UNITED REPUBLIC OF TANZANIA

MINISTRY OF AGRICULTURE AND FOOD-SECURITY

RIVER BASIN MANAGEMENT AND SMALLHOLDER IRRIGATION IMPROVEMENT PROJECT (RBMSHIP)

SMALLHOLDER IRRIGATION IMPROVEMENT COMPONENT

MAHENGE IRRIGATION SCHEME

ENVIRONMENTAL AUDIT

CRAFT REPORT

October 2003

Environmental Resources Consultancy
Consulting environmental conservation, natural resources management and capacity building

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ACKNOWLEDGEMENT

The team wishes to acknowledge with thanks the contributions of various staff members of the Ministry of Agriculture and Food Security’s Directorate of Irrigation and Technical Services, during the different stages of the preparation of this report: the Project Coordinator of Smallholder Irrigation Improvement Project, Mr. Masija; the Head of Environmental Unit Cell, Mr. Simukanga, and other staff. The team also extends its appreciation to the District Officers, in particularly the irrigation technicians who are in charge of the eight schemes, at Arumeru, Moshi Rural, Simanjiro, Korogwe, Iringa Rural and Mbarali Districts.

Thanks also go to the scheme management committees, farmers and other stakeholders of the eight schemes and the community members who actively participated in the discussions and helped to provide information that was very useful during the preparation of the Environmental Audit.

The team appreciates to more than 50 people who participated in data collection and analysis, especially the facilitators, research assistants, enumerators, water and soil staff, data analysts, etc. Last but not least, our appreciations go to ERC’s internal staffs who directly or indirectly contributed with enthusiasm to the EA reports.
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EXECUTIVE SUMMARY

The Government of Tanzania (GoT) through the Ministry of Agriculture and Food Security (MAFS) has taken various initiatives to improve agricultural sector in the country. One of these initiatives is undertaking the River Basin Management and Smallholder Irrigation Improvement Project (RBMSIIP); in context with which, is the Smallholder Irrigation Improvement Component (SIIC). Among others, the need to undertake the RBMSIIP arose out of a nation-wide realisation that the ecosystems of country’s river basins (especially those of the Rufiji and the Pangani Rivers) are not being properly managed, leading to extensive environmental degradation and loss of potentialities of these vital ecosystems. Moreover, it was also realised that in view of the above-mentioned loss of potentiality, smallholder traditional irrigation schemes are the worst affected; hence the need arose to undertake also the SIIC.

Support to smallholder traditional irrigation improvement and rehabilitation is, therefore, one of the major components of this RBMSIIP programme. The SIIC component focuses on improving management of water resources and crop husbandry practices in existing smallholder irrigation schemes. This can be achieved, among others, through improvement of natural resources, land and water, during implementation of the rehabilitation and upgrading of irrigation schemes. SIIC is geared at improvement of water management in smallholder irrigation schemes to ensure sustainable use of land and water resources and ultimately yield increase with minimal environmental degradation.

Under the auspices of the SIIC both the Scheme Environmental Assessment (SEA) as well as an Environmental Audit (EA) was carried out for the Mahenge Irrigation Scheme. Among others, the assessment and the audit were based on the Initial Environmental Assessments (IEE) studies carried out by the Environmental Cell Unit (ECU) of the Irrigation Section of the MAFS. This report presents the findings of the study.

The objective of the study was identifying changes that have taken place before/after scheme improvement, assessing and quantifying thereto environmental and social impacts, also duly preparing an environmental and social management plan as well as developing an environmental and social management and monitoring system. According to the ToR the expected outputs of this study are two in one interrelated reports i.e. covering both Environmental Audit (EA) as well as Scheme Environmental Assessment (SEA), analysing e.g. socio-economic, socio-cultural and engineering factors in order to provide quantitative information.

Furthermore, the report incorporates an assessment of compliance of the scheme’s improvement to the Tanzanian policy and legislation framework, as well as the World Bank’s relevant environmental safeguard policies (especially on OP 4.01).

Different methodologies were employed to carry out the task, including the following:

- Desk review of recommended documents
- Questionnaire administration to key stakeholders
- Participatory Rural Appraisal (PRA)

At different stages of the study the following approaches and analytical tools were applied

- Participatory data collection
- Key informant interview
- Trend analysis
- Geographical information system

Describing the location of the scheme, the study found that the Mahenge irrigation scheme lies down-stream of the Lushoto highlands about 17 km north-east of Korogwe township. Its coordinates are latitude 5°00’ South and longitude 38°30’ East, and are at an altitude of about 300m above mean sea level. It comprises the following villages: Kwanndolwa, Lombei, Mianzini, Kerenge, Lusungu, Kwandulu, and Darajani.

Villages around the Mahenge irrigation scheme have a total population of -------- people. The main ethnic groups in the scheme area are Wabondei, Wasambaa, Wapare and other smaller groups. The majority of these are agriculturalists. Few are livestock keepers.
The land use in the adjacent villages of Mahenge scheme is mainly irrigation as well as rain-fed cultivation and grazing.

The source of irrigation water for the Mahenge scheme is the Mkole/Bululu River, which unfortunately is not gauged. During design stage of the scheme there existed 37 years of river flow record of the Lwengera River at Korogwe ganging station. This was analysed and used to estimate river discharged at the Mahenge scheme. Dependable discharge in 5 dry year water available at the Mahenge scheme was at peak May/June/July/August (0.38, 0.50, 0.47, 0.38) cumecs but was lowest in Nov/Dec/Jan/Febr (0.14, 0.14, 0.13, 0.12) respectively.

Water abstractions by upstream users for domestic purposes, irrigation and livestock are likely to impact on the quality and quantity of water available to the scheme. Poor farming practices, especially cultivation of crops close to the riverbanks, is increasing silt load in the river and causing siltation of the irrigation structures.

The availability of good domestic water supply, coupled with good sanitation at Mahenge will considerably reduce downstream water pollution from domestic uses. Drained water from the scheme area is likely to be contaminated from activities carried out in the scheme area, including application of agro-chemicals, and sharing irrigation water with livestock. The on-farm activities will thus form the main source of pollution downstream.

Conflicts over water use have been recorded in the study area, especially in the dry season when river flows are at the lowest.

In the past say 10 years, fuel wood was obtained in the nearby forests. Deforestation for firewood, opening of new farms and uncontrolled wild fires have led a much decrease in forest areas.

With the irrigation structures improvement and prospects for higher income earnings from irrigated agriculture, there is greater loyalty to the leadership of Water Associations. Since most of the people are irrigators and members of the associations, the latter has greater influence beyond irrigation matters.

The following are some of the positive effects:

- Water availability has improved with more areas obtaining water than used to be in before improvement.
- Strengthening the existing Water Users Association.
- Temporal employment opportunities were created during the construction phase.
- Some farmers have attended on farm training and exchange visits to other areas to share experience with other farmers as well as learning new skills.
- The project has brought about improvement in water availability distribution and management.
- Crop production has improved a great deal

A summary of identified impacts differentiated at up-stream, down-stream and within scheme levels for resulting from Chapter 7 and appropriate mitigation measures are summarized in the Environmental and Social Management Plan as follows:

<table>
<thead>
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<th>ENVIRONMENTAL AND SOCIAL IMPACTS</th>
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<tr>
<td><strong>Up-stream impacts:</strong></td>
<td><strong>Category: Environmental Management:</strong></td>
</tr>
<tr>
<td>- Demographic trend (population changes)</td>
<td>- Promoting agro-forestry agricultural practices, coupled with afforestation and or reforestation program,</td>
</tr>
<tr>
<td>- Catchment degradation</td>
<td>- Strengthening enforcement of abstraction regulations</td>
</tr>
<tr>
<td></td>
<td><strong>Category: Enhancement of social-economic activities:</strong></td>
</tr>
</tbody>
</table>
Promoting environmental consciousness in all social-economic activities,
- Strengthening mechanisms for controlled acquisition and of land use-related social-economic practices,

**Downstream impacts:**
- Reduced water quantity
- Increased incidences of waterborne diseases
- Poor water quality

**Category: Environmental Management:**
- Establishment of mechanism for resolution of water conflicts.

**Category: Enhancement of social-economic activities:**
- Promoting irrigation agriculture as a potentially useful socio-economic activity for all age groups and gender
- Preparing and implementing a participatory land use plan (i.e. PLUM)

**Category: Improving health situation**
- Promoting awareness on waterborne diseases, as well as HIV/AIDS
- Improving availability of health, water and sanitation services.

**Irrigation scheme level impacts**
- Sand at intake structure
- Reduced water availability for irrigation
- Poor soil and water quality
- Fertilizers and pesticides use
- Increased incidences of waterborne diseases

**Category: Environmental Management**
- Promoting up-stream soil and water conservation activities and environmental protection program in general,
- Establishing effective water management system, namely: e.g. controlled allocation and distribution of water
- Promoting/providing education on appropriate irrigation practices on application of IPM and ISFM
- Establishing enforcement mechanisms on abstraction rights

**Category: Revisiting engineering designs and/or construction stages**
- Reviewing designs and construction to address arising siltation/sedimentation problems
- Establishing modalities for rehabilitation of destroyed structures

The monitoring program comprises the following attributes: water quality, groundwater, soil conservation, biodiversity, crop diseases, afforestation, socio-economic and health indicators
Additionally, the environmental audit main conclusions and recommendations are:

In up-stream areas of the scheme, the key issues constraining sustainability are increased soil erosion coupled with lack of soil and water conservation activities as well changes of the river's hydrological and hydraulic regime. In within-scheme areas the constraints are general poor soil fertility coupled with land hoarding practices. In down-stream area sustainability is mainly constrained by inadequacy of skills/knowledge of the farmers on appropriate irrigation practices.

One of the main recommendations is most of the identified mitigation measures are related with local community-based effective structural-organization. This means therefore that most of the measures can be implemented by local government authorities themselves with financial and technical assistance of funded projects e.g. RBMSHIP, NGOs and CBOs.
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<th>Description</th>
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<tr>
<td>NMA</td>
<td>National Meteorological Agency</td>
</tr>
<tr>
<td>MWLD</td>
<td>Ministry of Water and Livestock Development</td>
</tr>
<tr>
<td>a.m.s.l</td>
<td>Average mean sea level</td>
</tr>
<tr>
<td>SCAPA</td>
<td>Soil Conservation and Agro-forestry Project</td>
</tr>
<tr>
<td>SIRSC</td>
<td>Shamima Irrigation Rural Savings and Credit Society</td>
</tr>
<tr>
<td>DALDO</td>
<td>District Agricultural and Livestock Development Officer</td>
</tr>
<tr>
<td>WEO</td>
<td>Ward Executive Officer</td>
</tr>
<tr>
<td>VEO</td>
<td>Village Executive Officer</td>
</tr>
<tr>
<td>WUA</td>
<td>Water Users Association</td>
</tr>
<tr>
<td>NGO</td>
<td>Non Governmental Organization</td>
</tr>
<tr>
<td>CBO</td>
<td>Community Based Organization</td>
</tr>
<tr>
<td>NEMC</td>
<td>National Environmental and Management Council</td>
</tr>
<tr>
<td>PO-RALG</td>
<td>Presidents Office--Regional Administration and Local Government</td>
</tr>
<tr>
<td>EIA</td>
<td>Environmental Impact Assessment</td>
</tr>
<tr>
<td>WMA</td>
<td>Wildlife Management Areas</td>
</tr>
<tr>
<td>NLUC</td>
<td>National Land Use Commission</td>
</tr>
<tr>
<td>LDC</td>
<td>Less Developed Countries</td>
</tr>
<tr>
<td>PRSP</td>
<td>Poverty Reduction Strategy Paper</td>
</tr>
<tr>
<td>RDS</td>
<td>Rural Sector Development Strategy</td>
</tr>
<tr>
<td>ASDS</td>
<td>Agriculture Sector Development Strategy</td>
</tr>
<tr>
<td>IPM</td>
<td>Integrated Pest Management</td>
</tr>
<tr>
<td>TPRI</td>
<td>Tropical Pest Research Institute</td>
</tr>
<tr>
<td>TMA</td>
<td>Tanzania Meterology Agency</td>
</tr>
<tr>
<td>URT</td>
<td>United Republic of Tanzania</td>
</tr>
<tr>
<td>UNDP</td>
<td>United Nations Development Programme</td>
</tr>
<tr>
<td>FAO</td>
<td>Food and Agriculture Organization</td>
</tr>
<tr>
<td>MWL</td>
<td>Ministry of Water and Livestock</td>
</tr>
<tr>
<td>ERC</td>
<td>Environmental Resources Consultancy</td>
</tr>
<tr>
<td>CDTF</td>
<td>Community Development Trust Fund</td>
</tr>
<tr>
<td>DED</td>
<td>District Executive Director</td>
</tr>
<tr>
<td>EA</td>
<td>Environmental Audit</td>
</tr>
<tr>
<td>ECU</td>
<td>Environmental Cell Unit</td>
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<tr>
<td>GIS</td>
<td>Geographical information systems</td>
</tr>
<tr>
<td>IEE</td>
<td>Initial Environmental Examination</td>
</tr>
<tr>
<td>KIA</td>
<td>Kilimanjaro International Airport</td>
</tr>
<tr>
<td>MAFS</td>
<td>Ministry of Agriculture and Food Security</td>
</tr>
<tr>
<td>NIDP</td>
<td>National Irrigation Development Plan</td>
</tr>
<tr>
<td>PRA</td>
<td>Participatory Rural Appraisal</td>
</tr>
<tr>
<td>RBMSIIP</td>
<td>River Basin Management and Smallholder Irrigation Improvement Project</td>
</tr>
<tr>
<td>SIIC</td>
<td>Smallholder Irrigation Improvement Component</td>
</tr>
<tr>
<td>SPSS</td>
<td>Statistical Package for Social Science software</td>
</tr>
<tr>
<td>ToR</td>
<td>Terms of reference</td>
</tr>
<tr>
<td>UCLAUS</td>
<td>University College of Land and actectral studies</td>
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<tr>
<td>ZIO</td>
<td>Zonal Irrigation Office</td>
</tr>
<tr>
<td>GTZ</td>
<td>German Agency for Technical Cooperation</td>
</tr>
<tr>
<td>SECAP</td>
<td>Soil Erosion Control and Agro-forestry Project</td>
</tr>
<tr>
<td>UMKUMTA</td>
<td>Tanzania Partnership for Child Development</td>
</tr>
</tbody>
</table>
1 BACKGROUND

1.1 INTRODUCTION

The Government of Tanzania, through the Ministry of Agriculture and Food Security (MAFS), has undertaken various initiatives to improve the agriculture sector in the country. One of these initiatives is the River Basin Management and Smallholder Irrigation Improvement Project (RBMSIIP). The Smallholder Irrigation Improvement Component (SIIC) is included within the scope of RBMSIIP. RBMSIIP was developed in response to a water shortage crisis prevalent in many parts of the country. Water demands often exceed available resources; this is especially true in the Pangani and Rufiji basins.

Support to smallholder traditional irrigation improvement and rehabilitation is one of the major components of this project. SIIC focuses on improving the management of water resources and crop husbandry practices in existing smallholder irrigation schemes. This is achieved through, among other things, the improvement of natural resources (land and water) during implementation of the rehabilitation and upgrading of irrigation schemes.

The SIIC undertaking supports the objectives of the National Irrigation Development Plan (NIDP) which was formulated and adopted in 1994. The plan includes a management and decision-making framework that is based on the comprehensive ranking of schemes within each management unit (river or drainage basin).

Under NIDP the order of priority for irrigation development is as follows:
- Improvement/rehabilitation of Traditional Smallholder Irrigation Schemes;
- Water Harvesting Technology;
- Opening of New Smallholder Schemes;
- Large Scale Irrigation Schemes for Private Sector.

SIIC focuses on the improvement of water management in smallholder irrigation schemes to ensure the sustainable use of land and water resources. Ultimately, SIIC aims to facilitate increases in crop yields while minimizing environmental degradation. According to World Bank guidelines, the irrigation schemes in the Rufiji and Pangani basins are classified as Category B. Under this category, no major adverse environmental impacts are permitted and mitigation measures must be incorporated into the scheme design, implementation and operation.

Under the auspices of the SIIC, a feasibility study was carried out that resulted in the preparation of the Project Implementation Plan for 1996/97 - 2001/02. This plan, produced in October 1996, contains an assessment of environmental issues together with proposed environmental mitigation measures.

Under World Bank advisement, the Environmental Cell Unit (ECU) of the Ministry of Agriculture and Food Security conducted an Initial Environmental Examination (IEE) of the irrigation schemes. The IEEs were used as the basis for the Scheme Improvement Assessment Studies. The consultants, in collaboration with ECU, have been charged to conduct environmental audits in seven Category B sites: Ruanda Majenje, Igomelo, Mangalali, Nyamahana, Soko, Karnbi ya Tanga, and Mahenge. An additional site, Lemkuna, only required the development of an Environmental and Social Management Plan. This report is focused on presenting the findings of the environmental audit that was conducted for the Mahenge Irrigation Scheme.

This report draws heavily on intensive field observations by the study team. Discussions were held with farmers and other local people, village and district officials, and project staff. A review of various existing documents was also conducted in the preparation of this report.
1.2 UNDERSTANDING OF THE STUDY

1.2.1 Objective of the Study

The objective of the study is to get a better understanding of the present environmental conditions and relevant impact areas (environmental audit) within the scheme. Increased awareness will allow for improved monitoring of both negative and positive changes over time and will assist in the formulation of more effective mitigation measures. The environmental audit will also be the basis for the preparation of an environmental and social management plan and monitoring system.

Specifically, the study will undertake the following:

- Assess and quantify baseline environmental and social conditions
- Assess and quantify environmental and social impacts
- Conduct environmental audits in order to comply with existing Government of Tanzania and World Bank environmental and safeguard policies
- Prepare an environmental and social management plan
- Develop an environmental and social management and monitoring system
- Conduct public consultations

1.3 STRATEGIC APPROACH

The consultant’s environmental audit of the Mahenge irrigation scheme was characterized by three approaches: ecosystem, farming system and participatory. The basic approach of the study is illustrated in Figure 1-1.

1.3.1 Ecosystem Approach

In view of the fact that the project activities are wholly based in a rural area, potential conflicts between the project and the environment are likely to arise. Thus, issues pertaining to the use of natural resources (e.g. livestock grazing, agriculture, irrigation, water source protection, agro-forestry, etc.) have to be studied.

