperated with lakeside countries, Zaire and Burundi.

Lake Nyasa : there is a SADC (Southern African Development Community) programme supported by ODA (Overseas Development Agency). This programme also involves the neighbouring countries, Mozambique and Malawi.

Lake Viktoria : the programme aims at strengthening fishery in the lake and also at looking into the environmental problems such as overpopulation of Nile perch and effect of aquatic weed flourishing in the lake. The programme is funded by EEC (European Economic Community).

2.10.2 Problem identified

The present fishery in Tanzania has many problems and constraints as summarized below, which need the improvement in a long-term and patient way to resolve;

a. Most of natural fish catches are carried out by at a small scale and by poor individual fishermen without big enterprises or organizations. It makes the fishing inefficient as compared with the case in the large-scale fisling. It naturally leads to very low labour return.

b. The natural conditions, such as temperature, available water bodies, wide land, available green manure or fish feed, etc. offer excellent conditions to breed fish especially for inland or fresh water fish. The Tanzanian Government recognized the above favourable conditions and has made efforts including studies and researches thereon. However, the financial difficulty has made much promotion of actual fishery development very difficult.

2.10.3 Recommendation

The aforesaid facts suggest the high possibility of fresh water fish culture in future. But at present no suitable facilities such as hatcheries for spawning and breeding of fingerlings, appropriate transportation trucks, fish feed producing factories, fish ponds, etc. are not available. Therefore those fresh water pisciculture needs to be studied and planned in an

integrated manner all over Tanzania in order to establish desirable and practical action programme. In parallel with the above national planning, a freshwater pisciculture center should be established for the purpose of the researches and trial breeding of adequate species. The Pisciculture Center (P.C.) is expected to be utilized mainly for the following purposes under the integrated administration ;

a) Researches to find the best-suited fish species for future pisciculture as well as to establish the most appropriate breeding techniques.

b) Training of pisciculture extension engineers and technicians and later those private fish breeders.

c) Trial hatching from spawns and their breeding to suitable size fingerlings to establish best breeding techniques to be extended. The most appropriate breeding calender, kinds and weights of fish feeds to be given, optimum number of fingerings to be bred in an unit size of pond, etc. need to be determined for different species. Also the disease and parasite control method shall be clarified.

d) It is desirable to attach a small fish feed production facilities at a simple level at first, such as green feed processing, etc. In addition, the factory shall be gradually enlarged according to the need to suffice the feed demand.

Based upon the above researches made in the pisciculture center, actual pisciculture development should be realized step by step. For example selection of suitable natural water bodies and artificial fish ponds at a small scale should be made under the close guidance of the concerned Governmental organization. On the other hand, some financial institution should be established to finance the initial cost required for construction of necessary facilities and some expenses at the initial stage, including expenses for purchase of feeds, fingerlings, nets, etc.

If the existing agricultural bank can manage such credit system and can cover the fishery sector, it should establish "Fishery Credit Development".

2.10.4 Conclusion

The recommendation mentioned above is the general and basic one for the future pisciculture for inland freshwater fish in the whole Tanzania. However in case of the Ruvu River basin, it seems that there exist no appropriate pisciculture sites except the downstream reaches as a result of the careful study on topography.

If some of the proposed dams are constructed in future there is a high potential for " lake fishery." However new reservoir artificially created may bring about several serious constraints as summarized in the following:

a) Artificial lake usually produces methane and ethane gas for about 10 years or more due to submergence of vegetation in the lake which may change the lake water quality for some time to a extent that it is not suitable for pisciculture.

b) In some cases, especially in sparsely populated upstream area, many wild animals which are fond of fish will increase and eat a lot of fish. This will hinder pisciculture therein.

c) Normally lake pisciculture shows very low fish catch rate per ha due to the difficulty in fish catch in wide area. Even though a sufficient fish catch can be made, the fish caught includes various species and different size and ages, which often have no commercial value.

Such lake pisciculture can not be recommended for every reservoir created artificially, although it might be worthy of long future planning.

The Ruvu River had wide swamps in the middle to the downstream reach. However those natural swamps offer very erratic water bodies, year by year, or even season by season, subject to flood and drought. Even though a number of fish may grow well due to the favourable natural conditions, there are two big difficulties for fish catching. One is densely growing reeds, which hinder fishing very much. Another difficulty is so bad accessibility due to flood and soft soil under the water. From the above reasons the utilization of natural water bodies in Ruvu River basin for pisciculture would not be viable for commercial operation aside from personal fishing for his home consumption.

