Government of the Republic of Malawi

Ministry of Agriculture and Food Security

Irrigation, Rural Livelihoods and Agricultural Development Project

Environmental and Social Management and Monitoring Plan for Muona Irrigation Scheme – Nsanje

January 2009
EXECUTIVE SUMMARY

This document is an Environmental and Social Management and Monitoring Plan (ESMP) for the rehabilitation of an existing Muona Irrigation Scheme located in Mkhanga EPA in Nsanje District in the Southern Region. It is a strategic tool that will guide rehabilitation of the project in order to maximise socio-economic benefits whilst minimising adverse environmental and social effects that may arise from the rehabilitation activities.

Muona Irrigation Scheme was built by the Chinese (Taiwanese) Agricultural Mission in 1969 through involvement of local farmers that assisted with construction and ground levelling. The main crop grown in this scheme is rice, however maize, beans, sweet potatoes and pigeon peas are grown sometime during the year to a lesser extent.

The scheme is currently experiencing a number of challenges that include (but not limited to):
- Siltation of Thangadzi River due to wash down of eroded materials from upstream cultivation activities,
- Flooding of Thangadzi River resulting in loss of crop and damage to scheme infrastructure,
- Siltation and blockage of intake structures of the scheme due to eroded sediments,
- Lack of maintenance of structures resulting in water losses,
- Reduced productivity due to soil degradation and continued loss of nutrients.

Implementation of the project shall involve a number of rehabilitation activities that shall include (but not limited to):
- Reconstruction or replacement of the existing weir,
- Construction of new main supply canal
- Construction of a new night storage reservoir (NSR) to store irrigation water
- Rehabilitation of distribution canals in order to minimise water losses
- Installation of water distribution structures (weirs; gates; flumes) in canals,
- Levelling of some sections of the scheme, reconstruction of flood protection structures,
- Provision of power supply to the scheme offices and housing compound
- Improvement of portable water supply for the scheme
- Improvement of access roads for the scheme.

It is envisaged that project activities, both during the construction and operational phases, will potentially have both positive and negative impacts on the environment. The potential positive impacts shall include (but not limited to):
- Improvement of the socio-economic life of the farmers in the area through enhanced food security and access to income,
- Improvement in ecosystem management of Thangadzi River
- Gain of knowledge and skills related to agriculture and land resources management by farmers.

Potential negative impacts, on the other hand, will include (but not limited to):
- Loss of crop production during the construction phase,
- Surface/groundwater and soil pollution due to agricultural chemical inputs,
- Potential crop failure due to soil salinisation and excessive nutrient loss,
- Increased water borne and water vectored diseases,
- Occupational safety incidents for construction workers.

This Environmental and Social Management and Monitoring Plan has prescribed a number of mitigation measures for addressing the negative impacts. These include:-
- Improved soil and water management practices by beneficiary farmers
- River catchment conservation plan including introduction of widespread land conservation practices and rehabilitation of the riverine ecology (including tree planting)
- Introduction of sanitation infrastructure and launch of sensitisation programme on all water borne disease and HIV AIDS
- Implementation of Health and safety measures during construction phases

Furthermore, the plan has made recommendations on responsible authorities for effective implementation of the proposed measures. In general, most of the measures will be implemented throughout the project lifecycle.

A corresponding monitoring plan with associated verifiable indicators with baseline data has been prepared. The monitoring plan also indicates the frequency of monitoring and lists the responsible institutions for carrying out the monitoring activities,

In conclusion, this ESMP has provided recommendations to the implementing and monitoring stakeholders aimed at ensuring that the benefits of this plan are realised as expected. Overall, these recommendations have emphasised that unless the ecosystem of Nkhate River is properly managed and proper agricultural/land conservation practices are employed by farmers at all times, the sustainability of the scheme will be compromised and the benefits will not be realised as expected.
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1 INTRODUCTION AND BACKGROUND INFORMATION

1.1 Introduction
This document is an Environmental and Social Management and Monitoring Plan (ESMP) for the rehabilitation of an existing Muona Irrigation Scheme located in Mkhanga EPA in Nsanje District in the Southern Region. It is a strategic tool that will guide rehabilitation of the project in order to maximise socio-economic benefits whilst minimising adverse environmental and social effects that may arise from the rehabilitation activities.

Effective implementation of this ESMP will be dependent on concerted efforts by concerned stakeholders during the rehabilitation and throughout the project life span so as to sustain the expected benefits and avoid a decline in environmental quality.

1.2 Main Objective of the Environmental and Social Management Plan (ESMP)
The main objective of this Environmental and Social Management and Monitoring Plan is to identify potential environmental and social impacts, both negative and positive; analyse them and propose preferred measures for mitigating the negative impacts at various stages of the project. Furthermore, the plan recommends appropriate institutions as responsible authorities for the implementation and monitoring of the management plan.

1.3 Structure of the Report
This ESMP is organised into 6 sections. Section 1.0 provides the introductory information to the document, including the objectives of the management and monitoring plan. Section 2.0 outlines the main objective of the project, its location and bio-physical attributes, current challenges being experienced by the scheme and the main project activities to be implemented. Section 3 provides an outline of the physical, biological and socio-economic aspects of the project area. Section 4 provides an overview of the methodology for data collection and analysis during the development of this ESMP while Section 5 outlines the environmental and social impacts of the project, both negative and positive, including the impact-severity matrix for negative impacts. Section 6 contains the environmental and social management and monitoring plans in tabulated format. Finally, the conclusions and recommendations of the ESMP are presented in Section 7 of the document. Annexure 1 of the document has a list of stakeholder consulted; whilst Annexure 2 provides allocation map of the scheme.
2 PROJECT DESCRIPTION

2.1 Location and brief history of the project site
Muona Irrigation Scheme site is situated in Mkhangha EPA, Nsanje District, in the Southern Region. The scheme is located 58 Kms from Thabwa turnoff along the East Bank Road. It is a gravity fed irrigation scheme commanding a gross land area of 446 ha which is irrigated by water drawn from the Thangadzi River and benefits a total of 2266 farmers at present.

A location map has been enclosed under Annexure 2.

Muona Irrigation Scheme was built by the Chinese (Taiwanese) Agricultural Mission in 1969 through involvement of local farmers that assisted with construction and ground levelling. The main crop grown in this scheme is rice, however maize, beans, sweet potatoes and pigeon peas are grown sometime during the year to a lesser extent.

Thangadzi River is the source of irrigation water for Muona Scheme and flows from Thyolo escarpment towards Shire River. This river has experienced reduced flow over the years and it is predominantly due to catchment degradation being caused by intensive cultivation and deforestation of uphill areas which have resulted in heavy soil erosion. The reduction in water flows has negatively affected the productivity of the scheme. Furthermore, the absence of a night storage reservoir at the scheme has undermined the potential of the scheme in utilising the water from the River for crop production. The catchment and riverine degradation have also resulted in increased flooding events into the scheme that have caused regrettable crop losses.

2.2 Main objective of the project
The main objective of this project is to rehabilitate the infrastructure of Muona Irrigation Scheme in order to restore and enhance its productivity potentials so as to sustain the socio-economic status of the people in the area through increased food security and income without compromising environmental quality.

2.3 The main challenges being experienced by the scheme at present
Muona scheme is currently experiencing a number of negative impacts arising mainly from the degradation of the surrounding ecosystem and farmers’ management capacity deficiency. These include but not limited to:

a) Siltation of Thangadzi River and surrounding streams due to wash down of eroded materials from cultivation activities in the Thyolo escarpments resulting in reduced water flows;

b) Change in direction of the Thangadzi River course resulting in flooding of some sections of the scheme;

c) Siltation and blockage of in take structures of the scheme due to eroded sediments;

d) Degradation of Thangadzi River catchment area and its riverine ecosystem;

e) Lack of maintenance of structures resulting in water losses;

f) Reduced productivity due to soil degradation and continued loss of nutrients;

g) Irregular land topography in the scheme area that affect flow of irrigation water to some sections of the scheme.