In applying the ecosystem approach, the consultant not only focused on the Mahenge irrigation scheme but also on all the ecosystems upstream and downstream that impact the environmental and social characteristics of the area. To accomplish this, the study sought an understanding of all activities taking place within the irrigation scheme’s water catchment area. River pollution, sedimentation, flash floods, deforestation, destabilization of riverbanks, erosion, salinity, land degradation, and waterborne diseases (among others) are all contributing to degradation of the catchment area. In suggesting mitigation measures, sustainable practices for the use of water and land resources must be adopted to prevent and control environmental and social problems.

1.3.2 Farming System Approach

On the irrigation scheme level, a farming system approach was used to describe and analyse environmental and socio-economic conditions. Issues related to soil contamination, water pollution, the use and dangers of pesticides and fertilizers, health, and others have been identified. It is clear that the irrigation activities will transform village life and the whole farming system in the Mahenge area.

The success of the proposed mitigating measures will, therefore, depend on community involvement, improvement of the socio-economic situation, capacity building, and proper upgrading, maintenance and operation of the irrigation infrastructure. The latter should take into account the local environment as well as the prevailing institutional, economic and social conditions.

1.3.3 Participatory Approach

A participatory approach was adopted in preparation for the environmental audit. This entailed seeking information/experience from stakeholders (i.e. farmers, district and regional officers, RBMSIIP and other institutions who have been involved in the project). In order to ensure effective participation and cooperation it was necessary to inform stakeholders prior to the audit of the environmental and socio-economic problems to
be addressed. Their inputs have contributed to the development of more realistic and appropriate mitigation measures.
BASIC APPROACH TO THE STUDY

Figure 1.1

- Environmental Audit / IEE of eight schemes
  - Ecosystem
    - Upstream catchment
    - Downstream catchment
  - Farming system
    - On-farm level
  - Participatory
    - Consultations, Focus groups, Interviews
    - Voices of farmers
    - Farmers Plans
- Environment & Socio-economic Impacts
- Water quality, soil & socio-economic Impacts
- Mitigation Measures
- Environmental & Social Management Plan
- Monitoring system
1.4 METHODOLOGY

The methodology follows Tanzanian policy and legislation and the World Bank’s policies on environmental assessment (OP/BP 4.01 and related policies and guidance documents).

Available reference documents were reviewed for purposes of identifying pertinent environmental and social issues. Information was obtained on the Mahenge irrigation scheme before and after construction as well as during operation. Several meetings were held with SIIP project staff. In particular, the ECU team, which was involved in the Scheme Environmental Assessment, was consulted to discuss background and potential issues. Subsequently, a ten-day field mission was conducted in August by the study team and members of ECU. The team was used to: 1) complete further fieldwork at various sites in the Mahenge irrigation scheme, 2) collect additional information, 3) work with the irrigation scheme management team, and 4) to liaise with the various stakeholders including the district officials. During the field visits, the Public Consultation and Disclosure Plan for disseminating the results of the Draft Environmental Audit were developed with the ECU staff.

1.4.1 Consultation

Public consultations took place in two phases. The first phase took place during the Environmental Audit (EA) preparation process. This initial stage allowed for the identification of the key environmental issues and involved the gathering of information on stakeholder concerns and views of potential environmental and social impacts. During the secondly phase, consultations allowed stakeholders to review findings and give their comments.

1.4.2 Analytical Tools

The following methodologies were applied in the process of the study:

- Participatory data collection
- Key informant interviews
- Socio-economic and environmental analysis
- Trend analysis of river flow and rainfall
- Water and soil quality analysis
- Geographical information systems (GIS)

Participatory Data Collection

Participatory Rural Appraisal (PRA) involves problem analysis, ranking, proposal planning, role assigning and timing. The role playing consisted of a facilitator who played the role of an advisor on the different matters raised during the workshop (those which the team was not informed about or aware of). In the final analysis, a Logical Framework Approach workshop (also known as ZOPP) produced the Environmental Action Plan for the irrigation scheme.

Key Informant Interview

In addition to group discussions, information was also obtained from key informants. These were generally staff from the Zonal Irrigation Office (ZIO), the District Executive Director (DED), farmers of the Igomelo scheme, village officials (including village leaders), and others (agriculture and irrigation officers who are residents in the community). Any inconsistent information was cross-checked to ensure accuracy. Various officials conducted the crosschecking of information while members of the study team facilitated the group discussions.

Socio-economic and Environment

A total of 106 household questionnaires (sample size) have been administered using the random sampling method. This represents. Percent of households of the study area (upstream, down stream and scheme level) 80 percent (80 questionnaires) of selected sample size has been administered at Mahenge village (scheme level), where as 10 percent (10 questionnaires) has been administered at Kerenge and Kwanndolwa villages (upstream
village) and 10 percent (10 questionnaires) have been administered at Lwengera Darajani village (downstream village).

Qualitative data related to socio-economic and environment from the scheme was collected and analysed using SPSS (Statistical Package for Social Science) software.

**Trend Analysis of River Flow and Rainfall**

An investigation was conducted upstream and downstream on rivers that feed the scheme. Both statistical and visual interpretations of variability analysis were applied. To further reveal any existence of severe abstraction or flow regime changes, variability analysis was done month to month. Any possible causes for the change in the flow regime were quantified. In this regard, annual rainfall variability for stations in or around the study area was noted. Three approaches were followed to tackle the impacts problem:

- **Visual interpretation** – Understanding and interpreting the annual time series and percent deviation time series from the annual mean.
- **Testing randomness on the annual and monthly time series data** – This test indicates that if the null hypothesis tested for randomness is accepted, no flow regime change prevails in the record; otherwise, it shows the flow regime is changed or there is a likely impact on the river upstream or downstream.
- **Testing of breaks** – At times a break or jump may be observed in the time series of flow. If, for example, a huge volume of water is suddenly diverted to an irrigation area, segments before and after the diversion can have different means.

Subsequent sections provide scheme level variability analysis and interpretation of the results for both flow and rainfall.

The flow and rainfall data were collected from various sources. Rainfall data were collected partly from Tanzania Meteorology Agency (TMA) and partly from the Ministry of Water and Livestock Development (MWL). Flow data were partly collected from the Ministry of Water and Livestock (MWL) and partly from previous reports.

**Water and Soil Analysis**

Water and soil samples were analysed at the laboratory of the Department of Environmental Engineering, University College of Lands and Architectural Studies (UCLAS) and Mlingano Soil Laboratory. Procedures and analysis were done according to the International Standards of Water and Soil Analysis.

**Geographic Information System (GIS)**

Overlay maps and GIS were used to analyse sensitive/significant/relevant features of the irrigation scheme area. Attributes and features that were mapped and analysed included water bodies, land use patterns, vegetation cover, and cultural structures. The technique involved the physical overlaying of individual topographic maps to provide a composite picture of the overall environmental and social situation. Using ArcView 3.1, analysis was carried out to link spatial and non-spatial data.

### 1.5 LIMITATIONS

Data quantification proved a difficult exercise due to the following reasons:

(i) There was insufficient baseline data related to environmental and socio-economic parameters.
(ii) Updated meteorological and hydrological data were not available.
(iii) Most studies carried out by RBMSIIP are dealing with Pangani and Rufiji river basins not specifically with sub-catchment areas like Mahenge river basin. Catchment degradation studies conducted by RBMSIIP for Pangani and Rufiji basins were qualitative. These studies were more an overview papers,
and did not include measurement or simulation models. It should be highlighted that the dangers of reaching conclusions without quantification and sufficient scientific evidence.

(iv) Time and resources allocated are not adequate to investigate most of upstream and downstream impacts. For example, process of digitising maps took more than three weeks. The same with water and soil analysis and linking socio-economic and environmental data to GIS.
2. BASELINE CONDITIONS OF THE IRRIGATION SCHEME AREA

2.1 THE PHYSICAL ENVIRONMENT

2.1.1 Location

The Mahenge irrigation scheme is located in Kwamdolwa ward, Magoma division Korogwe Rural district of Tanga region. It lies about 17 Km north east of Korogwe Township. On the globe it also lies at latitude 5° 00' South and longitude 38° 30' East. Mahenge scheme is situated at an altitude of approximately 300m above sea level.
Map 2.1. Mahenge irrigation scheme: Location map
DEM 2.1: Digital elevation model 2D
2.2 BIOPHYSICAL ENVIRONMENT

2.2.1 Climatic

For the Mahenge scheme, climatic data was collected and analysed based on station no. based on similarity of topography, proximity of the station to the scheme area and the length and continuity of the records. The location of the station is

The scheme has a bimodal rainfall distribution set up, with peaks from March to May and October to December. The annual rainfall lies between 800 to 1000 mm with an average Temperature of 25.2°C.

Rainfall frequency analysis is an important factor for determining rainfall magnitudes at a desirable frequency required for designing the drainage system. The climatic station with reliable daily rainfall records nearest to the project area is Magoma meteorological station, which was used for rainfall frequency analysis. The series of 1, 2, and 3 days consecutive rainfall were extracted. The statistics were determined and extreme value (EVI) probability was fitted to each series. Rainfall intensities for return period of 2, 5, and 10 years were determined and are presented in Table 1. The climatic and hydraulic data were referred from the “Water Resource Assessment Report for Kambi ya Tanga, Lenkuna, Soko and Mahenge irrigation schemes”

<table>
<thead>
<tr>
<th>Return Period</th>
<th>Number of days</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Year)</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>71</td>
</tr>
<tr>
<td>5</td>
<td>91</td>
</tr>
<tr>
<td>10</td>
<td>108</td>
</tr>
</tbody>
</table>

2.2.2 Water Resources
The source of the water supply for the scheme is Nkole stream draining to Lwengera River just downstream of the scheme. This stream is not gauged anywhere along its reach and the actual flow quantity is not known. The catchment area upstream of the scheme intake is approximately 172 sq.km. The catchment area extends to the Eastern Usambara Mountain range. The scheme serves five villages around Mahenge. The water right of the scheme is 101.3 l/s during wet period and 100 l/s during dry period. The climatic and hydraulic data were referred from the “Water Resource Assessment Report for Kambi ya Tanga, Lemkuna, Soko and Mahenge irrigation schemes”

**Domestic Water Supply**

Majority of the villagers (about 76.4%) depend on irrigation water for domestic use. The quality of water for domestic consumption is questionable due to pollution. The water does not receive any kind of treatment prior to its use by humans. Livestock also use water directly from irrigation canals. There are no specific watering points for livestock. The following table indicates different water source with the percentage number of people depend on each source.

Table 2.2: Water resources

<table>
<thead>
<tr>
<th>Water source</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>River</td>
<td>58.5</td>
</tr>
<tr>
<td>Taps</td>
<td>9</td>
</tr>
<tr>
<td>Canal</td>
<td>26.4</td>
</tr>
<tr>
<td>Wells</td>
<td>14.2</td>
</tr>
<tr>
<td>Total</td>
<td>100.0</td>
</tr>
</tbody>
</table>

The distance between the residential area to the water source varies from 500 meters to 3000 meters but the results indicate many people to lie between less than 0.5 km to 1.5 km. The following table shows the distance walked in relation to percent of people.

Table: Distance for fetching water

<table>
<thead>
<tr>
<th>Distance (meters)</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-500</td>
<td>35.8</td>
</tr>
<tr>
<td>501-1000</td>
<td>33.0</td>
</tr>
<tr>
<td>1001-1500</td>
<td>17.9</td>
</tr>
<tr>
<td>1501-2000</td>
<td>7.5</td>
</tr>
<tr>
<td>2001-2500</td>
<td>3.8</td>
</tr>
<tr>
<td>2501-3000</td>
<td>1.9</td>
</tr>
<tr>
<td>Total</td>
<td>100.0</td>
</tr>
</tbody>
</table>

**Water use conflict**

The nature of the water use conflict at the Mahenge scheme is that it is apparently inadequate to suffice demand of the users.

**Water Distribution**

There has been some continuous tension and conflict between the irrigators over distribution of water.

**2.2.3 Soil**

Soil survey was carried out on the 5th September 2003. The survey was carried during dry season therefore it was somehow impossible to assess the crop yield. The scheme is found at an altitude ranging between 963 and 961 meters above mean sea level. The average slope is less than 1%. The area is ranked class 4. Crop grown is paddy in the flat land areas.
Dark brown 10YR3/4 to 10YR 3/3 moist, sand clay loam over sand loam silt clay over loamy sand or heavy clay, heavy clay silt clay and overlying sand loam texture. in areas under P 1, Structure is hard when dry friable when moist sticky and plastic when wet, moderate medium sub angular blocky structure, no out crop, no concretions.

Table below shows the data analysed and interpretation of the same.

Table 2.4: Soil data

<table>
<thead>
<tr>
<th>Horizon</th>
<th>MAHENG E (SITE 1)</th>
<th>MAHENG E (SITE 2)</th>
<th>MAHENG E (SITE 3)</th>
<th>MAHENG E (SITE 4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depth (cm)</td>
<td>0 - 20</td>
<td>40-60</td>
<td>0 - 20</td>
<td>40-60</td>
</tr>
<tr>
<td></td>
<td></td>
<td>43933</td>
<td>43934</td>
<td>43935</td>
</tr>
<tr>
<td></td>
<td>Lab. no.</td>
<td>43936</td>
<td>43937</td>
<td>43938</td>
</tr>
<tr>
<td>Coarse fraction %</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>clay</td>
<td>19</td>
<td>15</td>
<td>24</td>
<td>9</td>
</tr>
<tr>
<td>fine silt</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>coarse silt</td>
<td>24</td>
<td>15</td>
<td>18</td>
<td>7</td>
</tr>
<tr>
<td>very fine sand</td>
<td>19</td>
<td>20</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>fine sand</td>
<td>35</td>
<td>42</td>
<td>15</td>
<td>27</td>
</tr>
<tr>
<td>medium sand</td>
<td>2</td>
<td>7</td>
<td>18</td>
<td>25</td>
</tr>
<tr>
<td>coarse sand</td>
<td>1</td>
<td>1</td>
<td>13</td>
<td>11</td>
</tr>
<tr>
<td>very coarse sand</td>
<td>0</td>
<td>0</td>
<td>7</td>
<td>3</td>
</tr>
<tr>
<td>Sand clay loam</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sand loam</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LS</td>
<td>6.3</td>
<td>6.9</td>
<td>6.0</td>
<td>5.6</td>
</tr>
<tr>
<td>Si C</td>
<td>6.9</td>
<td>6.0</td>
<td>5.6</td>
<td>5.0</td>
</tr>
<tr>
<td>pH H2O 1:2.5</td>
<td>7.4</td>
<td>7.1</td>
<td>6.3</td>
<td>6.9</td>
</tr>
<tr>
<td></td>
<td>Mild alkaline</td>
<td>neutral</td>
<td>Slightly acid</td>
<td>Neutral</td>
</tr>
<tr>
<td>pH KCl 1:2.5</td>
<td>6.0</td>
<td>6.3</td>
<td>5.1</td>
<td>6.1</td>
</tr>
<tr>
<td>Ec mS/cm 1:2.5</td>
<td>1.05</td>
<td>0.03</td>
<td>0.09</td>
<td>0.10</td>
</tr>
<tr>
<td></td>
<td>Non saline</td>
<td>Non saline</td>
<td>Non saline</td>
<td>Non saline</td>
</tr>
<tr>
<td>Organic C%</td>
<td>1.84</td>
<td>1.00</td>
<td>3.88</td>
<td>0.45</td>
</tr>
<tr>
<td></td>
<td>medium</td>
<td>low</td>
<td>Very high</td>
<td>Very low</td>
</tr>
<tr>
<td>Total N%</td>
<td>0.10</td>
<td>0.10</td>
<td>0.34</td>
<td>0.03</td>
</tr>
<tr>
<td></td>
<td>low</td>
<td>medium</td>
<td>Very low</td>
<td>Very low</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>high</td>
<td>medium</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>mediu m</td>
<td>Very high</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Very high</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C/N</td>
<td>9</td>
<td>10</td>
<td>11</td>
<td>15</td>
</tr>
<tr>
<td>-------</td>
<td>------</td>
<td>------</td>
<td>------</td>
<td>------</td>
</tr>
<tr>
<td>C/N</td>
<td>Good quality</td>
<td>Good quality</td>
<td>Good quality</td>
<td>Modera te quality</td>
</tr>
<tr>
<td>Avail. P Bray I mg/kg</td>
<td>2.7</td>
<td>2.45</td>
<td>3.59</td>
<td>1.06</td>
</tr>
<tr>
<td>Avail. P Olsen mg/kg</td>
<td>2.49</td>
<td>2.07</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Avail. P Olsen mg/kg</td>
<td>Very low</td>
<td>Very low</td>
<td>low</td>
<td>Very low</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CEC me/100g</th>
<th>NH₄AOc me/100g</th>
<th>low</th>
<th>low</th>
<th>medium</th>
<th>Very low</th>
<th>high</th>
<th>low</th>
<th>high</th>
<th>high</th>
</tr>
</thead>
<tbody>
<tr>
<td>exch. Came/100g</td>
<td>8.8</td>
<td>5.1</td>
<td>5.8</td>
<td>3.8</td>
<td>14.4</td>
<td>2.4</td>
<td>5.7</td>
<td>7.0</td>
<td></td>
</tr>
<tr>
<td>exch. Mg me/100g</td>
<td>4.1</td>
<td>2.4</td>
<td>2.6</td>
<td>1.5</td>
<td>5.5</td>
<td>1.4</td>
<td>3.0</td>
<td>4.4</td>
<td></td>
</tr>
<tr>
<td>exch. K me/100g</td>
<td>0.32</td>
<td>0.21</td>
<td>0.72</td>
<td>0.25</td>
<td>1.04</td>
<td>0.37</td>
<td>0.71</td>
<td>0.59</td>
<td></td>
</tr>
<tr>
<td>exch. Na me/100g</td>
<td>0.57</td>
<td>0.33</td>
<td>0.58</td>
<td>0.39</td>
<td>2.77</td>
<td>0.34</td>
<td>0.55</td>
<td>0.76</td>
<td></td>
</tr>
<tr>
<td>ESP Exch able Na %</td>
<td>4.75</td>
<td>4.22</td>
<td>4.62</td>
<td>6.37</td>
<td>7.95</td>
<td>4.07</td>
<td>1.93</td>
<td>2.74</td>
<td></td>
</tr>
<tr>
<td>Comments</td>
<td>Non sodic</td>
<td>Non sodic</td>
<td>Non sodic</td>
<td>Non sodic</td>
<td>Slightly sodic</td>
<td>Non sodic</td>
<td>Non sodic</td>
<td>Non sodic</td>
<td></td>
</tr>
<tr>
<td>Base saturation %</td>
<td>97</td>
<td>68</td>
<td>54</td>
<td>35</td>
<td>46</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### 2.2.4 Biodiversity

Human settlements exist relatively far away from the Mahenge scheme. The scheme thence comprises mainly farmlands characteristically dotted with perennial large sized plants e.g. coconut palms, orange trees, and mango trees e.t.c. Over many years the area has been used for agricultural activities. There are therefore very little woodlands left. However, among species of wild animals which are still around are crocodiles (especially in the nearby Lwengera River), and monkeys/baboons, various bird types e.t.c.
2.3 SOCIO-ECONOMIC ENVIRONMENT

2.3.1 Population

The area has residents of various ethnic origins such as Wabondei, Wasambaa, Wadigo, Wapare, and several others from different parts of not only Tanzania, but also from as far as central, southern, as well as the whole of eastern Africa. e.t.c. Total population of Mahenge village is estimated to be over 774, where distributed as follows 10% upstream, 10% down stream and 8% live in the schem area.

