Environmental and Social Impact Assessment and Management Plan (ESIA/ESMP)

CHAKALAMBA IRRIGATION SCHEME (Phalombe District)

Contract Number: 019/IRLAD/PRO/06/3/2007:

SURVEY, DESIGN AND PREPARATION OF BIDDING DOCUMENTS FOR THE CONSTRUCTION OF NEW SMALL SCALE IRRIGATION SCHEMES IN CENTRAL AND SOUTHERN REGIONS

May 2009

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EXECUTIVE SUMMARY

This document is an Environmental and Social Assessment with accompanying Management and Monitoring Plan (ESMP) for the proposed Chakalamba irrigation Scheme in Phalombe District in Southern Malawi. It is a strategic tool that will guide implementation of the project in order to maximise socio-economic benefits whilst minimising adverse environmental and social effects that may arise from the project implementation.

Chakalamba Irrigation Scheme site is situated close to Mulanje Mountain along Lunguni River in Nkhulambe EPA in Phalombe District. The project area is on gentle slopes of between 0.5% in the upland towards the mountain and 0.1% on the lowland, where much of the scheme site is based. The project site, which is approximately 40 ha of land area, includes part of an existing scheme of approximately 9 ha which was developed with support from the Salvation Army Church in 2001.

Implementation of the project shall involve a number of activities which shall include:-

- Upgrading of an existing stone masonry weir,
- Installation of supply pipeline form weir to fields
- Construction of distribution canals for irrigation water,
- Construction of storm drains and flood protection structures,
- Construction of a storage reservoir for irrigation water,
- Demarcation of the project site into agricultural plots and:
- Construction of access roads for the scheme.

It is envisaged that project activities both during the construction and operational phases will have both positive and negative impacts on the environment. The positive impacts shall include, amongst others:-

- Improvement of the socio-economic life of the farmers in the area through enhanced food security and access to income,
- Gain of knowledge and skills related to agriculture and land resources management by farmers
- Improvement in the ecosystem management of Lunguni River

Potential negative impacts, on the other hand, will include, amongst others:-

- Reduced water quantities in Lunguni River due to irrigation water abstraction,
- Increased soil erosion due to intensified cultivation
- Surface and groundwater & soil pollution due to agricultural chemical inputs,
- Crop failure due to soil salinisation and excessive nutrient loss,
- Increased water borne and water vectored diseases, and:
- 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 and enhancing the positive impacts. 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.

In conclusion, this Environmental and Social Management and Monitoring Plan 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 Lunguni 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.
TABLE OF CONTENTS

1 INTRODUCTION AND BACKGROUND INFORMATION ----------------------------------------------- 5
  1.1 Introduction ------------------------------------------------------------------------------------ 5
  1.2 Main Objective of the Environmental and Social Management Plan (ESMP)  5
  1.3 Structure of the Report ------------------------------------------------------------------------ 5
2 PROJECT AND BIO-PHYSICAL DESCRIPTION ---------------------------------------------------------- 6
  2.1 Location and bio-physical description of the project site ----------------------------------- 6
  2.2 Main objective of the project ---------------------------------------------------------------- 6
  2.3 Main activities to be undertaken during the project life cycle ------------------------------- 6
3 METHODOLOGY FOR DATA COLLECTION ------------------------------------------------------------ 9
  3.1 Field Survey ----------------------------------------------------------------------- 9
  3.2 Stakeholder Consultation --- --------------------------------------------------------------- 9
  3.3 Literature Review --------------------------------------------------------------------------- 9
4 DESCRIPTION OF THE BIOLOGICAL, PHYSICAL AND SOCIO ECONOMIC ENVIRONMENT ---------------------- 10
  4.1 Physical environment -------------------------- 10
  4.2 Biological environment ------------------------- 14
  4.3 Social and economic environment --------------- 14
  4.4 Baseline Data -------------------------------- 15
5 DETERMINED ENVIRONMENTAL AND SOCIAL IMPACTS -------------------------------------------------- 16
  5.1 Potential Positive Environmental Impacts ------------------------- 16
  5.2 Potential Negative Environmental Impacts --------------- 16
  5.3 Potential Positive Social Impacts ---------------------------- 16
  5.4 Potential Negative Social Impacts ----------------------------------------------- 17
  5.5 Level of severity of Different Impacts, ----------------------------------------------------- 17
  5.6 Suggested mitigation measures to overcome Potential Negative Environmental and Social Impacts ----------------------------------------------- 17
6 ENVIRONMENTAL AND SOCIAL MANAGEMENT AND MONITORING PLANS ----------------------------------- 19
  6.1 ESMP ------------------------------------------ 19
  6.2 Contractor Obligations under the ESMP --------------------------------------------------- 19
  6.3 Beneficiary Obligations under the ESMP -------------------------------------------------- 19
  6.4 Estimated Budget for the ESMP ------------------------------------------------------------- 19
  6.5 Monitoring Plan -------------------------------- 20
  6.6 Environmental Audit Plan -------------------- 20
  6.7 Estimated Costs for Monitoring --------------- 20
7 CONCLUSIONS AND RECOMMENDATIONS ------------------------------------------------------------- 31

ANNEXE 1: List of Stakeholders Consulted During the Assessment------------------------------------ 33
### List of Acronyms