2.4 Main rehabilitation activities to be undertaken
The main project activities for the rehabilitation of Muona Irrigation Scheme shall include the following:

a) Excavation of Thangadzi River channel to re-direct it towards the Shire River;
b) Construction of a new off-take weir, 150 metres upstream of Fatima road bridge from which irrigation water will be conveyed into a supply canal through a 600 mm diameter steel pipe;

c) Based on (b) above, construction of a new supply canal over a distance of 2900 metres to convey water from the new weir into the scheme;

d) Construction of a night storage reservoir (NSR) to optimise efficient use of the available water resources;

e) Resurfacing by plastering some sections of the existing main supply canal and secondary canals in order to seal off exposed concrete aggregates thereby reducing water losses;

f) Improvement of water distribution capacity between canals through installation of hydraulic control and water measurement structures;

g) Reconstruction of secondary canal embankments over a total distance of 8865 metres in order to improve water flow;

h) Reconstruction and improvement of existing tertiary canal net work;

i) Land levelling in order to improve water flow gradient in some areas;

j) Re-excavation of field drains to a depth of 0.6 metres and invert width of 0.5 metres;

k) Unblocking some of the main external drains and construction of a number of culverts to carry water within these drains across internal access roads;

l) Reconstruction of all the flood protection structures across all the scheme boundaries by excavating 1.5 m deep by 4 m wide drains, erecting flood protection bunds and constructing high boundary roads;

m) Repair and maintenance of staff houses through replacement of broken/worn out doors, window panes, ceilings, electrical wiring, plumbing works and general painting, amongst others;

n) Repair and maintenance of offices, workshops and sheds;

o) Connecting the scheme to an ESCOM power grid complete with its own transformer;

p) Rehabilitation or replacement of the existing grinding mill;

q) Improvement of portable water supply by installing an electrical submersible borehole pump and storage header tanks;

r) Repair of all access roads, bridges and culverts and construction of additional access roads;

s) Construction of washing points for surrounding communities along the main supply canal.

t) Construction of pit latrines at strategic point so nth scheme to reduce incidence of water borne diseases.
3 METHODOLOGY FOR DATA COLLECTION

A number of methods for data collection were employed during the development of this ESMP; however the main ones include field survey through site observations, stakeholder consultations through interviews and focus group discussions; and literature review.

3.1 Field Survey
A number of field visit were conducted to the project site over the period May 2008 – December 2008 during which a detailed assessment was made for the rehabilitation of the Scheme. Specific discussions took place on 24th December 2008 in order to hold discussions on the environmental and social impact of the proposed rehabilitation. This was done in order to appropriately ascertain the current problems and environmental challenges within the project area and to determine the type of impacts that will likely be experienced during implementation of rehabilitation activities of the scheme and the operation phase.

Some of the bio-physical components of the environment observed during the field visit include but not limited to ecological regime of the surrounding surface waters, especially Thangadzi River, current land use practices on and around the project site, the type of water uses that compete with the scheme, the topography of the area, presence and sufficiency of sanitary hardware including latrines and sources of potable water.

3.2 Stakeholder Consultation
A number of stakeholders were consulted during data collection; however the focus was on government departments’ personnel that had and will have a direct stake in the planning and implementation of the project. The personnel consulted were therefore from the Ministry of Irrigation & Water Development (District Irrigation Advisory Service Unit) and the Ministry of Agriculture and Food Security. Other stakeholders that were consulted include beneficiary farmers, scheme management committee members and Water Users Association (WUA) committee members. Direct interviews and focus group discussions are the main methods that were used to capture information from these stakeholders.

3.3 Literature Review
Some of the information used in this ESMP came from published and unpublished literature. This information includes bio-physical parameters like water and soil quality, climatic conditions, topographic attributes of the area, flora and fauna, and demographic statistics, all of which were used to derive preferred mitigation and enhancement measures for the identified impacts of the project.
4. DESCRIPTION OF THE BIOLOGICAL, PHYSICAL AND SOCIO ECONOMIC ENVIRONMENT

4.1 Physical environment

4.1.1 Climate
Being in the Lower Shire Valley and having an altitude ranging between 70 and 100masl the climate is characterised by high temperature during most months of the year. Rainfall is limited to the months of Dec – April and the LTM average is about 760mm per annum. Rainfall is unreliable and often erratic. Due to the high temperature evaporation and evapotranspiration are also high (approx 2200mm and 1830mm per annum respectively) A summary of the weather data for the closest weather station has been provided in Table 1. Detailed weather data can be obtained in the Preliminary Design Report.

Table 1. Summary of Makanga LTM Climatical Data

<table>
<thead>
<tr>
<th></th>
<th>Rainfall mm</th>
<th>Evapotranspiration (mm)</th>
<th>Monthly</th>
<th>Daily</th>
<th>Sunshine</th>
<th>Temp Deg C</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Avg Max</td>
<td>Avg Min</td>
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<tr>
<td>Jan</td>
<td>183.1</td>
<td>176.2</td>
<td>174.8</td>
<td>5.8</td>
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<tr>
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<td>151.3</td>
<td>152.3</td>
<td>5.1</td>
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<td>9.0</td>
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<td>7.1</td>
<td>8.5</td>
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<tr>
<td>Dec</td>
<td>181.1</td>
<td>207.7</td>
<td>184.5</td>
<td>6.2</td>
<td>7.4</td>
<td>34.7</td>
<td>23.5</td>
</tr>
<tr>
<td>Average</td>
<td>764.5</td>
<td>2203.6</td>
<td>1836.1</td>
<td>5.1</td>
<td>8.1</td>
<td>32.4</td>
<td>19.9</td>
</tr>
</tbody>
</table>

4.1.2 Topography,
The scheme is situated on the Rift Valley floor at the edge of the eastern escarpment. The scheme has a gentle slope in the east to west direction dropping towards the Elephant Marsh. The adjacent escarpment (from which the Thangadzi rises) is very steep and characterised by numerous stream and river valleys that cut through the slopes. A contour map and general layout map has been presented in Fig 1 – overleaf.

4.1.3 Soils
Muona Soils are typically heavy clays, sandy clays and sandy clay loams. They are suited to rice growing as they can hold water on the surface for prolonged periods. A soil survey identified 4 soil types of which two (approx 60ha) showed above normal salinity and sodicity levels on the surface as well as at depth (60cm). These will require additional drainage management and careful monitoring.

An area of the scheme has also been inundated by flood waters and subsequent sediment deposition, rendering it unsuitable on grounds of the soil texture.
The soils good inherent fertility and ability to hold nutrients, however due to repeated cultivation, some macro nutrients have become depleted which have to be replenished by application of fertilizers. Nitrogen and Phosphorus are the two main nutrients which need to be applied according to crop requirements.

Details of the soil survey and soil sample analysis can be obtained from the Preliminary Design Report.

Baseline data:
There is a requirement to collect representative samples of the entire scheme at depths 0-30cm and 30-60cm and conduct analysis for pH, salinity and basic cations (Ca and Mg and Na) to provide baseline information for future monitoring purposes. This data must be collected as early as possible.

4.1.4 Water resources

a) Water quantity

There is not sufficient water flow in the Thangadzi River during the dry season to ensure that the entire scheme remains irrigated throughout the year. Furthermore, with the current headworks being inundated by sand and unable to capture maximum flow of the river due to seepage, and due to a poorly functioning irrigation network (due to lack of maintenance and flood damage) and lack of night storage capacity only 80-100ha can be cultivated during the dry season (June-Dec).

Construction of a new headworks, supply canal and introduction of an NSR as well as rehabilitation of the canal network and other infrastructure will have a positive impact in reducing water losses through improved water conveyance, distribution and application, and water management.

Details of River flow data can be obtained from the Preliminary Design Report.

b) Water quality

Water from the Thangadzi River is suitable for irrigation (physical; chemical and biological parameters); however there is a consistent problem of silt load esp. during the rainy season that requires adequate measures at the intake and in the main canal to reduce silt contamination (the current sediment trap mechanism is not working well) River water is not suitable for human consumption, however, the borehole at the Scheme offices has reasonable quality although the levels for hardness, TDs and salinity are high but still within he acceptable range.