Therefore only the artificial fish pond system can be recommended in the lowermost reaches. Even in the lowermost reaches the suitable sites are limited because pisciculture can not be carried out in habitually inundated areas. The ponds should be constructed at a slightly elevated land, which is protected from flood, allowing the easy gravity flow from the river in high water season. In some cases, due to the topographic condition, a fairly long channel is required to be constructed through excavation. If a pumping system is adopted, the maintenance and operation will face much difficulty in the estuary where there would be a possibility to operate pisciculture in brackish water. However there is no research and no past experience on brackish fishery. Therefore such pisciculture may not be realized in near future, but in remote future.

In the above context it is recommended that first of all a Pisciculture Center including a small scale of fish feed factory should be established under the integrated control of the concerned governmental organization with financial aid of some international organization or bilateral foreign aid.

3. PROSPECTIVE AGRICULTURAL DEVELOPMENT PLAN

3.1 Basic Concept for Agricultural Development

3.1.1 National irrigation policy

The "National Irrigation Policy" is a guideline for formulation of agricultural development plans. The plan has been prepared and finalized by the Irrigation Department of the Ministry of Agriculture. Although the final one was still under preparation during the study period, the direction of the policy could be derived from a draft paper thereof.

The policy intends to;

- reduce the government involvement in state farms through joint ventures of the Government and private sector investors,
- reduce the government intervention in irrigation development leaving new schemes for private sector, and
- introduce and spread low cost smallholder irrigation in order to increase rice production and to improve farmers' living standard.

With regard to development priority of the smallholder irrigation, serial discussions*4 have been made. In the discussions, criteria for selection of priority project have been formulated as follows;

Priority 1 : Rehabilitation or Upgrading of Existing Traditional Smallholders Irrigation Projects

Priority 2 : Construction of New Smallholder Schemes Based on Water Harvesting Technology

Priority 3 : Construction of New Smallholder Schemes Based on Phased, Minimum Disruption Scenarios

3.1.2 Basic concept

Taking into consideration of the National Development Programme, the National Irrigation Policy and agricultural condition in the basin, the agricultural development plan was* formulated on the basis of the following basic concepts;

Development of potential area to the maximum extent

The basin has an advantage of its location where the huge markets of Dar Es Salaam lie in the

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*4 : "Institutional Support to Irrigation Development working party on the future development of smallholder irrigation in Tanzania : Minutes of the 1 st Meeting, 21 Jan. 1993"
"A possible future strategy for irrigation development in the United Republic of Tanzania : Paper presented at a seminar on socio-economic aspects of irrigation development ISID, 24 Feb. 1993"

*

vicinity. The natural conditions such as soil, climate and topography are also favorable for agricultural production. In addition, huge potential area is left in the river basin. Under this favorable condition, the potential area should be developed as far as water resources are available.

Introduction of private funds for new development schemes

In order to minimize the development funds of the Government and make full use of economic viability of private sector, the private funds should be introduced positively to promote new large-scale agricultural developments.

Rehabilitation of existing schemes

In order to get immediate effects of development and to minimize the investment cost, rehabilitation of existing facilities, especially traditional irrigation systems, should be given high priority.

Support programme of smallholder schemes

In conformity with the national irrigation policy, the project which will encourage farmers of smallholder should be given high priority.

Introduction of gravity irrigation system

In order to reduce the operation and management cost of the project, introduction of gravity irrigation system should be designed so far as topographic condition permits.

3.2 Assessment of Land Resources

3.2.1 Potential areas identified in previous studies

Potential areas for agricultural development in the river basin were estimated in various reports previously prepared by FAO, French missions, etc. The location and area estimated in the reports are summarized in the following table;

Title of the Report	Potential area identified (Gross area in hectares)			
	Lower Ruvu	Middle Ruvu	Mgeta Plain	Total
- An Outline Plan for the Development of the Ruvu River (FAO, 1961)	11,600	93,600	67,200	172,400
- French Mission Report (1962)	56,000	56,000	33,600	145,600

These potential areas are selected on the basis of the topographic and soil conditions. The water resources, one of the essential factors, were considered to be sufficient for the areas at that time.

