Environmental and Social Impact Assessment and Management Plan

WINDU IRRIGATION SCHEME
(Dedza 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 Windu Irrigation Scheme in Dedza District in Central Region of 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.

Windu Irrigation Scheme site is situated close to Livizi River in Kanyama EPA, Dedza District, in the Central Region. The project area is on gentle slopes of between 0.5% in the upland and 0.1% on the flatter lowland, where much of the scheme site is based.

The proposed scheme will draw water for irrigation from the two springs which discharge water into Windu Stream. There is existing irrigation in place with very basic structures and hand dug canals. There are no major structures and this implies new construction of all the required components.

Implementation of the project shall involve a number of activities which shall include:-
- Construction of two concrete and stone masonry collector weirs,
- 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 Windu Springs and Lifizi River

Potential negative impacts, on the other hand, will include, amongst others:-
- Reduced water quantities from the Windu Springs 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 Windu Spring Catchment and Stream is properly managed and proper agricultural/land conservation practices are employed by farmers at all times, the sustainability of the scheme will be compromised and the benefits will not be realised as expected.
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1. INTRODUCTION AND BACKGROUND INFORMATION

1.1 Introduction
This document is an Environmental and Social Management and Monitoring Plan (ESMP) for a proposed Windu Scheme in Dedza 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 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.
2.0 PROJECT AND BIO-PHYSICAL DESCRIPTION

2.1 Location and bio-physical description of the project site

Windu Irrigation Scheme is located 25km north west of Dedza town. It has coordinates S 14 ° 15 E34 ° 18. The project site is located in Kanyama EPA. Fig.1 (overleaf) provides a location map for the scheme.

There is an existing irrigation scheme consisting of approximately 10 ha of irrigated crops drawing water from the Windu Springs. A stone masonry weir directly below the springs directs water into a hand dug earth canal. The scheme was established in 2001 with support from CARE (an NGO).

There are a total of 235 members (80 male and 155 female) who are part of the existing scheme. Beneficiary farmers are well established and have shown a keen interest in irrigation and have a firm commitment to the success of the proposed development. Crops grown are predominantly Irish potatoes, vegetables, beans and sweet peas.

The area is a high altitude site (1400masl) characterised by gentle to steep slopes being cultivated intensively by communities. Land use in the area of the scheme is characterised by intensive rain-fed agriculture. There a number of settlements and villages in and around the scheme.

2.2 Main objective of the project

The main objective of the proposed Windu Irrigation Scheme project is to develop a potential scheme of a land area of approximately 42 ha suitable for irrigation and thus providing an enabling environment for the farmers in the area 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 the proposed Windu Irrigation Scheme shall include the following:

a) Re-construction of two stone masonry collector weirs to deliver water into the main supply canal over a distance of about 800 metres;

b) Construction of a night storage reservoir (NSR) with a storage capacity of 35 megalitres. There will also be outlet control devices and inclusion of a spillway to cater for overflows;

c) Construction of a number of brick lined delivery canals amounting to 700 metres;

d) Construction of a number of brick lined secondary canals amounting to 3140 metres;

e) Construction of earth lined tertiary canals amounting to 4260 metres;

f) Construction of a number of drains amounting to 2960 metres to remove excess water from the fields;

g) Construction of approximately 68 drop fall and turn out distribution boxes with control gates amongst the network of feeder canals;

h) Construction of scheme access roads;

i) Demarcation of the project land in scheme fields.

A map with the proposed field layout has been provided in Fig 2 (page 8)
Fig. Map showing Location of Windu Scheme
Windu 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 Kanyama EPA, Dedza 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 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 Windu Springs and Stream, 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

Reliable and meaningful data that is available for the Windu area is from Dedza Meteorological Station (1969-2007). The available climatic data comprises of Rainfall, Evaporation, minimum and maximum Temperatures and have been summarized in Table 1 below.