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADD</td>
<td>Agricultural Development Division</td>
</tr>
<tr>
<td>ADMARC</td>
<td>Agricultural Development and Marketing Corporation</td>
</tr>
<tr>
<td>AEDC</td>
<td>Agriculture Extension Development Coordinator</td>
</tr>
<tr>
<td>AEDO</td>
<td>Agriculture Extension Development Officer</td>
</tr>
<tr>
<td>BoQ</td>
<td>Bills of Quantities</td>
</tr>
<tr>
<td>DAES</td>
<td>Department of Agricultural Extension Services</td>
</tr>
<tr>
<td>DAO</td>
<td>District Agriculture Office (ex-RDP Rural Development Project)</td>
</tr>
<tr>
<td>DANIDA</td>
<td>Danish International Development Agency</td>
</tr>
<tr>
<td>DIASU</td>
<td>District Irrigation Advisory Services Unit</td>
</tr>
<tr>
<td>DIO</td>
<td>District Irrigation Office</td>
</tr>
<tr>
<td>DoI</td>
<td>Department of Irrigation</td>
</tr>
<tr>
<td>DTM</td>
<td>Digital Terrain Model</td>
</tr>
<tr>
<td>EC</td>
<td>Electrical Conductivity</td>
</tr>
<tr>
<td>EIA</td>
<td>Environmental Impact Assessment</td>
</tr>
<tr>
<td>EMA</td>
<td>Environment Management Act (1996)</td>
</tr>
<tr>
<td>EMP</td>
<td>Environmental Management Plan</td>
</tr>
<tr>
<td>EPA</td>
<td>Extension Planning Areas</td>
</tr>
<tr>
<td>FAO</td>
<td>Food and Agriculture Organisation</td>
</tr>
<tr>
<td>GoM</td>
<td>Government of Malawi</td>
</tr>
<tr>
<td>GPS</td>
<td>Global Positioning System</td>
</tr>
<tr>
<td>GRP</td>
<td>Glass Reinforced Pipe</td>
</tr>
<tr>
<td>HIPC</td>
<td>Heavily Indebted Poor Countries</td>
</tr>
<tr>
<td>IFAD</td>
<td>International Food and Agriculture Development</td>
</tr>
<tr>
<td>IRLADP</td>
<td>Irrigation, Rural Livelihood and Agricultural Development Project</td>
</tr>
<tr>
<td>IWMU</td>
<td>Irrigation Water Management Unit</td>
</tr>
<tr>
<td>MoAFS</td>
<td>Ministry of Agriculture and Food Security</td>
</tr>
<tr>
<td>MoIWD</td>
<td>Ministry of Irrigation and Water Development</td>
</tr>
<tr>
<td>NGO</td>
<td>Non-Governmental Organisations</td>
</tr>
<tr>
<td>PCU</td>
<td>Project Coordination Unit</td>
</tr>
<tr>
<td>PM</td>
<td>Programme Manager</td>
</tr>
<tr>
<td>SMC</td>
<td>Scheme Management Committee</td>
</tr>
<tr>
<td>SM</td>
<td>Scheme Manager</td>
</tr>
<tr>
<td>TBM</td>
<td>Temporary Bench Mark</td>
</tr>
<tr>
<td>ToR</td>
<td>Terms of Reference</td>
</tr>
<tr>
<td>WB</td>
<td>World Bank</td>
</tr>
<tr>
<td>WUA</td>
<td>Water Users’ Association</td>
</tr>
</tbody>
</table>
1 INTRODUCTION AND BACKGROUND INFORMATION

1.1 Introduction
This document is an Environmental and Social Impact Assessment with accompanying Management and Monitoring Plan (ESMP) for a proposed Chakalamba irrigation Scheme in Phalombe District in Southern Malawi. It is a strategic tool that will guide implementation of the project in order to maximise socio-economic benefits whilst minimising adverse environmental and social effects that may arise from the project implementation.

Effective implementation of this ESMP will be dependent on concerted efforts by concerned stakeholders throughout the project life span so as to sustain the expected benefits and avoid a decline in environmental quality. Resources will be needed either from the project funds or other auxiliary projects for the implementation of various mitigation and enhancement measures.

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. The ESMP has been prepared in accordance with the Environmental Impact Assessment Guidelines for Irrigation and Drainage Projects (2002) from the Environmental Affairs Department.

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, including the main project activities to be implemented. Section 3 provides an outline of the methodology for data collection and analysis during the development of this ESMP while Section 4 outlines the environmental and social impacts of the project, both negative and positive, including the impact-severity matrix for negative impacts. Section 5 contains the environmental and social management and monitoring plans in tabulated format. Finally, the conclusions and recommendations of the ESMP are presented in Section 6 of the document. The Annexe of the document has a list of stakeholder consulted.
2 PROJECT AND BIO-PHYSICAL DESCRIPTION

2.1 Location and bio-physical description of the project site
Chakalamba Irrigation Scheme site is situated close to Mulanje Mountain along Lunguni River in Nkhulambe EPA in Phalombe District. A location map can be found in Fig 1 (overleaf). The project area is on gentle slopes of between 0.5% in the upland towards the mountain and 0.1% on the lowland, where much of the scheme site is based.

The project site includes part of an existing scheme of approximately 9 ha which was developed with support from the Salvation Army in 2001. The intake point for this scheme, which will also be upgraded for the proposed scheme, consists of a concrete weir from which water is delivered to the fields through submerged PVC pipes over a distance of about 1.7 Km. There is no system of distribution canals and drains for excess water under the current scheme and thus most fields are irrigated by means of flooded bed irrigation.

The project site is customary land, under cultivation and predominantly surrounded by villages and agricultural land. The catchment area of the proposed source of irrigation water, i.e Lunguni River, has natural vegetation of Miombo woodland stretching towards Mulanje Mountain where there is a plantation of cedar and pine trees.

Crops that are currently being cultivated on the project site and surrounding agricultural land include maize, pigeon peas, kidney beans and vegetables, amongst others. It is expected that scheme beneficiaries will continue cultivating the same types of crops though there is a probability of diversifying into other crop types such as paprika, sweet potato, ground nuts, Irish potato, high value vegetables, fruit crops and tree crops, where appropriate.

2.2 Main objective of the project
The main objective of the proposed Chakalamba Irrigation Scheme project is to upgrade the existing scheme into an area of approximately 40 ha suitable for irrigation from the current 9 ha and thus increasing the number of beneficiaries and the capacity of the existing farmers to produce more.

The ultimate goal of the project therefore is to enhance the socio-economic status of the people in the area through increased food security and income by promoting improved agricultural practices without compromising environmental quality.

2.3 Main activities to be undertaken during the project life cycle
The main project activities for Chakalamba Irrigation Scheme shall include the following:

a) Laying down of an underground conveyance pipe of 200mm diameter, parallel to the existing 75 mm diameter PVC pipe, over a distance of about 2 Km from the weir to the night storage reservoir (NSR);

b) Upgrading of the existing weir by enlarging the outlet in order to increase irrigation water intake;

c) Upgrading of the existing night storage reservoir by reconstructing the outlet control devices and inclusion of a spillway to cater for overflows;

d) Construction of a number of brick lined main delivery canals amounting to 450 metres;

e) Construction of a number of brick lined secondary distribution canals amounting to 4250 metres;

f) Construction of earth lined feeder canals amounting to 12,600 metres;

g) Construction of a drainage and flood protection system consisting of: in field open drains for excess water (4600 metres) and boundary cut off drains (175 metres) for protecting the scheme against runoff effects;
h) Construction of approximately 103 drop fall and turn out distribution boxes with control gates amongst the network of feeder canals;

i) Construction of scheme access roads;

j) Levelling off some portions of the project land in order to increase the flow of irrigation water to target fields;

k) Demarcation of the project land in scheme fields.

Fig 2 (overleaf) gives the proposed scheme layout.

*Fig 1 – Location Map – Chakalamba Irrigation Scheme*
Fig 2. General Layout – Chakalamba Scheme
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 visits were conducted to the project site in Nkhulambe EPA, Phalombe during the period May 2008 to December 2008 in the process of preparing detailed designs for the proposed irrigation scheme. Specific discussions relating to this ESIA were held on 19th December 2008 and 18th January 2009. The outcome of these visits as well as observations from other experts has been used to characterize the bio-physical components of the environment including ecological regime of the surrounding surface waters, especially Lunguni River, current land use practices on and around the project site, the type of water demanding uses that may compete with the irrigation project, 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; including direct beneficiaries as well as the 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. Direct interviews and focus group discussions were the main methods that were used to capture information from these stakeholders.