3.2.2 Potential areas identified in this study

The potential irrigation areas were preliminarily selected as a result of reviewal study of

previous reports, topographic maps at a scale of 1/50,000, reconnaissance survey along the river, result of soil analysis, study on environmental conditions, etc. The criteria applied for this selection are summarized as follows;

a) Assuming that the main crop to be planted is paddy, the area should be within the floodplain of the Ruvu River.

b) Soils should be suitable for agricultural production.

c) The areas should not lie near the National Parks and Game Reserves in order not to affect wildlife and natural conditions, and also to avoid damages to crops by wildlife.

The area and locations of potential irrigable areas preliminarily selected are tabulated below and illustrated in Fig. G.3.

Potential area identified (Gross area in hectares)			
Lower Ruvu	Middle Ruvu	Mgeta Plain	Total
24,000	30,000	30,000	84,000

3.3 Possible Agricultural Development Project Plans

Following 11 nos. of possible project plans are formulated on the basis of the potential land resources, soil conditions, the project priority ranking by FAO, the National Policy and requests from the Ministry of Agriculture and the regional offices.

1. Bagamoyo Irrigation Development Project
2. Low-lift Pump Irrigation Project
3. Makurunge Irrigation Project
   (Existing Pump Irrigation Schemes Rehabilitation Project)
4. Ruvu National Youth Irrigation Project
   (Existing Pump Irrigation Schemes Rehabilitation Project)
5. Kidunda Irrigation Project
   (Middle Ruvu Irrigation Development Project)
6. Ngerengere Irrigation Project
   (Middle Ruvu Irrigation Development Project)
7. Uluguru Mountain East Project
8. Mgeta Plain Irrigation Project
9. Mvuha Irrigation Project
   (Mgeta Plain Irrigation Project)
10. Mlali Irrigation Project
11. Uluguru Mountains West Project
    (Mgeta Traditional Irrigation Project)

Locations of these projects are depicted in Fig.G.4.

(1) Bagamoyo irrigation development project

Project description

- The Bagamoyo Irrigation Development Project was initiated in 1987 by introducing irrigated agricultural farming for rice cultivation along the Ruvu River basin.
- The potential area totals 2,000 hectares of which 1,000 hectares is planed to be irrigated by gravity irrigation system at the full development stage.
- The project construction works are divided into following three (3) phases.

Phase 1 : Experimental farm	:	8	ha (under operation)
Phase 2 : Pilot farm	:	100	ha (under construction)
Phase 3 : Full development stage	:	1,000	ha (proposed)

- In the phases 1 and 2, pumping irrigation is introduced on an experimental basis. As regards gravity irrigation system, the intake will be located at the NUWA's Lower Ruvu intake site.
- Proposed project works

The possibility of gravity irrigation system should be carefully examined in future study stage. Following project works are tentatively proposed assuming that the gravity system will be able to be constructed.

Main irrigation canal	:	11.5 km (1 no., Capacity : 2 m^3/sec)
Secondary canals	:	10 km
Secondary drainage canals	:	12 km
Improvement of intake weir improvement	:	1 no.
Width		3.5 m
Height		5.0 m
Type		Rubber Dam

(2) Low-lift pump irrigation project

Project description

- Low head lifting pump irrigation project is one of programme of the smallholder support irrigation project .
- Villagers of Kitonga, located on left bank of the Lower Ruvu Valley, made a request to the Ministry of Water, Energy and Minerals in 1993, supporting irrigated farming by pumps and farm machineries.
- Each irrigation scheme will be constructed on a small scale with temporary canals. Water will be supplied by a movable low-lift pump utilizing existing ponds as water resource, which are scattered in the floodplain

- Villagers will manage and maintain the pumps establishing water users' association.

Proposed project works

Pilot farm construction

Pilot farm	:	5 locations (size : 10 hectares)
Supply of pump unit	:	5 nos (Diameter : 150 mm)
Total head	:	10 m (HP : 15 - 18)
Capacity	:	55 (lit/sec)
Repair shop	:	1 no.
Supply of farm machinery	:	3 nos.

(3) Ruvu National Service Rice Irrigation Project

(Existing pump irrigation schemes rehabilitation project)

Project description

- The project was established in 1970 under the Chinese assistance for the purpose of training of youth in irrigated agricultural farming.
- The project faced the serious problem in terms of shifting the Ruvu River channel in 1976 and 1978. The pump station has not been utilized since then.
- Project area

Potential Area	:	800 ha
Designed area to be extended	:	200 ha
Area to be rehabilitated	:	24 ha

- The project aims at rehabilitation and reconstruction of the following facilities.