Table 1. Long Term Mean Meteorological Data – Dedza Met Station (1969-date)

<table>
<thead>
<tr>
<th></th>
<th>Dedza Monthly Rainfall (mm)</th>
<th>Dedza Monthly Evaporation (mm)</th>
<th>Dedza Daily Evaporation (mm)</th>
<th>Dedza Monthly Min Temp (DegC)</th>
<th>Dedza Monthly Max Temp (DegC)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan.</td>
<td>255.6</td>
<td>91.2</td>
<td>2.9</td>
<td>15.5</td>
<td>23.2</td>
</tr>
<tr>
<td>Feb.</td>
<td>209.9</td>
<td>81.5</td>
<td>2.8</td>
<td>15.1</td>
<td>23.4</td>
</tr>
<tr>
<td>Mar.</td>
<td>123.6</td>
<td>85.5</td>
<td>2.8</td>
<td>15.1</td>
<td>23.5</td>
</tr>
<tr>
<td>Apr.</td>
<td>73.1</td>
<td>79.3</td>
<td>2.6</td>
<td>13.7</td>
<td>22.8</td>
</tr>
<tr>
<td>May</td>
<td>7.9</td>
<td>88.3</td>
<td>2.8</td>
<td>11.5</td>
<td>21.8</td>
</tr>
<tr>
<td>Jun.</td>
<td>2.2</td>
<td>78.8</td>
<td>2.6</td>
<td>9.4</td>
<td>19.9</td>
</tr>
<tr>
<td>Jul.</td>
<td>2.7</td>
<td>83.3</td>
<td>2.7</td>
<td>9</td>
<td>19.3</td>
</tr>
<tr>
<td>Aug.</td>
<td>0.9</td>
<td>103.8</td>
<td>3.3</td>
<td>10.5</td>
<td>21.1</td>
</tr>
<tr>
<td>Sep.</td>
<td>1.3</td>
<td>137.9</td>
<td>4.6</td>
<td>13</td>
<td>23.8</td>
</tr>
<tr>
<td>Oct.</td>
<td>11.4</td>
<td>164.8</td>
<td>5.3</td>
<td>14.7</td>
<td>25.3</td>
</tr>
<tr>
<td>Nov.</td>
<td>60.6</td>
<td>126.8</td>
<td>4.2</td>
<td>15.9</td>
<td>25.7</td>
</tr>
<tr>
<td>Dec.</td>
<td>197.6</td>
<td>104.4</td>
<td>3.4</td>
<td>15.8</td>
<td>24.1</td>
</tr>
<tr>
<td>Total/Avg</td>
<td>946.9</td>
<td>1225.7</td>
<td>3.3</td>
<td>13.3</td>
<td>22.8</td>
</tr>
</tbody>
</table>

From the data it can be deduced that rainfall exceeds evaporation in 8 out of 12 months of the year. The annual evaporation is mild resulting in a relatively low water deficit (approx 300mm pa). Daily evaporation figures are at an average of 3.3m per day with a maximum of 5.3 in October. Minimum temperatures go below 10 deg C in June and July and could be prohibitive to plant growth.

4.1.2. Topography

4.1.3. This is a high altitude site (1450masl). The area designated for Windu scheme is characterised by gentle slopes dropping in the general northern direction towards the Livizi River in the north. There is a considerable headland above the scheme with similar slopes. There are also a number of hills and mountains in this area.

The difference in elevation is approximately 20m between the top and the lower sections of the scheme. The average slope is approximately 1.5-2% which renders the area suitable for surface irrigation. There are some very steep areas close to the river which are not suitable for irrigation or cultivation of any type. There are a number of water ways that run parallel to the source stream and there are two rock outcrops within the project site.

4.1.4. Soils

The following soils were identified during the soil survey:-

Soil Type 1:- These are soils in areas of contact between granitic and mafic parent geology on the gently undulating high ground. The soils are deep, dark brown fine grained sandy loams over dark
reddish brown well drained sandy clay loams to sandy clays. Sometimes the surface texture is as light as loamy sands where there has been a superficial deposit of surface sand wash. These soils are suitable for irrigation on account of their medium texture; good drainage and good depth which give the soil profile a high water holding capacity. Approximate gross area for these soils is 13ha

**Soil Type 2:-** The soils of this type are mainly of granitic origin and separated from 1 on basis of grayer surface colours and yellower subsoils. The soil depth is at least 60cm with surface colours of very dark greyish brown to dark brown (10YR) and textures of sandy loams to sandy clay loams. Subsoils are dark yellowish brown to strong brown (10YR to 7.5YR) sandy clay loams to sandy clays. Soils are moderately well drained and of slightly restricted suitability for irrigation on account of their drainage status. When used for irrigation, drainage structures are necessary to ensure that excess irrigation water is removed from the soil profile. Approximate area for these soils is 30 ha.