Details of River flow data have been presented in the Table 2.

Provision of washing points, pit latrine toilet facilities and improving in-field and scheme drainage would positively reduce risk of water borne diseases. (Diarrhoea, cholera, malaria, and bilharzia).

Baseline data:
There is a requirement to collect additional water samples through a period of 1 year from predetermined and fixed points (including river, drainage and stored water) and carry out physical, chemical and biological analysis. This information will provide baseline data against which the performance of ESMP measures can be gauged.
4.1.5 Land

Following massive deforestation and intensified vegetation loss due to intensive unplanned arable farming without even minimal land conservation measures the Thangadzi River catchment is experiencing accelerated soil erosion. Furthermore, uncontrolled and activities along the river banks are causing massive damage to the River ecosystem and the banks of River are being badly eroded. Massive silt and boulder loads result in clogging up the headworks and intake.

The southern dyke which protects the scheme from flood water from the Thangadzi River has been damaged and breached in several places and needs urgent repair. Most of the dykes and storm water drains are being used to cultivate crops which results in more damage.

4.2 Biological environment

4.2.1 Vegetation and Flora

The scheme catchment area has over time experienced a lot of natural indigenous vegetation loss (forests and grasslands) as land demand is increasing with increased population numbers practicing arable agriculture (maize, pigeon peas, sweet potatoes), more roads being built and settlements growing up. The increase in population also results in higher demand for wood for fuel so many remaining trees (esp. riverine vegetation) is diminishing through tree harvesting for fuel wood.

The rehabilitation works will include minimal removal of natural vegetation for the construction works. The main impact will be removal of a number of trees and shrubs form the proposed NSR site.

4.2.2 Fauna

There are no recorded wildlife species in the area apart from Hippos and crocodiles in Shire River/Elephant Marsh that, at times, come up to the scheme to forage on crops and fish (crocs). Impact on these animals will be minimal. According to the 2006/2007 livestock census, there were 6336 heads of cattle, 33,243 goats and 42 sheep, 5497 pigs and 50,663 heads of poultry in Mkhanga EPA. The cattle, goats and sheep are often found grazing in the less productive (uncultivated) grasslands as well as the non cultivated areas within the scheme (e.g. drains). Rehabilitation of the drainage works could result in loss of grazing for livestock.

4.2.3 Riverine Ecosystem

The Nkhate river is currently characterised as being heavily degraded and having very little natural vegetation remaining. The lower parts of the river (adjacent to the scheme) have been inundated by excessive sediment and sand deposition.

Baseline data: There is a requirement to undertake a baseline survey of the river ecosystem to assess occurrence of key indicator aquatic species at set locations along the river that can be used for future comparisons to assess rehabilitation progress and availability of minimum ecological flow of the river

4.3 Social and economic environment

4.3.1 Scheme Membership and Organisational Structure
Nkhate scheme has a total irrigable area of 395ha. There are a total of 2266 scheme members each holding one or more plots. The beneficiaries are made up of 1527 male and 739 female members.

Farmers elect a **Scheme Management Committee** (SMC) of 10 members (6 men and 4 women). The SMC is responsible for the following water management aspects:

- De-silting head-works and canal of sand
- Distribution of available water
- Clearing of canal embankments and vegetation within the canal
- Cleaning of distribution structures such as gates and dividing boxes.
- Feeder cleaning and maintenance
- Cleaning and maintaining drains and drainage structures.

The SMC also deals with land allocation issues and provides support for sub-committees.

Sub-committees comprise the following:

- **Irrigation Committee** (8 men + 1 woman). Responsibilities include land allocation, water distribution, canal maintenance and general issues.
- **Agricultural Committee** (13 men) made up of the Block Chairmen. Deal with minor disputes between farmers within each block.
- **Credit and Marketing Committee** (6 men + 3 women). Sources markets, negotiates prices and deals with loan repayments to lending facilities.
- **Finance Committee** (6 men + 3 women). Collects annual “22m x 11m bund” fee of MK50. This fee was not collected in 2007 but plans are in place to collect this money in 2008.
- **Disciplinary Committee** (4 men + 2 women). Responsible for resolving disciplinary issues on the scheme.
- **Mill Committee** (6 men + 4 women). Manage rice milling operations at the mill situated within the ARDA complex. At present all finance generated by the mill is administered by the Mill Committee.

The scheme is being supported by Government who employ the Scheme Manager and a number of Agricultural Extension and Development Officers (AEDO’s). The Scheme Manager advises the SMC on water management issues and on the required maintenance of civil structures required for water distribution.

### 4.3.2 Social Infrastructure around the Scheme

a) **Health Facilities**
The main hospital near the scheme is Trinity Hospital which is run by the Catholic Mission at Fatima (approx 10km’s from the scheme). There is an under five clinic at Mlolo.

b) **Education Facilities**
There are two primary schools around the scheme (Thangadzi FP School and Muona FP School). There is one Community Day Secondary School at Fatima.

c) **Domestic Water Supply**
There is an existing borehole at the scheme management houses which has a manual pump. Ideally an electrical pump should be installed and the water be pumped into storage tanks which supply a piped water system to all management houses. This system has been included
in the scheme budget. Water tests of the borehole showed that the water is suitable for human consumption, however has a high hardness level.

d) Electricity Supply
There is no electricity supply available at the scheme. There is power at the nearby Fatima mission and there is a new powerline being erected which passes the scheme along the main road. It would be beneficial if power supply was provided to the scheme offices and housing area, and therefore a provision has been made for power supply in the project budget.

e) Sanitation
There is one pit latrine at the scheme main office, however there are no latrines in the scheme itself. The scheme management houses also have pit latrines. With the prospect of running water supply, these will be upgraded to flush toilets with septic tanks. In addition, there is a requirement to increase the number of latrines to improve sanitation throughout the scheme

4.3.3 Access Roads
There are two access road to the Scheme – The S 152 which runs along the east-bank form Tabwa to Fatima and one that runs down the escarpment form Thyolo via Makwas. A third road to Bangula is impassable because of the bridge over the Shire being washed out. Both access roads are gravel roads that have sections which are in very bad condition (esp. drainage and bridges). This has a massive impact on the viability of the scheme as transport costs are high for all input sand outputs.

4.3.4 Telecommunications
Access by both CELTEL and TELEKOM mobile phone telecommunication networks is available at the scheme. There are no fixed lines or internet facilities.

4.3.5 Problems faced by Scheme members

The long serving farmer members mentioned the following as present social and economic problems:-

- Presently there is insufficient water to meet scheme requirements.
- Some areas are not being supplied by irrigation network (reduced area)
- Major water losses being experienced through lack of improved infrastructure (lining) and water management practices (distribution and scheduling).
- River flood damage is causing allot of damage to the scheme and reducing the arable irrigable area as well as threatening the scheme infrastructure.
- Siltation of canals is causing major problems on scheme operation and is very labour intensive to excavate and remove
- Poor condition of roads (both main access road and the scheme roads) result in high cost of transport
- Lack of coordination amongst farmers to access reliable markets resulting in farmers being forced to accept low prices from middle men and vendors
- Lack of coordination of farmers to access credit and to negotiate reduced input costs with suppliers
- High cost of inputs – esp. fertilizers
- Lack of capacity building on crop production and marketing
- Lack of extension workers;
- Decline in productivity of the soils due to poor practices in the past (mono culture with no rotation) and lack of nutrient replenishment
- The buildings and office infrastructure is insufficient for the scheme management committee.
5. DETERMINED ENVIRONMENTAL AND SOCIAL IMPACTS

Considering that Muona Irrigation Scheme is an already existing scheme, determination of impacts followed the auditing approach which ensures that both current and future impacts are brought into perspective at various stages of the project. Notably, the rehabilitation of this scheme will have both positive and negative impacts on the environment as outlined below.