Proposed project works

Pumping station	:	1 no.
Irrigation and drainage system	:	176 ha
Rehabilitation of existing system	:	24 ha
Main canal	:	5 km
Secondary canal	:	4 km
Secondary drainage canal	:	4 km

Rehabilitation of existing dyke system

(4) Makurunge Irrigation Project

(Existing pump irrigation schemes rehabilitation project)

Project description

- The project area is located on the left bank of the Ruvu River just downstream of the Bagamoyo-Makurunge road ferry port.
- The project was constructed in line with the national irrigation programme in 1972/73. However, the project area had chronically suffered from damage by flooding and lack of project fund, and was finally abandoned in 1987.
- At present, farmers in Makurunge village perform cultivation under the rainfed condition.
- The project aims at rehabilitation and reconstruction of the following facilities.

Potential Area	:	150 ha
Pump station	:	1 no.
Canal construction	:	2 km

(5) Kidunda irrigation project (Middle Ruvu irrigation development)

Project description

- The project has vast potential land of 30,000 ha for irrigation development. The area stretches on the both banks of the Ruvu River between the proposed Kidunda dam and the confluence of the Ruvu and Ngerengere Rivers. Out of the potential area, the left bank of 15,600 ha is selected as a priority area.
- The area is located in the Ruvu river floodplain, and chronically suffered from damage by flooding, wildlife and numerous harmful insects.
- Taking account of the large project size and sparse population in the area, it is worth considering introduction of funds from private sector.
- Proposed project works

Left main canal	:	50 km
Main drain	:	30 km
Secondary canals	:	130 km
Secondary drainage canals	:	75 km
Rehabilitation of trunk rural road	:	85 km
On-farm development	:	15,600 ha
Land preparation for settlement	:	5 locations

(6) Ngerengere irrigation project (Middle Ruvu irrigation development)

Project description

- Judging from the topographic condition, the project has a potential area of 5,000 ha for irrigation development. The area stretches on the right bank of the Ngerengere River just downstream of the proposed Negerengere Dam. The proposed irrigation area is close to the Kidunda irrigation project area.
- The proposed irrigation area is left as a wasteland at present.
- Proposed project works

Main Canal	:	11 km
Main drainage canal	:	6 km
Secondary canals	:	17 km
Secondary drainage canal	:	19 km
On-farm development	:	2,500 ha

(7) Uluguru mountain east project

Project description

- Th project area is characterized by its fruit production, especially orange. The proposed project area spreads out on the eastern slope of the Uluguru Mountains where the Ruvu River originates.
- From the viewpoint of the watershed management, afforestation should be properly scheduled.
- Proposed project works

Watershed management	:	10,500 ha
Rehabilitation of the trunk rural road	:	40 km
Construction of fruit sorting and packing facilities	:	1 location

(8) Mlali irrigation project

Project description

- The potential area totals 400 ha of which 150 ha was developed by WIID in 1954.
- One weir and five (5) secondary irrigation canals and five (5) secondary drainage canals were constructed in 1961.
- At present the irrigation system does not work because of serious sedimentation at the weir site and deterioration of irrigation facilities. These facilities require rehabilitation works.

- This project has the high priority in the Morogoro regional development progamme.

- Proposed project works

Irrigation and drainage system	
Intake weir	1 no.
Main canal	2 km with lining
Secondary irrigation canals	10 km
Drainage canals	9 km
Related drainage structure	1 no.

(9) Mgeta plain irrigation development project

Project description

- The potential area of 25,000 ha spreads over the both banks of the Ruvu River. The left bank area of 3,500 ha is presently cultivated with paddy in the low-lying area and with cotton, maize and sorghum in the flat hills at the foot of the Uluguru Mountains.

- The development of the left bank area depends upon the construction of the planned Mgeta Dam. A series of small dams on seasonal streams will not be useful for the irrigation development because of unstable water resources.

- Proposed project works

Main canal	40 km
Main drainage canal	3 km
Secondary canals	70 km
Secondary drainage canals	30 km
On-farm development	7,000 ha

(10) Mgeta plain Mvuha irrigation project

(Middle Ruvu irrigation development)

Project description

- The project area stretches along the Mvuha River. According to the agriculure office in Morogoro, the area is estimated to be some 5,000 ha.

- Basic data such as river discharge records are not available concerning the area. Therefore, basic data collection should be started prior to the commencement of a feasibility study on the project.