**Soil Type 3:-** These soils occur in valley bottom positions and include a variety of soils that are all located in relatively wet conditions. Some of their common features are:

a) dark or black surface layers;

b) high water table at +/- 40cm; and

c) a total soil depth in excess of 100cm.

Textures are variable but generally heavy sandy clay loams to clays. Most of the current irrigation is being carried out on these soils. With respect to drainage, these soils are moderately to poorly drained. White surface efflorescence is common on these soils pointing to the possibility of soil salinity which will be verified through laboratory analysis of the samples collected. If irrigated, these soils will require effective land drainage to remove excess water and minimize the risk of further base saturation. They can be classified as being of slightly restricted suitability for irrigation on account of their drainage status. The approximate area is 24 ha.

A soil Map has been provided in Fig. 3 (overleaf).

### 4.1.5. Water resources

a) Water quantity

Winda irrigation scheme draws water from two springs positioned on the upland side of the scheme. The springs have a cumulative flow of around 40l/s with an insignificant difference throughout the season. The Livizi River also passes along the northern boundary.

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 spring flow

<table>
<thead>
<tr>
<th>Date of Measurement</th>
<th>Method Of Measurement</th>
<th>Measured Combined Spring Discharge</th>
</tr>
</thead>
<tbody>
<tr>
<td>27 May 2008</td>
<td>V Notch</td>
<td>40l/s</td>
</tr>
<tr>
<td>15 July 2008</td>
<td>V Notch</td>
<td>38l/s</td>
</tr>
<tr>
<td>13 August 2008</td>
<td>V Notch</td>
<td>38l/s</td>
</tr>
<tr>
<td>18th September 2008</td>
<td>V Notch</td>
<td>36.7l/s</td>
</tr>
</tbody>
</table>

ii) There is no indication or recollection that the two springs have ever stopped flowing.

iii) The two springs have different flow rates – the upper spring flows at 15 l/s and the lower spring flows at 25l/s. These statistics are significant whilst designing the scheme.
iv) No flow measurements were taken on the Livizi, however flow rates appear to be significant throughout the year (20-100l/s across the season). There are a number or upstream users on this river and it was decided that the river should not be considered as a possible water source for the scheme to reduce potential water conflict (and given that the spring water is sufficient).

v) Assumptions on water availability

- Average flow for **early season >40 l/s**
- Average flow for the **mid-late season 38l/s**
- Frequency of non flow events – **None**

b) Water Quality

Water from both Spring sources and the Livizi stream was tested for chemical, physical and biological quality at the Central Water Laboratory. These results show that the quality of spring water is suitable for both irrigation and domestic purposes, however the Livizi water samples is only usable for irrigation. The results of the analysis are further confirmed by the successful production of crops at the scheme.

c) Other Water Users

- **Upstream users.**

  There are no other users of the Windu Springs. There are, however, a number of existing or planned irrigation schemes that utilise water from the Livizi river these are:-

  Mtengezu scheme – 52ha
  Livizi scheme – 11ha
  Galileya scheme – 5h
  Individual gardens – 3 ha
  Total – 71ha

  As mentioned earlier, these designs do not include extraction of water from the Livizi to avoid potential water conflict.

- **Downstream users.**

  The spring water discharges into the Livizi river within 800m of the spring location. The spring water contributes approximately 20-30% of the Livizi flow during April to August (estimated at 120l/s) and then is likely to contribute to up 50% in the period September to November. There is one structured irrigation scheme downstream of Windu scheme known as Khulo Scheme which has an area of approximately 8ha. In addition, there a number of individual gardens (approx 3ha) and other users of the Livizi e.g. domestic use, livestock use etc. It is essential therefore to ensure that some flow from the springs is maintained into the Livizi. The suggested flow would be between 5 and 10l/s which will be difficult to enforce, however this will be augmented by seepage water from the areas below the springs.

4.1.6. Land Tenure

The proposed area for the scheme 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. Members “rent” land form 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 vegetation in area around the scheme has been cleared for agricultural purposes leaving very little natural vegetation or planted forests in the immediate vicinity of the scheme site.