5.1 Potential Positive Environmental Impacts

These include but not limited to:

i. Enhancement of biodiversity conservation practices in the catchment area of Thangadzi River;
ii. Restoration of Thangadzi riverine ecology;
iii. Promotion of land resources conservation practices within the scheme area and amongst upstream communities;
iv. Enhancement of habitats for wildlife due to increased vegetative cover along Thangadzi River and its catchment area as a result of riverine afforestation initiatives;
v. Reduced water losses due to rehabilitation of scheme intake and distribution canals;
vi. Improved drainage systems resulting in improved water and soil management;
vii. Reduction in flooding systems in the scheme and related damage to crops.

5.2 Potential Negative Environmental Impacts

These include but not limited to the following:

i. Potential loss of nutrients due to soil erosion and leaching as a result of over-cultivation and over application of irrigation water;
ii. Potential Soil salinisation due to water logging that will result from poor drainage water management;
iii. Soil contamination as a result of persistent agricultural chemical inputs;
iv. Ground and surface water pollution due to agricultural chemical inputs and construction debris, as well as oil and fuel leakages from construction machinery;
v. Disturbance and loosening of soils due to earth moving works and mechanical cultivation;
vi. Noise and air pollution from construction machinery;
vii. Potential risk of crop failure or yield reduction due to soil salinity and nutrient loss;
viii. Potential loss of crop due to incorrect flood events into the scheme.

5.3 Potential Positive Social Impacts

These impacts include but not limited to the following:

i. Improved crop production capacity due to improved availability of irrigation water and increase in land for cultivation;
ii. Poverty reduction amongst farmers due to increased income from sales of surplus crop yields;
iii. Improvement in health and nutritional status of farmers due to availability of food at domestic level;
iv. Improvement in farming practices and techniques amongst farmers and surrounding communities as a result of IRLADP capacity building initiatives;
v. Creation of employment to surrounding communities during the construction phase.

5.4 Potential Negative Social Impacts

These include the following:-

i. During the construction phase, construction workers will likely be exposed to health and safety hazards that could lead to injury;
ii. Loss of crop production during the implementation of rehabilitation works
iii. Land use conflicts due to loss of agricultural land as a result of reclaim of riverine buffer zone;
iv. Increase in water borne and vectored diseases like bilharzias and malaria;

v. Accidents caused by drowning in drains and canals by both adults and children;

vi. Water use conflicts within the scheme as well as with up- and downstream users, due to
increased demand for irrigation water against decreased water supply quantities.

5.5 Level of severity of Different Impacts.

The above mentioned impacts were assessed and classified according to level of severity
(from 0 (no significant impact) to -3 (High adverse impact)) and according to length of impact
(Short term to long term impacts). Table 1 (overleaf) provides an overview of the level of
severity and the time frame for the identified impact for two phases of the project
(construction and operation phases).

5.6 Suggested mitigation measures to overcome Potential Negative Environmental
and Social Impacts

A number of mitigation measures have been suggested to mitigate and overcome the potential
negative impacts associated with rehabilitation of the scheme. These mitigation measures
have been listed in detail in Table 3 within the proposed ESMP. The proposed measures form
part of the construction and operational stages.
Table 1: Impact – Severity Matrix for Negative Environmental and Social Impacts of the Project

<table>
<thead>
<tr>
<th>Project Phase</th>
<th>Construction Phase</th>
<th>Operational phase</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Terrestrial</td>
<td>Aquatic</td>
</tr>
<tr>
<td></td>
<td>biodiversity</td>
<td>biodiversity</td>
</tr>
<tr>
<td></td>
<td>-1M</td>
<td>-1S</td>
</tr>
<tr>
<td></td>
<td>0L</td>
<td>-2S</td>
</tr>
</tbody>
</table>

Legend:  
-1 = Low adverse impact  
-2 = Moderate adverse impact  
-3 = High adverse impact  
0 = No significant impact  
L = Long Term  
M = Medium Term  
S = Short Term
6.0 ENVIRONMENTAL AND SOCIAL MANAGEMENT AND MONITORING PLANS

6.1 ESMP

Table 3 (overleaf) provides a comprehensive overview of the suggested Environmental and Social Management Plan. The plan has taken into consideration only significant negative environmental and social impacts that require attention by concerned stakeholders, based on the existing and projected bio-physical and social conditions in the project area, in order to avoid a decline in environmental quality and to ensure that benefits are sustained. The plans include the time frame in which the implementation is to be completed.

6.2. Estimated Budget for the ESMP

The estimated cost of implementation of the ESMP has been developed and a summary of which has been presented in Table 2 below. The costs have been generated from either the detailed BoQ from the Detailed design report.

Table 3 – Estimated ESMP budget

<table>
<thead>
<tr>
<th>Item</th>
<th>Activity</th>
<th>Estimated Total Cost</th>
<th>Annual Costs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Year 1</td>
</tr>
<tr>
<td>Collection of</td>
<td>Water quality measurement</td>
<td>312,000</td>
<td>312,000</td>
</tr>
<tr>
<td>Baseline Information</td>
<td>Soil salinity samples</td>
<td>90,000</td>
<td>90,000</td>
</tr>
<tr>
<td></td>
<td>Assessment of Riverine Indicator Aquatic Species</td>
<td>375,000</td>
<td>375,000</td>
</tr>
<tr>
<td></td>
<td>Other</td>
<td>75,000</td>
<td>75,000</td>
</tr>
<tr>
<td></td>
<td>Sub total - Baseline data Collection</td>
<td>852,000</td>
<td>852,000</td>
</tr>
<tr>
<td>Catchment Conservation plan</td>
<td>Coordination and administration</td>
<td>5,000,000</td>
<td>2,170,000</td>
</tr>
<tr>
<td></td>
<td>Farmer training land conservation practices</td>
<td>7,500,000</td>
<td>3,255,000</td>
</tr>
<tr>
<td></td>
<td>Tree nurseries and planting</td>
<td>5,500,000</td>
<td>2,387,000</td>
</tr>
<tr>
<td></td>
<td>Conservation crop nurseries and planting</td>
<td>7,000,000</td>
<td>3,038,000</td>
</tr>
<tr>
<td></td>
<td>Sub Total</td>
<td>25,000,000</td>
<td>10,850,000</td>
</tr>
<tr>
<td>River Training and Dykes</td>
<td>See detailed BoQ</td>
<td>46,828,300</td>
<td>28,096,980</td>
</tr>
<tr>
<td>Maintenance of dykes</td>
<td>See detailed BoQ</td>
<td>702,400</td>
<td>234,133</td>
</tr>
<tr>
<td>Maintenance of Drains</td>
<td>See detailed BoQ</td>
<td>161,400</td>
<td>53,800</td>
</tr>
<tr>
<td>Training of Farmers</td>
<td>Sustainable Practices and Soil Management</td>
<td>7,500,000</td>
<td>2,500,000</td>
</tr>
<tr>
<td>Health Sensitization campaign</td>
<td>HIV AIDS and Water Borne Disease Prevention</td>
<td>1,500,000</td>
<td>500,000</td>
</tr>
<tr>
<td></td>
<td>Installation of Water Supply</td>
<td>750,000</td>
<td>750,000</td>
</tr>
<tr>
<td></td>
<td>Installation of Electricity Supply</td>
<td>806,000</td>
<td>806,000</td>
</tr>
<tr>
<td></td>
<td>Installation of Pit Latrines</td>
<td>50,000</td>
<td>50,000</td>
</tr>
</tbody>
</table>

| Total ESMP costs            | 84,150,100                                    | 44,692,913           | 20,803,593 | 18,653,593 |

6.3 Monitoring Plan

An Environmental and Social Monitoring plan has been presented in Table 4. The plan includes verifiable mitigation actions as well as verifiable indicators which can be compared to baseline (current) indicator information for both the construction and operational phases of the project. The plan also indicates the monitoring frequency and which institutions are deemed responsible to carry out the monitoring activities. Where baseline information is not available, a budget with estimated costs of acquiring the information has been included in Table 2 above.
6.4 Environmental Audit Plan
The proposed audit plan for monitoring implementation of mitigation measures and their effectiveness is as follows:-

a) During the construction phase – monthly including contractor mobilisation and decommissioning
b) During the operational phase – every 6 months.