(11) Uluguru mountain west project

(Mgeta traditional irrigation project)

Project description

- Vegetables are widely planed on the steep slopes of the Uluguru Mountains. Forest has been cleared and developed by farmers without any control. It is feared that the forest will disappear through the planless deforestation and that consequently chronic soil erosion problem will take place.
- The Mgeta River, one of major tributaries of the Ruvu, originates from the area. In order to conserve the drainage basin of the river, watershed management is essential.
- The trunk road between Mlali and Kikeo requires the rehabilitation for the smooth operation of watershed management project. Out of the total road length of 42 km, the trunk section of 20 km long between Mlali and Langali should be improved in earlier stage.
- Proposed project works

  Afforestation in the area
  Improvement and rehabilitation of existing irrigation system for erosion control
  Number of systems 68 nos.
  Total canal length 170 km
  Soil conservation area 2,000 ha
  Improvement of accessibility
  Trunk rural road 42 km (Mlali - Langali 20 km)
- The traditional irrigation systems in the project area are listed in Table G.9.

The general features of these projects are summarized in Table G.8.

3.4 Priority Ranking Study

3.4.1 General

The Ruvu River basin has vast potential for agricultural development. However, limitation of development fund and available water resources require stage-wise development based on the priority of the proposed projects. In order to estimate the project priority, above mentioned 11 projects are evaluated from various aspects.

3.4.2 Criteria for selection of priority project

For the purpose of selection of the priority project(s), the Study Team prepared the following four (4) major selection criteria accompanied with various factors:

(a) Conformity with the Government policy

The Government of Tanzania introduced free marketing system in 1989/90. In line with the new national economic policy, the Irrigation Department of the Ministry of Agriculture has prepared a new irrigation policy referring to the project ranking made by ISID*5. Under this circumstances, keeping conformity with the national policies is crucial for formulation of the future development plan. The Government policy considered for the priority study comprises those stated in the following documents;

- Long Term Perspective Plan 1981 - 2000
- National Irrigation Policy (draft)
- Priority Project Ranking Study by ISID

(b) Socio-economic aspect

In case the project area is located in the densely populated area, the settlement programme with construction of basic infrastructure will bacome necessary in parallel with irrigation development. Quality life pertains mostly to access to social services such as dispensary, etc. Without the good accessibility and basic infrastructure, the project would not be attractive to local people. The socio-economic aspect was assessed by the following factors;

- Population served
- Accessibility

(c) Technical aspect

Technical aspects are assessed by the availability of water resources, suitability of soil condition and that of water quality for irrigated agricultural farming. In addition, the easiness for implementation was evaluated by the current situation of the proposed project area. Thus, the technical aspect was assessed in consideration of the following;

- Water resources
- Soil condition
- Water quality
- Easiness for implementation

(d) Economic Aspect

The economic viability of the project is an important factor to judge whether the project should be implemented. Unit construction cost per hectare is a common factor to evaluate the appropriateness of the project cost. In this study, the ratio of total benefit to total cost (B/C ratio) is simply calculated dividing total benefit by total finacial cost in order to compare with the economic advantages of the projects one another. The economic aspect was assessed by the following economic indices;

- Construction cost
- Benefit
- Total benefit / Total cost ratio

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*5 ISID stands for "Institutional Support to Irrigation Development", which is the FAO/UNDP project.

3.4.3 Project cost estimate

Construction cost of each possible project on a maximum scale was preliminarily estimated for the purpose of selection of the priority project. Prior to the cost estimate, the irrigation and drainage system for each project was designed on a preliminary basis to estimate the work volume.

a. Preliminary layout plan of irrigation and drainage canal system

The layout plan of main and secondary canals was prepared based on the topographic maps at a scale of 1/50,000 for each possible project. In the layout plan, existing natural streams and rivers are planned to be utilized as drainage canals as much as possible. The general layout plan of each project is illustrated in Fig.G.5.

b. Design discharge

The design discharges of irrigation canals and related structures are calculated based on the unit water requirement, cropping patterns, crop intensities and the adjustment factor applying the USBR design standard.