3.3 Literature Review
Most of the information used in this ESMP came from field work and design data and not form published and unpublished literature. The information used 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

Dependable data that is available for the area around the scheme is from Phalombe (rainfall only) and from Mulanje (1969-2007). The available climatic data comprises of Rainfall, Evaporation, minimum and maximum Temperatures. The LTM data has been summarized in Table 1 below.

Table 1. Long Term Mean Meteorological Data – Mulanje and Naminjawa (rainfall) weather station (1969-2007)

<table>
<thead>
<tr>
<th></th>
<th>Rainfall (mm)</th>
<th>Effect. Rainfall (mm)</th>
<th>Naminjwa rainfall (mm)</th>
<th>Eto (mm/day)</th>
<th>Temp max (deg C)</th>
<th>Temp min (deg C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan</td>
<td>318</td>
<td>157</td>
<td>242.7</td>
<td>4.1</td>
<td>29</td>
<td>19</td>
</tr>
<tr>
<td>Feb</td>
<td>316</td>
<td>157</td>
<td>210.4</td>
<td>4</td>
<td>29</td>
<td>19</td>
</tr>
<tr>
<td>Mar</td>
<td>340</td>
<td>159</td>
<td>150.4</td>
<td>3.5</td>
<td>28</td>
<td>18</td>
</tr>
<tr>
<td>Apr</td>
<td>172</td>
<td>123</td>
<td>37</td>
<td>3.3</td>
<td>28</td>
<td>16</td>
</tr>
<tr>
<td>May</td>
<td>71</td>
<td>63</td>
<td>4.6</td>
<td>2.8</td>
<td>25</td>
<td>13</td>
</tr>
<tr>
<td>Jun</td>
<td>60</td>
<td>54</td>
<td>1.1</td>
<td>2.3</td>
<td>23</td>
<td>11</td>
</tr>
<tr>
<td>Jul</td>
<td>34</td>
<td>32</td>
<td>1.2</td>
<td>2.5</td>
<td>24</td>
<td>10</td>
</tr>
<tr>
<td>Aug</td>
<td>36</td>
<td>34</td>
<td>0.7</td>
<td>3.2</td>
<td>26</td>
<td>11</td>
</tr>
<tr>
<td>Sep</td>
<td>18</td>
<td>18</td>
<td>1.4</td>
<td>4.1</td>
<td>29</td>
<td>13</td>
</tr>
<tr>
<td>Oct</td>
<td>67</td>
<td>60</td>
<td>23.3</td>
<td>5.1</td>
<td>32</td>
<td>16</td>
</tr>
<tr>
<td>Nov</td>
<td>188</td>
<td>131</td>
<td>66.7</td>
<td>4.6</td>
<td>31</td>
<td>18</td>
</tr>
<tr>
<td>Dec</td>
<td>288</td>
<td>154</td>
<td>219.4</td>
<td>4.2</td>
<td>30</td>
<td>19</td>
</tr>
<tr>
<td>LTM Avg/Tot</td>
<td>1908</td>
<td>1142</td>
<td>958</td>
<td>4</td>
<td>28</td>
<td>15</td>
</tr>
</tbody>
</table>

As is valid for the rest of Malawi, rainfall is insignificant during the months of April to November where evaporation exceeds precipitation. Based on the Mulanje evaporation figures it is estimated that there is approximately 1300mm of annual evaporation against actual rainfall of 958mm. This indicates a moisture deficit of 350-400mm per annum.

From these climatic statistics it can be deduced that irrigation is a necessity for improved and extended agricultural production. Temperatures indicate that there are good growing conditions throughout the year that will not have a negative effect on plant growth

4.1.2 Topography,

Chakalamba irrigation scheme is characterised by steeper slopes on the upland positions and flattens out on the lower areas. There is an elevation difference of 42m between the outlet of the off-take weir and inlet of the Night Storage Reservoir. Between the dam and the lowest part of the scheme the elevation difference is approximately 14m. The area planned for irrigation development is characterised by a gentle slope of between 0.05% and 0.15% The slope is suitable for surface irrigation development with minimal earth movement.
4.1.3 Soils

There is no existing detailed soil survey of the project site or the surrounding area. A soil survey was carried out to identify and sample the main soil types. A map showing the main soil types that were identified and mapped at Chakalamba is available in the Preliminary Design Report. Descriptions of these soils are presented below, supported by pedological descriptions and laboratory analysis data for samples that were collected using soil augers during the survey.

The Chakalamba site is located in a narrow river valley and the target project area is a combination of upland in situ derived soils on an interfluve as well as alluvial soils in the valley bottoms. The soils survey that was carried out identified four main soil types as

**Soil Type 1:** The soils of this type are located on relatively higher ground from the river and around the pond, soils are deep, over 100cm, dark brown (7.5YR) medium grained sandy loams (sometimes loamy sands) over well drained dark brown (7.5YR) to dark reddish brown (5YR) similar sandy clay loams to clays. These soils are suitable for irrigation on account of their good depth and medium texture which lead to a good water holding capacity. The soils are also well drained which, again, is a critical requirement for most of the crops intended for the scheme. These soils occupy a gross area of 10.7 ha at this site.

**Soil Type 2:** These soils occur down slope of soil type 1 soils in the vicinity of the graveyard. The soils exhibit lighter or greyer surface colours being very dark greyish brown (10YR) medium grained loamy sands and occasionally sandy loams which overlie dark brown (7.5YR) clays with yellowish iron and manganese stains. The soils are poorly drained as a result of the heavy textured subsoil and as indicated by the presence of mottles, stains and iron manganese stains, indicating that they are waterlogged during part of the rainfall season. They are therefore of very restricted suitability for irrigation and therefore require better drainage and better management than adjacent soil types. There is a gross area of 11.1 ha of these soils at Chakalamba.

**Soil Type 3:** These soils are similar to Soil Type 1 and have alluvial influence. They are deep, over 100cm dark brown (7.5YR) fine grained loamy sands and sandy loams overlying well drained dark reddish brown (5YR) fine grained sandy loams.

They are suitable for the irrigated production of most crops planned for the scheme, especially maize, vegetables, and beans. Soil type 3 covers a gross area of 9.2 ha at Chakalamba.