The audit would be carried out by IRLAD staff and EAD officials in conjunction with respective representatives from District offices.

6.5 Estimated Costs for Monitoring
The estimated costs for monitoring activities which are described in detail in Table 4 are listed below:-

Table 4 Estimated Annual Monitoring Costs

<table>
<thead>
<tr>
<th>Monitoring Item</th>
<th>Analysis/Activity</th>
<th>No of Samples</th>
<th>Est. Cost per Sample (MK)</th>
<th>Estimated Total Cost (MK)</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Groundwater analysis</td>
<td>Depth, Physical, Chemical and Biological Analysis</td>
<td>50</td>
<td>2,600.00</td>
<td>130,000</td>
<td>Annual</td>
</tr>
<tr>
<td>Soil Chemical Analysis</td>
<td>pH, Ec and Basic Cations analysis</td>
<td>230</td>
<td>1,200.00</td>
<td>276,000</td>
<td>Annual</td>
</tr>
<tr>
<td>Surface water quality analysis</td>
<td>Physical, Chemical and Biological Analysis</td>
<td>85</td>
<td>2,600.00</td>
<td>221,000</td>
<td>Annual</td>
</tr>
<tr>
<td>River Discharge Recording</td>
<td>Daily River Gauge Station Readings</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inventory of Riverine Ecology</td>
<td>Annual Surveys</td>
<td></td>
<td></td>
<td>125,000</td>
<td>Annual</td>
</tr>
<tr>
<td>Analysis of Catchment Conservation</td>
<td>Aerial Photos or Satellite Imagery</td>
<td></td>
<td></td>
<td>250,000</td>
<td>Every 3 years</td>
</tr>
<tr>
<td>Total estimated cost for monitoring</td>
<td></td>
<td></td>
<td></td>
<td>1,014,500</td>
<td></td>
</tr>
</tbody>
</table>

