Government of the Republic of Malawi

Ministry of Agriculture and Food Security

Irrigation, Rural Livelihoods and Agricultural Development Project

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

MIDULE IRRIGATION SCHEME
(Blantyre 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

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EXECUTIVE SUMMARY

This document is an Environmental and Social Impact Assessment and accompanying Management and Monitoring Plan (ESMP) for a proposed Midule irrigation Scheme in Blantyre 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.

Midule Irrigation Scheme site is situated close to Midule Primary School in Chipande EPA, Blantyre District, in the Southern Region. The project area is characterised by gentle slopes on the north-western side and steep slopes towards the neighbouring escarpment on the south-eastern side. A number of streams flow down from this escarpment towards Shire River and one of which is Midule River, the source of water for the proposed scheme.

The project site includes part of an existing scheme which was established on a pilot basis in 2007 under the IRLAD project. The current setting has a temporary sand bag weir from which irrigation water is supplied to a hand dug canal using a 110 mm diameter PVC pipeline.

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

- Construction of a stone masonry weir,
- 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 Midule River

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

- Reduced water quantities in Midule River due to irrigation water abstraction,
- 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 Midule 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 .............................. 15  
   5.1 Potential Positive Environmental Impacts ........................................... 15  
   5.2 Potential Negative Environmental Impacts ......................................... 15  
   5.3 Potential Positive Social Impacts ....................................................... 16  
   5.4 Potential Negative Social Impacts ...................................................... 16  
   5.5 Level of severity of Different Impacts ................................................. 16  
   5.6 Suggested mitigation measures to overcome Potential Negative Environmental and Social Impacts .................................................................................................................. 16  

6. ENVIRONMENTAL AND SOCIAL MANAGEMENT AND MONITORING PLANS ........................................... 18  
   6.1 ESMP ................................................................................................. 18  
   6.2 Contractor Obligations under the ESMP ............................................. 18  
   6.3 Beneficiary Obligations under the ESMP ........................................... 18  
   6.4 Estimated Budget for the ESMP ......................................................... 18  
   6.5 Monitoring Plan ................................................................................ 19  
   6.6 Environmental Audit Plan .................................................................. 19  
   6.7 Estimated Costs for Monitoring ....................................................... 19  

7. CONCLUSIONS AND RECOMMENDATIONS ................................................. 30  

ANNEXE 1: List of Stakeholders Consulted During the Assessment ...................... 32  

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

1.1 Introduction
This document is an Environmental and Social Impact Assessment and accompanying Management and Monitoring Plan (ESMP) for a proposed Midule irrigation Scheme in Blantyre District in Southern Malawi under the IRLAD Project. 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 ESIA and accompanying 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 7 sections. Section 1. provides the introductory information to the document, including the objectives of the management and monitoring plan. Section 2. 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 provides information on scheme physical and social characteristics. 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. 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
Midule Irrigation Scheme site is situated close to Midule Primary School in Chipande EPA, Blantyre District, in the Southern Region. A location map has been provided in Fig. (overleaf). The project area is characterised by gentle slopes on the north-western side and steep slopes towards the neighbouring escarpment on the south-eastern side. A number of streams flow down from this escarpment towards Shire River and one of which is Midule River, the source of water for the proposed scheme.

The project site includes part of an existing scheme which was established on a pilot basis in 2007 under the IRLAD project. The current setting has a temporary sand bag weir from which irrigation water is supplied to a hand dug canal using a 110mm diameter PVC pipeline.

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. Midule River, has patches of vegetation and cultivated land in some areas.

Crops that are currently being cultivated on the project site and surrounding agricultural land include maize, pigeon peas, beans, pumpkins 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, Irish potato, sweet potato, high value vegetables, fruit crops and other tree fruit crops, where appropriate.

2.2 Main objective of the project
The main objective of the proposed Midule Irrigation Scheme project is to upgrade the existing scheme into an area of approximately 21 to 32 ha suitable for irrigation from the current 10 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 Midule Irrigation Scheme shall include the following:
   a) Construction of a stone masonry weir or gabion basket weir with a sediment/sand trap from which a conveyance steel pipe of 200mm will deliver water into the main supply canal over a distance of about 170 metres;
   b) Construction of night storage reservoir (NSR) with a storage capacity of 25 Megalitres. The NSR will have outlet control devices and a spillway to cater for overflows;
   c) Construction of a masonry lined main supply canal amounting to 519 metres;
   d) Construction of a number of masonry lined main delivery canals amounting to 573 metres;
   e) Construction of a number of brick lined secondary canals amounting to 2463 metres;
   f) Construction of earth lined tertiary canals amounting to 6371 metres;
   g) Construction of a drainage and flood protection system consisting of in field open drains for excess water (175 metres) and boundary cut off drains for protecting the scheme against surface runoff effects;
   h) Construction of approximately 68 drop fall and turn out distribution boxes with control gates amongst the network of feeder canals;
   i) Construction of scheme access roads;
j) Construction of terraces on the section of the scheme having the most steep gradient (this is optional depending on cost-benefit analysis);
k) Demarcation of the project land in scheme fields.