**Soil Type 4:** These soils occur on the flat alluvial floodplain, in close proximity to the river. They are variable in nature but generally comprising stratified soil profiles of sandy loams overlying in the surface overlying sandy clay loams, to clays in the subsoil. Due to the alluvial stratification, the soil profiles sometimes have a thin 10 – 15cm layer of sand in the upper subsoil, which does not detract heavily from the high water holding capacity of the soil profile. Temporary waterlogging conditions are known to occur in these soils mainly because of their low topographic location which renders them a receptacle of drainage waters from all surrounding higher areas. Thus, if brought into irrigation, these soils will need drainage structures to remove excess water. Pending the return of soil analysis data for samples collected in the survey at Chakalamba, field observations indicate that the soils are inherently fertile. They are suitable for irrigation with the only proviso being the need for drains to remove excess water. Soil type 4 covers a gross area of 16.0 ha at Chakalamba.

**Soil Type 5:** These occur along the Lunguni River and are predominantly inert sands resulting from recent river depositions during high flows and floods. They are not suitable and should be excluded from any designs.

A map showing distribution of different soil types can be found in Fig 3. (overleaf).
Figure 3: Soil Map for Chakalamba irrigation Scheme showing approximate soil boundaries

Soil 1 - Dark brown loamy sands and sandy loams over dark brown to dark reddish brown sandy clay loams to clays. 100cm deep. Suitable for irrigation
Soil 2 - Very dark greyish brown loamy sands and sandy loams over dark brown and stained clays 105cm deep. Of restricted suitability for irrigation
Soil 3 - Dark brown fine loam sands and sandy loams over dark reddish brown fine sandy loams 100cm deep. Suitable for irrigation
Soil 4 - Variable alluvial soils stratified 100cm deep. Suitable for irrigation with provision of drains
Soil 5 - River sand deposits
4.1.4 Water resources

a) Water quantity

There is no flow gauging station on the Lunguni River.

The catchment size and available data from adjacent flow stations are not adequate for any significant or meaningful analysis for flow estimations.

A number of flow estimates have been done using a temporary “V-Notch” weir to monitor flow during the assessment period. These estimates have been supplemented with information that was derived from discussions with beneficiaries and have led to the following findings:-

i) Measured stream flow

<table>
<thead>
<tr>
<th>Date of Measurement</th>
<th>Method Of Measurement</th>
<th>Measured River Discharge</th>
</tr>
</thead>
<tbody>
<tr>
<td>15 June 2008</td>
<td>Cut Throat Flume</td>
<td>120l/s</td>
</tr>
<tr>
<td>9 August 2008</td>
<td>V- Notch</td>
<td>60l/s</td>
</tr>
<tr>
<td>26 September</td>
<td>V- Notch</td>
<td>20l/s</td>
</tr>
</tbody>
</table>

ii) The last year that water stopped flowing all together was in October 1994.

iii) Flood flow levels – these were estimated by applying flow calculations from estimated water levels indicated by flood marks (debris) and indications from the local community.

iv) Assumptions on water availability

From these findings it can be deduced that the river is perennial and has stopped flowing once in 14 years, flow declines from approx 120l/s in the early part of the irrigating season to 20l/s in the later part of the season. Low flow is taken at 20l/s.

Any weir structures should be built to withstand maximum estimated daily flows during heavy rainstorms and floods in excess of 3000l/s.

- Average flow for early season >100 l/s
- Average flow for the mid-late season 20l/s
- Frequency of non flow events – no reported
- Estimated flood flows – 3000l/s

b) Water quality

A sample taken from Lunguni River was tested for chemical, physical and biological quality at the Central Water Laboratory. The analysis shows that the quality of stream water is suitable for irrigation purposes but is not suited for human consumption. The results of the analysis are further confirmed by the successful production of crops at the scheme.

There is evidence of rubble and debris which is brought down during floods during the rainy season; however the silt load is lower relevant to other SSI schemes.
4.1.5 Land Tenure

The proposed area is customary land and is administered under the Traditional Authority Currently under small scale crop production with an average plot size of 0.2ha per farmer. Scheme members "rent" land from the land owners during irrigating season only. The land owners then cultivate the land during the rainy season. Most land owners (but not all) are members of the scheme.

Under IRLADP, the intention is to formalise the land ownership under the WUA. This is regarded as an essential step that will ensure long term sustainability of the scheme.

4.2 Biological environment

4.2.1 Vegetation and Flora

The site is at the base of Mt Mchese and Mt Mulanje. Both mountains are covered by natural and planted forest which are protected forest reserves. The area close to the site has been cleared for intense agriculture with very little natural vegetation or forests.

4.2.2 Fauna

No large wildlife mammal species was reported for this site. The main types of large fauna found in the area are domestic animals such as cattle, sheep, goats, pigs and poultry. Observations were made of numerous indigenous bird, reptile (lizards, snakes, frogs) and insect species in and around the site.

4.2.3 Riverine Ecosystem

The riverine ecosystem is well protected in the areas where the river flows in the forest reserve, however when it flows into the site area, it is clear that the ecosystem has been degraded heavily with few to no trees and cultivation taking place up to the river banks. There are clear signs of heavy erosion along the river banks in this area.

4.3 Social and economic environment

4.3.1 Scheme Membership and Organisational Structure

The main village where most beneficiary households are residing is called Rwanwa village. At present there are a total of 178 members registered as heads of households who are beneficiaries of the scheme of which 123 are men and 65 are women.

4.3.2 Social Infrastructure around the Scheme

a) Health Facilities

The closest health facility is Nkhulambe Health Centre which provides very basic health care. The closest hospital is at Phalombe (23km’s).

b) Education Facilities

There is one Primary School close to the scheme namely Nkhulambe FP School. The closest Secondary School is at Phalombe.

c) Domestic Water Supply

There are a number of functioning boreholes with hand pumps around the scheme. The borehole is used for drinking whilst the Lunguni is used for washing and bathing.

d) Electricity Supply
There is no power supply to the site and the closest power lines are found either at Phalombe (23kms) or Muloza (35kms).

e) Sanitation
Pit latrines are found at most homesteads. There is a requirement to construct a number of latrines on the proposed scheme due to the distance to the inhabited area.

4.3.3 Access Roads
The shortest route is through the Fort Lister Gap which links the site directly to Phalombe. This is a dirt road that deteriorates badly during the rains. Alternate routes are considerably longer and not necessarily in better condition.

4.3.4 Telecommunications
There is no cell phone network coverage in this area.

4.4 Baseline Data
Samples and data collected for the designs are not sufficient to provide a full baseline data set against which the scheme’s environmental performance can be gauged. It is therefore important that a number of baseline surveys are conducted during the first year. These include:-

- Collection of detailed river water discharge levels
- Collection of additional water samples for quality analysis
- Assessment of riverine indicator species
- Collection of additional soil samples for chemical and physical analysis
- Collection of social information on land tenure and land use arrangements

The estimated costs have been included in the ESMP costs (see section 6.2).
5. DETERMINED ENVIRONMENTAL AND SOCIAL IMPACTS

There are several environmental and social impacts, both negative and positive, that the project will effect and will experience that will require mitigation and enhancement measures at various stages of the project.