These costs will need to be allocated to various responsible departments as well as to the scheme itself in order to ensure effective implementation of the monitoring plan.
<table>
<thead>
<tr>
<th>SN</th>
<th>Environmental/Social Impact</th>
<th>Type of Impact and Severity</th>
<th>Preferred Mitigation Action</th>
<th>Implementation Timeframe</th>
<th>Estimated Costs</th>
<th>Responsible Institution</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td><strong>Construction Phase</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.1</td>
<td>Degradation of aquatic life downstream of the intake point on Thangadzi River due to a decrease in water quantities;</td>
<td>Negative but low in severity due to insignificant abstraction of water.</td>
<td>Ensuring a considerable flow of water beyond the intake point.</td>
<td>Immediate and daily control until commissioning</td>
<td>Part of construction contract</td>
<td>Contractor, Project Manager, WUA</td>
</tr>
</tbody>
</table>
| 1.2 | Water quality degradation in Thangadzi River due to construction debris, as well as oil and fuel leakages from construction machinery | Negative and moderate in severity | i. Avoid and minimise pushing construction debris towards the river or storage of the same near the riverine  
  ii. Timely maintenance of construction equipment to minimise unnecessary oil and fuel leakages;  
  iii. Washing/servicing of construction machinery away from the river course or drains. | Immediate and daily control until commissioning | Part of construction contract | Contractor, Project Manager, Ministry of Irrigation and Water Development |
| 1.3 | Disturbance and loosening of soils during excavations of irrigation water ways & water storage reservoir and land levelling/preparation | Negative and moderate in severity | i. Appropriate compaction of access roads and earth lined canals to minimise erosion of soils by both wind and water;  
  ii. Minimal tillage during land levelling to reduce amount and depth of soil loosening. | Immediate and weekly control until commissioning | Part of construction contract | Contractor, Project Manager |
| 1.4 | Noise and Air pollution due to construction machinery and dust emission during excavations of irrigation water ways & water storage reservoirs and land levelling/preparation | Negative and moderate in severity | i. Use of ear protection;  
  ii. Sprinkling of water, where appropriate, to minimise dust emission | Immediate and daily control until commissioning | Part of construction contract | Contractor, Project Manager, Department of Occupational Safety & Health of the Ministry of Labour. |
<p>| 1.5 | Exposure of construction workers to health and safety hazards like dust and equipment;     | Negative and moderate in severity | Provision of appropriate protective wear to workers and orientation on appropriate occupational &amp; safety measures during | Immediate and daily control until commissioning | Part of construction contract | Contractor, Project Manager and Department of |</p>
<table>
<thead>
<tr>
<th>SN</th>
<th>Environmental/Social Impact</th>
<th>Type of Impact and Severity</th>
<th>Preferred Mitigation Action</th>
<th>Implementation Timeframe</th>
<th>Estimated Costs</th>
<th>Responsible Institution</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1.8  Loss of crop production during the implementation of rehabilitation works.</td>
<td>Negative but moderate in severity</td>
<td>Adequate Planning Shortening the construction phase by engaging competent contractors</td>
<td>Immediate and weekly control until commissioning</td>
<td></td>
<td>Contractor Project Manager IRLADP</td>
</tr>
<tr>
<td></td>
<td>2.0  Operational Phase</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.1</td>
<td>Degradation of aquatic life downstream of the intake point on Thangadzi River due to a decrease in water quantities;</td>
<td>Negative and moderate in severity</td>
<td>i. Ensuring a considerable flow of water beyond the intake point, especially during periods of minimal river flow; ii. Appropriate supply of irrigation water to fields depending on crop-water demand to avoid unwarranted water over-abstraction.</td>
<td>i) Monthly monitoring of river flow – Apply min flow ii) Irrig. schedule implemented at start of each irrigation season Farmer training in Year 1-3</td>
<td>Catchment conservation: K25 million River training and Dykes: already completed. Maintenance of dykes: K 194,000/annum</td>
<td>WUA, Ministry of Irrigation and Water Development.</td>
</tr>
<tr>
<td></td>
<td>2.2  Risk of extreme flows (flooding and river drying up) which in turn will lead to loss of production and possible water use conflict amongst beneficiaries</td>
<td>Negative and high in severity</td>
<td>i. Develop integrated catchment conservation plan and along the Thangadzi river ii. Improve river training and flood protection iii. Low flow conflict resolution mechanisms</td>
<td>Develop appropriate agro-chemicals list and programme year 1 Introduction of land conservation measures – Year 1 onwards Farmer training Year 1-3</td>
<td>K25 million (as above)</td>
<td>Dept.ofLandResources/ Dept of Forestry IRLADP Ministry of Irrigation and Water Dev. Min of Agriculture</td>
</tr>
<tr>
<td></td>
<td>2.3  Ground and surface water pollution due to agricultural chemical inputs</td>
<td>Negative and high in severity</td>
<td>iv. Application of appropriate quantities of chemical inputs to avoid concentration of unused chemical load in soils; v. Promotion of appropriate agricultural and</td>
<td>Farmer training Year 1-3</td>
<td>n/a</td>
<td>WUA, Ministry of Agriculture &amp; Food Security and Ministry of</td>
</tr>
<tr>
<td>SN</td>
<td>Environmental/Social Impact</td>
<td>Type of Impact and Severity</td>
<td>Preferred Mitigation Action</td>
<td>Implementation Timeframe</td>
<td>Estimated Costs</td>
<td>Responsible Institution</td>
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</tr>
</tbody>
</table>
| 2.4 | Loss of nutrients due to soil erosion and leaching as a result of over-cultivation and irrigation | Negative and high in severity | i. Promotion of appropriate agricultural and land conservation practices, including minimal tillage and compost making, amongst farmers;  
ii. Application of appropriate quantities of irrigation water to crops depending on crop-water demand requirements to avoid water logging and subsequent leaching of nutrients  
iii. Use of appropriate organic and inorganic fertilizers to supplement crop growth. | Introduction of land conservation measures – Year 1 onwards  
Farmer training Year 1-3 | Training and Capacity Building:  
K2.5 million per annum for 3 years  
K7.5 million | WUA, Ministry of Agriculture & Food Security, Ministry of Irrigation and Water Development. |
| 2.5 | Soil salinisation due to water logging poor drainage water management | Negative and high in severity | i. Construction of sufficient drains at appropriate terrains to remove excess water and avoid blockage of the drains at all times;  
ii. Application of appropriate quantities of irrigation water to crops depending on crop-water demand requirements to avoid water logging | Drainage Maintenance Year 1 onwards | Drains: part of construction contract  
Drain Maintenance: K337,000/annum | Contractor, Project Manager, WUA, Ministry of Irrigation and Water Development. |
| 2.6 | Soil contamination as a result of persistent agricultural chemical inputs | Negative and high in severity | i. Application of appropriate quantities of chemical inputs to avoid concentration of unused chemical load in soils;  
ii. Promotion of organic farming through use of compost manure in order to minimise inorganic fertilizer inputs;  
iii. Use of agro-chemicals (pesticides, herbicides etc) with short degradation | Year 1 onwards | Capacity Building and field demonstrations: K450,000 per annum | Ministry of Agriculture and Food Security |
<table>
<thead>
<tr>
<th>SN</th>
<th>Environmental/Social Impact</th>
<th>Type of Impact and Severity</th>
<th>Preferred Mitigation Action</th>
<th>Implementation Timeframe</th>
<th>Estimated Costs</th>
<th>Responsible Institution</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.7</td>
<td>Siltation of the intake point due to sediment transported from upstream of the intake point;</td>
<td>Negative and moderate in severity</td>
<td>i. Use of silt/debris traps on the intake system to prevent clogging of the system; ii. Promotion of appropriate agricultural and land conservation practices on fields upstream of the intake point to minimise soil erosion; iii. Conservation of vegetation and re-planting of trees along Thangadzi River.</td>
<td>Catchment conservation initiatives Year 1-3 Farmer training Year 1-3</td>
<td>Sensitization campaigns: K500,000/annum for 3 years K1.5 Mln</td>
<td>Contractor, Project Manager, Ministry of Agriculture and Food Security, Department of Forestry, WUA.</td>
</tr>
<tr>
<td>2.8</td>
<td>Land use conflicts due to loss of agricultural land as a result of reclaim of riverine buffer zone</td>
<td>Negative but low in severity</td>
<td>Incorporation of farmers with loss in agricultural land into the scheme area.</td>
<td>Year 1 onwards</td>
<td>As above</td>
<td>WUA</td>
</tr>
<tr>
<td>2.9</td>
<td>Increase in water borne and vectored diseases like bilharzias and malaria;</td>
<td>Negative and moderate in severity as awareness in hygienic practices is already prevalent in the area.</td>
<td>i. Sensitization of farmers on proper sanitary behaviour in the scheme area when undertaking agronomic practices; ii. Promotion of appropriate sanitary practices in the surrounding communities; iii. Minimise water logging in the scheme through appropriate irrigation techniques.</td>
<td>Year 1 onwards</td>
<td>As above</td>
<td>WUA, Ministry of Health, Ministry of Irrigation and Water Development</td>
</tr>
<tr>
<td>2.10</td>
<td>Proliferation of HIV/AIDS due to increased promiscuity as a result of increased income amongst farmers;</td>
<td>Negative and high in severity</td>
<td>Sensitization of farmers and surrounding communities on issues related to HIV/AIDS</td>
<td>Year 1 onwards</td>
<td>As above</td>
<td>Ministry of Health</td>
</tr>
<tr>
<td>2.11</td>
<td>Water use conflicts due to increased demand for irrigation water against decreased water supply quantities</td>
<td>Negative and high in severity</td>
<td>i. Establishment of an appropriate system on sharing of water by farmers; ii. Application of appropriate quantities of irrigation water to crops depending on crop-water demand requirements.</td>
<td>Year 1 onwards</td>
<td>As above</td>
<td>WUA, Ministry of Irrigation and Water Development</td>
</tr>
<tr>
<td>2.12</td>
<td>Accidents caused by drowning in drains and canals by both adults and children.</td>
<td>Negative and high in severity</td>
<td>i. Sensitization of farmers and surrounding communities on the dangers related to drains and supply canals;</td>
<td>Year 1 onwards</td>
<td>As above</td>
<td>Contractor, Project Manager, WUA.</td>
</tr>
<tr>
<td>SN</td>
<td>Environmental/Social Impact</td>
<td>Type of Impact and Severity</td>
<td>Preferred Mitigation Action</td>
<td>Implementation Timeframe</td>
<td>Estimated Costs</td>
<td>Responsible Institution</td>
</tr>
<tr>
<td>----</td>
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</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>ii. Provision of access cross-over points, in a form of bridges, at strategic places on canals and drains.</td>
<td>During Construction and annual maintenance thereafter</td>
<td>As above (2.2)</td>
<td>Contractor, Project Manager, Forestry Department, Department of Land Resources Conservation</td>
</tr>
<tr>
<td>2.13</td>
<td>Loss of crop due to flood events into the scheme.</td>
<td>Negative and high in severity</td>
<td>i. Construction of flood protection structures like bunds and drains on the boundaries of the scheme; ii. Stabilization of the banks of Thangadzi River and surrounding streams by reclaiming and re-vegetating the buffer zone iii. Promotion of appropriate agricultural and land conservation practices on fields upstream of the River/streams to minimise siltation due to soil erosion</td>
<td></td>
<td>K 58.9 Mln</td>
<td></td>
</tr>
<tr>
<td>SN</td>
<td>Environmental Impact</td>
<td>Type of Impact and Severity</td>
<td>Preferred Mitigation/Enhancement Action</td>
<td>Verifiable Indicator Mitigation Activity</td>
<td>Monitoring Unit</td>
<td>Monitoring Frequency</td>
</tr>
<tr>
<td>-----</td>
<td>----------------------------------------------------------------------------------------</td>
<td>-----------------------------</td>
<td>-----------------------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------------------------------------</td>
<td>-----------------------------------------------------</td>
<td>---------------------</td>
</tr>
<tr>
<td>1.0</td>
<td>Construction Phase</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.1</td>
<td>Degradation of aquatic life downstream of the intake point on Thangadzi River due to a decrease in water quantities;</td>
<td>Negative but low in severity due to insignificant abstraction of water.</td>
<td>Ensuring a considerable flow of water beyond the intake point.</td>
<td>Volume of water flowing in Thangadzi River and presence of indicator aquatic species</td>
<td>M3/sec or 1/s of river flow</td>
<td>Daily flow readings</td>
</tr>
</tbody>
</table>
| 1.2 | Water quality degradation in Thangadzi River due to construction debris, as well as oil and fuel leakages from construction machinery | Negative and moderate in severity | i. Avoid and minimise pushing construction debris towards the river or storage of the same near the riverine  
ii. Timely maintenance of construction equipment to minimise unnecessary oil and fuel leakages;  
iii. Washing/servicing of construction machinery away from the river course or drains. | Weekly check of river flow  
Clauses in contract | Amount of debris in Thangadzi River  
