

REPUBLIC OF ZAMBIA

**DETAILED ASSESSMENT,  
CONCEPTUAL DESIGN AND  
ENVIRONMENTAL AND SOCIAL IMPACT  
ASSESSMENT (ESIA) STUDY  
FOR THE IMPROVED USE  
OF PRIORITY TRADITIONAL CANALS  
IN THE BAROTSE SUB-BASIN OF THE  
ZAMBEZI**

***ENVIRONMENTAL AND SOCIAL IMPACT  
ASSESSMENT***

***Final Report***

*October 2014*



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Document title	<b>Environmental and Social Impact Assessment for the improved use of priority canals in the Barotse Sub-Basin of the Zambezi</b>
Document reference	800568
Code	V.3

Date	Code	Observation	Written by	Validated by
May 2014	V.1		<b>Eric Deneut:</b> ESIA montage,	
July 2014	V.2		Environmental baseline and impact assessment	
October 2014	V.3		<b>Charles Kapekele Chileya:</b> Social baseline and impact assessment <b>Christophe Nativel:</b> support in social baseline report	Eric Verlinden

# ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT FOR THE IMPROVED USE OF PRIORITY TRADITIONAL CANALS IN THE BAROTSE SUB-BASIN OF THE ZAMBEZI

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## List of acronyms

BRE : Barotse Royal Establishment

CTF : Clean Technology Fund

ESIA: Environmental and Social Impact Assessment

ESMP: Environmental and Social Management Plan

FIP : Forest Investment Program

PPCR: Pilot Program Climate Resilience

PPCR: Pilot Program for Climate Resilience

SREP: Scaling Up Renewable Energy Program

ZAWA: Zambian Wildlife Authority

# 1. INTRODUCTION

This document is an Environmental and Social Impact Assessment (ESIA) for the “Study for the improved use of priority traditional canals in the Barotse sub-basin of the Zambezi” in the Western Province of Zambia.

This ESIA was written by BRLi and NIRAS by the following experts:

- ▶ Eric Deneut (BRLi): ESIA montage, Environmental baseline and impact assessment, Project description.
- ▶ Charles Kapekele Chileya (NIRAS): Social baseline and impact assessment.
- ▶ Christophe Nativel (BRLi): support in social baseline report.
- ▶ Gordon Mudenda (NIRAS): Fish baseline and impact assessment.

The priority traditional canals are (see map next page):

- ▶ Muoyowamo canal (further in the study the Namitome, a natural tributary of the Muoyowamo was added to the study);
- ▶ Lubitamei canal (also called “Nangula canal” on its eastern part (from Ndiki to Kate) and “Nonge canal” on the western part (from Kate to its end in the Mongu / Kalabo waterway) ;
- ▶ N'gombala canal (further in the study this canal was divided in N'gombala and Nebubela);
- ▶ Fisheries canal ;
- ▶ Musiamo canal.

The Study for the improved use of priority traditional canals in the Barotse sub-basin of the Zambezi has proposed activities to restore canals, these activities are described as the “Project” in this report. These activities were developed in a participative manner, involving local population and stakeholders’ participation through social surveys and workshops. Stakeholder and location population opinion are incorporated in the restoration/rehabilitation work.

The aim of the ESIA is to study sociological, economic and cultural baseline components as well as environmental components and to analyze the impacts brought by the proposed Project on these components. This ESIA allows for the development of mitigation measures to ensure that all activities impacts are avoided, mitigated or compensated.

## 1.1 BACKGROUND OF THE PROJECT

The Government of the Republic of Zambia has been allocated grant funds from the Climate Investment Funds (CIF) that are administered by the World Bank and African Development Bank and executed by the Zambian Ministry of Transport, Works, Supply and Communications. The CIF include four key programs that help developing countries in implementing low-emissions and climate resilient programs:

- ▶ Clean Technology Fund (CTF);
- ▶ Forest Investment Program (FIP);
- ▶ Scaling Up Renewable Energy Program (SREP);
- ▶ Pilot Program Climate Resilience (PPCR).