5.1. Potential Positive Environmental Impacts

These include but not limited to:

i. Enhancement of biodiversity conservation practices in the catchment area of Lunguni River;
ii. Restoration of Lunguni riverine ecology;
iii. Promotion of land resources conservation practices amongst farmers in the area;
iv. Recharge of underground aquifers;
v. Enhancement of habitats for wildlife due to increased vegetative cover along Lunguni River as a result of riverine afforestation initiatives;
vi. Increased grazing area for livestock due to rehabilitation of vegetation and restoration of Lunguni Riverine.

5.2. Potential Negative Environmental Impacts

5.2.1 Construction Phase

These include but not limited to the following:

i. Ground and surface water pollution due to construction debris
ii. Disturbance and loosening of soils during excavations of irrigation water ways & water storage reservoirs, construction of scheme access roads and land levelling/preparation;
iii. Air pollution due to dust emissions during the construction phase

5.1.2 Operational Phase

These include but not limited to the following:

i. Loss of water and resulting degradation of aquatic life downstream of the intake point due to a decrease in water quantities (requires maintenance of minimum environmental flow)
ii. Loss of nutrients due to soil erosion and leaching as a result of over-cultivation and irrigation;
iii. Soil salinisation due to water logging and persistent chemical input during cultivation;
iv. Soil contamination as a result of persistent agricultural chemical inputs;
v. Ground and surface water pollution due to agricultural chemical inputs and construction debris;
vi. Siltation of the in take point due to cultivation activities upstream of the intake point;
vii. Crop failure or yield reduction due to soil salinity and nutrient loss;
viii. Increased levels of Pests and Diseases (as a result of irrigated crops)and additional costs associated with their control

5.3. Potential Positive Social Impacts

These impacts include but not limited to the following:

i. Increase in crop harvests due to increase in number of cultivation times per year;
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. Access to water for washing at pressure breaking and distribution points within reach of homesteads;
v. Improvement in farming practices and techniques amongst farmers and surrounding communities;
vi. Increase in aquaculture activities due to establishment and restoration of fish ponds along the main irrigation water delivery pipes and overnight water storage reservoir;
vii. Creation of employment to surrounding communities during the construction phase.

5.4. Potential Negative Social Impacts

i. Land use conflicts due to loss of agricultural land as a result of reclaim of riverine buffer zone;
ii. Land use conflicts between rainfed and irrigation farmers
iii. Increase in water borne and vectored diseases like bilharzias and malaria;
iv. Water logging in the nearby graveyard due to increase in groundwater table as a result of irrigation water;
v. Proliferation of HIV/AIDS due to increased promiscuity as a result of increased income amongst farmers;
vi. Water use conflicts due to increased demand for irrigation water against decreased water supply quantities;
vii. Construction workers will likely be exposed to health and safety hazards like dust and equipment;
viii. Accidents caused by drowning in drains and canals by both adults and children.

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 3 (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 6 within the proposed ESMP. The proposed measures form part of the construction and operational stages.
### Table 3: Impact – Severity Matrix for Negative Environmental and Social Impacts of the Project

<table>
<thead>
<tr>
<th>Project Phase</th>
<th>Bio-Physical and Social Factors</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Terrestrial biodiversity</td>
</tr>
<tr>
<td>Construction Phase</td>
<td>-2M</td>
</tr>
<tr>
<td>Operational phase</td>
<td>0L</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. 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 Contractor Obligations under the ESMP
During the Construction Phase the contractor will be required to adhere to all mitigation measures set out in the ESMP. It is recommended that a number of obligations are included in the contract to ensure compliance. These should include:-

- Correct safety procedures on site with adequate training of workers on safety awareness and procedures
- Adequate safety wear for site employees
- Provision of machinery that is in good well maintained condition (unlikely to cause damage to human beings or the environment).
- Adherence to waste management guidelines
- Adherence to guidelines set out for borrow pits
- Management and control of Dust emissions

6.3. Beneficiary Obligations under the ESMP
After completion of the construction works, Beneficiary Farmers will take the lead role in implementing the measures listed in the EMP during the operational phase. These should be managed through the WUA structure with obligations as follows:-

- Participation in Organisational Structure and provision of support to all elected committees
- Participation in Capacity Building initiatives aimed at improving skills and knowledge
- Adherence to recommended mitigation measures listed in the EMP to reduce impact on the elements of the environment (e.g rehabilitation of riverine ecology by not cultivating along the river banks, soil erosion control measures, sustainable agricultural practices- use of manure, crop residues and intercropping; correct irrigation scheduling and maintenance of irrigation and drainage network)
- Adhere to conflict resolution on issues of land tenure and low flow conditions.

6.4. 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 4 (overleaf). The costs have been derived form the BoQ’s of the detailed designs, or from experience with similar projects.
Table 4 – Estimated ESMP budget

<table>
<thead>
<tr>
<th>Item</th>
<th>Activity</th>
<th>Estimated Total Cost</th>
<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collection of Water quality measurement</td>
<td></td>
<td>62,400</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baseline Information</td>
<td>Soil Analysis for salinity, Ph and Basic Cations</td>
<td>48,000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Assessment of Riverine Indicator Aquatic Species</td>
<td>35,000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Other</td>
<td>20,000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sub total - Baseline data Collection</td>
<td>165,400</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Catchment Conservation plan</td>
<td>Coordination and administration</td>
<td>780,000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Farmer training land conservation practices</td>
<td>1,170,000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Tree nurseries and planting</td>
<td>858,000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Conservation crop nurseries and planting</td>
<td>1,092,000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sub Total</td>
<td>3,900,000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maintenance of Storm Water Protection</td>
<td>Clearing and stabilisation</td>
<td>60,000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Contour Bunds and Erosion Gulley Control</td>
<td>Vetiver planting and check dams</td>
<td>75,000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maintenance of Drains</td>
<td>See detailed BoQ</td>
<td>75,000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Training of Farmers</td>
<td>Sustainable Practices and Soil Management</td>
<td>450,000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Health Sensitization campaign</td>
<td>HIV AIDS and Water Borne Disease Prevention</td>
<td>150,000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sub Total</td>
<td>3,900,000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total ESMP costs</td>
<td>4,875,400</td>
<td>1,935,400</td>
<td>1,470,000</td>
<td></td>
</tr>
</tbody>
</table>

6.5 Monitoring Plan
An Environmental and Social Monitoring plan has been presented in Table 7. 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 4 above.

6.6 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.