Water quality analysis | Weekly during construction | Contractor, Project Manager, Ministry of Irrigation and Water Development |
| 1.3 | Disturbance and loosening of soils during excavations of irrigation water ways & water storage reservoir and land levelling/preparation; | Negative and moderate in severity | i. Appropriate compaction of access roads and earth lined canals to minimise erosion of soils by both wind and water;  
ii. Minimal tillage during land levelling to reduce amount and depth of soil loosenig. | Clauses in contract  
Verification of contract activities  
Number of beneficiaries and contract employees trained in erosion control | Amount of soil eroded  
Visible signs of gulleys and other erosion features | Weekly during construction by consultant  
Monthly Audit | Contractor, Project Manager |
| 1.4 | Soil erosion by wind                                                                    | Negative but low in severity | i. Minimise depth of tillage of soils during land levelling;  
ii. Sprinkling water on tilled surfaces to minimise blowing | Amount of soils eroded  
No. of complaints by communities surrounding the site | Weekly during construction contract | Contractor, Project Manager |
<table>
<thead>
<tr>
<th>SN</th>
<th>Environmental Impact</th>
<th>Type of Impact and Severity</th>
<th>Preferred Mitigation/Enhancement Action</th>
<th>Verifiable Indicator Mitigation Activity</th>
<th>Monitoring Unit</th>
<th>Monitoring Frequency</th>
<th>Responsibility</th>
</tr>
</thead>
</table>
| 1.5 | Noise and Air pollution due to dust emission during excavations of irrigation water ways & water storage reservoirs and land levelling/preparation | Negative and moderate in severity | i. Avoid earth-moving construction works on windy days;  
ii. Sprinkling of water, where appropriate, to minimise dust emission | Identification of noise dust prone areas. Implementation of dust control measures  
Enforcement of ear protection | No. of complaints by communities surrounding the site | Weekly during construction contract | Contractor, Project Manager |
| 1.6 | Exposure of construction workers to health and safety hazards like dust and equipment; | Negative and moderate in severity | Provision of appropriate protective wear to workers and orientation on appropriate occupational & safety measures during construction | Record of the number of occupational health and safety incidents or accidents  
Availability of protective wear amongst workers | Number of incident and accident free days. Record of accidents | Daily during construction contract | Department of Occupational Safety & Health of the Ministry of Labour  
Contractor, Project Manager |
| 1.7 | Loss of crop production during the implementation of rehabilitation works.            | Negative but moderate in severity | Shortening the construction phase by engaging competent contractors | Land area cultivated and frequency of cultivation |  |  | Contractor, IRLADP |
| 2.0 | Operational Phase                                                                    |                             |                                                                                                           |                                                                                                          |                                                   |                         |                                        |
| 2.1 | Degradation of aquatic life downstream of the intake point on Thangadzi River due to a decrease in water quantities; | Negative and moderate in severity | i. Ensuring a considerable flow of water beyond the intake point, especially during periods of minimal river flow;  
ii. Appropriate supply of irrigation water to fields depending on crop-water demand to avoid unwarranted water over-abstraction. | i)Volume of water flowing in Thangadzi River and presence of indicator aquatic species  
ii)Irrigation Schedule  
iii)Water Management Records | M3/sec or l/s of river flow above and below offtake  
Comparison of indicator to baseline  
mm of water applied per ha vs water requirement | Daily flow readings  
Annual inventory of indicator species  
Daily irrigation records | Ministry of Irrigation and Water Development  
WUA, |
| 2.2 | Risk of extreme flows (flooding and river drying up) which in turn will lead to loss of production and | Negative and high in severity | vii. Develop integrated catchment conservation plan and along the Thangadzi river  
iii. Improve river training and | Availability of silt traps at in-take point  
Presence of appropriate | Daily record of silt level in sediment trap  
Ha’s of effectively | Daily  
Annual | Ministry of Agriculture and Food Security, Department of |
<table>
<thead>
<tr>
<th>SN</th>
<th>Environmental Impact</th>
<th>Type of Impact and Severity</th>
<th>Preferred Mitigation/Enhancement Action</th>
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<tr>
<td></td>
<td>possible water use conflict amongst beneficiaries</td>
<td></td>
<td>flood protection</td>
<td>land conservation practices on fields upstream of intake point</td>
<td>conserved land in catchment vs target. M3/sec or l/sec river flow</td>
<td>Daily</td>
<td>Forestry, WUA.</td>
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<td>ix.</td>
<td>Low flow conflict resolution mechanisms</td>
<td></td>
<td></td>
<td>Regular Flow measurements</td>
<td>Ha’s of riverine forest (by aerial photo or direct measurement).</td>
<td>Annual</td>
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<td>2.3</td>
<td>Ground and surface water pollution due to agricultural chemical inputs</td>
<td>Negative and high in severity</td>
<td>i. Application of appropriate quantities of chemical inputs to avoid concentration of unused chemical load in soils;</td>
<td>Availability and implementation of appropriate water management practices.</td>
<td>Chemical analysis of ground and scheme surface water samples compared to base line soil data</td>
<td>Representative samples collected annually</td>
<td>Ministry of Agriculture &amp; Food Security and Ministry of Irrigation &amp; Water Development. WUA</td>
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<td>ii. Promotion of ecological methods for pest control to minimise use of pesticides.</td>
<td>Regular collection and analysis of surface and ground water samples</td>
<td>Amount of IPM and organic pest control methods</td>
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<td></td>
<td>Availability of appropriate water management practices</td>
<td>Verifiable land conservation structures per ha vs target</td>
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<td>2.4</td>
<td>Loss of nutrients due to soil erosion and leaching as a result of over-cultivation and irrigation</td>
<td>Negative and high in severity</td>
<td>i. Promotion of appropriate agricultural and land conservation practices, including minimal tillage and compost making, amongst farmers;</td>
<td>Regular collection and analysis of soil samples</td>
<td>Chemical analysis of soil samples compared to base line soil data</td>
<td>Annual collection of representative soil samples Annual training of farmers in land conservation techniques</td>
<td>WUA, Ministry of Agriculture &amp; Food Security, Ministry of Irrigation and Water Development.</td>
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<td>ii. Application of appropriate quantities of irrigation water to crops depending on crop-water demand requirements to avoid water logging and subsequent leaching of nutrients.</td>
<td>Availability of appropriate land and water conservation practices</td>
<td>Verifiable land conservation structures per ha vs target</td>
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| 2.5 | Soil salinisation due to water logging and poor drainage water management | Negative and high in severity | i. Construction of sufficient drains at appropriate terrains to remove excess water and avoid blockage of the drains at all times;  
ii. Application of appropriate quantities of irrigation water to crops depending on crop-water demand requirements to avoid water logging | Regular collection and analysis of soil samples  
Number of drains constructed and maintained.  
Availability of appropriate water management practices. | Level of Soil Ec vs bench mark and baseline  
No and capacity of drains per ha  
No of functional well maintained drains | Annual audit  
Annual audit  
Annual audit | WUA, Ministry of Irrigation and Water Development. |
| 2.6 | Soil contamination as a result of persistent agricultural chemical inputs | Negative and high in severity | i. Application of appropriate quantities of chemical inputs to avoid concentration of unused chemical load in soils;  
ii. Promotion of organic farming through use of compost manure in order to minimise inorganic fertilizer inputs;  
iii. Use of agro-chemicals (pesticides, herbicides etc) with short degradation cycle. | Regular collection and analysis of soil samples  
Availability of appropriate land/soil conservation practices | Chemical analysis of soil samples compared to base line soil data  
Number of trained farmers | Annual  
Annual | Farmers, Ministry of Agriculture and Food Security |
| 2.7 | Siltation of the intake point due to sediment transported from upstream of the intake point; | Negative and moderate in severity | i. Use of silt/debris traps on the intake system to prevent clogging of the system;  
ii. Promotion of appropriate agricultural and land conservation practices on fields upstream of the intake point to minimise soil erosion;  
iii. Conservation of vegetation and re-planting of trees along Thangadzi River. | Availability of silt traps at intake point  
Ha’s of appropriate land conservation practices on fields upstream of intake point  
Amount of vegetation along Thangadzi River | Daily record of silt level in sediment trap.  
Ha’s of effectively conserved land in catchment vs target.  
M3/sec or l/sec river flow  
Ha’s of riverine forest (by aerial photo or direct | Daily  
Annual  
Daily  
Annual | Ministry of Agriculture and Food Security, Department of Forestry, WUA. |
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<tr>
<td>2.8</td>
<td>Land use conflicts due to loss of agricultural land as a result of reclaim of riverine buffer zone</td>
<td>Negative but low in severity</td>
<td>Incorporation of farmers with loss in agricultural land into the scheme area.</td>
<td>Absence of land use conflicts amongst farmers</td>
<td>Recording system for land-use conflicts</td>
<td>Annual summary of records</td>
<td>WUA</td>
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<tr>
<td>2.9</td>
<td>Increase in water borne and vectored diseases like bilharzias and malaria;</td>
<td>Negative and moderate in severity as awareness in hygienic practices is already prevalent in the area.</td>
<td>i. Sensitization of farmers on proper sanitary behaviour in the scheme area when undertaking agronomic practices; ii. Promotion of appropriate sanitary practices in the surrounding communities; iii. Minimise water logging in the scheme through appropriate irrigation techniques.</td>
<td>Records of water borne diseases’ prevalence</td>
<td>Incidence of disease per unit of population vs baseline data (2008) Water analysis vs baseline No of toilets</td>
<td>Monthly (MoH) Monthly (Central Water Laboratory) Annual</td>
<td>Ministry of Health, Ministry of Irrigation and Water Development WUA</td>
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<td>2.10</td>
<td>Proliferation of HIV/AIDS due to increased promiscuity as a result of increased income amongst farmers;</td>
<td>Negative and high in severity</td>
<td>Sensitization of farmers and surrounding communities on issues related to HIV/AIDS</td>
<td>Sensitisation campaign</td>
<td>Incidence of disease per unit of population vs baseline data (2008)</td>
<td>Annual</td>
<td>Ministry of Health</td>
</tr>
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<td>2.11</td>
<td>Water use conflicts due to increased demand for irrigation water against decreased water supply quantities</td>
<td>Negative and high in severity</td>
<td>i. Establishment of an appropriate system on sharing of water by farmers; ii. Application of appropriate quantities of irrigation water to crops depending on crop-water demand requirements to avoid water wastage.</td>
<td>Establishment of effective WUA structures – esp on conflict resolution</td>
<td>Number of Conflicts related to water use amongst farmers</td>
<td>Annual</td>
<td>WUA, Ministry of Irrigation and Water Development.</td>
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<tr>
<td>2.12</td>
<td>Accidents caused by drowning in drains and</td>
<td>Negative and high in severity</td>
<td>i. Sensitization of farmers and surrounding communities on</td>
<td>Sensitization events</td>
<td>Number of accidents in drains</td>
<td>Annual</td>
<td>WUA. Ministry of</td>
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<td>canals by both adults and children.</td>
<td>severity</td>
<td>i. the dangers related to drains and supply canals; ii. Provision of access cross-over points, in a form of bridges, at strategic places on canals and drains.</td>
<td>Effective flood water control structures in place Maintenance of flood water control structures Catchment conservation initiatives (see 2.1 and 2.2)</td>
<td>and canals</td>
<td>and canals</td>
<td>and canals</td>
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<td>2.13</td>
<td>Loss of crop due to flood events into the scheme.</td>
<td>Negative and high in severity</td>
<td>i. Construction of flood protection structures like bunds and drains on the boundaries of the scheme; ii. Stabilization of the banks of Thangadzi River and surrounding streams by reclaiming and re-vegetating the buffer zone</td>
<td>Records of flood incidents</td>
<td>Annual</td>
<td>Records of flood incidents</td>
<td>WUA, Ministry of Irrigation and Water Development Forestry Department, Department of Land Resources Conservation</td>
</tr>
</tbody>
</table>
7.0 CONCLUSIONS AND RECOMMENDATIONS