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 majority of the catchment of the springs and the Windu stream as well as the Livizi riverine ecosystem is heavily degraded with stretches of river bank that have been cultivated and very few tress and other vegetation remaining. 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 10 villages that have taken part in the existing scheme and preparatory work for the proposed development. These are:-
- Mkumpira
- Thundu
- Khongoni
- Mphenziwa
- Kudzala
- Mazizi
- Bowa
- Chikanga
- Cheu
- Goliati

There are a total of 235 registered members of the scheme of which 80 are men and 155 are women heads of households.

4.3.2. Social Infrastructure around the Scheme

a) Health Facilities
The following health facilities are found close to the site:-
- Kanyama Health Centre. (Roman Catholic facility), only 2km to the north of the EPA.
- Chikuse Health Centre. (14km to the N)
- Dzindevu Health Centre. (14km to the NE)

The closest hospital is at Dedza boma (32km).
b) Education Facilities
The main educational facilities close to the scheme are Windu Junior Primary School. STD 1 to 5 and Makota FP (Std 1-8) and Makota Community Day Secondary School.

i) Domestic Water Supply
There are a number of boreholes in the area. Communities are also making use of the spring water for drinking water. The Livizi and Windu Stream are used for bathing and washing.

j) Electricity Supply
There is no electricity at the scheme site and the closest point where electricity is found is at Dedza town (32km).

k) Sanitation
There are a number of latrines around the homesteads, however there is a requirement to construct one or more strategically placed latrines to reduce the risks of water borne diseases.

4.3.3. Access Roads
There are two ways to access the site:-
    a) Chikuse Road The shortest road From Dedza to Kanyama EPA. It is central and straightest one. It passes through WICO and Dedza Secondary school. It heads north from Dedza Boma.
    b) Nkomeko/Kankhomba road. This road is slightly longer. It branches from the main M1 tarmac road to Lilongwe at Malawi College of Forestry.

4.3.4. Telecommunications
There is intermittent to low coverage of both TNM and Zain cellular networks at this 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.

- Collection of detailed spring 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 Windu Springs and Stream;
ii. Restoration of Windu Stream and Livizi 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 Windu Stream and Livizi River as a result of riverine afforestation initiatives;

5.2. Potential Negative Environmental Impacts

5.1.1. Construction Phase
These include but are 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. 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. 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. 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 excavations for water supply canals;

ii. Land use conflicts between rainfed and irrigation farmers;

iii. Land use conflicts due to loss of agricultural land as a result of reclaim of riverine buffer zone

iv. Water use conflicts due to increased demand for irrigation water against decreased water supply quantities;

v. Increase in water borne and vectored diseases like bilharzias and malaria;

vi. Proliferation of HIV/AIDS due to increased promiscuity as a result of increased income amongst farmers Construction workers will likely be exposed to health and safety hazards like dust and equipment;

vii. 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>
<thead>
<tr>
<th>Project Phase</th>
<th>Terrestrial biodiversity</th>
<th>Aquatic biodiversity</th>
<th>Water quality</th>
<th>Water quantity</th>
<th>Soil quality</th>
<th>Air quality</th>
<th>Land use conflicts</th>
<th>Water use conflicts</th>
<th>Health</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction Phase</td>
<td>-1M</td>
<td>-1S</td>
<td>-2S</td>
<td>-1S</td>
<td>-2M</td>
<td>-1S</td>
<td>-2S</td>
<td>0S</td>
<td>-1S</td>
</tr>
<tr>
<td>Operational phase</td>
<td>0L</td>
<td>-2S</td>
<td>-3L</td>
<td>-2M</td>
<td>-3L</td>
<td>0L</td>
<td>0L</td>
<td>-3L</td>
<td>-2L</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 6 (Page 19)) provides a comprehensive overview of the suggested Environmental and Social Management Plan. The plan has taken into consideration only significant negative environmental and social impacts that require attention by concerned stakeholders, based on the existing and projected bio-physical and social conditions in the project area, in order to avoid a decline in environmental quality and to ensure that benefits are sustained. The plans include the time frame in which the implementation is to be completed.