6.7 Estimated Costs for Monitoring
The estimated costs for monitoring activities (which are described in detail in Table 7) are listed in Table 5 below:-

Table 5. 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 costs</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Groundwater Analysis</td>
<td>Physical; Chemical and Biological Analysis</td>
<td>12</td>
<td>1,200</td>
<td>14,400</td>
<td>Annual</td>
</tr>
<tr>
<td>Surface water Analysis</td>
<td>Physical; Chemical and Biological Analysis</td>
<td>24</td>
<td>2,600</td>
<td>62,400</td>
<td>Annual</td>
</tr>
<tr>
<td>Soil Chemical Analysis</td>
<td>Analysis for salinity, pH and Macro nutrient</td>
<td>45</td>
<td>2,300</td>
<td>103,500</td>
<td>Annual</td>
</tr>
<tr>
<td>River Discharge Recording</td>
<td>Daily river gauging station readings</td>
<td></td>
<td></td>
<td></td>
<td>Daily</td>
</tr>
<tr>
<td>Inventory of Riverine Ecology</td>
<td>Annual Surveys</td>
<td></td>
<td></td>
<td>75,000</td>
<td>Annual</td>
</tr>
<tr>
<td>Analysis of catchment condition</td>
<td>Aerila photos or satellite images</td>
<td></td>
<td></td>
<td>125,000</td>
<td>Every 3 years</td>
</tr>
<tr>
<td>Total estimated monitoring Cost (MK)</td>
<td></td>
<td></td>
<td></td>
<td>309,467</td>
<td></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 Time frame</td>
<td>Estimated Costs Of Mitigating Action</td>
</tr>
<tr>
<td>----</td>
<td>------------------------------</td>
<td>-----------------------------</td>
<td>-----------------------------</td>
<td>--------------------------</td>
<td>-------------------------------------</td>
</tr>
<tr>
<td>1.0</td>
<td><strong>Construction Phase</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.1</td>
<td>Decrease in water quantities Lunguni River leading to shortage of water and degradation of aquatic life downstream of the intake point;</td>
<td>Negative but low in severity due to insignificant abstraction of water.</td>
<td>Ensuring a suitable environmental Flow of water beyond the intake point.</td>
<td>Immediate and daily thereafter</td>
<td>n/a</td>
</tr>
<tr>
<td>1.2</td>
<td>Water quality degradation in Lunguni River due to construction debris</td>
<td>Negative and moderate in severity</td>
<td>Avoid and minimise pushing construction debris towards the river or storage of the same near the riverine.</td>
<td>Immediate and daily control until commissioning</td>
<td>Part construction contract</td>
</tr>
</tbody>
</table>
| 1.3 | Disturbance and loosening of soils during excavations of irrigation water ways & water storage reservoir, construction of scheme access roads 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 daily control during earth works up to commissioning | Part construction contract | Contractor, Project Manager, |
| 1.4 | Air pollution due to dust emission during excavations of irrigation water ways & water storage reservoirs, construction of scheme access roads and land levelling/preparation | Negative but low in severity | i. Avoid earth-moving construction works on windy days; 
ii. Sprinkling of water, where appropriate, to minimise dust emission especially during paving of access roads | Immediate and daily control during earth works up to commissioning | Part construction contract | Contractor, Project Manager, |
<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 Time frame</th>
<th>Estimated Costs Of Mitigating Action</th>
<th>Responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.5</td>
<td>Exposure of construction workers to health and safety hazards like dust and equipment;</td>
<td>Negative and moderate in severity</td>
<td>Provision of appropriate protective wear to workers and orientation on appropriate occupational &amp; safety measures during construction</td>
<td>Immediate and daily control during earth works up to commissioning</td>
<td>Part construction contract</td>
<td>Contractor, Project Manager, and Department of Occupational Safety &amp; Health of the Ministry of Labour</td>
</tr>
<tr>
<td>2.0</td>
<td>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 Lunguni 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>Farmer Training Initiatives K500,000 per annum for 3 years</td>
<td>WUA, Ministry of Irrigation and Water Development.</td>
</tr>
<tr>
<td>2.2</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; ii. Promotion of appropriate agricultural and land conservation practices that enhances optimal water retention capacity of soils thereby minimising chemical movement through leaching and erosion; iii. Promotion of ecological methods for pest control to minimise use of pesticides.</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>As above</td>
<td>WUA, Ministry of Agriculture &amp; Food Security and Ministry of Irrigation &amp; Water Development.</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 Time frame</td>
<td>Estimated Costs Of Mitigating Action</td>
<td>Responsibility</td>
</tr>
<tr>
<td>----</td>
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<td>----------------------------</td>
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</tr>
<tr>
<td>2.3</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; 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>Introduction of land conservation measures – Year 1 onwards Farmer training Year 1-3</td>
<td>As above</td>
<td>WUA, Ministry of Agriculture &amp; Food Security, Ministry of Irrigation and Water Development.</td>
</tr>
<tr>
<td>2.4</td>
<td>Soil salinisation due to water logging and poor drainage water management</td>
<td>Negative and high in severity</td>
<td>i. Construction of sufficient drains at appropriate terrains to remove excess water; ii. Application of appropriate quantities of irrigation water to crops depending on crop-water demand requirements to avoid water logging</td>
<td>Drainage maintenance plan to start on commissioning Irrigation scheduling to be implemented every season.</td>
<td>Farmer training as above Drain maintenance K25,000 per annum</td>
<td>Contractor, Project Manager, WUA, Ministry of Irrigation and Water Development.</td>
</tr>
<tr>
<td>2.5</td>
<td>Soil contamination as a result of persistent 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; ii. Promotion of organic farming through use of compost manure in order to minimise inorganic fertiliser inputs; iii. Use of agro-chemicals (pesticides, herbicides etc) with short degradation cycle.</td>
<td>Develop appropriate agro-chemicals list and programme year 1 onwards Farmer training Year 1-3</td>
<td>Farmer training as above Additional farmer training on correct choice and use of Agrochemicals first 3 years K25,000/pa</td>
<td>Ministry of Agriculture and Food Security 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 Time frame</td>
<td>Estimated Costs Of Mitigating Action</td>
<td>Responsibility</td>
</tr>
<tr>
<td>------</td>
<td>---------------------------------------------------------------------------------------------</td>
<td>-----------------------------</td>
<td>---------------------------------------------------------------------------------------------</td>
<td>-------------------------------------------</td>
<td>-----------------------------------------------</td>
<td>---------------------------------------------------------------------------------</td>
</tr>
</tbody>
</table>
| 2.6  | Risk of extreme flow events (river drying up and flooding) – causing crop failure and or damaging infrastructure and sedimentation causing damage to infrastructure; | Negative and moderate in severity | **i.** Use of silt/debris traps on the in take pipe to prevent clogging of pipes;  
**ii.** Promotion of appropriate agricultural and land conservation practices on fields upstream of the in take point to minimise soil erosion;  
**iii.** Conservation of vegetation and re-planting of trees along Lunguni River. | Catchment conservation initiatives Year 1-3  
Farmer training Year 1-3 | Catchment conservation initiative:-  
K2 million per year for 3 years  
Tree planting along river  
K50,000 per annum for 3 years | Contractor, Project Manager,, Ministry of Agriculture and Food Security, Department of Forestry, WUA. |
| 2.7  | Land use conflicts due to loss of agricultural land as a result of reclaim of riverine buffer zone | Negative but low in severity | Incorporation of farmers with loss in agricultural land into the scheme area. | Year 1 -3 | Farmer training as above 2.1 | WUA |
| 2.8  | Land use conflicts between rainfed farmers and irrigated farmers on the same project site | Negative and moderate in severity | **i.** Ensure all rainfed farmers are incorporated in the scheme  
**ii.** Develop conflict mitigation mechanisms | Year 1-2 | Farmer training as above | WUA and DIASU |
| 2.9  | Increase in water borne and vectored diseases like bilharzias and malaria; | Negative and moderate in severity as awareness in hygienic practices is already prevalent in the area. | **i.** Sensitisation 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. | Sensitization programme to start at Construction Phase  
Drainage management every year from Year 1 onwards | Health education initiatives K250,000 | WUA, Ministry of Health, Ministry of Irrigation and Water Development |
<p>| 2.10 | Proliferation of HIV/AIDS due to increased promiscuity as a result of increased income amongst | Negative and high in severity | Sensitisation of farmers and surrounding communities on issues related to HIV/AIDS | Annually starting at construction | As above 2.8 | Ministry of Health |</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 Time frame</th>
<th>Estimated Costs Of Mitigating Action</th>
<th>Responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>farmers;</td>
<td></td>
<td></td>
<td>phase</td>
<td></td>
<td></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 to avoid water wastage.</td>
<td>Irrigation scheduling to be implemented every season Cap building annually for first 3 years.</td>
<td>Farmer training as above 2.1</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. Sensitisation of farmers and surrounding communities on 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>Annual sensitization starting during the construction phase</td>
<td>Farmer training as above 2.1</td>
<td>Contractor, Project Manager, WUA.</td>
</tr>
</tbody>
</table>