A diagram showing the proposed scheme layout can be seen in Fig 2 (overleaf)

*Fig 1. Location Map of Midule Irrigation Scheme*
Fig. 2 General Layout of Midule Irrigation 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 Chipande EPA, Blantyre 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 23rd Dec 2008 and 27th 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 Midule 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 from 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 Midule area is from Chileka Met Station (1969-2007). The available climatic data comprises of Rainfall, Evaporation, minimum and maximum Temperatures. Table 1 below provides details of the Long Term Averages for various climatic data:

Table 1. Long Term Mean Meteorological Data – Chileka weather station (1969-2007)

<table>
<thead>
<tr>
<th></th>
<th>Tot Rain (mm)</th>
<th>Tot Et (mm)</th>
<th>Avg Et (mm/d)</th>
<th>Min Temp</th>
<th>Max Temp</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>215.9</td>
<td>125.4</td>
<td>4.18</td>
<td>20.4</td>
<td>28.4</td>
</tr>
<tr>
<td>February</td>
<td>186.6</td>
<td>122.1</td>
<td>4.07</td>
<td>19.9</td>
<td>28.3</td>
</tr>
<tr>
<td>March</td>
<td>134.8</td>
<td>114.3</td>
<td>3.81</td>
<td>19.7</td>
<td>27.5</td>
</tr>
<tr>
<td>April</td>
<td>44</td>
<td>111.6</td>
<td>3.72</td>
<td>18.1</td>
<td>26.2</td>
</tr>
<tr>
<td>May</td>
<td>9.1</td>
<td>95.7</td>
<td>3.19</td>
<td>15.8</td>
<td>24.3</td>
</tr>
<tr>
<td>June</td>
<td>2</td>
<td>82.2</td>
<td>2.74</td>
<td>14.1</td>
<td>24.2</td>
</tr>
<tr>
<td>July</td>
<td>1.5</td>
<td>89.7</td>
<td>2.99</td>
<td>13.7</td>
<td>26.5</td>
</tr>
<tr>
<td>August</td>
<td>2</td>
<td>113.4</td>
<td>3.78</td>
<td>14.9</td>
<td>29.6</td>
</tr>
<tr>
<td>September</td>
<td>4.8</td>
<td>142.8</td>
<td>4.76</td>
<td>17.6</td>
<td>31.4</td>
</tr>
<tr>
<td>October</td>
<td>28.9</td>
<td>164.7</td>
<td>5.49</td>
<td>19.7</td>
<td>31.2</td>
</tr>
<tr>
<td>November</td>
<td>97.2</td>
<td>153.6</td>
<td>5.12</td>
<td>20.7</td>
<td>29.5</td>
</tr>
<tr>
<td>December</td>
<td>166</td>
<td>132.3</td>
<td>4.41</td>
<td>20.6</td>
<td>28</td>
</tr>
<tr>
<td>Total/Avg</td>
<td>893</td>
<td>1447.8</td>
<td>4.02</td>
<td>17.9</td>
<td>27.9</td>
</tr>
</tbody>
</table>

Evaporation exceeds rainfall in 8 out of 12 months a year with a total mean annual rainfall of 893.8mm per annum and a total mean annual Evapotranspiration of 1447mm per annum (average of 4.02mm/day). This equates to a mean annual moisture deficit of 554mm which will need to be replenished with an irrigation system. Mean minimum temperatures do not go below 13 degrees and mean maximum is approx 28 degrees. 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
Midule irrigation scheme is characterised by steep slopes on the upland positions and flattens out on the lower areas. There is an elevation difference of 16m between the proposed weir position and the command area. The elevation difference between the top and bottom of the area planned for irrigation development is 23m over a distance of 661m indicating a moderately steep slope of 3.5%. The land has a naturally level with few depressions and or ridges. The slope is suitable for surface irrigation development with minimal earth movement. A total of 45 ha were surveyed using a total station and a number of bench marks were placed.
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. Descriptions of these soils are presented below, supported by pedological descriptions and laboratory analysis data for samples that were collected by using soil augers during the survey and which are presented in Preliminary Design Report Appendix 2.