6.2. Estimated Budget for the ESMP

The estimated cost of implementation of the ESMP has been developed and a summary of which has been presented in Table 4 below. Some of the costs have been generated from either the detailed BoQ from the Detailed design report.

6.3 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

6.4. 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.
### 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</td>
<td>Water quality measurement</td>
<td>62,400</td>
<td>62,400</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>48,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Assessment of Riverine Indicator Aquatic Species</td>
<td>35,000</td>
<td>35,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Other</td>
<td>20,000</td>
<td>20,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sub total - Baseline data Collection</td>
<td>165,400</td>
<td>165,400</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Catchment Conservation plan</td>
<td>Coordination and administration</td>
<td>780,000</td>
<td>300,000</td>
<td>240,000</td>
<td>240,000</td>
</tr>
<tr>
<td></td>
<td>Farmer training land conservation practices</td>
<td>1,170,000</td>
<td>450,000</td>
<td>360,000</td>
<td>360,000</td>
</tr>
<tr>
<td></td>
<td>Tree nurseries and planting</td>
<td>858,000</td>
<td>330,000</td>
<td>264,000</td>
<td>264,000</td>
</tr>
<tr>
<td></td>
<td>Conservation crop nurseries and planting</td>
<td>1,092,000</td>
<td>420,000</td>
<td>336,000</td>
<td>336,000</td>
</tr>
<tr>
<td></td>
<td>Sub Total</td>
<td>3,900,000</td>
<td>1,500,000</td>
<td>1,200,000</td>
<td>1,200,000</td>
</tr>
<tr>
<td>Maintenance of Storm Water Protection</td>
<td>Clearing and stabilisation</td>
<td>60,000</td>
<td>20,000</td>
<td>20,000</td>
<td>20,000</td>
</tr>
<tr>
<td>Contour Bunds and Erosion Gully Control</td>
<td>Vetiver planting and check dams</td>
<td>75,000</td>
<td>25,000</td>
<td>25,000</td>
<td>25,000</td>
</tr>
<tr>
<td>Maintenance of Drains</td>
<td>See detailed BoQ</td>
<td>75,000</td>
<td>25,000</td>
<td>25,000</td>
<td>25,000</td>
</tr>
<tr>
<td>Training of Farmers</td>
<td>Sustainable Practices and Soil Management</td>
<td>450,000</td>
<td>150,000</td>
<td>150,000</td>
<td>150,000</td>
</tr>
<tr>
<td>Health Sensitization campaign</td>
<td>HIV AIDS and Water Borne Disease Prevention</td>
<td>150,000</td>
<td>50,000</td>
<td>50,000</td>
<td>50,000</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>1,470,000</td>
</tr>
</tbody>
</table>

#### 6.5 Monitoring Plan

An Environmental and Social Monitoring plan has been presented in Table 5. The plan includes verifiable mitigation actions as well as verifiable indicators which can be compared to baseline (current) indicator information for both the construction and operational phases of the project. The plan also indicates the monitoring frequency and which institutions are deemed responsible to carry out the monitoring activities. Where baseline information is not available, a budget with estimated costs of acquiring the information has been included in Table 2 above.