**TOTAL ESTIMATED COSTS**

K 4.875 mln
Table 7: Environmental Monitoring Plan

<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 Implementation Action</th>
<th>Monitoring Unit</th>
<th>Frequency of monitoring</th>
<th>Responsibility</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>
<td></td>
</tr>
<tr>
<td>1.1</td>
<td>Decrease in water quantities Lunguni River leading to shortage of water and degradation of aquatic life downstream of the intake point.</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>i. Minimum Environment flow:- April – June: 40l/s July-Sept:20l/s Oct-Dec:20l/s</td>
<td>i. M3/sec or l/s of river flow</td>
<td>i. Monthly flow readings</td>
<td>Contractor, Project Manager, WUA</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(ii. Monitor Indicator species)</td>
<td>i. Monitoring Unit</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1.1.1 Water quality degradation in Lunguni River due to construction debris.</td>
<td>Negative and moderate in severity</td>
<td>Avoid and minimise pushing construction debris towards the river or storage of the same near the riverine</td>
<td>Weekly check of river flow Clauses in contract</td>
<td>Amount of debris in River Water quality analysis</td>
<td>Weekly during construction</td>
<td>Contractor, Project Manager,</td>
</tr>
<tr>
<td></td>
<td>1.1.2 Disturbance and loosening of soils during excavations of irrigation water ways &amp; water storage reservoirs, construction of scheme access roads and land levelling/preparation;</td>
<td>Negative and moderate in severity</td>
<td>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.</td>
<td>i. Clause in contract  ii. Verification of contract activities iii. Number of beneficiaries and contract employees trained in erosion control</td>
<td>Amount of soil eroded Visible signs of gulleys and other erosion features</td>
<td>Weekly during construction by consultant Monthly Audit</td>
<td>Contractor, Project Manager,</td>
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<td>1.1.3 Air pollution due to dust emission during excavations for irrigation water ways &amp; water storage reservoirs, construction of scheme access roads and land levelling/preparation;</td>
<td>Negative but low in severity</td>
<td>i. Avoid earth-moving construction works on windy days; ii. Sprinkling of water, where appropriate, to minimise dust emission especially during paving of access roads</td>
<td>Identification of dust prone areas. Implementation of dust control measures</td>
<td>No. of complaints by communities surrounding the site</td>
<td>Weekly during construction contract</td>
<td>Contractor, Project Manager,</td>
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<td>1.1.4 Exposure of construction workers to health and safety hazards like dust and equipment;</td>
<td>Negative and moderate in severity</td>
<td>Provision of appropriate protective wear to workers and orientation on appropriate occupational &amp; safety measures during the availability of protective wear amongst workers. Number of employees trained</td>
<td>Number of incident and accident free days. Record of daily during construction contract</td>
<td></td>
<td></td>
<td>Contractor, Project Manager and Department of Occupational Safety and Health</td>
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<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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<th>Frequency of monitoring</th>
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<td>in occupational safety incidents Clause in contract</td>
<td>accidents</td>
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<td>construction</td>
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<td>2.0</td>
<td>Operational Phase</td>
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<td>i. Ensuring a considerable flow of water beyond the intake point, especially during periods of minimal river flow;</td>
<td>i. Minimum Environ flow:- April – June: 30l/s July-Sept:15l/s Oct-Dec:5l/s</td>
<td>i. M3/sec or l/s of river flow above and below offtake ii. Comparison of indicator to baseline iii. mm of water applied per ha vs water requirement</td>
<td>i. Monthly flow readings ii. Annual inventory of indicator species iii. Monthly irrigation records</td>
<td>Safety &amp; Health of the Ministry of Labour</td>
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<td>2.1</td>
<td>Degradation of aquatic life downstream of the intake point on Lunguni due to a decrease in water quantities;</td>
<td>Negative and moderate in severity</td>
<td>i. Application of appropriate quantities of chemical inputs to avoid concentration of unused chemical load in soils; ii. Promotion of appropriate agricultural and land conservation practices that enhances optimal water retention capacity of soils thereby minimising chemical movement through leaching and erosion; iii. Promotion of ecological methods for pest control to minimise use of pesticides.</td>
<td>Availability and implementation of appropriate water management practices</td>
<td>i. Chemical analysis of ground and scheme surface water samples compared to baseline soil data ii. Verifiable land conservation structures per ha vs target iii. Amount of IPM and organic pest control methods</td>
<td>i. Representative samples collected annually ii. Annual verification of land conservation practices iii. Annual assessment of agricultural practices</td>
<td>WUA, Ministry of Irrigation and Water Development.</td>
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<td>2.2</td>
<td>Ground and surface water pollution due to agricultural chemical inputs</td>
<td>Negative and high in severity</td>
<td>i. Regular collection and analysis of soil</td>
<td>i. Chemical analysis of soil</td>
<td>i. Annual collection of</td>
<td></td>
<td>WUA, Ministry of Agriculture &amp; Food Security and Ministry of Irrigation &amp; Water Development.</td>
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<td>2.3</td>
<td>Loss of nutrients due to soil erosion and leaching</td>
<td>Negative and high in severity</td>
<td>i. Promotion of appropriate agricultural and land</td>
<td>i. Regular collection and analysis of soil</td>
<td>i. Chemical analysis of soil</td>
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<td>WUA, Ministry of</td>
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| 2.4 | 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;  
ii. Application of appropriate quantities of irrigation water to crops depending on crop-water demand requirements to avoid water logging | i. Regular collection and analysis of soil samples  
ii. Number of drains constructed  
iii. Availability of appropriate water management practices | i. Level of Soil Ec vs bench mark and baseline  
ii. No and capacity of drains per ha  
iii. Water management system and record | Annual audit  
Annual audit  
Annual audit | Contractor, WUA, Ministry of Irrigation and Water Development. |
| 2.5 | 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 fertiliser inputs;  
iii. Use of agro-chemicals (pesticides, herbicides etc) with short degradation cycle. | i. Regular collection and analysis of soil samples  
ii. Availability of appropriate land/soil conservation practices  
iii. Number of farmers trained in use of organic farming and use of enviro friendly chemical | i. Chemical analysis of soil samples compared to baseline soil data  
ii. Number of trained farmers | Annual  
Annual | WUA, Ministry of Agriculture and Food Security |
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<tr>
<td>2.6</td>
<td>Risk of extreme flow events (river drying up and flooding) – causing crop failure and or damaging infrastructure and sedimentation causing damage to infrastructure</td>
<td>Negative and high in severity</td>
<td>i. Use of silt/debris traps on the in take pipe to prevent clogging of pipes; 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 LunguniRiver.</td>
<td>i.Availability of silt traps at in-take point; ii.Presence of appropriate land conservation practices on fields upstream of intake point; iii.Regular Flow measurements; iv.Amount of vegetation along LunguniRiver</td>
<td>Daily; Annual; Daily; Annual</td>
<td>Daily; Annual; Monthly</td>
<td>Contractor, Ministry of Agriculture and Food Security, Department of Forestry, WUA.</td>
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<td>2.7</td>
<td>Land use conflicts due to loss of agricultural land as a result of reclam 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, WUA</td>
<td>WUA</td>
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<td>2.8</td>
<td>Land use conflicts between rainfed farmers and irrigated farmers on the same project site</td>
<td>Negative and moderate in severity</td>
<td>i. Ensure all rainfed farmers are incorporated in the scheme; ii. Develop conflict mitigation mechanisms</td>
<td>Absence of land use conflicts amongst farmers.</td>
<td>Recording system for land-use conflicts</td>
<td>Annual summary of records, WUA</td>
<td>WUA</td>
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<td>2.9</td>
<td>Increase in water borne and vectored diseases like bilharzias and malaria;</td>
<td>Negative and moderate in severity, awareness in hygienic practices is already prevalent in the area.</td>
<td>i. Sensitisation 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>i.Records of water borne diseases’ prevalence; ii.Regular collection and analysis of water samples; iii.Availability of appropriate sanitary hardware</td>
<td>Monthly (MoH), Monthly (Central Water Laboratory)</td>
<td>Annual</td>
<td>WUA, Ministry of Health, Ministry of Irrigation and Water Development</td>
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<td>due to increased promiscuity as a result of increased income amongst farmers;</td>
<td>high in severity</td>
<td>surrounding communities on issues related to HIV/AIDS</td>
<td>HIV/AIDS in the area</td>
<td>HIV/AIDS</td>
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<td>Health</td>
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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>i. Number of conflicts related to water use amongst farmers ii. Number of farmers trained Irrigation scheduling and distribution records</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 canals by both adults and children.</td>
<td>Negative and high in severity</td>
<td>i. Sensitisation of farmers and surrounding communities on the dangers related to drains and supply canals; ii. Provision of access cross-over points canals and drains</td>
<td>Number of accidents in drains and canals</td>
<td>Monthly</td>
<td>Project Manager, Contractor, WUA.</td>
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7. CONCLUSIONS AND RECOMMENDATIONS