**Soil Type 1:** These soils occur mainly in lower flatter areas of the proposed schemes which are currently under irrigation and they consist of deep (over 100cm) black vertic clays with small yellowish mottling in subsoils. The mottles indicate that the soils are moderately to poorly drained such that there would be need for the installation of good drainage structures when an irrigation scheme is established on them. They are otherwise very suitable for a wide range of crops under irrigation. Soil texture (using the hand method), infiltration rates (from visible assessments of the soils being irrigated); AMC and TAM (which are estimates) indicate that the soils are highly suitable. Crops that could be grown include maize, beans, vegetables and even paddy rice. A gross area of 17.6 ha of type 1 soils suitable for irrigation is available at Midule.

**Soil Type 2:** The soils of this type are deep medium grained sandy clay loams over well drained dark reddish brown (5YR) clays. Soils are suitable for the irrigated production of a variety of common crops on account of their good depth, medium to heavy texture and good drainage. They are suitable for the production of most common crops except rice. Unfortunately, most of the land on which they occur is heavily settled and any irrigation development would attract a high resettlement cost as well as other social destabilisation costs. A gross area of 6.6 ha of these soils was found in the soil survey.

**Soil Type 3:** These are heavily eroded soils that are sodic and consist of thick coarse surface sand wash abruptly changing to dense extremely hard subsoil. They are not suitable for irrigation and should be protected from further erosion. If beneficiaries are in agreement, these areas should be excluded from irrigation or at best be terraced to avoid further soil loss to erosion. The estimated area for this Soil type is 9 ha.

**Soil Type 4:** These soils are found in the northern area of the scheme (beyond the proposed northern boundary but fall under command of the canal. They are light grey/brown semi eroded soils with a lighter texture than types 1 and 2, with considerable amount of gravel and sand at different levels. These soils are highly susceptible to erosion and have a low water holding capacity. They are not ideally suited to irrigation. The estimated area of this soil type is 12.8ha.

Fig 3 (overleaf) shows the distribution of different soil types at Midule.
Figure 3: Soil Map for Midule irrigation Scheme showing approximate soil boundaries

- **Soil 1**: Black vertic clays 100cm deep, suitable for irrigation with effective drainage
- **Soil 2**: Dark reddish brown sandy clay loams to clays
  Suitable for irrigation
- **Soil 3**: Eroded sodic soils unsuitable for irrigation
- **Soil 4**: Light textured sandy clay soils with gravel layers
  Low to medium suitability for irrigation
4.1.4. Water resources

a) Water quantity

There is no flow gauging station on this stream.

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:

a) Measured River flow.

<table>
<thead>
<tr>
<th>Date of Measurement</th>
<th>Method Of Measurement</th>
<th>Measured River Discharge</th>
</tr>
</thead>
<tbody>
<tr>
<td>16 June 2008</td>
<td>V- Notch</td>
<td>35l/s</td>
</tr>
<tr>
<td>22 July 2008</td>
<td>V-Notch</td>
<td>34l/s</td>
</tr>
<tr>
<td>11 August 2008</td>
<td>V- Notch</td>
<td>15l/s</td>
</tr>
<tr>
<td>28 September</td>
<td>V-Notch</td>
<td>12l/s</td>
</tr>
</tbody>
</table>

b) Non flow events:

According to discussions with beneficiary farmers, the river has stopped flowing on a number of occasions in recent years around November.

c) Flood flow level:

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

d) Assumptions on water availability

From these findings it can be deduced that the stream is perennial and has stopped flowing once in 14 years, flow declines from approx 35l/s in the early part of the irrigating season to 12l/s in the later part of the season. Low flow is taken at 10l/s.

Any weir structures should be built to withstand maximum estimated daily flows during heavy rainstorms and floods in excess of 1600l/s

b) Water quality

A sample taken from Midule Stream was tested for chemical, physical and biological quality at the Central Water Laboratory. The analysis results show 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.

4.1.5. Land Tenure

The proposed area is customary land and is administered under the Traditional Authority which is 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
Apart from small pockets of natural vegetation, the project area has been cleared for agricultural activity which has left very little natural or planted vegetation.

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 heavily degraded with stretches of river bank that have been cultivated and very few trees and other vegetation remaining. There are signs of heavy erosion along the river bank. There is an urgent need to rehabilitate and conserve the river banks.

4.3. Social and economic environment

4.3.1. Scheme Membership and Organisational Structure
There are 3 villages that have taken part in the existing scheme and preparatory work for the proposed development. These are Mlombozi and Midule villages under GVH Maloya. Currently there are a total of 125 members registered as heads of households who are beneficiaries of the scheme of which 75 are men and 50 are women.