#### 6.6 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>42</td>
<td>2,300</td>
<td>96,600</td>
<td>Annual</td>
</tr>
<tr>
<td>River Discharge Recording</td>
<td>Daily river gaugung 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>Aerial photos or satellite images</td>
<td></td>
<td></td>
<td>75,000</td>
<td>Every 3 years</td>
</tr>
<tr>
<td></td>
<td>Total estimated monitoring Cost (MK)</td>
<td></td>
<td></td>
<td>285,900</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>
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<td>--------------------------</td>
<td>-------------------------------------</td>
</tr>
<tr>
<td>1.0</td>
<td>Construction Phase</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.1</td>
<td>Reduction in water flow downstream of the intake point on Windu Springs and Stream leading to potential conflict and degradation of aquatic life</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 5l/s)</td>
<td>Immediate and daily thereafter</td>
<td>n/a</td>
</tr>
<tr>
<td>1.2</td>
<td>Water quality degradation in Windu Springs and Stream 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>
<tr>
<td>1.3</td>
<td>Disturbance and loosening of soils during excavations of irrigation water ways &amp; water storage reservoir, 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>Immediate and daily control during earth works up to commissioning</td>
<td>Part construction contract</td>
</tr>
<tr>
<td>1.4</td>
<td>Air pollution due to dust emission during excavations of 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>Immediate and daily control during earth works up to commissioning</td>
<td>Part construction contract</td>
</tr>
<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 construction up to commissioning</td>
<td>Part construction contract</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>
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</tr>
<tr>
<td>2.0</td>
<td>Operational Phase</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.1</td>
<td>Reduction in water flow downstream of the intake point on Windu Springs and Stream leading to potential conflict and degradation of aquatic life;</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>
</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>
</tr>
<tr>
<td>2.3</td>
<td>Risk of soil erosion formation of gulleys and general soil degradation</td>
<td>Negative and high in severity</td>
<td>i. Undertake gulley reclamation activities such as check dams and planting of stabilizing grasses and trees ii. Implement measures to reduce destructive agricultural practices</td>
<td>Year 1-3</td>
<td>As above</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>
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<td>-------------------------------------</td>
</tr>
</tbody>
</table>
| 2.4 | Loss of nutrients due to soil erosion and leaching as a result of over-cultivation and irrigation | Negative and high in severity | i. Promotion of appropriate agricultural and land conservation practices, including minimal tillage and compost making, amongst farmers;  
ii. Application of appropriate quantities of irrigation water to crops depending on crop-water demand requirements to avoid water logging and subsequent leaching of nutrients. | Introduction of land conservation measures – Year 1 onwards Farmer training Year 1-3 | As above | WUA, Ministry of Agriculture & Food Security, Ministry of Irrigation and Water Development. |
| 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 |
<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>2.7</td>
<td>Risk of Windu Spring drying – causing crop failure</td>
<td>Negative and moderate in severity</td>
<td>i. Promotion of appropriate agricultural and land conservation practices on fields upstream of the intake point to minimise soil erosion; ii. Conservation of vegetation and re-planting of trees along Windu Springs and Stream.</td>
<td>Catchment conservation initiatives Year 1-3 Farmer training Year 1-3</td>
<td>Catchment conservation initiative:- K1.2 million per year for 3 years Tree planting along river K50,000 per annum for 3 years</td>
<td>Contractor, Project Manager,, Ministry of Agriculture and Food Security, Department of Forestry, WUA.</td>
</tr>
<tr>
<td>2.8</td>
<td>Land use conflicts due to loss of agricultural land as a result of reclaim of riverine buffer zone</td>
<td>Negative but low in severity</td>
<td>Incorporation of farmers with loss in agricultural land into the scheme area.</td>
<td>Year 1 -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 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>Health education initiatives 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;</td>
<td>Irrigation scheduling to be implemented every season</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>
</tr>
<tr>
<td></td>
<td></td>
<td></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, Farmers, WUA.</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>ii. Application of appropriate quantities of irrigation water to crops depending on crop-water demand requirements to avoid water wastage.</td>
<td>Cap building annually for first 3 years.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

TOTAL ESTIMATED COSTS

MK 4.9 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>Construction Phase</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.1</td>
<td>Reduction in water flow downstream of the intake point on Windu Springs and Stream leading to potential conflict and degradation of aquatic life</td>
<td>Negative and moderate in severity</td>
<td>Ensuring a considerable flow of water beyond the intake point.</td>
<td>i. Minimum Environment flow: - April – June: 5l/s July-Sept: 5l/s Oct-Dec:5l/s ii. Comparison of indicator to baseline 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>1.2</td>
<td>Water quality degradation in Windu Springs and Stream 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 Windu Springs and Stream Water quality analysis</td>
<td>Weekly during construction</td>
<td>Contractor, Project Manager,</td>
</tr>
<tr>
<td>1.3</td>
<td>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. 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>1.4</td>
<td>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>
</tr>
<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</td>
<td>Availability of protective wear amongst workers. Number of incident and accident free days.</td>
<td>Number of accident free days.</td>
<td>Daily during construction contract</td>
<td>Contractor, Agricane and Department of Occupational</td>
</tr>
</tbody>
</table>