Field data indicated that about 38.7% of the population are indigenous, in other words, the majority of the population (51.3%) are immigrants. Largest immigration into the area had taken place between 1951 to 1975 (about 23.6%), as well as 1976 to 2000 (about 26.4%).

2.3.2 Occupation/ land use

Farmers of the Mahenge scheme, most of whom live in Mahenge village total up to a population of 774.

While a large segment 80 percent of the population is engaged in farming, 10 percent carry out other activities such as trading, carpentry, and formal employment e.g. teachers, for their livelihood.

Agriculture Practices

Mahenge is a high potential area; there is both irrigation and rained farming. Farmers cultivate paddy, maize, beans and vegetables as an annual crops and mainly used as food and cash crops. There are plenty of fruit trees like citrus fruits mangos, papaya, bananas and coconut trees which mainly used as cash crops.

The total irrigated area of Mahenge scheme is 350 ha The area is characterized by three major land uses namely: rain fed agriculture, irrigated agriculture, and livestock keeping. The farm size ranges from 2.51 to more than 10 acres per household. However the irrigation area has no opportunity for farmers to increase land for product in future.

2.3.3 Livestock keeping

Farmers also keep various types of farm animals such as cattle, goats and poultry, however farmers reported to have no proper place for grazing and drinking of water for their animals, which bring the misunderstands and conflict due to crop destruction caused by animals during grazing. 70% of interviewed farmers indicate the improper livestock keeping and grazing caused resource use conflict while 30% found to have no any conflict.

Table 2.5: Farm size (acres) ownership of farmers (%)

<table>
<thead>
<tr>
<th>Percent</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1.00 - 2.50</td>
<td>23.5</td>
</tr>
<tr>
<td>2.51 - 5.00</td>
<td>41.5</td>
</tr>
<tr>
<td>5.01 - 7.25</td>
<td>12.3</td>
</tr>
<tr>
<td>7.25 - 10.00</td>
<td>14.2</td>
</tr>
<tr>
<td>&gt; 10.00</td>
<td>8.5</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
</tr>
</tbody>
</table>


2.3.4 Markets and Marketing Information

The findings show that farmers’ access to market and market information is not a problem at the Mahenge scheme due to good accessibility.

Education

According to the survey result which included the whole population in Mahenge indicate 25.81% of the population does not attain any formal education. 70.36% attain primary school education, while 3.82% have secondary school education.

2.3.5 Existing facilities near the irrigation scheme

There are 2 public primary schools within the scheme area and outside the area, but it caters mainly for pupils both outside and inside the scheme.

There is no any hospital or dispensary, therefore people go to the upstream village dispensary, which has an old experienced midwife nurse who take care of the sick.

Sanitation in Mahenge village is generally of poor quality due to existing extensive rural characteristics. Traditional latrines, without adequate roofing, and constructed walls and commonly found in the area.

2.3.6 Energy Supply

Fuel-wood and charcoal are the main sources of energy for cooking.

There are traders selling charcoal in the area apparently because charcoal is considered to be relatively more conducive to use than firewood, although relatively more expensive.

2.3.7 Extension Services
The farmers enjoy extension services. Villagers are advised on the type of fertilisers to use, depending on the types of crops they are planting and on the type of pesticides. 98.1% of interviewed people appreciated the availability of extension services in the area.

2.3.8 Social Capital

There are a few organisations operating in the area and all of them are community based namely women groups and a co-operative society. Water user's associations and/or co-operatives and UMKUMTA which is the Tanzania partnership for children development.

The main co-operative society is the Kumekucha Mkulima Co-operative Society, which was established in 1997. About 55.7% of the villagers are, however, recorded to have said that they do not belong to any of the local organisations, whereas, the rest (i.e. 44.3%) stated that they do. Almost all of them (97.2%) stated that there are no credit schemes.

2.4 DESCRIPTION OF ENVIRONMENTALLY SENSITIVE AREAS

In villages around Mahenge scheme, field study showed that there are no environmentally sensitive areas of special scientific and/or cultural value.
3. DEVELOPMENT PROGRAMMES AND STAKEHOLDERS

3.1 SOIL EROSION CONTROL AND AGRO-FORESTRY PROJECT (SECAP)

This development program started in early 1990s. The overall aim of the program is promotion of productivity and incomes of small-scale farmers while simultaneously decreasing degradation of natural resources. The project started with village focus approach. But presently, the project has adopted catchment approach covering 7 divisions out of 8 in Lushoto District. This is therefore very pertinent with respect to the Mahenge scheme, because, in effect, the project contributes towards conservation of up-stream areas of the Mahenge irrigation scheme whose soils are suspected to be prone to erosion. The Government of Germany through the German Agency for Technical Co-operation (GTZ), finances the project.

Non-Governmental Organisation(s)

Field studies could not identify any local NGO in/around the Mahenge scheme.

3.2 NGOs

The District Agricultural Development Plan (2003/4) has reported few NGOs which are operating in the area. Example is World Vision, which conducts training to farmer on agricultural practices. There are also 32 cooperative societies and 24 savings and credit societies and associations.

3.3 WATER USERS ASSOCIATION

One cooperative society was established in 1997 under the terms of 1991 cooperative Act. Another, cooperative society Kumekucha Mkulima cooperative society, was registered in 1998 with the registration number TAR 298. The society has water right No 4523, and the annual water fee is 111,798.80 Tshs.

The organization structure for Kumekucha Mkulima cooperative society - Mahenge IG is given in Figure 3.1

![Organization Structure Diagram](image-url)
Executive committee has 15 members including secretary (3 women and 12 men). The Committee meets once per month last meeting was conducted on 11 June 2003. General meeting held twice per year the last general meeting were conducted on 23 July 2003. There are 3 sub committee members namely planning and finance, security/defence and production. There is no any committee concerned with addressing environmental issues.

About 55.7% of the villagers are, however, recorded to have said that they do not belong to any of the local organisations, whereas, the rest (i.e. 44.3%) stated that they do. Almost all of them (97.2%) stated that there are no credit schemes.

3.4 STAKEHOLDER’S ROLE

3.4.1 Identified stakeholders

In order of vested powers in decision-making roles enforcement the identified stakeholders are as follows:

- District Council’s i.e., through the District Executive, Director (DED) with his/her relevant committee and functional officers e.g. District Agricultural and Livestock Development Officer (DALDO), District Water Engineer, District Council Development office, etc.
- Ward Executive Officers i.e., through the Ward Executive Officers (WEO) with their relevant committee and functional offices, e.g. Ward Agricultural Officer.
- Village Executive Officer i.e. through the village Executive Officers (VEO) with their relevant committee and functional officer e.g. Village Agricultural Officer.
- Water users association.
- Farmers’ groups/associations.
- Private organization, e.g. NGOs, CBOs, etc
- Donors

3.4.2 Analysis of stakeholders

In general for sake of sustainability influential role of all the identified stakeholders is synergetic. For example, at the highest level, the District Council chaired by the council chairperson and all its relevant committees and functional officers have to be fully involved so that they can put in their agenda and plans financial issues of the scheme. In that way further development of the scheme will get both the support and the authority it requires.

Likewise even at the lowest level (i.e. at village government/farmers associations level) the stakeholders need to be fully involved because being at grass-roots, they are capable of providing solution on a routine bases.

3.4.3 Involvement of stakeholders in environmental audit and implementation of ESMP

In view of the above therefore different stakeholders were and will be involved in environmental auditing and implementation of ESMP as follows:

**Water users association**
Managing water resources within schemes

**Farmers associations/groups**
Carrying out routine activities/controlling actions
Identifying/formulating required action to VEO.
Saving and credit organisations.

**Village Executive Office (VEO)**
Grass-roots representation of local government system.
Mobilizes, receives, identified required action and forwards them to WEO for considerations.
Ward Executive Officer (WEO)
Grass roots representative of local government system.
Mobilizes, receives checks and controls identified required action and forwards them to District Council (through relevant its committees).

District Council
District development planning.
Mobilizes, receives and deliberates identified required action and incorporates them into the district development plan for financing.
Finance/overseas implementation of the identified actions.

Private Organization/NGOs/CBOs
Promotes identification and implementation of identified action.
Helps to secure funding of the actions.

Donor agency
Promotes development cooperation.
Finances/overseas implementation of action plans

3.4.4 Ensuring incorporation of concern of stakeholders in ESMP

In order to ensure the concern of stakeholders are incorporated in ESMP, it is proposed that the following measures be taken after finalization/submission of the ESMP:

Seeking government approval of ESMP
This government approval of ESMP is imperative because the councils are not allowed to implement a plan unknown to the government. Under these circumstances the ESMP has to be approved firstly by MAFS, NEMC and then by PO-RALG.

Dissemination of the ESMP to relevant district
After government approval, then the ESMP should be disseminated to relevant district for implementation. This should be followed by a series of workshops, seminar, etc. to enable public discussion on the ESMP. The discussion should start at district level then percolate to lower and lower levels as indicated above.
4. COMPLIANCE WITH TANZANIA’S POLICIES, LEGAL FRAMEWORK AND WITH WORLD BANK’S SAFE GUARD POLICIES

4.1 NATIONAL POLICIES

Relevant policies with a bearing on agricultural and rural development in general, and irrigation in particular, and therefore Mahenge irrigation scheme, have been examined. These include the National Environment policy, the Land policy, the National Water policy, the Energy policy, the National Agriculture policy, Draft Rural Development Policy, Poverty Reduction Strategy, Draft Rural Development Strategy, Agriculture Sector Development Strategy, the Forest policy and the Wildlife policy. These policies affect direct key sectoral activities and were examined because they automatically affect important land uses in the area viz-a-viz: agriculture, water, livestock, energy, forest and wildlife.

4.1.1 National Environment Policy of 1997

Implementation of the river basin management and smallholder irrigation project and particularly the irrigation schemes under operation is consistent with the overall objectives of the National Environment Policy. The policy provides a framework for multi-sectoral participation and cooperation to achieve sustainable development; and seeks to ensure sustainable and equitable use of resources for meeting the basic needs of present and future generations, without degrading the environmental resource base or risking health and safety. The policy emphasize the need to prevent and control degradation of land, water, vegetation and air which constitute our life support systems; to conserve and enhance our natural and man made heritage; including biological diversity; to improve the condition and productivity of degraded areas including rural and urban settlements; to raise public awareness and understanding of the essential linkages between environment and development and promote individual and community participation in environmental action, among others.

Furthermore the policy calls for improved agricultural practices, and better utilization of the scarce water for irrigation, ensure efficiency, minimize losses and avoid salinisation as well as proper use of agrochemicals to minimize reduce/pollution of water sources.

The design, re-construction and operation of the schemes have taken into account the above considerations. Additionally, planned training of farmers in effective and efficient management of water resources intends to contribute to achievement of the objectives of the environment policy.

4.1.2 Agriculture Policy 1997

The implementation of the RBM-SIIP on the basis of farmer groups and rural community participation is consistent with the Agricultural and Livestock Policy (ALP) of 1997, which provides policy guidance on the development of the agricultural sector. The policy seeks to ensure that the direction and pattern of development in the sector meets economic, social and environmental objectives. The policy aims at accelerated growth of production and exports through among others, assuring national food security, developing and introducing new technologies which will increase productivity of labour and land; promote integrated and sustainable use and management of natural resources and providing agricultural support services.

The smallholder irrigation projects aims at providing agricultural support services; improve income of the rural poor, promote rational use of water resources and introduce appropriate technologies among others.

4.1.3 Land Policy of 1995

The National Land Policy of 1995 provides incentives for efficient use of land and its resources. It seeks to promote and ensure a secure land tenure system, encourage optimal use of land resources and facilitate broad-based social and economic development without up setting or endangering the ecological balance of the environment. Farmer groups and communities participating in the project have acquired customary rights of occupancy from their respective villages and some villages are processing granted rights. Both granted and customary rights of occupancy secure land ownership add incentives for farmers to maintain and develop their farms accordingly, reduce land use conflicts and increase the value of land.
4.1.4 Water Policy of 2002

The National Water Policy (2002) provides a comprehensive framework for promoting optimal, sustainable and equitable development and use of water resources for sustainable development. The policy seeks to ensure supply of good quality of water to meet domestic, environmental and other priority development purpose. Emphasis is placed on the need to ensure more efficient utilization of existing water resources through institutional improvements, proper soil management to prevent soil erosion and flooding and improved monitoring to control water quality and contamination from industrial sewerage and excessive use of pesticides and fertilizers. These objectives require integrated and holistic planning and management in areas, water use and disposal of effluents. The planned project objectives are supportive of the objectives of the water policy through education, awareness and training on better agricultural practices, effective and efficient utilization of water, water conservation, and application of agrochemicals to minimize pollution of water sources to mention a few.

4.1.5 Forest Policy of 1998

The main objective of the National Forestry Policy is to enhance contribution of the forestry sector in sustainable socio-economic development of the country, as well as conservation and management of the natural resource-base for the benefit of both the present and future generations. In view of the general objective, the policy focuses its intervention in the following four area (i) forest land management.

Conservation of the forestry resources in the upper catchment is crucial for ensuring sustainable flows of water for irrigation purposes and other uses. The establishment of the scheme is thus an extra incentive for undertaking conservation measures in the catchment area of Mt. Meru.

4.1.6 Wildlife Policy of 1998

The main Wildlife Policy is to seek involvement of a broader section of the society in wildlife conservation, and in particular the rural local communities, as well as the private sector with only a role of stimulating and duly guiding both the rural local communities and the private sector by administering, regulating and promoting management of wildlife resources. In view of this general objective, the policy facilitates its interventions in the following area: (i) wildlife protection (i.e. incorporating management and development of protected areas) (ii) wildlife utilization (i.e. incorporating promotion of establishment of Wildlife Management Areas conservation as well as management measures and (iii) international cooperation and coordination. Within the scheme there are no wildlife management areas. The developments have also concentrated on the already existing scheme, with therefore little likelihood of encroaching into wildlife areas.

4.1.7 Energy Policy of 2002 (Draft)

Sufficient and efficient supply of energy is crucial for national development. The objective of the energy policy is therefore to contribute to the national socio-economic development process by providing an efficient energy production, procurement, transportation, distribution and end-use system in an environmentally sound manner and with due regard to gender issues.

Provision of energy for scheme farmers in a convenient manner will allow more time for women farmers to participate in farm activities. It is against this background that communities are being encouraged to use fuel-efficient charcoal and wood stoves.

4.2 LEGAL FRAMEWORK

The smallholder irrigation project will be implemented in the overall context legal framework that governs agricultural and rural development. Some of the few legal frameworks that are supportive of the project include but not limited to: -
4.2.1 Environment Legislation

Currently Tanzania lacks a single comprehensive environmental legal framework or environmental law. Efforts are underway to prepare such a framework. To-date, the management of environment and natural resources is governed by fragmented sectoral pieces of legislation that are yet to be fully harmonized.

There are some guidelines on Environmental Impact Assessment (EIA) and the Government is working on an act to make EIAs mandatory for all development projects. In this regard an environmental legislation aimed at "promoting and managing environmental conservation in the country" is in the making.

The term "environmental" legislation incorporates nearly one hundred acts and ordinances and several additional subsidiary legislation from all sectors of the economy, which affect the environment. However, given the broad policy goal of achieving sustainable development and the specific policy objectives, issues of unsustainable utilization of resources, deforestation, desertification, salinization, land degradation, pollution of water resources, and impacts on rural land use have been emphasized.

The design and operational strategy of the Mahenge scheme have taken these legal considerations into account.

4.2.2 NEMC

Act no. 19 of 1983

This act establishes the National Environment Management Council as a statutory body responsible for advising and coordinating environmental management issues. Among the many functions of the Council, the act seeks to provide a framework for evaluation of existing and proposed development policies, programmes, plans and activities of both public and private that are likely to affect the environment and recommend measures to ensure adequate account of environmental effects. Furthermore, the act provides for the specification of environmental standards, norms, criteria, guidelines for the protection and maintenance of the quality of the environment, cooperation between government, local authorities and bodies engaged in environmental programmes and stimulates public and private participation in environmental and natural resource management.

Relevant legislation pertaining to agricultural development in general, and irrigation in particular and how it relates to the proposed projects, including Mahenge irrigation scheme was examined. The following are the sectoral environment legislations.

4.2.3 Land Act no. 4 and Village Land Act no. 5 of 1999

Both laws became operational in May 2001, following the approval of their regulations. The acts seek control land use and clarify controversial issues pertaining to ownership of land and land-based resources, transactions on land and land administration. The new land act identifies three categories of land i.e. village (customary land), public/gazetted land (i.e. national parks, forest reserves) and general land that does not fall in any of the above two categories for private investment.

Implementation of the project is consistent with both legislations. For purposes of controlling land in the village and to protect it from alienation to foreign investors, village governments would be given documents indicating their boundaries. However, in order to give value to land there is a need for completion of the process of land survey and demarcation which amounts to land titling and allocation to different land use categories to speed up investment in agriculture.

Land allocation at the Mahenge scheme was guided by existing land tenure arrangements which are in line with these legal provisions. Both men and women have received irrigation plots.