The Chipande EPA staff have taken an active and lead role in the development of the existing scheme. This includes the responsible AEDC and AEDO. In addition support has been provided by the Blantyre DIASU and Blantyre District Irrigation Officer.

4.3.2. Social Infrastructure around the Scheme

a) Health Facilities
The closest health facilities are Chitera, Namadzi and Makata Health Centres. The closest hospital is Mlambe Hospital in Lunzu (approximately 15kms).

c) Education Facilities
There is a school at the site called Midule Primary School. Other schools in the area are Mlombozi FP School, Ngongomwa Community Day Secondary School (CDSS) and Namwanje CDSS.

d) Domestic Water Supply
There is a bore hole at Midule school with a hand pump with good quality water.

e) Electricity Supply
There is no electricity supply at this site and the closest point where electricity supply is found is near Lunzu (15kms) or Lirangwe (12kms).

f) Sanitation
All houses as well as the school have pit latrines.
4.3.3. Access Roads
Access is by a dirt road from Lunzu trading centre (approx 25 km’s). There are a number of narrow bridges and the road deteriorates during the rainy season.

4.3.4. Telecommunications
There is limited cell phone network coverage in and around the site.

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 Midule River;
ii. Restoration of Midule 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 Midule River and its catchment area as a result of riverine afforestation initiatives;