Following table shows the adjustment factor applied to this study :

Area (ha)	Adjustment Factor
20 - 50	3.00
50 - 100	1.75
150 - 250	1.20
250 - 500	1.15
500 - 1,500	1.10
1,500 - 2,500	1.05
2,500 and greater	1.00

Source: USBR

The unit irrigation water requirement and assumed cropping patters and crop intensities for each of the three zones are calculated as follows;

Zone	Dry Season	Rainy Season	Design discharge	Unit water requirement (peak in dry season)
Lower Ruvu	Paddy (40%) Maize (20%)	Paddy(100%)	1.65 lit./ha	1.25 lit./ha
Middle Ruvu	Paddy (20%) Maize (40%)	Paddy(100%)	1.86 lit./ha	1.15 lit./ha
Upper Ruvu	Paddy(20%) Maize(40%) Cotton(40%)	Paddy(20%) Maize(40%)	1.02 lit./ha	1.02 lit./ha

Unit water reuirement in each zone is calculated as shown in Table G.10.

The design discharge of drainage canal is estimated at 3.5 lit./sec/ha for field and 5.0 lit/sec/ha for hilly and mountainous areas taking into consideration design rainfall and duration of on-field storage of excessive water.

c. Canal lining

Since no site survey along the proposed canals are carried out, data on percolation of the canals are not available. Taking this condition into account, concrete canal lining is designed for 10% of the total length of the major irrigation canals and no canal lining for secondary canals

d. Related structures

Required numbers of canal related structures are assumed based on the following standard;

Structure	Density
Main canal related structure	
Turnouts (outlet)	as per required by the canal layout
Regulator	an interval of 5km
Syphon	an interval of 10km
Culvert/Cross drain	an interval of 2km
Spillway	an interval of 4km
Secondary canal related structure	
Turnouts (outlet)	as per required by the canal layout
Regulator	an interval of 2km
Syphon	as per required by the canal layout
Culvert/Cross drain	an interval of 1km
Spillway	an interval of 4km

e. Work quantity

The work quantity is calculated for each of the major work items such as earthwork and concrete work. The work volumes of main and secondary system are calculated based on the canal layout plan. As for the on-farm canal system, work quantity is calculated based on the standard design applying a constant canal density of 80 m/ha. The work quantities of structures are calculated using standard design of various types of structures.

f. Unit construction cost

Since no construction cost data on the irrigation projects in the basin are available, the unit cost of the "Kitivo Irrigation Project - Lusoto, Tanga " is applied to estimate construction costs of irrigation and drainage works. Cost data on improvement and rehabilitation of rural road were collected from the Ministry of Works. These cost data are listed in Table G.11.

g. Project construction cost

The total project construction cost comprises direct construction cost, and costs for land acquisition, O&M equipment, administration (office and quarters), engineering services, physical contingency. The price contingency is not included in this project construction cost .

The project construction costs of the possible projects are summarized as follows;

Project Title	Const. Cost (Million Tshs)	Total Cost (Million Tshs)	Unit Cost per ha (US$)
Bagamoyo Irrigating Development	1,371	1,768	3,543
Low-lift pump irrigation (Pilot Farm)	57	72	3,135
Makurunge irrigation	206	266	3,850
Ruvu National Youth Irrigation	420	540	5,875
Kidunda Irrigation	20,120	25,949	3,605
Ngerengere Irrigation	2,969	3,829	3,398
Uluguru Mountain East	4,801	6,191	5,130
Mlali Irrigation	583	752	4,089
Mgeta Plain Irrigation	9,091	11,725	3,641
Mgeta Plain Mvuha Irrigation	4,291	5,534	3,437
Uluguru Mountain West	3,195	4,121	4,479

The detailed cost breakdown for each project is shown in Table G.12.

h. Benefit

Net incremental benefit of the project is defined as the difference between the net production value under "with project" condition and the production value under "without project" condition. The net production value is further defined as the difference between the gross production value and the crop production costs in both "with project" and "without project" conditions

The benefit by project is shown in Table G.13.

3.4.4 Selection of priority projects

The weights are applied to represent the importance of each factor as shown in Table G.14. As a first step, scoring for each factor is carried out taking account of the current project site conditions and study results. As a second step, further evaluation is made to categorize the proposed projects into 3 classes, namely Class A, B, C. Each class has the flowing priority.

Class A : High Priority
Class B : Priority
Class C : Low Priority

Following table shows the result of the priority ranking study.

Project	Total Score	Class
1. Bagamoyo Irrigation Development	71	A
2. Low-lift pump irrigation	65	A
3. Makurunge irrigation	59	B
4. Ruvu National Youth Irrigation	42	C
5. Kidunda Irrigation	52	B
6. Ngerengere Irrigation	51	B
7. Uluguru Mountain East	53	B
8. Mlali Irrigation	64	A
9. Mgeta Plain Irrigation	49	C
10. Mgeta Plain Mvuha Irrigation	48	C
11. Uluguru Mountain West	73	A

The detailed evaluation sheet is presented in Table G.15.