4.2.4 Wildlife Act 1974 (with amendments of 1978)

Wildlife act provides for protection, conservation, development, regulations and control in both acquisition and utilization of products of both fauna and flora. To this end, therefore the Act stipulates “modus operandi”, i.e. required restrictions in the following areas (i) in protected areas: namely game reserves, game controlled areas, partial game reserves, national parks, etc. (ii) proper procedures in hunting, capturing and photographing of wildlife and (iii) proper handling of trophies. Furthermore, in the wake of the Wildlife policy, which stipulates for villagers’ involvement in Wildlife Management Areas (WMA), the Act also provides modalities and
procedures for designation, operation and involvement of local communities in the management of the WMAs. Within the scheme there are no wildlife management areas.

4.2.5 Water Acts of 1974

As mentioned before the Water Acts principally seek to ensure that water is utilized without sectoral conflicts, and without causing pollution. This is the spirit of both Act no. 42 of 1974 and Act no. 10 of 1981. They were enacted to control and protect water resources. The legislation defines “water” as all water flowing over the surface of the ground or contained or flowing in or from a spring or stream or natural lake, swamp or beneath a watercourse. The Act places a regime of water rights to govern access to water use. Pollution control norms and standards are embodied in the water rights.

Apart from incorporating pollution control and having prevention conditionality in the water rights, the Act goes a step further by putting in place a regime in consent with discharge of effluent. Under Section 15 A (1) of the Act, no person may discharge of effluent from any commercial, industrial or other trade waste systems into receiving waters without a consent duly granted by a Water Officer. The Act also contains two schedules, which set standards for receiving waters and effluent. The Mahenge irrigation has a water right in which the rights and obligations of scheme operators, the farmers, are stipulated.

4.2.6 Forest Act 1974

The Forest Act deals with the protection of forests and forest products in forest reserves and restrictions and prohibitions in forest reserves. The forest management plans are administered under the Forest Ordinance (1957). Any contravention of the restrictions and prohibition is considered an offence under this ordinance and subject to enforcement. However, the law is being revised to meet new requirements under a new Forest Policy. There is no forest land within the scheme area.

4.2.7 The Town and Country Planning Ordinance, Cap 378 of 1956

The Town and Country Planning Ordinance Cap 378, Part IV provides for control of urban development while implementing a scheme of land development. Important aspects include the designation and allocation of adequate land for solid waste disposal in any urban scheme. The law further stipulates the design of a good sewerage system to manage liquid waste from various major water consumers. The law empowers local authorities to enforce such schemes and punishments as stipulated in the Act. The law further empowers neighbours and any individual to take to court anyone who injuriously affects others due to his/her unhygienic activities. The Water Users' Association at the scheme may pass by-laws to this effect. However, they would need support from local authorities, particularly with regard to enforcement.

4.2.8 Local Government Act (District and Urban Authorities) Acts of 1982

This Act provides detailed responsibility for urban and district councils in the administration of their day-to-day activities. Waste management is pointed out as one of the activities to be managed by urban authorities. This Act is the backbone of the Village Government’s operation, powers, responsibilities of various local authorities and structure. The law requires that the Village Assemblies act as the apex authorities in decision-making processes at the village level. However, such meetings rarely take place in most villages, leaving decisions to be made by few leaders without having consulted with the village public. This being the case, many Village Governments fail to bring about development for their villagers.

4.2.9 Land Use Planning Commission Act of 1984

The National Land Use Commission (NLUC) was established under this Act as the principal advisory organ of the Government on all matters related to land use. Among other things, it recommends measures to ensure that the Government policies, including those for development and conservation of land are in harmony. It also takes adequate account of their effects on land use and seeks for the advancement of scientific knowledge of changes in land use; it encourages the development of technology to prevent, or minimize adverse effects that endanger man’s health and his/her welfare; it also specifies standards, norms and criteria for the protection of beneficial uses and the maintenance of the quality of the land.
In accordance with the functions mentioned above, the Commission can indirectly help to prevent or minimize pollution by restricting location of potential and actual pollution sources. The major issue is the sectoralisation of the Government’s operations while neglecting holistic view of each activity on land and their impacts on others. There is a tendency of each sector making decisions without consulting the others. For example, Wildlife Division can designate an area for game conservation without consulting the Agriculture and Food Security Divisions to avoid grabbing land for agriculture activities.

The Mahenge scheme is included in the National Irrigation Development Plan which has been officially adopted by the Government.

4.2.10 The Land Acquisitions Act of 1967

The Land Acquisition Act gives powers to the President to take “land” from private occupants for public purposes when the public’s interests to do so. The new Land laws declare all land in Tanzania as “Public Land” and vested to the President as trustee of all citizens. However, the Land Acquisition law has been watered down by the New Land Laws, which restrict the President’s powers not to acquire land without negotiation with the owners. Again the new laws stipulate detailed compensations to be paid on any acquired land that amounts to deterring the President to do so without careful considerations.

4.2.11 By-Laws

All villages in Tanzania are allowed to form by-laws. This has been done in Mahenge village whose by-laws address proper use of land and water to ensure public health.

4.3 NATIONAL STRATEGIES

In order to guide national development more effectively and systematically, Tanzania has prepared a number of strategies aiming at operationalizing the various policies in key sectors. Some of the strategies that have a bearing on irrigation development and discussed below include: the Government Vision 2025, Poverty Reduction Strategy Paper, Rural Sector Development Strategy and the Agricultural Sector Development Strategy.

4.3.1 Government Development Vision 2025

The Government Development Policy 2025 is guiding framework for national development to the year 2025. It aims at achieving a high quality livelihood for the people, characterized by sustainable and equitable growth. It also aims at attaining good governance through the rule of law and at developing a strong and competitive economy by moving from a less developed country (LDC) to a middle-income country by 2025.

Scheme irrigation committees and water users’ associations are potential nuclei for promoting good governance and democratic practices in rural villages. By adhering to common practices and cropping patterns, farmers will realize more or less equal and higher incomes.

4.3.2 Poverty Reduction Strategy Paper (PRSP) of 2000

The Poverty Reduction Strategy Paper (PRSP) concentrates on efforts aimed reducing income poverty; improving human capabilities, survival and social well-being. The PRSP has set medium term goals to be achieved by the year 2010 through sustaining macroeconomic stability, rural sector development and export, and private sector development.

Improvement of food supply and security is key to infant and maternity health as well as to income generation. A number of activities, including construction and consultancy services have been performed by the private sector. This has contributed to local capacity building.

4.3.3 Rural Sector Development Strategy (RDS) of 2000
The Strategy aims at reducing rural poverty as means of managing resources sustainably, since widespread poverty in rural areas compels people, in search for survival, to over-exploit the natural resources. The RDS envisages the following:

- Revising legislation and regulations with a view to enhancing community participation in management and utilization of natural resources.
- Revising the licensing procedures related to utilization of natural resources.
- Introducing procedures for cost and benefit sharing of natural resources.
- Introducing EIA as a pre-requisite for all development projects.
- Developing procedures for natural resources with regard to entitlement of the state, communities and individuals.
- Developing procedures for conflict resolution in matters of natural resources utilization.

The Mahenge scheme will contribute to the principle objective of the RDS of poverty reduction through raising incomes and better resource utilization. The work of the water users' association involves a number of elements targeted by the Strategy.

4.3.4 Agricultural Sector Development Strategy (ASDS) of 2001

The ASDS, which was formulated through a broad based consultative process, aims at transforming the agricultural sector into a modernized, commercial, highly productive and profitable sector that shall utilize natural resources in a sustainable manner and shall act as an effective basis for intersectoral linkages.

The ASDS will address the key weaknesses facing the agricultural sector, which include low productivity, poor coordination and limited capacity, underdeveloped supporting facilities, erosion of the natural resource base, inappropriate technology, dependency on rain fed agriculture, impediments to food market access as well as low public and private expenditure levels.

The investments and other interventions made in improving the irrigation system at Mahenge are highly relevant and well in line with the targets of the ASDS. These improvements will contribute to higher productivity, income generation, better water and land utilization, all of which are targets of the Strategy.

4.4 COMPLIANCE WITH WORLD BANK SAFEGUARD POLICIES

A list of World Bank environmental and social safeguard policies is listed in Appendix 2. This part of the report contains an analysis of the compliance of the Mahenge scheme with the Bank Safeguard policies. It is based on intensive field observation by the study team, coupled with discussions held with the farmers and other local people, including village and district officials as well as project staff. The report is also based on the review of various existing documents.

Environmental Assessment (OP/BP 4.01)

In order to ascertain that project proposals submitted for funding are environmentally sound and sustainable, the World Bank requires that Environmental Assessment (EA) of the proposals be carried out. An Environmental Assessment (EA) of Mahenge Scheme was carried out as part of the overall base line study of the scheme. The assessment also built on the work done earlier by the Environmental Cell Unit (ECU) of the Ministry of Agriculture and Food Security.

In view of the present day nature of activities at the scheme, it was found that the scheme can not bring about adverse environmental impacts and that depending on proper handling of several factors; e.g. land tenure issues, its sustainability may also be ensured.

The findings of the study were discussed with, farmers as well as local community leaders at meetings held at the scheme and also with district officials at their district headquarters. Their opinions and ideas were taken into account in finalising the Environmental and Social Management and Monitoring Plan.

From the above-mentioned observation the Mahenge Irrigation Scheme is considered to be in compliance with the Bank Environmental Assessment.

Natural Habitat (OP/BP 4.04)
Mahenge irrigation scheme is a relatively newly established scheme. It has only recently been rehabilitated and improved. Its expansion is restricted on all four sides in an extensively cultivated area. There are therefore no neighbouring natural habitats which require protection and conservation. The scheme does not therefore trigger the Natural Habitat safeguard policy of the World Bank.

**Pest Management (OP 4.09)**
Use of pesticides at the Mahenge scheme is currently at low level. The farmers, through the extension service, are encouraged to apply IPM approaches. Farmers are also trained on safe use, storage and disposal of chemicals. These efforts will lead to greater compliance with the Integrated Pest Management policy of the World Bank, than present day situation.

**Involuntary Resettlement (OP/BP 4.12)**
As mentioned above, Mahenge is a relatively newly established scheme and has only recently been rehabilitated. The farmers have been living in the area originally for the purpose of practising livestock rearing; however with introduction of irrigation agriculture, they also took it up in order to increase their incomes. The place was originally only bush land. There were therefore no resettlements carried out. The scheme does not, therefore, trigger the Involuntary Resettlement safeguard policy of the World Bank.

**Indigenous Peoples (OD 4.20)**
Again in historical terms, the present locality of the scheme was originally aimed at accommodating former workers of defunct sisal plantations. At the time of initial settlement there were no indigenous people in the area. During its peak days i.e. in early 1950s, the sisal industry attracted people from the whole of Tanzania, as well as from eastern, southern and central Africa. For this reason present day population structure at the area comprises people of various ethnic origins. They belong not only to the neighbouring regions of e.g. Arusha, Kilimanjaro, Singida and Tanga regions, but also to as far off regions of e.g. western and southern parts of Tanzania, and additionally from neighbouring countries e.g. of Burundi Rwanda and the Congo. They are presently permanently settled in the area, and in response to the questionnaire, no household indicated plans to move away. In view of the above, it is evident that project activities at Mahenge would not trigger the indigenous policy of the World Bank.

**Forests (OP/BP 4.36)**
Neither the up-stream nor the down-stream areas of the scheme have forested areas, which may be adversely impacted by project activities of the scheme. For this reason, project activities at the scheme may not trigger the World Bank's safeguard policy on Forests.

**Safety of Dams (OP/BP 4.37)**
There are presently no dams, and moreover none are under consideration at Mahenge irrigation scheme. The scheme does not therefore trigger this safeguard policy of the World Bank.

**Cultural Property (OPN 11.03 – draft OP 4.11)**
The scheme does not have movable or immovable objects, sites, natural features and landscapes that have archaeological, palaeontological, historical, architectural, religious, aesthetic, or cultural significance. Therefore, the scheme does not trigger this safeguard policy.

**Projects on International Waterways (OP/BP 7.50)**
The scheme is using waters of the Bululu/Konde River. The River does not flow to other states. The scheme does not therefore trigger this safeguard policy.

**Project in Disputed Areas (OP/BP 7.60)**
The scheme does not operate in disputed areas and it does not therefore trigger this safeguard policy.

**Consultation and Disclosure Requirements (BP 17.50)**
The findings of study and recommendations have been discussed with farmers’ representatives at the scheme. They endorsed the findings and recommendations. The Environmental Audit report will be submitted to the relevant government authorities for review and approval prior to the disclosure through newspapers, district offices, MAFS, and government websites.
5.0 TOOLS AND TECHNIQUES USED IN ASSESSING AND ANALYZING ENVIRONMENTAL AND SOCIAL IMPACTS

5.1 INTRODUCTION

There are several tools and techniques recommended for prediction of environmental and social impacts:

- Checklists
- Interaction matrixes
- Networks
- Geographic Information Systems (GIS)
- Mathematical modelling

During the environmental audit, the consultants used two tools: checklists and GIS.

Checklists
The environmental checklist was used to record physical observations during the assessment of the irrigation scheme.

Geographical Information Systems (GIS)
GIS was used to analyse hydrological changes and trends in water and soil quality of the irrigation scheme.

5.2 IMPACT ASSESSMENT

Impact assessment is a complex activity and mainly utilizes a wide range of baseline data. Depending on available baseline data, many techniques can be applied to the study:

- Mathematical models (such as groundwater and river models, noise propagation models, air and water dispersion models, income multipliers)
- Physical models (such as hydrological models for trend analysis, wind tunnels and hydraulic models for estuaries)
- Scientific experience, judgment and observations
- Structured/semi-structured approaches (e.g. changes in landscape and social impacts)

Impacts analysis and assessment must also provide information on the following aspects:

- Duration (time period over which they will occur)
- Likelihood or probability of occurrence (very likely or unlikely, etc.)
- Reversibility (natural recovery or aided by human intervention)
- Area affected (size and whether near or far from the project)
- Number (and characteristics) of people likely to be affected and their locations
- Trans-boundary aspects (do impacts cross-national borders?)

Due to a lack of baseline data and time constraints, the consultant was not able to conduct an impact assessment utilizing mathematical and physical models. For environmental and social impacts, structured/semi-structured approaches, focused group discussions, scientific experience, observations, judgment, and GIS were used to quantify and evaluate impacts.
6.0 CONSULTATIONS WITH COMMUNITY AND FARMERS

6.1 INTRODUCTION

Meetings
During the environmental auditing process, meetings were held at district, village and scheme levels. At the village level, government leaders and irrigation association leaders participated in the meetings. The major aim of the meetings was to understand the District Development Plan and how it has tackled environmental and social issues at the irrigation scheme. In addition, the meetings served to identify ways for the mitigation of pressing problems.

The Mahenge Irrigation Scheme is located in Korogwe District. A meeting was held with the District Executive Director and the District Agricultural Officer as well as other staff from the district. The discussions focused on reviewing project activities at the scheme. The consultants were informed that the district plan includes health activities and an awareness campaign for the scheme. A component of the awareness campaign is to sensitize villagers on the hazards of contaminated water.

Focus group discussions
Various focus group discussions were held at the scheme. A group of men and a group of women each identified priority issues concerning the irrigation scheme.

Participants
Thirty-two men and youth, and ten women participated in the focus group discussions.

6.2 MAJOR ENVIRONMENTAL AND SOCIAL ISSUES IDENTIFIED BY STAKEHOLDERS: AS PRESENTED BY MEN

Water-related diseases
Water-related diseases are a serious problem at this scheme. The problem is believed to be caused by the presence of polluted water coupled with the unavailability of alternative sources of clean and safe water for domestic use. The prevalence of disease in the local community is causing increases in death rates and a reduction in manpower.

Capital
Most farmers indicated that initial working capital is low. Farmers suggest that district staff should assist them to establish local SACCOs to improve the availability of savings and credit facilities.

Fishing by use of poisonous chemicals
Many farmers have been using poison in the canal to catch fish. There are concerns about the effect of the poisons on people’s health and the environment. Although this was identified as a serious concern, no mitigation measures were suggested to tackle the problem.

Destruction of canals
Due to the high number of livestock grazing on the canal banks, degradation of the channels is occurring quite rapidly. Currently, the scheme does not have any maintenance schedules for the upkeep of the canals. Farmers are concerned about water loss and its potential impact on crop yields. Farmers suggested the development of a proper maintenance plan for the canals. In addition, they proposed that the canal be lined.

Water pollution
The scheme is having problems with water pollution. There are concerns about waste disposal in the canals and the corresponding health implications.

Destructive birds
The scheme is having problems with birds. Flocks of *quelea quelea* often enter the paddy fields causing crop destruction.

Soil erosion and siltation
This scheme has been experiencing soil erosion due to deforestation practices occurring upstream. Increased siltation at the intake and in the canals has been occurring.

**Conflict within the community**
Both livestock keepers and farmers live within the scheme area. Farmers said that livestock interferes and damages irrigated fields when they search for drinking water. Livestock keepers indicate that the irrigated fields are blocking traditional water sources. The men suggested that additional watering points for livestock be developed.

**Washing and bathing**
Members of the scheme have a habit of washing and bathing at the intake and in the canal itself. The men are concerned about how this practice contributes to water pollution and water-related diseases.

**Salinity**
There is a big problem of salinity in the scheme—especially in the Legeza Mwendo area. Salinity in the soil and water courses is believed to be reducing crop production. Some farmers expressed that they have had to hire additional labor.

**MAJOR ENVIRONMENTAL AND SOCIAL IMPACTS IDENTIFIED BY STAKEHOLDERS: AS PRESENTED BY WOMEN**

**Domestic water**
The water, which is trapped along the river and is used by the villages, is contaminated and dirty. This is because villagers often bath, wash, defecate, and urinate in the water. The water is, therefore, unsafe for human consumption. Further complicating the problem is the fact that there are no functioning boreholes nearby that the women can use to get clean water. In the past, there was a working borehole that the women could use but it has since gone into disrepair.

The women request that the district government repair the old borehole as well as install new ones. This is an urgent priority as there are significant health risks from the consumption, contact, and presence of the contaminated water.

**Energy**
Quantities of available firewood in the village are low. As many areas within the scheme have been deforested, women have to travel great distances from their homes to collect firewood.

**Health Services**
The village does not have any modern health services or facilities. An upstream village has a small dispensary but the staff is not well qualified.

**Hunger**
Due to the recent shortage of rainfall, many crops have failed. Consequently, there is a real concern for famine among the local population. Many people have decided to simply plant whichever crop will allow them to survive. Some villagers have sought manual labour opportunities.