5.2. Potential Negative Environmental Impacts

5.1.1 Construction Phase
These include but not limited to the following:

i. Ground and surface water pollution due to pollution with 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 intake 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. Improvement in farming practices and techniques amongst farmers and surrounding communities;
   v. 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. Increase in water borne and vectored diseases like bilharzias and malaria;
   iii. Proliferation of HIV/AIDS due to increased promiscuity as a result of increased income amongst farmers;
   iv. Water use conflicts due to increased demand for irrigation water against decreased water supply quantities;
   v. Land use conflicts between rainfed and irrigation farmers;
   vi. Land use conflicts due to loss of agricultural land as a result of reclaim of riverine buffer zone
   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 4: 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 2 below. Some of the costs The costs have been generated from either the detailed BoQ from the Detailed design report.
### Table 4 – 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>Year 1</td>
<td>Year 2</td>
</tr>
<tr>
<td>Collection of Water quality measurement</td>
<td>62,400</td>
<td>62,400</td>
<td></td>
</tr>
<tr>
<td>Baseline Information Soil Analysis for salinity, pH and Basic Cations</td>
<td>24,000</td>
<td>24,000</td>
<td></td>
</tr>
<tr>
<td>Assessment of Riverine Indicator Aquatic Species</td>
<td>35,000</td>
<td>35,000</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td></td>
<td>20,000</td>
<td>20,000</td>
</tr>
<tr>
<td>Sub total - Baseline data Collection</td>
<td>141,400</td>
<td>141,400</td>
<td></td>
</tr>
<tr>
<td>Catchment Conservation plan Coordination and administration</td>
<td>1,200,000</td>
<td>400,000</td>
<td>400,000</td>
</tr>
<tr>
<td>Farmer training land conservation practices</td>
<td>1,800,000</td>
<td>600,000</td>
<td>600,000</td>
</tr>
<tr>
<td>Tree nurseries and planting</td>
<td>1,320,000</td>
<td>440,000</td>
<td>440,000</td>
</tr>
<tr>
<td>Conservation crop nurseries and planting</td>
<td>1,680,000</td>
<td>560,000</td>
<td>560,000</td>
</tr>
<tr>
<td>Sub Total</td>
<td></td>
<td>6,000,000</td>
<td>2,000,000</td>
</tr>
<tr>
<td>Maintenance of Storm Water Protection Clearing and stabilisation</td>
<td>60,000</td>
<td>20,000</td>
<td>20,000</td>
</tr>
<tr>
<td>Contour Bunds and Erosion Gully Control Vetiver planting and check dams</td>
<td>75,000</td>
<td>25,000</td>
<td>25,000</td>
</tr>
<tr>
<td>Maintenance of Drains See detailed BoQ</td>
<td>75,000</td>
<td>25,000</td>
<td>25,000</td>
</tr>
<tr>
<td>Training of Farmers Sustainable Practices and Soil Management</td>
<td>450,000</td>
<td>150,000</td>
<td>150,000</td>
</tr>
<tr>
<td>Health Sensitization campaign HIV AIDS and Water Borne Disease Prevention</td>
<td>150,000</td>
<td>50,000</td>
<td>50,000</td>
</tr>
<tr>
<td><strong>Total ESMP costs</strong></td>
<td><strong>6,951,400</strong></td>
<td><strong>2,411,400</strong></td>
<td><strong>2,270,000</strong></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 (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>24</td>
<td>2,600</td>
<td>62,400</td>
<td>Annual</td>
</tr>
<tr>
<td>Surface water Analysis</td>
<td>Physical; Chemical and Biological Analysis</td>
<td>10</td>
<td>1,200</td>
<td>12,000</td>
<td>Annual</td>
</tr>
<tr>
<td>Soil Chemical Analysis</td>
<td>Analysis for salinity, pH and Macro nutrient</td>
<td>20</td>
<td>2,300</td>
<td>46,000</td>
<td>Annual</td>
</tr>
<tr>
<td>River Discharge Recording</td>
<td>Daily river gauging station readings</td>
<td></td>
<td></td>
<td>12,500</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 satelite images</td>
<td></td>
<td></td>
<td>125,000</td>
<td>Every 3 years</td>
</tr>
<tr>
<td><strong>Total estimated monitoring Cost (MK)</strong></td>
<td></td>
<td></td>
<td></td>
<td>249,567</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 Midule River 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. (minimum 20l/s)</td>
<td>Immediate and daily thereafter</td>
<td>n/a</td>
</tr>
<tr>
<td>1.2</td>
<td>Water quality degradation in Midule 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,         |
<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 construction | Immediate and daily control during construction up to commissioning | Part construction contract            | Contractor, Project Manager, and Department of Occupational Safety &amp; Health of the Ministry of Labour |
| 2.0 | <strong>Operational Phase</strong>                                                                        |                                                                  |                                                                                                              |                                          |                                      |                                      |
| 2.1 | Decrease in water quantities Midule River leading to potential shortage of water and         | Negative and moderate in severity                                | i. Ensuring a suitable environmental flow of water beyond the intake                                        | Monthly monitoring of river flow –       | Farmer Training Initiatives K500,000 per | WUA, Ministry of Irrigation and Water Development, |</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>degradation of aquatic life downstream of the intake point.</td>
<td>Negative and high in severity</td>
<td>Apply min flow ii Irrig. schedule implemented at start of each irrigation season Farmer training in Year 1-3</td>
<td>Year 1 onwards</td>
<td>annum for 3 years</td>
<td>As above WUA, Ministry of Agriculture &amp; Food Security; Dept of Land resources</td>
</tr>
<tr>
<td>2.2</td>
<td>Risk of soil erosion and worsening of existing gulleys and general soil degradation</td>
<td>Negative and high in severity</td>
<td>Undertake gulley reclamation activities such as check dams and planting of stabilizing grasses and trees Implement measures to reduce destructive agricultural practices</td>
<td>Year 1 onwards</td>
<td>As above</td>
<td>WUA, Ministry of Agriculture &amp; Food Security; Dept of Land resources</td>
</tr>
<tr>
<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; 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>Introduction of land conservation measures – Year 1 onwards Farmer training Year 1-3</td>
<td>As above WUA, Ministry of Agriculture &amp; Food Security and Ministry of Irrigation &amp; Water Development.</td>
<td></td>
</tr>
<tr>
<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,</td>
<td>Introduction of land conservation measures – Year 1 onwards</td>
<td>As above WUA, Ministry of Agriculture &amp; Food Security, Ministry of Irrigation and Water Development.</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>
<td>Responsibility</td>
</tr>
<tr>
<td>---</td>
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<td>---</td>
<td>---</td>
<td>---</td>
</tr>
</tbody>
</table>
|   |   |   | 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. | Farmer training Year 1-3 |   |   |
| 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;  
   |   |   | ii. Application of appropriate quantities of irrigation water to crops depending on crop-water demand requirements to avoid water logging | Drainage maintenance plan to start on commissioning Irrigation scheduling to be implemented every season. | Farmer training as above  
   |   |   | Drain maintenance K25,000 per 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 fertiliser inputs;  
   |   |   | iii. Use of agro-chemicals (pesticides, herbicides etc) with short degradation cycle. | Develop appropriate agro-chemicals list and programme year 1 onwards Farmer training Year 1-3 | Farmer training as above  
   |   |   | Additional farmer training on correct choice and use of Agrochemicals first 3 years K25,000/pa |   | Ministry of Agriculture and Food Security WUA |
| 2.7 | Risk of extreme flow events (river drying up and flooding) – causing crop failure and or damaging infrastructure and sedimentation causing damage | 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 | Catchment conservation initiatives Year 1-3 Farmer training | Catchment conservation initiative:-  
<p>|   |   | K2 million per year for 3 years |   | Contractor, Project Manager., Ministry of Agriculture and Food Security, |</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>to infrastructure;</td>
<td></td>
<td>conservation practices on fields upstream of the intake point to minimise soil erosion;</td>
<td>Year 1-3</td>
<td>Tree planting along river K50,000 per annum for 3 years</td>
<td>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 1-3</td>
<td>Farmer training as above 2.1</td>
<td>WUA</td>
</tr>
<tr>
<td>2.9</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 area. ii. Develop conflict mitigation mechanisms</td>
<td>Year 1-2</td>
<td>Farmer training as above</td>
<td>WUA and DIASU</td>
</tr>
<tr>
<td>2.10</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. 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>Sensitization programme to start at Construction Phase Drainage management every year from Year 1 onwards</td>
<td>K250,000</td>
<td>WUA, Ministry of Health, Ministry of Irrigation and Water Development</td>
</tr>
<tr>
<td>2.11</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>Sensitisation of farmers and surrounding communities on issues related to HIV/AIDS</td>
<td>Annually starting at construction phase</td>
<td>As above 2.8</td>
<td>Ministry of Health</td>
</tr>
<tr>
<td>2.12</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</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>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></td>
<td></td>
<td></td>
<td>requirements to avoid water wastage.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.13</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>Project Manager, WUA.</td>
</tr>
</tbody>
</table>