3.4.5 Assessment of the project priority

(1) High priority project

The proposed projects can be divided into the following two types:

Type I : Dam related project

Type II : Project which is independent of water resources development scenario

As a result of the priority ranking study, following 4 (four) projects are selected as the high priority projects :

1. Bagamoyo Irrigation Development Project
2. Low-lift Pump Irrigation Project (Phase I : Pilot farm construction project)
3. Mlali Irrigation Project
4. Uluguru Mountain West Project (Mgeta traditional irrigation)

Among these projects, the Bagamoyo development and Low-lift Pump Irrigation projects in the Lower Ruvu are categorized into the Type I project. The Type I projects need water supply from proposed dam(s) for irrigation in the dry season. In this context, the Type I projects will be implemented after construction of the proposed Dam(s).

On the other hand, the Mlali Irrigation and Uluguru Mountain West projects are planned to intake irrigation water from a tributary of the Ruvu River or small streams in the Uluguru Mountains. These projects are categorized into the Type II project, which will be able to be implemented independently of construction of the proposed dam(s).

In addition, the Mlali Irrigation and Uluguru Mountain West Project projects have important roles as pioneer projects in promotion of gravity irrigation, selling water to private sector and giving support to smallholder irrigation. Taking all above into consideration, we recommend that the Mlali Irrigation and Uluguru Mountain West projects should be implemented prior to construction of the Type I project.

It is also recommendable that a feasibility study on the Mlali Irrigation and Uluguru Mountain West projects should be conducted at the same time as a single package taking into consideration of their project scales, neighboring location and the common problems of soil erosion in the Uluguru West area and sedimentaion at the Mlalai intake site.

The recomendable stage-wise implementation plan by project type are summarized below;

	Type I project	Type II project
1st Step	Dam Construction	Mlali irrigation Uluguru Mt. West
2nd Step	Bagamoyo Irrigation Development Low-lift Irrigation	
3rd Step	Kidunda Irrigation Ngerengere Irriagtion Mgeta Plain Irrigation	Uluguru Mt. East
4th Step	Makurunge Pump Irrigation Ruvu National Youth Irrigation	Mgeta Plain Mvuha Irrigation

3.5 Agricultural Development Scenario

3.5.1 Available water resources

Available discharges in dry season for the irrigation purpose are 12.27 m^3/sec in the scenario-1 and 0.23 m^3/sec in the scenario-2, respectively.

Scenario	Dam/Reservoir to be constructed	Available Discharge for Irrigation (m^3/sec)
Scenario-1	Kidunda	12.27
Scenario-2	Ngerengere + Mgeta	0.23

3.5.2 Agricultural development plan for scenario-1

(1) Development plan for scenario-1

Development of Dam related project

In the scenario-1, projects located downstream of the Kidunda reservoir will be targeted. In order to develop all these project areas to the maximum extent, total water demand will amount to 16.4 m^3/sec in dry season. On the other hand, available water amount constantly released from the Kidunda reservoir is estimated at 12.27 m^3/sec.

Therefore, an area equivalent to 4.13 m^3/sec of water should be limited in terms of the cultivation in the dry season. In the rainy season, water amount released from the Kidunda reservoir is sufficient for irrigation of the whole area. Judging from the project priority, required project cost and project scale, reduction of 5,100 ha of the Kidunda irrigation project area from the maximum development is recommendable.

Maximum Development Case				Revised Plan	
Project title	Project Area (ha)	Unit Water Requ. (l/sec)	Water demand (m^3/sec)	Project Area (ha)	Demand (m^3/sec)
Kidunda Irrigation	15,600	1.15	17.94	10,500	12.07
Bagamoyo Irrigation Development	1,100	1.25	1.38	1,100	1.38
Low-lift pump Irrigation	2,400	1.25	3.00	2,400	3.00
Ruvu National Youth Irrigation	200	1.25	0.25	200	0.25
Makurunge Irrigation	150	1.25	0.19	150	0.19
Total	19,450		22.76	14,350	16.89
Irrigation water right counted by scenario			-1.00		-1.00
Return flow from Kidunda Irrigation (30% of intake water amount)			-5.38		-3.62
Water Demand of Irrigation			16.38	Revised =	12.27

(2) Implementation Program for scenario-1

Development of Dam related project

The Bagamoyo Irrigation Development project, the highest priority project, should be implemented immediately after construction of the Kidunda Dam.