The Chakalamba Irrigation Scheme has a high potential to change the socio-economic profile of the communities in Nkhulambe 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 scheme beneficiaries and the institutions charged with the monitoring responsibilities will be expected to ensure that the catchment area of Lunguni River is protected at all times. This is because the scheme is dependent on the availability of water which likely decrease if the river catchment area is disturbed. Furthermore, the scheme may suffer flooding or loss of land if the riverine is not stabilised with vegetation at all times;

b) Proper land conservation and agricultural practices shall have to be enforced by agricultural extension advisors and relevant institutions at all times as lack of these will cause substantial loss of soils and nutrients, the result of which will be significant reduction in agricultural outputs by the target beneficiaries;

c) Proper water management practices in the scheme will require strict adherence at all times 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;

d) The shortest access route to the project area from Phalombe is through the Fort Lister escarpment and yet the current state of this route requires a considerable improvement. If the beneficiaries are to realise meaningful benefits of the proposed irrigation scheme, then Government and other concerned stakeholders should endeavour to upgrade this route to passable standards to enable easy transportation of produce to target markets.
REFERENCES


ANNEXE 1: List of Stakeholders Consulted During the Assessment

1. Ms Chikondi Mangulenje  
   Water Management Specialist (Water Users Association Coordinator); Ministry of Irrigation and Water Development, Phalombe District Irrigation Advisory Service Unit (DIASU);

2. Mr Limbani Mzembe  
   Water Management Specialist; Ministry of Irrigation and Water Development, Phalombe District Irrigation Advisory Service Unit (DIASU);

3. Mr Prince Makuti  
   Agricultural Extension Development Officer, Nkhulambe EPA, Phalombe;

4. Mrs Ireen Jekete  
   Vice Chairperson, Chakalamba Irrigation Management Committee

5. Mrs Lizy Rich  
   Treasurer, Chakalamba Irrigation Management Committee;

6. Mrs Anne Thyolani  
   Vice Secretary, Chakalamba Irrigation Management Committee;

7. Mrs Feliat Tembani  
   Member, Chakalamba Irrigation Management Committee;

8. Mr Sailesi Namwera  
   Chairman, Chakalamba Irrigation Management Committee;

9. Mr Henry Tebulo  
   Chairman, WUA

10. Mr Kingstone Pamilo  
    Member, Chakalamba Irrigation Management Committee;

11. Mr Damson Khawolera  
    Vice Secretary, Chakalamba Irrigation Management Committee;

12. Village Headman Khangá,  
13. Village Headman Ruwaniwa,  