| TOTAL ESTIMATED COSTS | K6.9 mln |

24
<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></td>
<td><strong>Construction Phase</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.0</td>
<td><strong>1.1 Decrease in water quantities Midule River leading to shortage of water and degradation of aquatic life downstream of the intake point.</strong></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 Environ flow: - April – June: 20l/s July-Sept:5l/s Oct-Dec:3l/s ii. Monitor indicator species</td>
<td>i. M3/sec or l/s of river flow</td>
<td>i. Monthly flow readings ii. Annual inventory of indicator species</td>
<td>Contractor, Project Manager, WUA</td>
</tr>
<tr>
<td></td>
<td><strong>1.2 Water quality degradation in Midule River due to construction debris</strong></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 Midule River Water quality analysis</td>
<td>Weekly during construction</td>
<td>Contractor, Project Manager,</td>
</tr>
<tr>
<td></td>
<td><strong>1.3 Disturbance and loosening of soils during excavations of irrigation water ways &amp; water storage reservoirs, construction of scheme access roads and land levelling/preparation;</strong></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. Clauses 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>
</tr>
<tr>
<td></td>
<td><strong>1.4 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</strong></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>
</tr>
<tr>
<td></td>
<td><strong>1.5 Exposure of construction workers to health and safety hazards like dust and equipment;</strong></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</td>
<td>Availability of protective wear amongst workers. Number of employees trained</td>
<td>Number of incident and accident free days. Record of</td>
<td>Daily during construction contract</td>
<td>Contractor, and Department of Occupational Safety</td>
</tr>
</tbody>
</table>