Windu Scheme
<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>Windu Scheme</td>
<td></td>
<td>measures during the construction</td>
<td>employees trained in occupational safety incidents Clause in contract</td>
<td>Record of accidents</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.0</td>
<td><strong>Operational Phase</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.1</td>
<td>Reduction in water flow downstream of the intake point on Windu Springs and Stream leading to potential conflict and degradation of aquatic life</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. Minimum Environ flow:- April – June: 5l/s July-Sept: 5l/s Oct-Dec:5l/s ii. Monitor indicator species iii. Water management records</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>WUA, Ministry of Irrigation and Water Development.</td>
</tr>
<tr>
<td>2.2</td>
<td>Risk of soil erosion formation of gulleys and general soil degradation</td>
<td>Negative and high in severity</td>
<td>i. Undertake gulley reclamation activities such as check dams and planting of stabilizing grasses and trees ii. Implement measures to reduce destructive agricultural practices</td>
<td>i. Measure gulley length, depth and width ii. Number of structures built iii. Number of trees and stabilisation material planted</td>
<td>i. meters of gulley ii. number of checkdams per m of gulley iii. number fo trees planted per annum</td>
<td>Annual</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 Availability and implementation of appropriate water management practices</td>
<td>i. Chemical analysis of ground and scheme surface water samples compared to base line soil data ii. Verifiable land conservation structures per ha vs target</td>
<td>i. Representative samples collected annually ii. Annual verification of land conservation practices iii. Annual assessment of</td>
<td>WUA, Ministry of Agriculture &amp; Food Security and Ministry of Irrigation &amp; Water Development.</td>
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<td>SN</td>
<td>Environmental Impact</td>
<td>Type of Impact and Severity</td>
<td>Preferred Mitigation/Enhancement Action</td>
<td>Verifiable Indicator Implementation Action</td>
<td>Monitoring Unit</td>
<td>Frequency of monitoring</td>
<td>Responsibility</td>
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<td>chemical movement through leaching and erosion; iii. Promotion of ecological methods for pest control to minimise use of pesticides.</td>
<td>ii. Amount of IPM and organic pest control methods</td>
<td>ii. Annual collection of representative soil samples vs benchmark soil data iii. Number of drains constructed vs target.</td>
<td>Annual audit</td>
<td>WUA, Ministry of Agriculture and Food Security</td>
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<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. 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</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;</td>
<td>i. Regular collection and analysis of soil samples ii. Availability of appropriate</td>
<td>i. Chemical analysis of soil samples compared to base line soil data</td>
<td>Annual</td>
<td>WUA, Ministry of Agriculture and Food Security</td>
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<td>2.7</td>
<td>Risk of Windu Springs drying up leading to crop failure</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 Windu Springs and Stream.</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 Windu Springs and Stream</td>
<td>i. Number of 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 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</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</td>
<td>Negative and moderate in severity</td>
<td>i. Sensitisation of farmers on proper sanitary behaviour in the scheme area when</td>
<td>i. Records of water borne diseases’ prevalence</td>
<td>i. Incidence of disease per unit of population vs</td>
<td>Monthly (MoH)</td>
<td>WUA, Ministry of Health, Ministry of</td>
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<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>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</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>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</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>Number of incidents recorded</td>
<td>Monthly</td>
<td>Project Manager, Contractor, Farmers, WUA.</td>
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</table>
7. CONCLUSIONS AND RECOMMENDATIONS

The Windu Irrigation Scheme has a high potential to change the socio-economic profile of the communities in Kanyama 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 catchment area of Windu Springs and Stream is highly disturbed due to intensive cultivation upstream of the project site. This is a threat to water levels in the river and will in the long run compromise the future of the scheme. Efforts will have to be put in place right from the planning stage by all stakeholders, especially Land Resources Conservation Department, Forestry Department, WUA, the Ministry of Irrigation and Water Development, in order to restore the catchment ecosystem. It must be noted that farmers themselves will not be able to deal with the catchment area degradation trend as is the case at present. IRLADP should therefore plan to allocate special funds for catchment management otherwise implementing this project will ever be counterproductive to the expected benefits.

b) Proper water management practices in the scheme will require strict adherence at all times in order to prevent soil salinity. This is because soil salinisation has been known to shorten life spans of irrigation schemes dramatically worldwide and in the process causing significant irreversible adverse socio-economic effects on beneficiaries;
REFERENCES