**Lack of culverts**
A number of places within the scheme are missing culverts. As a result, too much water often enters fields or is diverted into unintended areas. The women feel that the contractor and RBMSIIC should install culverts immediately.

**Livestock Intrusion**
Livestock is often entering fields and destroying crops in search of drinking water. This conflict between livestock keepers and farmers needs to be resolved quickly. The women suggest that alternative sources of drinking water must be developed for the livestock.

**Pest and disease**
Most women complained that they are facing pest and disease problems with their crops. Although they are sharing the costs in fighting these problems, their efforts have not been completely successful.
Lack of land
In the scheme, available land for cultivation is becoming increasingly scarce due to increases in demand and inundation from irrigation waters.

Diseases
There are many waterborne diseases prevalent in the scheme: malaria, bilharzias, and typhoid. Incidences of tuberculosis are increasing due to the consumption of milk that has not been boiled properly. No HIV cases have been reported within the scheme.

Workload
Most women stated that their husbands work very little or not at all. They cannot determine whether it is due to a prevailing cultural norm or to simple laziness.

Lack of decision-making
The women stated that they have very little influence upon or involvement in the decision-making organs of the community. In addition, they said that the men often exclude them from the process of selling the harvests. The women suggest that a seminar or workshop to highlight issues of gender equality be conducted in the near future by district staff and the community development officer.

Lack of capital
Most of the farmers depend on their crop harvests to secure capital. Unfortunately, due to the recent crop failures, capital is currently very scarce within the community. The immediate area does not have any savings or credit institutions.

Crop theft
The scheme has been facing a problem of crop theft. The women indicated that villagers have been reluctant to accuse any persons for fear of possible reprisals.

Low price
Farmers have been receiving low prices for their harvests. The women suggested that alternative high-value crops should be researched for potential planting. Also, identifying additional markets may be helpful.

Participatory environmental action plan developed by farmers during focus group discussions is presented in Appendix 3.
7.0 IDENTIFIED ENVIRONMENTAL AND SOCIAL IMPACTS

7.1 INTRODUCTION

Key environmental and social issues/impacts identified for the Mahenge Irrigation Scheme were based on the following sources: field observations, IEE reports of 1998, and focus group discussions. Table 7.1 presents a summary of the issues that are considered pertinent and significant now and in the future.

Table 7.1: Summary of key environmental and social/impacts for Mahenge

<table>
<thead>
<tr>
<th>IDENTIFIED ISSUES BASED ON FIELD OBSERVATIONS</th>
<th>IDENTIFIED PROBLEMS BASED ON IEE REPORTS OF 1998</th>
<th>IDENTIFIED ISSUES BASED ON FOCUS GROUP DISCUSSION</th>
<th>IDENTIFIED QUANTIFIABLE/ NON-QUANTIFIABLE IMPACTS IN ESMP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upstream</td>
<td>Downstream</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Irrigation level</td>
<td>Salinity</td>
<td>Poor sanitation conditions</td>
<td>Water related diseases and pollution</td>
</tr>
<tr>
<td>No cross-drainage structures</td>
<td>Waterborne diseases</td>
<td>Water related diseases and pollution</td>
<td></td>
</tr>
<tr>
<td>Livestock destroy structures</td>
<td>Water use conflicts</td>
<td>Lack of capital</td>
<td></td>
</tr>
<tr>
<td>Existence of water hyacinth</td>
<td></td>
<td>Destruction of structures</td>
<td></td>
</tr>
<tr>
<td>Weak leadership</td>
<td></td>
<td>No turn-outs</td>
<td></td>
</tr>
<tr>
<td>Stagnant water in scheme</td>
<td></td>
<td>Water hyacinth infestation</td>
<td></td>
</tr>
<tr>
<td>* Siltation</td>
<td></td>
<td>Gender inequalities</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Destructive birds/vermin/pests</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Water pollution due to washing/bathing in canals</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Salinity</td>
<td></td>
</tr>
<tr>
<td>* Upstream</td>
<td>- Demographic trend</td>
<td>Reduced water availability for irrigation</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(population changes)</td>
<td>Poor soil and water quality</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fertilizers and pesticides use</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Increased incidences of waterborne diseases</td>
<td></td>
</tr>
<tr>
<td>* Downstream</td>
<td>- Reduced water quantity</td>
<td>Increased incidences of waterborne diseases</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Increased</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

This chapter presents a brief description of identified environmental and social impacts of the Mahenge Irrigation Scheme. The impacts are based on changes, which have or are expected to occur, prior or post improvement of the scheme. Attempts have been made to indicate both positive as well as negative impacts, but for the sake of preparing an effective Environmental and Social Management Plan (ESMP), negative impacts have featured more than positive impacts. The impacts may also be categorized (based on localities) as follows:

- Upstream and downstream impacts
7.2 UPSTREAM AND DOWNSTREAM IMPACTS

7.2.1 Demographic trend (population changes)
There is higher population upstream compared to downstream (Lengere Darajani) and in the irrigation level (Mahenge). The scheme is located in rural areas with low economic development.

| Table 7.2: Population data in upstream, downstream and Mahenge (irrigation) area
Upstream – Kerenge Kibaoni |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>AREA</td>
<td>MALE</td>
<td>FEMALE</td>
<td>TOTAL</td>
</tr>
<tr>
<td>Adults</td>
<td>498</td>
<td>497</td>
<td>970</td>
</tr>
<tr>
<td>Youth</td>
<td>103</td>
<td>104</td>
<td>211</td>
</tr>
<tr>
<td>Children</td>
<td>413</td>
<td>441</td>
<td>854</td>
</tr>
</tbody>
</table>

| Table 7.3 Downstream – Lwengera Darajani |
|---------------------------------|-----------------|----------------|------|
| AREA | MALE | FEMALE | TOTAL |
| Adults | 310 | 322 | 632 |
| Youth | 108 | 105 | 213 |
| Children | 44 | 43 | 87 |

| Table 7.4 Irrigation level - Mahenge |
|---------------------------------|-----------------|----------------|------|
| AREA | MALE | FEMALE | TOTAL |
| Adults | 200 | 217 | 417 |
| Youth | 103 | 112 | 215 |
| Children | 73 | 91 | 164 |

Source: Respective village offices (2002)

7.2.2 Catchment degradation
Deforestation in the catchment area is contributing to soil erosion and water contamination.
A topographical map of 1982 indicates that most of the area was once a vast seasonal swamp. The swamp was bordered upstream by vast scrublands and scattered cultivation.

Satellite imagery of 1998 indicates that despite the potential for soil erosion upstream of the Mahenge Irrigation Scheme, the current land use/vegetation cover is, nevertheless, mainly cereal and rice cultivation. Furthermore, medium-sized herbaceous crops characterize land use/vegetation cover farther upstream.

Therefore, it appears that the Mahenge scheme is surrounded by soils prone to erosion; hence the need to develop appropriate mitigation measures.

7.2.3 Water quality on downstream users

The pH ranges between 6.98 and 7.29, which is a near neutral pH band. The dissolved oxygen (DO) ranges from 6.26 mg/l to 7.22 mg/l, indicating good aeration and might be fairly low in organic pollution levels.
7.2.4 Socio economic impacts on downstream users

The villages surrounding the Mahenge Irrigation Scheme have no well-functioning domestic water supply systems. The non-availability of good domestic water supply, coupled with poor sanitation conditions at Mahenge village, will considerably increase downstream water pollution. There are cases where the irrigation waters are used for catching fish with poison, washing, and bathing.

Major water users downstream include domestic users, irrigators and livestock keepers. Water availability is a problem especially during the dry season due to low base flow. There are potential water use conflicts with scheme users during periods of water scarcity.

Increases in the incidences of waterborne diseases in the downstream areas as a result of habits carried out by water users in the scheme area and upstream are one of the main socio-economic impacts on downstream users.

7.3 IRRIGATION SCHEME LEVEL IMPACTS

7.3.1 Sand at intake structure

During the field visit, it was observed that there was a considerable amount of sand accumulating at the intake structure. This could be caused by one or a combination of the following:

- Change of hydrologic regimes at intake structures due to the existence of erosion-prone soil types at the intake or by reduced velocity at intake leading to sand deposition.
- Inappropriate upstream land use practices leading to land degradation, soil erosion and soil deposition at the intake structure.

The field survey team also confirmed the situation as shown in Photo 7.1. The farmer groups attributed the cause of the siltation as increased deforestation upstream in the Usambara Mountains. Despite the severity of the problem, the youth of the villages have created an economic opportunity out of the silt deposition. They dredge...
the sand every day and generate income by selling it. A lorry of sand (approximately 7 tones) sells for around 3500 Tshs.

Plate 7.1: Dredged sediments prepared for sell

7.3.2 Reduced water availability for irrigation

The availability of water is significantly reduced in some canal systems due to canal seepage, canal overflow and, in some instances, interference of gully trenches.

Due to its location on an extensive flood plain, which is annually inundated, the scheme is seasonally water logged. Drainage was reported as serious problem in the scheme area during this time. However, some farmers have been able to practice flood recession agriculture during the wet season.

Accounting of impacts at the scheme level is detailed below.

Seepage and overflow from the canal systems

High seepage losses are reported on the main canal (MC: Length 2075 m) at reach from 1075 to 1615 m. Canal bank flow occurs on both sides of the main canal at the reaches from 120 to 200, 500 to 550, 650 to 800, 950 to 1075, 1600 to 1730 and from 1850 to 1950 m.

Seepage losses occur from secondary Canal No. 1 (SC1: Length 1575m) on both sides of the canal, specifically at the reaches 10 to 100 m and 115 to 300 m. Overflow occurs through the right bank of canal reaches from 100 to 200, 500 to 550, 700 to 970m. Due to an improper drainage system, ponds are formed adjacent to SC1. Seepage and overflow problems occur on the Secondary Canal No. 2 (SC2: Length 758m) at the reach between 508 and at the junction of SC5.

Secondary Canal No. 3 (SC3: Length 2525m) is not fully constructed. Only drainage from 0.00 to 350m is completed. Also, the constructed portion of the canal passes through a swampy area; as a result, the canal banks are weak and shallow contributing to the overflow of water to the fields. Seepage losses also occur from SC4 and SC5. Apart from difficulty in crossing, the petty trenches, situated across some portion of the main canal and secondary canals, prohibits some Tertiary Canals (TC24 and TC32) from receiving water.

Poor Drainage System

Due to lack of proper drainage work, two runoff collection ponds existing adjacent to the main canal overflow during the rainy season and cause disruption of service roads. The ponds are situated at the reaches from 700 to 750 and 1000 to 1075m.
Some drains (SD3 and SD4) do not drain water properly due to the lack of a proper slope. SD4 is supposed to drain the return flow into Lwengera River. But the drainage connection up to the river is not yet completed. It is hanging about 600m away from the river. As a result, return flows from SD4, TD4, TD42, SD4, TD44 create ponding problems. This has, consequently, caused water from TC41, SC5, TC42, TC43, TC44, and TC45 to flood into the fields.

Due to the lack of cross drainage works across the petty trenches, crossing to tertiary canals and drains is difficult. In some areas, the petty trenches measure up to 6 m wide and 2 m deep.

Flooding Problem
The dyke protection constructed to protect the field from being flooded by Lwengera River has insufficient height provisions for a reach extending after SC3. During the rainy season, Lwengera River overtops its dyke and floods the areas commanded by TC3. This usually causes water and sediment to fill the secondary drains. When the drains are overfilled, it subsequently causes flooding the tertiary canals supplied by SC4.

Water Use efficiency
There was no irrigation activity before the new scheme. The overall efficiency of the scheme is 20 and 26% during the wet and dry seasons of the year, respectively. Still the water use efficiency is low. As shown in Table 7.6 application efficiency is responsible for the low overall efficiency.

Table 7.6: Water efficiency at Mahenge

<table>
<thead>
<tr>
<th>Condition</th>
<th>Conveyance eff.</th>
<th>Field canal eff.</th>
<th>Application eff.</th>
<th>Overall eff.</th>
<th>Cropping Pattern</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Ec</td>
<td>Eb</td>
<td>Ea</td>
<td>E</td>
<td>Wet season</td>
</tr>
<tr>
<td>Before Rehab</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>After Rehab</td>
<td>Feb. 2002</td>
<td>0.78</td>
<td>0.63</td>
<td>0.45</td>
<td>0.20</td>
</tr>
<tr>
<td>After Rehab</td>
<td>Sept. 2002</td>
<td>0.72</td>
<td>0.72</td>
<td>0.50</td>
<td>0.26</td>
</tr>
</tbody>
</table>

7.3.3 Soil quality
Four representative soil samples were collected from Mahenge irrigation scheme for examination of physical and chemical properties of the soil. The analysis also checked for the presence of salinity and trends.
The soil pH ranged from strongly acidic to slightly acidic for farms located downstream. Fertility ranged from very low to low, although mineralization levels are good. There is very low available phosphorus in the whole farm. Downstream areas have high cation exchange capacity while the upstream farms have low cation exchange capacity. Exchangeable sodium percentage shows that the upstream and the downstream farms are non sodic while the middle farms are slightly sodic. Soil sodicity has been detected in farms located in the middle of the scheme at site number 3 while the rest is non sodic. Generally, soil fertility is low within the irrigation scheme.

The soils at the upstream are neutral pH number 3 are slightly acidic while all the top soils downstream have very strong acid.

Table 7.7: Soil Sites and Results

<table>
<thead>
<tr>
<th>S/N</th>
<th>pH</th>
<th>EC mS/cm</th>
<th>SOLUBLE SALTS</th>
<th>P Mg/kg</th>
<th>C %</th>
<th>N %</th>
<th>C/N</th>
<th>Particle size %</th>
<th>Texture</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Ca Mg K Na</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>sand silt clay</td>
<td></td>
</tr>
<tr>
<td>RM1</td>
<td>7.4</td>
<td>1.05</td>
<td>8.8 4.1 0.32 0.57 2.49</td>
<td>1.84</td>
<td>1.09</td>
<td>9</td>
<td>73 24 19</td>
<td>SCL</td>
<td></td>
</tr>
<tr>
<td>RM2</td>
<td>6.3</td>
<td>0.09</td>
<td>5.8 2.6 0.72 0.58 2.7</td>
<td>3.88</td>
<td>0.34</td>
<td>11</td>
<td>58 18 24</td>
<td>SC</td>
<td></td>
</tr>
<tr>
<td>RM3</td>
<td>6.0</td>
<td>0.24</td>
<td>14.4 5.5 1.04 2.7 3.99</td>
<td>3.49</td>
<td>0.29</td>
<td>12</td>
<td>23 40 37</td>
<td>HC</td>
<td></td>
</tr>
<tr>
<td>RM4</td>
<td>5.0</td>
<td>0.13</td>
<td>5.7 3.0 0.71 0.55 2.84</td>
<td>6.48</td>
<td>0.53</td>
<td>12</td>
<td>16 38 46</td>
<td>HC</td>
<td></td>
</tr>
</tbody>
</table>

7.3.4 Water quality
The salinity and total dissolved solids (TDS) values of the incoming water (measured from the intakes) indicate that the water used for irrigation is fresh and very suitable for that matter. The salinity is zero throughout the entire scheme, while TDS ranges between 46.4 mg/l to 47.8 mg/l. This is fresh water that has started to show signs of degradation. This fact is supported by the low values of total hardness (36-60 mg/l as CaCO₃). The turbidity is low and ranges from 3 NTU to 8 NTU. The colour of the water is also appreciably low, with a range of 22-44 Hazen°. The water has a chemical oxygen demand (COD) of 31-73 mg/l, indicating low organic pollution level. Faecal contamination level ranges from 86-198 FC/100 ml, values indicating low human/animal waste pollution.