*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>2.0</td>
<td>Operational Phase</td>
<td></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 Midule river due to a decrease in water quantities;</td>
<td>Negative and moderate in severity</td>
<td>construction</td>
<td>in occupational safety incidents Clause in contract</td>
<td>accidents</td>
<td></td>
<td>Health of the Ministry of Labour</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.2</td>
<td>Risk of soil erosion and worsening of existing gulleys and general soil degradation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
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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>
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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; 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>i. Regular collection and analysis of soil samples ii. Availability of appropriate land and water conservation practices iii. Number of farmers trained in land conservation practices</td>
<td>i. Chemical analysis of soil samples compared to baseline soil data ii. Verifiable land conservation structures per ha vs target. iii. Number of farmers trained</td>
<td>i. Annual collection of representative soil samples ii. Annual training of farmers in land conservation techniques</td>
<td>Farmers, WUA, Ministry of Agriculture &amp; Food Security, Ministry of Irrigation and Water Development.</td>
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<td>2.5</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>i. Regular collection and analysis of soil samples ii. Number of drains constructed iii. Availability of appropriate water management practices</td>
<td>i. Level of Soil EC vs bench mark and baseline ii. No and capacity of drains per ha iii. Water management system and record</td>
<td>Annual audit ii. Annual audit iii. Annual audit</td>
<td>Contractor, WUA, Ministry of Irrigation and Water Development.</td>
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<td>2.6</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 and verifiable land management practices</td>
<td>i. Regular collection and analysis of soil samples ii. Availability of appropriate land/soil</td>
<td>i. Chemical analysis of soil samples compared to baseline soil data ii. Number of</td>
<td>Annual audit ii. Annual audit iii. Annual audit</td>
<td>WUA, Ministry of Agriculture and Food Security</td>
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<td>2.7</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 Midule River.</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 Midule River</td>
<td>trained farmers</td>
<td>Daily Annual Daily Annual</td>
<td>Contractor, Ministry of Agriculture and Food Security, Department of Forestry, WUA.</td>
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<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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<td>2.9</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</td>
<td>WUA</td>
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<td>2.10</td>
<td>Increase in water borne and vectored diseases like bilharzias and malaria</td>
<td>Negative and moderate in severity as awareness in hygienic</td>
<td>i. Sensitisation of farmers on proper sanitary behaviour in the scheme area when undertaking agronomic practices;</td>
<td>i. Records of water borne diseases’ prevalence ii. Regular collection and analysis of</td>
<td>i. Incidence of disease per unit of population vs baseline data (2008)</td>
<td>Monthly (MoH) Monthly (Central Water)</td>
<td>WUA, Ministry of Health, Ministry of Irrigation and Water</td>
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<td>2.11 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>Sensitisation of farmers and surrounding communities on issues related to HIV/AIDS</td>
<td>Prevalence of HIV/AIDS in the area</td>
<td>Incidence of HIV/AIDS</td>
<td>Annual</td>
<td>Ministry of Health</td>
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<td>2.12 Water use conflicts due to increased demand for irrigation water against decreased water supply quantities</td>
<td>Negative and high in severity</td>
<td>Establishment of an appropriate system on sharing of water by farmers; Application of appropriate quantities of irrigation water to crops depending on crop-water demand requirements to avoid water wastage.</td>
<td>Number of conflicts related to water use amongst farmers Number of farmers trained Irrigation scheduling and distribution records</td>
<td>i.Record of conflict ii.Number Mm/ha applied vs plan and water balance</td>
<td>Annual</td>
<td>WUA, Ministry of Irrigation and Water Development.</td>
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<td>2.13 Accidents caused by drowning in drains and canals by both adults and children.</td>
<td>Negative and high in severity</td>
<td>Sensitisation of farmers and surrounding communities on the dangers related to drains and supply canals; Provision of access cross-over points canals and drains</td>
<td>Number of accidents in drains and canals Number of incidents recorded</td>
<td>Monthly</td>
<td>Project Manager, Contractor, Farmers, WUA.</td>
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- ii. Promotion of appropriate sanitary practices in the surrounding communities;
- iii. Minimise water logging in the scheme through appropriate irrigation techniques.
- ii. Water analysis vs baseline
- iii. No of toilets
- ii. 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.
- i. Number of conflicts related to water use amongst farmers
- ii. Number of farmers trained
- Irrigation scheduling and distribution records
- i. Record of conflict
- ii. Number Mm/ha applied vs plan and water balance
- 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
- Number of accidents in drains and canals
- Number of incidents recorded
- Monthly Project Manager, Contractor, Farmers, WUA.
7. CONCLUSIONS AND RECOMMENDATIONS

The Midule Irrigation Scheme has a high potential to change the socio-economic profile of the communities in Chipande 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;

The scheme beneficiaries and the institutions charged with the monitoring responsibilities will be expected to ensure that the catchment area of Midule River is protected at all times considering that it is steep and fragile hence vulnerable to degradation. The scheme is dependent on the availability of water which will likely decrease if the catchment area is not properly conserved. Some of the portions of the scheme have shallow and fragile soils coupled with sloppy terrain hence requiring intensive management. Therefore, 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;

Proper water management practices in the scheme will require strict adherence at all times in order to avoid soil salinity. 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;
REFERENCES


ANNEXE 1: List of Stakeholders Consulted During the Assessment

1. Ms Julia Qoto Water Management Specialist (Water Users Association Coordinator); Ministry of Irrigation and Water Development, Blantyre District Irrigation Advisory Service Unit (DIASU);

2. Mr J Kafausiyanj Water Management Specialist; Ministry of Irrigation and Water Development, Blantyre District Irrigation Advisory Service Unit (DIASU);