It is likely that the Kidunda irrigation project will become a compensation area for the villagers in the proposed reservoir area of the Kidunda dam. In such case, the Kidunda irrigation project should be implemented in parallel with the construction of the Kidunda dam.

The low-lift pump irrigation project has also the high priority. For the smooth operation of this type of the project, establishment of water users association of farmers is essential. Therefore, the project should be started on a pilot scale of 50 ha after construction of the Kidunda dam.

Proposed implementation program for the scenario-1 is depicted in Fig. G.6.

(3) Project cost and benefit of scenario-1

The project cost and benefit are estimated as follows;

Project title	Project Area (ha)	Project Cost (Million TSHs)	Benefit (Million TSHs/Year)
Type I project (Kidunda dam related project)			
Kidunda Irrigation	10,500	17.416	2.009
Bagamoyo Irrigation Development	1,100	1.768	0.248
Low-lift pump Irrigation	2,400	3.461	0.441
Ruvu National Youth Irrigation	200	0.540	0.045
Makurunge Irrigation	150	0.266	0.030
Total	14,350	23.451	2.773
Type II project (Independent project)			
Mlali Irrigation	400	0.752	0.068
Uluguru Mountain West	2,000	4.121	1.189

3.5.3 Agricultural development plan for scenario-2

(1) Development plan for scenario-2

Development of Dam related project

In the scenario-2, only the Bagamoyo irrigation development project with highest priority can be implemented using existing water rights of the abandoned projects.

Maximum Development Case				Revised Plan	
Project title	Project Area (ha)	Unit Water Requ. (l/sec)	Water demand (m^3/sec)	Project Area (ha)	Demand (m^3/sec)
Mgeta Plain Irrigation	7,000	1.02	7.14	0	0.00
Ngerengere Irrigation	2,450	1.15	2.82	0	0.00
Bagamoyo Irrigation Development	1,100	1.25	1.38	980	1.23
Low-lift pump Irrigation	2,400	1.25	3.00	0	0.00
Ruvu National Youth Irrigation	200	1.25	0.25	0	0.00
Makurunge Irrigation	150	1.25	0.19	0	0.00
Total	13,300		14.78		1.23
Irrigation water right counted by scenario			-1.00		-1.00
Return flow (30% of intake water amount)			-2.99		0.00
Water Demand of Irrigation			10.79	Revised =	0.23

(2) Implementation Program for scenario-2

The proposed implementation program for the scenario-2 is shown in Fig. G.6.

(3) Project cost and benefit

The project cost and benefit are estimated as follows;

Project title	Project Area (ha)	Project Cost (Million TSHs)	Benefit (Million TSHs/Year)
Type I project (Dam related project)			
Bagamoyo Irrigation Development	980	1.575	0.221
Type II project (Independent project)			
Mlali Irrigation	400	0.752	0.068
Uluguru Mountain West	2,000	4.121	1.189

APPENDIX-G

TABLES

Table G.1 IRRIGATION AREA IN TANZANIA

Region	Potential Area (ha)	Present Status			
		Pre-Feasibility (ha)	F/S Completed (ha)	Under Construction	Under Irrigation
Arusha	19,520	5,030	0	530	8,280
Coast	73,131	65,221	1,881	1,231	693
Dodoma	6,298	6,572	5,788	2,176	2,137
Dar-Es-Salaam	2,898	15	15	0	131
Iringa	14,845	2,540	2,540	170	1,607
Kagera	13,840	1,506	1,245	40	122
Kigoma	4,770	4,310	3,040	0	658
Kilimanjaro	45,030	16,405	4,310	0	14,790
Lindi	2,447	784	214	73	505
Mara	24,360	12,588	5,228	2,129	1,943
Mbeya	39,200	27,890	16,070	6,551	6,632
Morogoro	24,710	300	3,000	100	8,217
Mtwara	10,380	1,516	956	0	2,917
Mwanza	2,087	1,881	1,789	0	233
Rukwa	3,427	402	102	2	878
Ruvuma	2,356	170	0	0	18
Shinyanga	16,956	9,815	225	132	7,843
Singida	71,428	1,645	1,645	20	20
Tabora	25,800	3,045	2,860	932	3,034
Tanga	9,542	8,795	1,370	527	8,005
Total	413,025	170,430	52,278	14,613	68,663

Source : Irrigation Department , Ministry of Agriculture , Feb. 1992