Table 7.8: Water Analysis Results

<table>
<thead>
<tr>
<th>S/N</th>
<th>PARAMETER</th>
<th>UNIT</th>
<th>TC1</th>
<th>TC2</th>
<th>TC3</th>
<th>TC4</th>
<th>TC5</th>
<th>TC6</th>
</tr>
</thead>
<tbody>
<tr>
<td>21.</td>
<td>pH</td>
<td></td>
<td>6.98</td>
<td>7.29</td>
<td>7.28</td>
<td>7.25</td>
<td>7.24</td>
<td>7.26</td>
</tr>
<tr>
<td>22.</td>
<td>Temperature (Celcius)</td>
<td></td>
<td>23.9</td>
<td>23.9</td>
<td>24.5</td>
<td>24.1</td>
<td>24.2</td>
<td>26.0</td>
</tr>
<tr>
<td>23.</td>
<td>Electric Conductivity</td>
<td>μS/cm</td>
<td>94.2</td>
<td>94.0</td>
<td>94.9</td>
<td>93.7</td>
<td>94.1</td>
<td>94</td>
</tr>
<tr>
<td>24.</td>
<td>Salinity (%)</td>
<td></td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>25.</td>
<td>Colour (Hazen°)</td>
<td></td>
<td>29</td>
<td>36</td>
<td>36</td>
<td>029</td>
<td>36</td>
<td>44</td>
</tr>
<tr>
<td>26.</td>
<td>Turbidity (NTU)</td>
<td></td>
<td>6</td>
<td>5</td>
<td>8</td>
<td>8</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>27.</td>
<td>Dissolved Oxygen (mg/l)</td>
<td></td>
<td>7.08</td>
<td>6.94</td>
<td>7.14</td>
<td>6.26</td>
<td>6.62</td>
<td>6.89</td>
</tr>
<tr>
<td>28.</td>
<td>Total Dissolved Solid</td>
<td>mg/l</td>
<td>47.1</td>
<td>46.4</td>
<td>46.9</td>
<td>46.9</td>
<td>47.0</td>
<td>47.0</td>
</tr>
<tr>
<td>29.</td>
<td>Nitrate-Nitrogen (mg/l)</td>
<td></td>
<td>0.73</td>
<td>0.61</td>
<td>0.61</td>
<td>0.73</td>
<td>0.86</td>
<td>0.86</td>
</tr>
<tr>
<td>30.</td>
<td>Nitrite-Nitrogen (mg/l)</td>
<td></td>
<td>0.029</td>
<td>0.029</td>
<td>0.027</td>
<td>0.020</td>
<td>0.022</td>
<td>0.027</td>
</tr>
<tr>
<td>31.</td>
<td>Ammonia-Nitrogen (mg/l)</td>
<td></td>
<td>0.26</td>
<td>0.33</td>
<td>0.23</td>
<td>0.21</td>
<td>0.26</td>
<td>0.26</td>
</tr>
<tr>
<td>32.</td>
<td>Phosphate (mg/l)</td>
<td></td>
<td>0.09</td>
<td>0.21</td>
<td>0.27</td>
<td>0.20</td>
<td>0.35</td>
<td>0.25</td>
</tr>
<tr>
<td>33.</td>
<td>Sulphate (mg/l)</td>
<td></td>
<td>6.6</td>
<td>10.0</td>
<td>10.6</td>
<td>10.0</td>
<td>10.0</td>
<td>10.6</td>
</tr>
<tr>
<td>34.</td>
<td>Total Alkalinity (mg/l)</td>
<td></td>
<td>34</td>
<td>38</td>
<td>34</td>
<td>34</td>
<td>35</td>
<td>30</td>
</tr>
<tr>
<td>35.</td>
<td>Total Hardness as CaCO₃</td>
<td>mg/l</td>
<td>44</td>
<td>36</td>
<td>38</td>
<td>38</td>
<td>60</td>
<td>65</td>
</tr>
<tr>
<td>36.</td>
<td>Calcium (Ca) (mg/l)</td>
<td></td>
<td>37</td>
<td>32</td>
<td>34</td>
<td>30</td>
<td>29</td>
<td>34</td>
</tr>
<tr>
<td>37.</td>
<td>Acidity as CaCO₃ (mg/l)</td>
<td></td>
<td>8</td>
<td>9</td>
<td>11</td>
<td>9</td>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td>38.</td>
<td>Chloride (mg/l)</td>
<td></td>
<td>23</td>
<td>24</td>
<td>21</td>
<td>22</td>
<td>25</td>
<td>23</td>
</tr>
<tr>
<td>39.</td>
<td>Faecal coliforms (Count/100ml)</td>
<td></td>
<td>150</td>
<td>128</td>
<td>198</td>
<td>112</td>
<td>98</td>
<td>86</td>
</tr>
<tr>
<td>40.</td>
<td>Chemical Oxygen (mg/l)</td>
<td></td>
<td>31</td>
<td>73</td>
<td>51</td>
<td>31</td>
<td>62</td>
<td>62</td>
</tr>
</tbody>
</table>

7.3.5 Waterborne diseases
According to data obtained from dispensaries in the area, which serve the irrigation scheme, malaria and diarrhoea diseases are the leading diseases in the study area. Surprisingly, malaria affects the population above five years more than it affects the younger generation (i.e. children less than 5). The male population is affected more by malaria in the area. There are also cases of schistosomiasis, but these are at a very low level and are not a threat to irrigators in the area. Disease prevalence in the study area is presented in Table 7.11 below.

Diarrhoea diseases seem to be on the decline with fewer cases being recorded each year. The situation is different for typhoid where a fluctuating trend is observed indicating that the disease is still a big threat to those above five years of age.

Table 7.9: Disease prevalence in the Mahenge area

<table>
<thead>
<tr>
<th>YEAR</th>
<th>NUMBER OF PATIENTS</th>
<th>FEMALE</th>
<th>MALE</th>
<th>&gt;5</th>
<th>&lt;5</th>
<th>DISEASE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>199</td>
<td>138</td>
<td>134</td>
<td>203</td>
<td>MALARIA</td>
</tr>
<tr>
<td>1999</td>
<td></td>
<td>58</td>
<td>81</td>
<td>130</td>
<td>9</td>
<td>SCHISTOSOMIASIS</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1024</td>
<td>11</td>
<td>12</td>
<td>20</td>
<td>TYPHOID</td>
</tr>
<tr>
<td></td>
<td></td>
<td>36</td>
<td>28</td>
<td>14</td>
<td>50</td>
<td>DIARRHEA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>109</td>
<td>168</td>
<td>133</td>
<td>144</td>
<td>MALARIA</td>
</tr>
<tr>
<td>2000</td>
<td>910</td>
<td>32</td>
<td>49</td>
<td>70</td>
<td>11</td>
<td>SCHISTOSOMIASIS</td>
</tr>
<tr>
<td></td>
<td></td>
<td>12</td>
<td>16</td>
<td>28</td>
<td></td>
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</tr>
<tr>
<td></td>
<td></td>
<td>43</td>
<td>26</td>
<td>13</td>
<td>56</td>
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</tr>
<tr>
<td></td>
<td></td>
<td>209</td>
<td>231</td>
<td>203</td>
<td>237</td>
<td>MALARIA</td>
</tr>
<tr>
<td>2001</td>
<td>1436</td>
<td>80</td>
<td>73</td>
<td>114</td>
<td>9</td>
<td>SCHISTOSOMIASIS</td>
</tr>
<tr>
<td></td>
<td></td>
<td>13</td>
<td>6</td>
<td>16</td>
<td>3</td>
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</tr>
<tr>
<td></td>
<td></td>
<td>57</td>
<td>49</td>
<td>35</td>
<td>71</td>
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<tr>
<td></td>
<td></td>
<td>191</td>
<td>139</td>
<td>111</td>
<td>219</td>
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</tr>
<tr>
<td>2002</td>
<td>1197</td>
<td>63</td>
<td>75</td>
<td>128</td>
<td>10</td>
<td>SCHISTOSOMIASIS</td>
</tr>
<tr>
<td></td>
<td></td>
<td>12</td>
<td>16</td>
<td>24</td>
<td>4</td>
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<tr>
<td></td>
<td></td>
<td>21</td>
<td>31</td>
<td>11</td>
<td>41</td>
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</tr>
<tr>
<td></td>
<td></td>
<td>108</td>
<td>83</td>
<td>81</td>
<td>120</td>
<td>MALARIA</td>
</tr>
<tr>
<td>2003</td>
<td>13</td>
<td>9</td>
<td>19</td>
<td></td>
<td>4</td>
<td>TYPHOID</td>
</tr>
<tr>
<td></td>
<td>JAN-AUGUST</td>
<td>43</td>
<td>36</td>
<td>76</td>
<td>3</td>
<td>SCHISTOSOMIASIS</td>
</tr>
<tr>
<td></td>
<td></td>
<td>15</td>
<td>12</td>
<td>5</td>
<td>22</td>
<td>DIARRHEA</td>
</tr>
</tbody>
</table>

7.3.6 Water and sanitation

There is poor sanitation in the scheme. Water sources are easily contaminated with human faeces, urine and agrochemicals that have been leached from soils. The water is, thusly, unfit for human consumption.

7.3.7 Drinking water quality and sanitation

The villages surrounding the Mahenge Irrigation Scheme do not have a well-functioning domestic water supply system. The main canal from the intake passes through the village and is used for drinking and bathing. The status of domestic water supply is illustrated in the following table.

Table 7.10: Water supply
Villages | Source of Drinking Water | Remarks
--- | --- | ---
Mahenge | Irrigation Canal, Nkole River | Hand pump well in disrepair; Investigation on availability of ground water on going by the regional water engineer
Kerenge Makaburini | Hand Pump Well; Rwengera River | Functioning
Kerenge Kibaoni | Hand Pump Well; Nkole River | Functioning
Mng'áza | Hand Pump Well | Functioning
Kwanndolwa | Hand Pump Well; Nkole River | Functioning

Source: IEE 1998

### 7.3.8 Fertilizer and pesticides

Few farmers (1%) use industrial fertilizers during farming, while 23% do use manure. The majority (75%) of farmers plant without any fertilizer.

**Table 7.11: Fertilizers used in Mahenge**

<table>
<thead>
<tr>
<th>Type</th>
<th>Percent of farmers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manure</td>
<td>23</td>
</tr>
<tr>
<td>Urea/SA</td>
<td>1</td>
</tr>
<tr>
<td>None</td>
<td>76</td>
</tr>
</tbody>
</table>

The use of amount of pesticides used is very small in Mahenge. Findings indicate that 92% of farmers farm without the use of pesticides.

**Table 7.12: Pesticides, insecticides, and herbicides used in Mahenge**

<table>
<thead>
<tr>
<th>Type</th>
<th>Percent of farmers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blue copper</td>
<td>1</td>
</tr>
<tr>
<td>Diazon</td>
<td>3</td>
</tr>
<tr>
<td>Dithane thionex</td>
<td>1</td>
</tr>
<tr>
<td>Not using</td>
<td>92</td>
</tr>
<tr>
<td>Round up</td>
<td>1</td>
</tr>
<tr>
<td>Submission thiodan</td>
<td>1</td>
</tr>
<tr>
<td>Thionex</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
</tr>
</tbody>
</table>

### 7.3.9 Socio-economic: positive and negative impacts of villages within the scheme

**Negative Impacts**
- Irrigation development has caused an increase in the prevalence of water related diseases.
- Water carries harmful pollutants (e.g. agrochemicals, human waste, and household waste).
- Immigration has caused an increase in the number of HIV/AIDS cases.
- Building houses without proper plans have contributed to solid waste disposal problems.
- Few proper latrines in the scheme. In 1998 only 8% of the household had toilets.
- Shortage of fuel wood due to an increased distance to sources.

**Positive Impacts**
- There is an increase in the level of income among farmers; hence, there is an improvement in the standard of living and now many farmers are able to contribute to the education of their children.
- The condition of weir/intake has improved.
- More extension services and training available to farmers.
- Improved availability of water resources.
- Increased opportunities to grow and earn more.
8. IDENTIFIED MITIGATION MEASURES

8.1 INTRODUCTION

This section presents a brief description of the identified impacts and subsequent mitigation measures. The description addresses itself to three categories of identified impacts as presented in previous chapter, as well as four categories of identified mitigation measures. The categories of identified impacts include the following:

- Impacts in up-stream areas of scheme
- Impacts at scheme areas
- Impacts in down areas of schemes

Furthermore, the categories of identified mitigation measures include the following:

- Environmental management
- Enhancement of social-economic activities
- Improving health situation
- Revisiting engineering designs and/or construction.

8.2 UPSTREAM AND DOWNSTREAM

8.2.1 Environmental Management

The up-stream mitigation measures under category of environmental management therefore include the following:

- Promoting up-stream afforestation/reforestation and agro-forestry activities to arrest wind/water erosion.
- Promotion of soil and water conservation activities in up-stream area and up-stream environmental protection in general; in order to arrest apparently on-going up-stream soil erosion phenomena. This should incorporate measures to contain the problem e.g. river training; construction of groynes etc.
- Strengthening local community’s capacity monitor and control up-stream water abstractions.

In general environmental management involves adoption of integrated approaches in natural resources management. The mitigation measures, among others, include:

- Soil and water conservation
- Afforestation/reforestation
- Enforcement of regulations in abstraction of water resources.
- Establishment of mechanisms for resolution of conflicts

Priority should be given to introduction of catchment management plans and enforcement mechanism upstream of the scheme to control deforestation activity and introduction of social or community forests as alternative means of wood products.

In down stream areas, among others, the key mitigation measures related to environmental management include: water management, as well as embarking on educational programs seeking to improve irrigation practice, appropriate uses of agro-chemicals etc.

8.2.2 Enhancement of social economic activities

For this reasons, at up-stream, down-stream and within scheme, mitigation measures under category of enhancement of social-economic activities include the following:

- Promotion of environment consciousness in all socio-economic activities.
• Strengthening mechanisms for controlled acquisition and uses of land and water resources.
• Promoting of irrigation agriculture as a viable social economic activity for all age groups and for all sex groups.
• Embarking on educational programs to improve stalls on proper irrigation practices e.g. on proper uses of water, agro-chemicals, IPM approaches, etc.

8.3 IRRIGATION LEVEL

8.3.1 Environmental management

The mitigation measures under the category of environmental management would therefore include the following:

• Establishment and/or strengthening local-based (i.e. scheme-based) effective water management system) namely which can control both allocation and distribution on water.
• Establishing and/or strengthening local-based mechanism for resolution of conflicts in use of both water and land resources.
• Combating weeds infestation.

8.3.2 Revisiting engineering designs and construction

One of the most important up-stream aspects to be revisited is the hydraulic regime of the intake structure. Opinion of the consultant is that accumulation of sand in the area could have been caused by many factors, e.g. changes of reach water speed. There is therefore the need to examine these factors vis-à-vis the designing and eventually construction of the intake.

Further more within the scheme farmers complained about lack of cross-drainage levelling of the farms. This aspect might not have been included in the improvement program, but now that it's becoming a constraint to development in the area there is need to address in focus.

Revisiting engineering designs and construction should also look into the issue of stagnant water in the farm. Leveling should there be carried out as appropriate

8.3.3 Prevention of sedimentation and river bank erosion

Sedimentation is currently not a significant problem in Mahenge irrigation scheme, but as agricultural activities intensify along the riverbanks sedimentation is a potential negative impact. Irrigators should be educated on good farming practices, which minimize soil erosion. Cultivation up to the riverbank should be discouraged and buffer zones along the riverbanks should be established to protect them. Other measures focus on:

• Minimizing surface flow velocity during irrigation applications
• Planting permanent crops along the river banks to avoid frequent soil tilling or minimize tilling operations
• Institute by-laws to prevent farming activities along the riverbanks.

8.3.4 Improvement of water quality

Mitigation measures to prevent or minimize pollution at water sources should be undertaken; and these could include:

• Special restrictions in the use of pesticides in areas with sensitive water resources, e.g. in the vicinity of drinking water points/sources.
• Control and regulation in handling, storage, application and disposal of agrochemical containers
• Measurements of pesticide residues in irrigation canals, drains and rivers and in soils should be carried out (once per year)
• Record keeping of pesticides in use, application methods at all seasons
• Adopt recommendations from TPRI regarding safe and correct handling, storage, application (pesticide selection, timing, rate and methods) and disposal.
8.3.5 Improving health situation

This category of measure should be relevant for identified impacts at both scheme levels, as well as in downstream areas of the scheme.

One of the known environmental impacts of irrigation activities is spread of water borne diseases, e.g. bilharzias, dysentery, malaria, and etc. Furthermore, expected influx of people, as irrigation agriculture increases will mean that promiscuity will also arise. This calls for the need to embark on a program for prevention of HIV/AIDS, as well as strengthening existing health and water supply services, as appropriate.
9.0 ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN (ESMP)

9.1 INTRODUCTION

The mitigation measures proposed in the previous chapter represent the core findings of the EA and are important elements in implementing the current improvement of the irrigation scheme and mitigating potentially adverse social and environmental impacts. The Environmental and Social Management Plan (ESMP) in the following sections presents:

- Identification and summary of major anticipated adverse environmental impacts
- Description of mitigation measures
- Description of elements of monitoring program
- Institutional arrangement
- Implementation schedule for mitigation measures
- Performance monitoring and reporting procedures
- Cost estimates and sources of funds

The ESMP is based on the guidelines defined in the World Bank Operational Manual OP/BP 4.01.

9.2 OBJECTIVES

General objectives of the Environmental and Social Management Plan (ESMP) for the Mahenge irrigation scheme would be to promote sustainable and efficient irrigation agricultural activities in the area.

Specifically, the objectives of the Environmental and Social Management Plan for the Mahenge irrigation scheme are therefore mainly two-fold; namely:

(i) To promote sustainability of the schemes through:

- Improving capacities, knowledge/skills,
- Establishing/strengthening mechanisms for resolution of conflicts pertaining to uses of natural resources especially water and land resources,
- Establishing/strengthening mechanisms for enforcement of regulations for water abstractions and pollution control
- Strengthening local community leadership and effective mechanism for control in acquisition and uses of land resources.

(ii) To promote efficiency in irrigation agricultural activities, through:

- Providing/educating on appropriate irrigation practices, e.g. on proper uses of agro-chemicals, IPM approaches,
- Strengthening implementation of water management concept.
- Revisiting designing and construction stages of the scheme to assess the need for review of the stages.
### 9.3 SUMMARY OF MAJOR ENVIRONMENTAL IMPACTS AND IDENTIFIED MITIGATION MEASURES

A summary of major environmental impacts and identified impacts are depicted in the table below:

**Table 9.1: Environmental and social impacts mitigation measures**

<table>
<thead>
<tr>
<th>ENVIRONMENTAL AND SOCIAL IMPACTS</th>
<th>MITIGATION MEASURES</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Up-stream impacts:</strong></td>
<td><strong>Category: Environmental Management:</strong></td>
</tr>
<tr>
<td>Demographic trend (population changes)</td>
<td>Promoting agro-forestry agricultural practices, coupled with afforestation and reforestation program,</td>
</tr>
<tr>
<td>Catchment degradation</td>
<td>Strengthening enforcement of abstraction regulations</td>
</tr>
<tr>
<td><strong>Category: Enhancement of social-economic activities:</strong></td>
<td></td>
</tr>
<tr>
<td>Promoting environmental consciousness in all social-economic activities,</td>
<td></td>
</tr>
<tr>
<td>Strengthening mechanisms for controlled acquisition and use of land use-related social-economic practices,</td>
<td></td>
</tr>
<tr>
<td><strong>Downstream impacts:</strong></td>
<td><strong>Category: Environmental Management:</strong></td>
</tr>
<tr>
<td>Reduced water quantity</td>
<td>Establishment of mechanism for resolution of water conflicts.</td>
</tr>
<tr>
<td>Increased incidences of waterborne diseases</td>
<td><strong>Category: Enhancement of social-economic activities:</strong></td>
</tr>
<tr>
<td>Poor water quality</td>
<td>Promoting irrigation agriculture as a potentially useful socio-economic activity for all age groups and gender</td>
</tr>
<tr>
<td></td>
<td>Preparing and implementing participatory land use plan (i.e. PLUM)</td>
</tr>
<tr>
<td></td>
<td><strong>Category: Improving health situation</strong></td>
</tr>
<tr>
<td></td>
<td>Promoting awareness on waterborne diseases, as well as HIV/AIDS</td>
</tr>
<tr>
<td></td>
<td>Improving availability of health, water and sanitation services.</td>
</tr>
<tr>
<td><strong>Irrigation scheme level impacts</strong></td>
<td><strong>Category: Environmental Management</strong></td>
</tr>
<tr>
<td>Sand at intake structure</td>
<td>Promoting up-stream soil and water conservation activities and environmental protection program in general,</td>
</tr>
<tr>
<td>Reduced water availability for irrigation</td>
<td>Establishing effective water management system, namely: e.g. controlled allocation and distribution of water</td>
</tr>
<tr>
<td>Poor soil and water quality</td>
<td>Promoting/providing education on appropriate irrigation practices on application of IPM and ISFM</td>
</tr>
<tr>
<td>Fertilizers and pesticides use</td>
<td>Establishing enforcement mechanisms on abstraction rights</td>
</tr>
<tr>
<td>Increased incidences of waterborne diseases</td>
<td><strong>Category: Revisiting engineering designs and/or construction stages</strong></td>
</tr>
<tr>
<td></td>
<td>Reviewing designs and construction to address arising siltation/sedimentation problems</td>
</tr>
<tr>
<td></td>
<td>Establishing modalities for rehabilitation of destroyed structures</td>
</tr>
<tr>
<td><strong>Positive impacts in general</strong></td>
<td>Increased households incomes and broadened socio-economic base or</td>
</tr>
</tbody>
</table>

**46**
earning opportunities
Improved water and land resources management and hence ensuring effective environmental management
Improved productivity e.g. through education on appropriate agricultural practices, proper uses of agro-chemicals, provision of improved seed varieties etc
Improved access to water services both for agriculture as well as for domestic uses.
Desalination due to on-going irrigation activities e.g. at the Mahenge scheme.