3. Mrs Chisomo Taulo Irrigation Engineer, Chikwawa IRLADP Office;

4. Mr Alex Mkwapatira Agricane;

5. Mr Simba Mafumo Agricane;

6. Mr Fransisco Ganaziyo Chairman, Midule Irrigation Management Committee;

7. Mr Lucias Nelson Secretary, Midule Irrigation Management Committee;

8. Mr Collins Kapita Vice Secretary, Midule Irrigation Management Committee;

9. Mr Andrea Soya Beneficiary farmer;

10. Mr Bamusi Kumpita Beneficiary farmer;

11. Mr Daiton Mkozomba Beneficiary farmer;

12. Mr Thomas Frank Beneficiary farmer;

13. Mr Hawald Usubeni Beneficiary farmer;

14. Mr Fransisco Makande Beneficiary farmer;

15. Mr Lazalo Nyangu Beneficiary farmer;

16. Mr Shadreck Chibweza Beneficiary farmer;

17. Mr Yohane James Beneficiary farmer;

18. Mr Yohane Matope Beneficiary farmer;

19. Mr Petro Andrea Beneficiary farmer;

20. Mr Chelewani Bauleni Beneficiary farmer;

21. Mr Menasi Kaipa Beneficiary farmer;

22. Mr Adack Goliati Beneficiary farmer;

23. Mr Nelson Luka Beneficiary farmer;

24. Mr Jonathan Douglas Beneficiary farmer;
25. Mr Evans Malombe Beneficiary farmer;
26. Mr Elias Mmina Beneficiary farmer;
27. Mr Stephano Mapila Beneficiary farmer;
28. Mr Chriford Mdangwe Beneficiary farmer;
29. Group Village Headman Maloya
30. Sylvester Nkhuche Beneficiary farmer;
31. Mrs Idesi Momba Beneficiary farmer;
32. Mrs Christina Banda Beneficiary farmer;
33. Mrs Linly Harry Beneficiary farmer;
34. Mrs Agness Chiotcha Beneficiary farmer;
35. Mrs Hilda Phiri Beneficiary farmer;
36. Mrs Anne Amos Beneficiary farmer;
37. Mrs Edna Goliati Beneficiary farmer;
38. Mrs Catherine Mataka Beneficiary farmer;
39. Mrs Esnart Chikwina Beneficiary farmer;
40. Mrs Agness Kasawala Beneficiary farmer;
41. Mr Janet Makisinti Beneficiary farmer;
42. Mrs Dorica Isaki Beneficiary farmer;
43. Mrs Mary Msasa Beneficiary farmer;
44. Mrs Violet Jali Beneficiary farmer;
45. Mrs Merriam Nyoni Beneficiary farmer;
46. Mrs Mary Mazonda Beneficiary farmer;
47. Mrs Christina Fabiano Beneficiary farmer;
48. Mrs Anne Magola Beneficiary farmer;
49. Mrs Selina Mafomo Beneficiary farmer;
50. Mrs Esnart Katinji Beneficiary farmer;
51. Mrs Enelesi Momba Beneficiary farmer;
52. Mrs Elegina Edson Beneficiary farmer;
53. Mr Joseph Kanyenga  Beneficiary farmer;
54. Mrs Donata Sagonja  Beneficiary farmer;
55. Mrs Maria Kasonde  Beneficiary farmer;
56. Mr Charles Mandala  Beneficiary farmer;
57. Mrs Judith Chiotcha  Beneficiary farmer;
58. Mrs Emily Eladi  Beneficiary farmer;
59. Mrs Katalina Edward  Beneficiary farmer;
60. Mrs Rose Taimu  Beneficiary farmer;
61. Mrs Grace Mugomo  Beneficiary farmer;
62. Mrs Elestina Chapola  Beneficiary farmer;
63. Mrs Sevelina Binauli  Beneficiary farmer;
64. Mrs Mary Mtambo  Beneficiary farmer;
65. Mrs Modesta Friday  Beneficiary farmer;
66. Mrs Modesta Luka  Beneficiary farmer;
67. Mrs Anne Kamtumbiza  Beneficiary farmer;
68. Mrs Ulaliya Kondwani  Beneficiary farmer;
69. Mrs Rhoda Nyala  Beneficiary farmer;
70. Mrs Selina Makina  Beneficiary farmer;
71. Mr John Makato  Beneficiary farmer;
72. Mrs Melise Sandikonda  Beneficiary farmer;
73. Mrs Eliza Maloya  Beneficiary farmer;
74. Mrs Patricia Chimera  Member, Midule Irrigation Management Committee;
75. Mrs Agness Malinki  Treasurer, Midule Irrigation Management Committee;
76. Mrs Ester Khumuwa  Member, Midule Irrigation Management Committee;
77. Mrs Mary Kamunga  Member, Midule Irrigation Management Committee;
78. Mrs Teleza Chimunya  Chairman, Midule Irrigation Management Committee;