The Muona Irrigation Scheme has a high potential to further improve the socio-economic profile of the communities in Mkhanga EPA for the better. However, there is need to ensure that the proposed mitigation measures outlined in this management and monitoring plan are given prior consideration at appropriate stages of the project as suggested. All the beneficiaries and responsible implementing and monitoring stakeholders will have a role in the effective sustainability of this project.

Below are the recommendations for this Environmental and Social Management and Monitoring Plan, which have dwelled much on the sustainability of the scheme as a function of the stability of the ecosystem in and around the project area. Thus;

a) The stability and sustainability of rehabilitated infrastructures at Muona Scheme will depend on the management efforts of scheme beneficiaries as well as prime stakeholders like government departments and Non Governmental Organisations (NGOs); otherwise the benefits of the rehabilitation efforts will be short-lived. Catchment management shall require coordinated efforts by Muona Scheme and upstream farmers in order to put in place land resource management measures. Government departments will also be required to coordinate their efforts throughout the project life; examples of which are the Forestry Department and Water Development Department that will be expected to put in place catchment management programmes for Thangadzi River Water Shed.

b) Proper irrigation and drainage water management practices in the scheme will require strict adherence at all times in order to avoid soil salinity and sodicity from spreading from the already affected areas. This is because soil salinisation has been known to shorten lifespans of irrigation schemes dramatically worldwide and in the process causing significant irreversible adverse socio-economic effects on beneficiaries;

c) Vandalism of scheme infrastructure will require stringent preventive measures otherwise the efficiency of some of the scheme’s processes will be compromised. The scheme irrigation management committee will be required to strengthen its by-laws and enforcement of the same in order to arrest the malpractice.
REFERENCES


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<tr>
<th>No.</th>
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<th>Position and Details</th>
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<tbody>
<tr>
<td>1</td>
<td>Mr Edward Mjiku</td>
<td>Water Management Specialist; Ministry of Irrigation and Water Development, Nsanje District Irrigation Advisory Service Unit (DIASU);</td>
</tr>
<tr>
<td>2</td>
<td>Mr Ephraim Kamgona</td>
<td>Beneficiary Farmer;</td>
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<td>3</td>
<td>Mr Nowadays Chingamuka</td>
<td>Beneficiary Farmer and Committee Member for Water Users’ Association (WUA);</td>
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<td>4</td>
<td>Mr Maxwell Kalazina</td>
<td>Beneficiary Farmer and Chairman of Village Development Committee;</td>
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<tr>
<td>5</td>
<td>Mr Stanford Kanfana</td>
<td>Beneficiary Farmer and Member of Disciplinary Committee;</td>
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<tr>
<td>6</td>
<td>Mr Abdulla Kagaza</td>
<td>Chairman, Disciplinary Committee;</td>
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<td>7</td>
<td>Mr Piston Nsona</td>
<td>Beneficiary Farmer;</td>
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<tr>
<td>8</td>
<td>Mr Edward Mzamva</td>
<td>Beneficiary Farmer;</td>
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<td>9</td>
<td>Mr Richard Banda</td>
<td>Beneficiary Farmer and Committee Member for WUA;</td>
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<td>10</td>
<td>Mr Raphael Douglas</td>
<td>Beneficiary Farmer;</td>
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<td>11</td>
<td>Mrs Eurita Limau</td>
<td>Vice Chair, Disciplinary Committee;</td>
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<td>12</td>
<td>Mrs Mercy Zalimba</td>
<td>Beneficiary Farmer and Committee Member for WUA;</td>
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<td>13</td>
<td>Mrs Marita Jimu</td>
<td>Beneficiary Farmer;</td>
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<tr>
<td>14</td>
<td>Mrs Christina Guta</td>
<td>Beneficiary Farmer and Secretary for WUA;</td>
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<td>15</td>
<td>Mrs Martha Zambezi</td>
<td>Beneficiary Farmer and Vice Secretary for WUA;</td>
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<tr>
<td>16</td>
<td>Mr Gerald Mithambo</td>
<td>Beneficiary Farmer and Vice President for WUA;</td>
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<td>Mr. Henry Ntopi</td>
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<td>18</td>
<td>Village Headman Mwaliya</td>
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<td>21</td>
<td>Mr Everson Moloka</td>
<td>Beneficiary Farmer;</td>
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<tr>
<td>22</td>
<td>Mr A K Semu</td>
<td>Scheme Manager (Assistant Irrigation Officer).</td>
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ANNEXURE 2 – LOCATION MAP