Non quantifiable negative impacts
Conflicts among natural resources (especially water and land resources) users

Establishing /strengthening locally based mechanisms for addressing conflicts in uses of natural resources

9.4 DESCRIPTION OF ELEMENTS OF MONITORING PROGRAM

Monitoring objectives
Monitoring refers to a systematic collection of data/information and due analysis, with the aim of following up on the subsequent phenomena in the wake of implementation of the ESMP. Activities are followed up, their status assessed, quantified and rectified accordingly. This process should be considered as part of the ESMP. The District Council will keep a close eye on changing conditions and keep records, as accurately as possible, to check, among others, on compliance with statutory environmental protection provisions and World Bank Safeguard Policies.

Description of performance indicators which provide linkages to impacts and mitigation measures in the EA

Water quality
Water quality will be monitored as follows:

- The water quality of the Pangani River will be assessed continuously to determine the overall impact of, fertilizers, insecticides or pesticides used in the irrigation project and upstream agricultural activities.
- The water flow volume in the river will be measured through the established gauging stations. Water balance modeling should be done for predication proposes. This exercise will help to assess base flows, water yields, and hydrological characteristics of the catchment area.

Ground water
- The ground water will be checked to determine salinity of ground water as a result of project operations.
- The changes in pH of ground water will be monitored to check the impacts on ground water of the various types of crops planted.
- Changes in levels of water table will be monitored in sample areas of crops that consume too much of ground water including the well-documented eucalyptus species.

Soil Conservation
Soil composition, texture and structure in the irrigation project area will be monitored in the sample areas to determine impacts from various agricultural practices.

The fertility level of soils (i.e. nutrient concentration and soil moisture) in the sample crop areas will be monitored to determine impacts from the planted crops. Changes in salinity, porosity, pH level and types of biota in the soils will also be monitored in the sample crop areas. Alteration of these parameters could be expected in cases where crops are grown alongside water or nutrient demanding trees, which may consequently jeopardize the well being of the crops.

Biodiversity indicators
The following are pertinent indicators for catchment management: sedimentation rates, riverbank erosion, flashfloods and deforestation rates. The District Natural Resource Office supported by other stakeholder and RBM should monitor these.
Other important ecological parameters include vegetation; (i.e. both on dry land as well as on river valleys), fish, (i.e. plankton, invertebrates); and birds, and other living organisms available in the area.

**Crop Diseases**
The type of diseases affecting planted trees will be monitored in the sample compartments to determine common diseases to various crops that will require special treatment in the next rotation of crop farming or application of appropriate pesticides for treatment of the disease.

The most damaging crop pests, especially those that have caused extensive loss of production in the farms in Tanzania will be monitored. The monitoring of emerging pests and insects in and around the project area will help determine the most suitable disease control mitigation measure.

**Afforestation**
- Provenance and species resistance to diseases and pests for planting in the community and individual’s forest plots within the project will be screened. Provenance and nursery plots will be established. DBH and heights will be measured.
- The amount of carbon and other greenhouse gases in the soils will be monitored in and around the project area. The amount of greenhouse gases will be monitored to assess the impacts of forest sequestration of greenhouse gases, especially carbon.

**Socio-economic**
The District Office should monitor the characteristics, activities and attitudes of the adjacent communities in order to develop feasible extension programs. The major objectives will be to reduce pressure on the irrigation area *inter alia* through encouraging alternative enterprises. The steps would include:

- Promoting agro-forestry in the local community farms.
- Infrastructure development such as accessibility, marketing, education, health and other proposed activities by the local community around the project area.
- Net immigration monitoring of people in the local community. Population dynamics will be monitored in sub-villages and around the project.
- Fuel wood requirements for the local community will also be monitored to determine local demand and develop possible strategies such as agro-forestry, community forest areas and conservation of natural woodlands in the villages around the project.

**Health indicators**
The main health indicators to be monitored are water-borne diseases such as malaria and bilharzias.

Description of parameters to be measures, methods to be employed, sampling locations, frequency of measurements, detection limits (where appropriate) and definition of thresholds that will signed the need for remedial actions, institutional responsibilities, timing and timescales for monitoring. Reporting arrangements (to regulatory authorities and the Bank), and costs and financing provisions are presented in the table below.
### Table 9.2: Monitoring Plan

<table>
<thead>
<tr>
<th>S/N</th>
<th>Attributes to be Monitored</th>
<th>Sampling Location</th>
<th>Sampling Frequency</th>
<th>Measuring Units</th>
<th>Institution responsible</th>
<th>Presently Measured By whom</th>
<th>Priority Level</th>
<th>Dates in a year</th>
<th>Cost Estimate US $</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><strong>Water quality</strong>&lt;br&gt;(a)Surface Water&lt;br&gt;- Nutrients (nitrates, nitrites, Ammonium, phosphates, Bicarbonates)&lt;br&gt;- Salinity&lt;br&gt;- Biological Oxygen Demand (BOD)&lt;br&gt;- pH&lt;br&gt;- Temperature&lt;br&gt;- Suspended solids&lt;br&gt;- Transparency</td>
<td>On the River Nkola intake to the irrigation scheme, seven locations within the scheme and down stream</td>
<td>Twice annually</td>
<td>For most parameters mg/l</td>
<td>Regional Water Engineer/Pangani River Basin office</td>
<td>None</td>
<td>High</td>
<td>February and September (wet and dry season)</td>
<td>200</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>None</td>
<td></td>
<td>None</td>
<td>Medium High</td>
<td>Do</td>
<td>900</td>
</tr>
<tr>
<td></td>
<td><strong>Ground Water</strong>&lt;br&gt;- Relative water table&lt;br&gt;- Salinity&lt;br&gt;- pH</td>
<td>Sample Compartments</td>
<td>Once annually</td>
<td>Setch depth</td>
<td>Do</td>
<td>None</td>
<td>Medium</td>
<td>Do</td>
<td>900</td>
</tr>
<tr>
<td>2. Soil quality</td>
<td>Sample compartments</td>
<td>Once annually</td>
<td>Parts/thousand</td>
<td>DALDO</td>
<td>None</td>
<td>High</td>
<td>Do</td>
<td>1200</td>
<td></td>
</tr>
<tr>
<td>---</td>
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<td>---</td>
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<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td></td>
</tr>
<tr>
<td>• Salinity</td>
<td>Depends on soil select 8 sampling points</td>
<td>+ or -7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>• pH (H2O,KCL)</td>
<td></td>
<td>Mn/diameter</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Texture/grain size</td>
<td></td>
<td>Me/100g</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Exchangeable Bases</td>
<td></td>
<td>C/N (Mg/Kg)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Organic Matter (Carbon, Nitrogen)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>3. Catchment management</th>
<th>Upstream</th>
<th>Once annually</th>
<th>Tree species</th>
<th>DNRO</th>
<th>None</th>
<th>Low</th>
<th>Feb and Sept</th>
<th>300</th>
</tr>
</thead>
<tbody>
<tr>
<td>River flows</td>
<td>Irrigation scheme</td>
<td></td>
<td>Animal species</td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<td>Sedimentation loads</td>
<td>Down stream</td>
<td>Species</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
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<td>Riverbank erosion</td>
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<td>Deforestation rates</td>
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</table>

<table>
<thead>
<tr>
<th>4. Meteorology</th>
<th>Nearest Station</th>
<th>Daily</th>
<th>Celsius(C)</th>
<th>Regional Water Engineer</th>
<th>Regional Water Engineer</th>
<th>High</th>
<th>Noon</th>
<th>1400</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Max / Minimum Temperatures</td>
<td></td>
<td>Mm</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
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<td>• Rainfall</td>
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<td>% N,E,S,W</td>
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<td>• Relative humidity</td>
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<td>Wind Direction</td>
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<tr>
<td>• Wind</td>
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<td>Meters/Second</td>
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<tr>
<th>5. Crop Diseases</th>
<th>Crop plots</th>
<th>Monthly</th>
<th>Lab tests</th>
<th>DALDO</th>
<th>DALDO</th>
<th>High</th>
<th>Do</th>
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<tr>
<td>• Pests</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Afforestation</td>
<td>Farm plots</td>
<td>Once yearly</td>
<td>DBH- M3, Mt.</td>
<td>DFO</td>
<td>None</td>
<td>Medium</td>
<td>Do</td>
</tr>
<tr>
<td></td>
<td>Provenance test</td>
<td></td>
<td></td>
<td>% C/N in soils</td>
<td></td>
<td></td>
<td>High</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Disease resistance</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td>Carbon sequestration</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>7</td>
<td>Socio-economic</td>
<td>Mahenge and other sub villages</td>
<td>Once annually</td>
<td>Village Executive Officers</td>
<td>Village Records</td>
<td>VEOs</td>
<td>Medium</td>
<td>June</td>
</tr>
<tr>
<td></td>
<td>Population changes</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<td></td>
<td>Increase income</td>
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<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Improved housing</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Gender balance</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fuel wood demand</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Waterborne disease</td>
<td>Upstream irrigation scheme</td>
<td>Once a year</td>
<td>District Health Officer</td>
<td>Dispensary</td>
<td>DHO</td>
<td>High</td>
<td>February</td>
</tr>
<tr>
<td></td>
<td>Malaria</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td>Bilharzias</td>
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<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td>Others</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Down stream</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
9.5 INSTITUTIONAL RESPONSIBILITY

The fundamental area for consideration is empowerment of existing administrative and organisational arrangements. These include farmers, local communities, both as a group as well as in their individual capacities, in both upstream and downstream villages. The empowerment has to be carried out through provision of capacity building, public awareness campaigns, tailor-made training, etc.

As a strategic approach SIIC should strengthen partnership among the Mahenge community in the use of water and land resources. Based on the adopted organisational-structure and job descriptions of various committees to be established, for the operation of the scheme, a framework should be established through which the stakeholders are able to actively engage in a dialogue aimed at equitable and sustainable use of the common resources.

The project should firstly embark on a programme of key and strategic activities which are part of the above outlined Environmental and Social Management Plan and should enhance attainment of the above objectives. More specifically, the following are proposed:

- Hold meetings of various committees as per agreement
- Assist: (i) to organise ward or district-based farmers' day,
  And (ii) participation in local and national events like farmers day
- Undertake joint study visits
9.6 INPUTS REQUIREMENTS AND EXPECTED OUTPUTS

Inputs

The following inputs will be required:

- Human resources to enable capacity building for farmers, district officials and others
- Involvement of NGOs, CBOs, local associations/societies etc to enable facilitation and capacity building
- Farmers labour
- Private sector, residents, farmers' financial and material contributions.
- Equipment/facilities
- Transport/communications
- Evaluation and monitoring facilities

Outputs

The following outputs are expected:

- Enhanced capacity of farmers, WUA, district staff and other stakeholders
- Improved productivity
- Mahenge village land use plan prepared and under implementation
- Improved water quality for domestic purposes
- Improved irrigation practices
- Improved partnership between and among stakeholders
- Effective and efficient uses of water and soil
- Upgrading of awareness on environmental management and social development
- Improved health and productivity of farmers and people in the scheme area and beyond
- Improved agricultural production and enhanced irrigated land
- Community empowered in management of natural resources and the environment
- Enhanced socio-economic activities in Mahenge.

9.7 IMPLEMENTATION SCHEDULE FOR MITIGATION MEASURES

The Environmental and Social Management Plan (ESMP) is presented in Table 7.3. For all impacts the ESMP incorporates the following elements:

- Identified mitigation measures,
- Institutional roles and responsibilities in relation to mitigation measures,
- Expected targets, outputs/outcomes,
- Proposed activity/work schedule
- Provisionally estimated costs.
Table 9.3: The Environmental and Social Management Plan (ESMP)

<table>
<thead>
<tr>
<th>MITIGATION MEASURES</th>
<th>Responsible</th>
<th>Target</th>
<th>Outcomes</th>
<th>Provision Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Promoting agro-forestry agricultural practices, coupled with afforestation and or reforestation program, -Strengthening enforcement of abstraction regulations</td>
<td>District Council, Water Users Association</td>
<td>Establishing or increasing more greency</td>
<td>Improved environmental conditions</td>
<td>800</td>
</tr>
<tr>
<td>Strengthening mechanisms for controlled acquisition and of land use- related social-economic practices</td>
<td>District Council</td>
<td>Ensuring efficient and rational use of land resources</td>
<td>Less land degradation</td>
<td>300</td>
</tr>
<tr>
<td>Promoting environmental consciousness in all social – economic activities, -</td>
<td>District Council</td>
<td>Establish environmental dissemination programme</td>
<td>Increased environmental awareness</td>
<td>500</td>
</tr>
<tr>
<td>Promoting up-stream soil and water conservation activities and environmental protection program in general,</td>
<td>District Council</td>
<td>Less water pollution and improved water uses</td>
<td>Less conflicts in uses of water resources</td>
<td>1200</td>
</tr>
<tr>
<td>Strengthening mechanisms for resolution of conflicts in resource uses</td>
<td>District Council</td>
<td>Establish harmonious land uses</td>
<td>Land use conflicts avoided</td>
<td>400</td>
</tr>
<tr>
<td>-Promoting/providing education on appropriate irrigation practices on application of IPM and ISFM -</td>
<td>District Council</td>
<td>Improved skills and knowledge to local communities</td>
<td>Improved extension activities</td>
<td>750</td>
</tr>
<tr>
<td>Establishing effective water management system, namely:</td>
<td>District Council</td>
<td>Improved water</td>
<td>Effective and efficient use of</td>
<td>300</td>
</tr>
<tr>
<td>Activity</td>
<td>Responsible Entity</td>
<td>Expected Impact</td>
<td>Year</td>
<td></td>
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<td>-------------------------------------------------------------------------</td>
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<td>-----------------------------------------------------</td>
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<tr>
<td>e.g. controlled allocation and distribution of water</td>
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</tr>
<tr>
<td>Promoting awareness on HIV/AIDS and waterborne diseases</td>
<td>District Council</td>
<td>Improved health conditions</td>
<td>900</td>
<td></td>
</tr>
<tr>
<td>Improving availability of social services, e.g. on health, water supply and sanitation</td>
<td>District Council</td>
<td>Improved health conditions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reviewing designs and construction to address arising siltation/sedimentation problems</td>
<td>MAFS</td>
<td>Improved designs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Establishing modalities for rehabilitation of destroyed structures</td>
<td>MAFS</td>
<td>Better structures</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MITIGATION MEASURES</td>
<td>TIME SCHEDULE</td>
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<tr>
<td>Promoting agro-forestry agricultural practices, coupled with afforestation and or reforestation program.</td>
<td>2004 x 2005 x</td>
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<tr>
<td>-Strengthening enforcement of abstraction regulations</td>
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<tr>
<td>.Strengthening mechanisms for controlled acquisition and of land use-related social-economic practices</td>
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<tr>
<td>Promoting environmental consciousness in all social-economic activities,</td>
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<tr>
<td>Promoting up-stream soil and water conservation activities and environmental protection program in general.</td>
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<tr>
<td>Strengthening mechanisms for resolution of conflicts in resource uses</td>
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<td></td>
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</tr>
<tr>
<td>-Promoting/providing education on appropriate irrigation practices on application of IPM and ISFM</td>
<td>x</td>
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<tr>
<td>Establishing effective water management system, namely: e.g. controlled allocation and distribution of water</td>
<td>x x x x</td>
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<tr>
<td>Promoting awareness on HIV/AIDS and waterborne diseases</td>
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<tr>
<td>Topic</td>
<td>Action</td>
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<tr>
<td>Improving availability of social services, e.g. on health, water supply, and sanitation</td>
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<tr>
<td>Reviewing designs and construction to address arising siltation/sedimentation problems</td>
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<tr>
<td>Establishing modalities for rehabilitation of destroyed structures</td>
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</table>
10. CONCLUSIONS AND RECOMMENDATIONS

10.1.1. General conclusion

Based on review of baseline information, field visits to Mahenge irrigation scheme and data analyses, it is evident that there are environmental and social issues and impacts which need to be addressed in order to ensure sustainable and sound operation of the irrigation scheme. As outlined in above chapters (among others): in upstream areas of the scheme, the key issues constraining sustainability are increased soil erosion coupled with lack of soil and water conservation activities as well changes of the river’s hydrological and hydraulic regime. In within-scheme areas the constraints are general poor soil fertility coupled with land hoarding practices. In down-stream area sustainability is mainly constrained by inadequacy of skills/knowledge of the farmers on appropriate irrigation practices. These constraints manifest either to upstream environmental degradation, (particularly of the catchment area), or within-the-scheme impacts, (e.g. due to inappropriate irrigation practices), or also in down-stream areas (due to uncontrolled water abstractions leading to community conflicts.

Baseline data with comprehensive benchmark parameters related to various studies like hydrogeology, socio-economic, environment, water quality, etc. at catchment and irrigation levels were not available in the area. Environment and social assessment impact requires “before and after” studies, and perhaps experience from similar environment to facilitate assessment of the severity of perceived problems. Quantification of impacts requires collection of data, understanding of process and analysis of results, which take more time and resources.

Through ecosystem, farming system and participatory approaches, the key impacts were identified and, as far as was possible, quantified. Additionally, measures pertaining to prevention and/or control have been proposed. An Environmental and Social Management Plan, for the Mahenge irrigation scheme were developed.

10.1.2 Specific conclusions

Location

In conclusion, it was found that the location of the scheme enhances sustainability of the scheme. This is because the scheme is located near a relatively busy road leading to Lushoto and Mombasa, which means ready availability of much trading opportunities.

Bio-physical environment

The Mahenge scheme lies in a wet and relatively fertile and hence high potential area of Tanzania, where there is high agricultural potential. In conclusion it was therefore found that scheme improvement has been of even more beneficial to the local community, had it not been for the apparent ineffective administrative organization of the local government.

Socio-economic environment

Field observations indicated that in general local community at Mahenge area apparently not willing to carry out intensive agriculture and especially of annual crops. They had rather depend on perennial crops e.g. fruits, coconuts, etc. In any case people practicing irrigation at the scheme are those who are not equipped with the necessary awareness and skills/knowledge on irrigation agriculture.

Identified impacts

It is important that the positive aspects of development emerge, especially because these are what motivate the people at village (farm) level and dictate the decisions they take or are willing to have taken on their behalf.

In view of the above, therefore irrigation activities at the scheme are relatively not intensive, and as such, environmental and social impacts are relatively also not significant.
Positive impacts

In the Mahenge irrigation scheme positive impacts are:

- Increased incomes and production, leading to alleviation of poverty
- Improved land and water resources management and distribution,

Negative impacts

Negative impacts identified upstream of the Mahenge scheme are hydrological changes, i.e. in terms of e.g. change of regime of river flow etc. The downstream impacts are increased incidences of water borne diseases and improved income generation. Within the irrigation scheme major impacts are soil salinity and waterborne diseases

Mitigation measures

A number of mitigation measures were proposed to address the identified impacts. As far as possible, preventive management measure are given priority in combating soil and water pollution, catchment degradation, and pollution of the river and disease control.

Compliance with the Tanzanian legislation and World Bank Safeguard Policies

The study team has demonstrated that the Mahenge irrigation scheme is in compliance with the Tanzanian legislation and policies, and World Bank Safeguard Policies.

10.2 RECOMMENDATIONS

Role of Local Government authorities

Most of the identified mitigation measures are related with local community-based effective structural – organization. This means therefore that most of the measures can be implemented by local government authorities themselves with financial and technical assistance of funded projects e.g. RBMSIIP, NGOs and CBOs.

Partnership building

It is recommended that arrangements should be made to share experience and information from other partners in the area. The Korogwe District could collaborate with these stakeholders in implementation of environmental and social management plan, which are relevant to Mahenge irrigation scheme and others in Pangani River Basin.

In order to minimize water and land use conflicts, stakeholders of Pangani River Basin in general should work together as partners to improve production and sustainable development of the watershed management and the scheme’s sustainable development.

Similar projects should develop institutional arrangements geared to share responsibility (decision making) for catchment management plan and prevention management activities in the Pangani River Basin. A partnership approach, however, also needs an appropriate institutional framework, which clearly lays on the roles and responsibilities of each project, district councils and stakeholders. Community and farmers participation could be solicited in planning, management, financing, construction and maintenance of catchment areas and receiving bodies.
Environmental and social impacts monitoring

A participatory monitoring system has been developed for the Mahenge irrigation scheme. There is need to establish process-based plan and monitoring, to build capacity of scheme management team and to develop a databank on the environmental and social impact management plan including the monitoring plan.

Capacity Building

Capacity building is vital for sustainability of the scheme. For this reason, capacity building is relevant for all administrative levels, i.e. starting with a farmer (as an individual), a household, farmers’ committees, associations and groups, village and/or wards, up to district authorities as well as local based public and private organizations e.g. NGOs, CBOs, etc.

Baseline Studies

It is vital for any sustainable smallholder irrigation development and management in the river basin that there is a minimum knowledge about water resources and quantified (baseline data) related to environmental and social issues. It is therefore, proposed a mechanism for regular collection of baseline data be established in the future smallholder irrigation improvement projects.
REFERENCES

2. Agricultural co-operative society Ltd—Kumekucha irrigation scheme
4. Design report for Mahenge Irrigation scheme in 2000 by GIBB (EA) Ltd
13. Korogwe mwaka 2003 na kimeandaliwa na Wizara ya Afya Tanzania
15. MAFS (1996) River Basin Management and Smallholder Irrigation Improvement Project,
18. MAFS (2001) Luganga Smallholder Irrigation Scheme, Scheme Improvement Assessment Report, River Basin Management and Smallholder Irrigation Improvement Project, Tanzania
23. Mahenge Irrigation scheme field report
24. Mfumo wa Taarifa za Uendeshaji wa Huduma za Afya (MTUHA) toleo 2.0, kituo cha Berenge
32. Smallholder Irrigation Improvement Component, Sociological Issues
33. URT (…) Guidelines for Scheme Development for Project and District Catchment Facilitation Teams.
APPENDIX 1: Terms of Reference

TERMS OF REFERENCE FOR ENVIRONMENTAL AUDIT OF GROUP B IRRIGATION SCHEMES

PROJECT BACKGROUND AND OBJECTIVES

The Government of the United Republic of Tanzania has been implementing River Basin Management and Smallholder Irrigation Improvement Project (RBMSIIP) since 1996 through IDA credit. The project aims at (i) strengthening the government capacity to manage its water resources in an integrated and comprehensive manner that ensure equitable, efficiency and sustainable development of the resource and address water related environmental concerns at the National level and in the Rufiji and Pangani basins; and (ii) improve irrigation efficiency of selected smallholder traditional irrigation schemes in these two basins. The Ministry of Agriculture and Food Security and the Ministry of Water and Livestock Development are implementing the project.

The Smallholder Irrigation Improvement Component of the project is focusing on the improvement of existing traditional irrigation schemes. Under existing World Bank Environmental Policy (OD 4.01), the River Basin Management and Smallholder Irrigation Improvement Project (RBMSIIP) has been classified as a category "B" project requiring a limited environmental analysis and, if necessary the inclusion of mitigation measures in project design. This essence means that no major environmental impacts are expected and that only mitigation measures can be incorporated into the scheme design, implementation and operation (SAR 1995)

SCOPE OF WORK

The Environmental Cell Unit (ECU) of the Irrigation section carried out the Initial Environmental Examination (IEEs) in 15 traditional irrigation schemes to ascertain environmental issue and suggest mitigation measures that have to be incorporated during scheme design, Construction and Operation and Maintenance. Based on the IEE findings, IEE Reports were prepared as part of Scheme Improvement Assessment Studies.

The consultants in collaboration with ECU will be required to carry out Environmental Audit in seven (7) group B Scheme of Ruanda Majenje, Igomelo, Mangalali, Nyamahana, Soko, Kambi ya Tanga and Mahenge irrigation schemes. The consultant did environmental Review of Lemkuna irrigation scheme in 2001, thus it requires an Environmental and Social Management Plan only. The schemes are now in operation phase.

The assignment is a continuation of the last activities of Environmental Audit of group A and C irrigation schemes. This will be done in accordance with GoT and World Bank safeguard policies

LOCATION OF IRRIGATION SCHEMES

<table>
<thead>
<tr>
<th>Name of scheme</th>
<th>Location</th>
<th>Area (ha)</th>
<th>Irrigation crops</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Igomelo</td>
<td>Mbarali District</td>
<td>300</td>
<td>Paddy, maize, vegetables</td>
</tr>
<tr>
<td>2. Ruanda Majenje</td>
<td>Mbarali District</td>
<td>450</td>
<td>Maize, paddy, vegetables</td>
</tr>
<tr>
<td>3. Mangalali</td>
<td>Iringa Rural District</td>
<td>190</td>
<td>Vegetables, maize and paddy</td>
</tr>
<tr>
<td>4. Nyamahana</td>
<td>Iringa Rural District</td>
<td></td>
<td>Paddy, vegetables</td>
</tr>
<tr>
<td>5. Kambi ya Tanga</td>
<td>Arumeru District</td>
<td>410</td>
<td>Maize, cassava, vegetables, bananas</td>
</tr>
<tr>
<td></td>
<td>Location</td>
<td>District</td>
<td>Count</td>
</tr>
<tr>
<td>---</td>
<td>----------------</td>
<td>---------------------</td>
<td>-------</td>
</tr>
<tr>
<td>6</td>
<td>Soko</td>
<td>Moshi Rural District</td>
<td>370</td>
</tr>
<tr>
<td>7</td>
<td>Mahenge</td>
<td>Korogwe District</td>
<td>300</td>
</tr>
<tr>
<td>8</td>
<td>Lemkuna</td>
<td>Simanjiro</td>
<td>430</td>
</tr>
</tbody>
</table>
AVAILABLE REPORTS

The reports available at the Irrigation Section (PFT) include Initial Environmental Examination, Engineering, Socio-Economic, Topographical Surveys, Agronomy/Agriculture and Water Resource Studies.

The consultant is therefore required to compile quantitative and qualitative information from these supplemented by field visit in order to have baseline information on environmental issues to develop a model for future review of Initial Environmental Examination reports under RBMSIIP.

TIMING

The consultant is expected to spend about five month starting May 2003.

OUTPUTS

The consultant will be required to produce 17 copies of reports for each irrigation scheme for review by NEMC in hard copy and in MS Word diskette for submission to World Bank for review.

The document should address the following issues:

- Analysis of Engineering, Socio Economic, Agricultural, Soils and Water Resources reports in order to provide quantitative information given the qualitative information in the IEE reports.
- Compliance with EIA procedures according to the Government of Tanzania and World Bank guidelines.
- Proper methodology and approach including criteria for assessment,
- Integrated Pest Management.
- Prepare Environmental Management plan to specify clearly who and when mitigation measures can be implemented.
APPENDIX 2  List of Persons Met

1. Anjelina Yoram
2. Rose Jushu
3. Zubeda Omari
4. Anna Kibiyi
5. Christina Antony
6. Joyce Mhina
7. Dorosea Evariso
8. Fatuma Salehe
9. Blandina Samwel
10. Ahmadi Selemani
11. Steven Mwagu
12. Michael Mchome
13. Rajabu Omari
14. Jumanne Mussa
15. Adamu Mussa
16. Amos Stephen
17. Hassan Ahmadi
18. Y. Mgonja
19. Alexander Lucas
20. Mrsho Smandalo
21. Herbet Aleni
22. Athanasi Omari
23. Juma Mussa
24. Robert Songaeli
25. Mwamwaya Lameck
26. Issa Twaibu
27. Michael Clement
28. Jabili Rajabu
29. Ramdhani Kihiyo
30. Mussa A. Mwewe
31. Issa Mahanyu
32. Mgeni Omari
33. Mussa Hassani
34. Angumbwike Mwakalinga
35. Ibrahimu Omari
36. Nassoro Abdalah
37. Omari Mihambo
38. Bakari Mhina
39. Saidi Mohamed
40. Mussa Kupaza
41. Hassani A. Kimphaka
42. Mama Sophia
APPENDIX 3

PARTICIPATORY ENVIRONMENT AND SOCIO ACTION PLAN: MEN

<table>
<thead>
<tr>
<th>S/N</th>
<th>Problems</th>
<th>Causes</th>
<th>Effects</th>
<th>Mitigation measures</th>
<th>Implementers</th>
<th>Time to implement</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Conflict between farmers and livestock keepers</td>
<td>-Livestock intrusion into irrigated fields -No alternative watering points</td>
<td>-Destruction of crops and irrigation structures</td>
<td>-Provide additional livestock watering points.</td>
<td>-Farmers -IGs committee</td>
<td>-Immediately</td>
<td>8</td>
</tr>
<tr>
<td>2</td>
<td>Water-related diseases</td>
<td>-Polluted and dirty water</td>
<td>-Death and loss of manpower</td>
<td>-Develop other sources of clean drinking water -Research ways to clean up water courses</td>
<td>ADD AN IMPLEMENTER</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>Soil erosion</td>
<td>-Deforestation upstream</td>
<td>-Siltation at the intake and in canals</td>
<td>-Dredge at the intake and in the canals</td>
<td>-Farmers</td>
<td></td>
<td>7</td>
</tr>
<tr>
<td>4</td>
<td>Destruction of canals</td>
<td>-Intrusion of livestock</td>
<td>-Water losses -Low production</td>
<td>-Prepare and follow an operation and maintenance plan -Canal lining -Enforce bylaws.</td>
<td>Farmers -MAFS-IDTS -District Council.</td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>Water pollution</td>
<td>-Waste disposal in canals</td>
<td>-Water-related diseases -Water-related diseases</td>
<td>-Enforce bylaws.</td>
<td>-Farmers -IGs committee</td>
<td></td>
<td>5</td>
</tr>
<tr>
<td>6</td>
<td>Salinity at Legeza Mwendo</td>
<td>-Presence of salt in soils and water</td>
<td>-Reduced production</td>
<td></td>
<td></td>
<td></td>
<td>10</td>
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<tr>
<td>7</td>
<td>Destructive birds</td>
<td>-Birds attracted to crops</td>
<td>-Reduced production -Higher labor costs</td>
<td>-Bird scaring</td>
<td>-Farmers</td>
<td></td>
<td>6</td>
</tr>
<tr>
<td>8</td>
<td>Washing and bathing in canals</td>
<td>-Absence of domestic water supply</td>
<td>-Water pollution -Increase of water-related diseases.</td>
<td>-Enforce bylaws.</td>
<td>-Farmers</td>
<td></td>
<td>9</td>
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<tr>
<td>9</td>
<td>Fishing by using poisons</td>
<td>-Poisons entering water courses -Health hazard</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>10</td>
<td>Low capital</td>
<td>-No savings and credit facilities</td>
<td>-Low production</td>
<td>-Establish SACCOs</td>
<td>-Farmers -District Council</td>
<td></td>
<td>2</td>
</tr>
</tbody>
</table>
APPENDIX 4

World Bank Environmental and Social Safeguard Policies

Environmental Assessment (OP/BP 4.01). Outlines Bank policy and procedure for the environmental assessment of Bank lending operations. The Bank undertakes environmental screening of each proposed project to determine the appropriate extent and type of EA. The Bank classifies the project into one of four categories, depending on the type, location, sensitivity, and the scale of the project and the nature and magnitude of its potential environmental impacts. RBMSIIC is Category B.

Natural Habitats (OP/BP 4.04). The conservation of natural habitats, like other measures that protect and enhance the environment, is essential for long-term sustainable development. The Bank does not support projects involving the significant conversion of natural habitats unless there are no feasible alternatives for the project and its citing, and comprehensive analysis demonstrates that overall benefits from the project substantially outweigh the environmental costs. If the environmental assessment indicates that a project will significantly convert or degrade natural habitats, the project includes mitigation measures acceptable to the Bank. Such mitigation measures include, as appropriate, minimizing habitat loss (e.g. strategic habitat retention and post-development restoration) and establishing and maintaining an ecologically similar protected area.

Pest Management (OP 4.09). The policy supports safe, affective, and environmentally sound pest management. It promotes the use of biological and environmental control methods. An assessment is made of the capacity of the country's regulatory framework and institutions to promote and support safe, effective, and environmentally sound pest management.

Involuntary Resettlement (OP/BP 4.12). The resettlement policy is triggered when people are affected by loss of land, loss of property and/or loss of access to resources. It is therefore irrelevant whether or not the impact will entail physical relocation of the affected people, the policy is triggered in all such cases. This means that the impact may be of such kind that only compensation in cash or kind is necessary.

Indigenous Peoples (OD 4.20). This directive provides guidance to ensure that indigenous people benefit from development projects, and to avoid or mitigate adverse effects of Bank-financed development projects on indigenous people. Measures to address issues pertaining to indigenous peoples must be based on the informed participation of the indigenous people themselves.

Forests (OP/BP 4.36). This policy applies to the following types of Bank-financed investment projects (a) projects that have or may have impacts on the health and quality of forests, (b) projects that affect the rights and welfare of people and their level of dependence upon or interaction with forests, and (c) projects that aim to bring about changes in the management, protection, or utilization of natural forests or plantations, whether they are publicly, privately, or communally owned. The Bank does not finance projects that, in its opinion, would involve significant conversion or degradation of critical forest areas or related critical habitats. If a project involves the significant conversion or degradation of natural forests or related natural habitats that the Bank determines are not critical, and the Bank determines that there are no feasible alternatives to the project and its citing, and comprehensive analysis demonstrates that overall benefits from the project substantially outweigh the environmental costs, the Bank may finance the project provided that it incorporates appropriate mitigation measures.

Safety of Dams (OP/BP 4.37). For the life of any dam, the owner is responsible for ensuring that appropriate measures are taken and sufficient resources provided for the safety to the dam, irrespective of its funding sources or construction status. The Bank distinguishes between small and large dams. Small dams are normally less than 15 m in height, this category includes, for example, farm ponds, local silt retention dams, and low embankment tanks. For small dams, generic dam safety measures designed by qualified engineers are usually adequate.

Cultural Property (OPN 11.03). The term "cultural property" includes sites having archaeological (prehistoric), paleontological, historical, religious, and unique natural values. The Bank's general policy
regarding cultural property is to assist in their preservation, and to seek to avoid their elimination. The Bank (i) normally declines to finance projects that will significantly damage non-replicable cultural property, and will assist only those projects that are sited or designed to prevent such damage, and (ii) will assist in the protection and enhancement of cultural properties encountered in Bank-financed projects, rather than leaving that protection to chance. The management of cultural property of a country is the responsibility of the government. The government's attention will be drawn specifically to what is known about the cultural property aspects of the proposed project site. Appropriate agencies, NGOs, or university departments will be consulted if there are any questions concerning cultural property in the area, and a brief reconnaissance survey will be undertaken in the field by a specialist.

Projects on International Waterways (7.50). The Bank recognizes that the cooperation and good will of riparian is essential for the efficient utilisation and protection of international waterways and attaches great importance to riparian making appropriate agreements or arrangement for the entire waterway or any part thereof. Projects that trigger this policy include hydroelectric, irrigation, flood control, navigation, drainage, water and sewerage, industrial, and similar projects that involve the use or potential pollution of international waterways. The riparian are being notified in accordance with this policy, no additional steps need to be taken at the level of the subprojects.

Disputed Areas (OP/BP/7.60): Projects in disputed areas may occur between the Bank and its member countries as well as between the borrower and one or more neighbouring countries. Any dispute over an area in which a proposed project is located requires formal procedures at the earliest possible stage. The Bank attempts to acquire assurance that it may proceed with a project in a disputed area if the governments concerned agree that, pending the settlement of the dispute, the project proposed can go forward without prejudice to the claims of the country having a disp