It is under the PPCR that the Study takes place. The PPCR is implemented through a partnership of five Multi-lateral Development Banks: African Development Bank, Asian Development Bank, Inter-American Development Bank, the European Bank for Reconstruction and Development and the World Bank Group (WBG). The World Bank is the Trustee for the CIF and hosts the CIF Administrative Unit

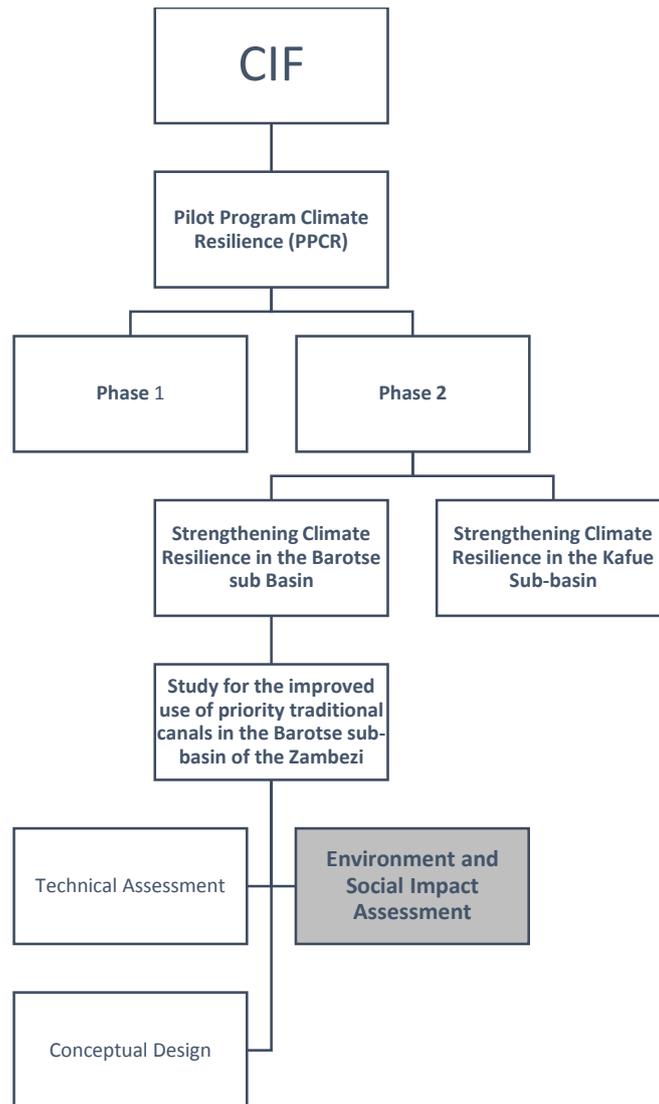
The Pilot Program for Climate Resilience (PPCR) is lead by the Ministry of Finance. It is divided in two phases; Phase I (2010 to 2013) was a preparatory phase focusing on:

- ▶ Mainstreaming climate resilience into national development planning;
- ▶ Strengthened institutional coordination ;
- ▶ Improved information for decision makers ;
- ▶ Targeted awareness of communication ;
- ▶ Preparation of phase II.

Phase II is composed of two investment projects:

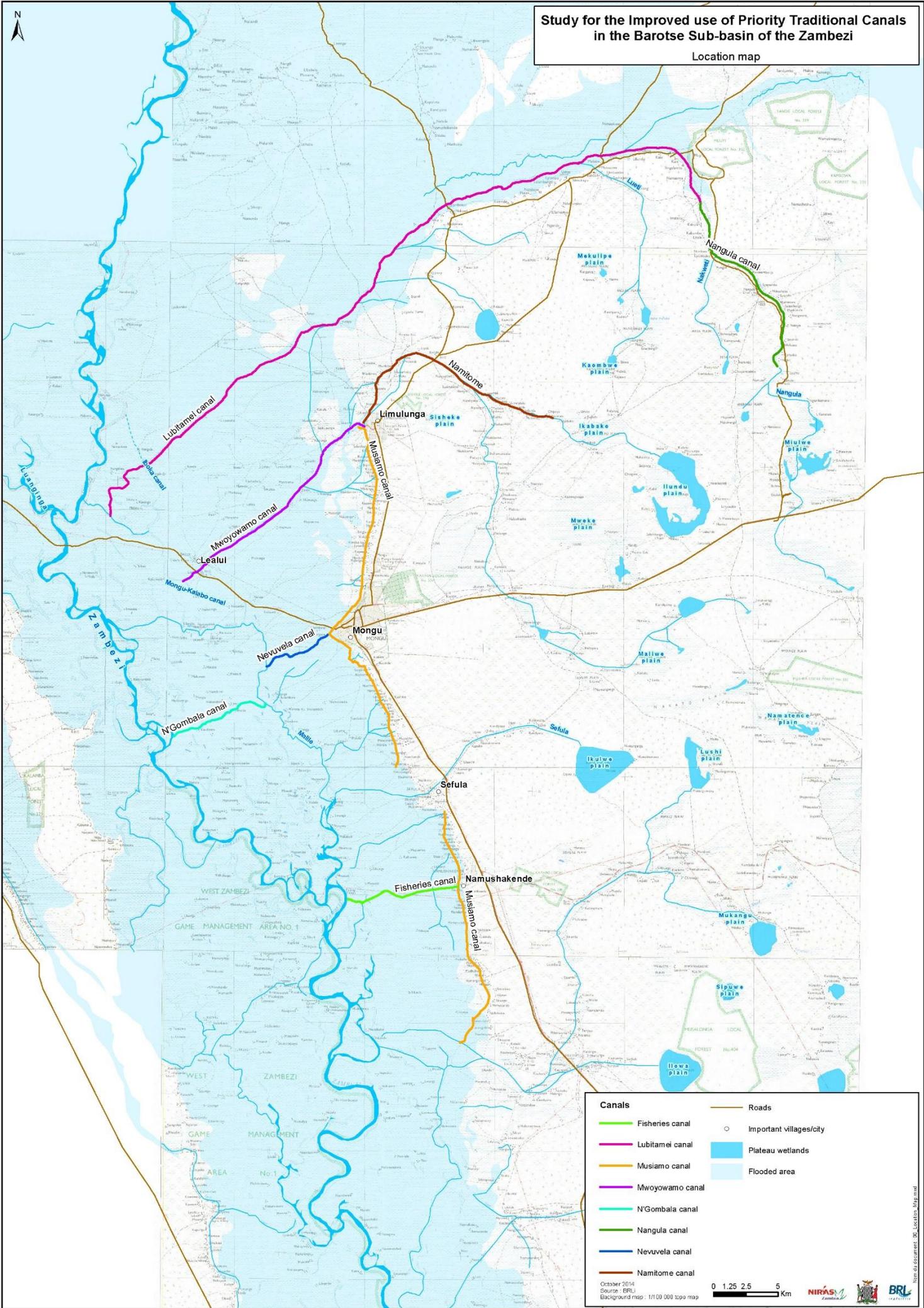
- ▶ The first one is entitled “Strengthening Climate Resilience in the Barotse sub Basin“. It is funded by the World Bank and will last from 2013 to 2019. The Detailed Assessment, Conceptual Design and Environmental and Social Impact Assessment (ESIA) Study for the improved use of priority traditional canals in the Barotse sub-basin of the Zambezi is part of this Phase.
- ▶ The second one, entitled “Strengthening Climate Resilience in the Kafue Sub-basin” is funded by the African Development Bank and will last from 2013 to 2018.

The following graph summarizes the Study background.



# Study for the Improved use of Priority Traditional Canals in the Barotse Sub-basin of the Zambezi

Location map



Canals		Roads
	Fisheries canal	
	Lubitamei canal	
	Musiamo canal	
	Mwoyowamo canal	
	N'Gombala canal	
	Nangula canal	
	Nevuvela canal	
	Namitome canal	

October 2014  
Source: EBU  
Background map: 1:100 000 topo map

0 1.25 2.5 5 Km

Map of Barotse Sub-basin of the Zambezi

## 1.2 SUMMARY DESCRIPTION OF THE PROJECT INCLUDING PROJECT RATIONALE

### 1.2.1 Project rationale

The canals network is presently suffering from malfunction due to poor maintenance resulting in major siltation, banks degradation and progressive loss of canal trajectories. This situation prevents population from using them at their full potential (mainly navigation and agriculture), which causes economic losses. With climate change, the incidence of floods and droughts in this sub-basin is higher, which worsen the already threatened traditional canal systems, forestry and fishing resources. The intensification of both dry and rainy seasons may affect crop (particularly the anticipated flash floods) and livestock production. These situations highlight multiple challenges:

- ▶ Technical: canals undergo major constraints during floods as parts of their reaches are below water level, which lead to recurrent sand remobilisation and damages along the canal banks and beds;
- ▶ Management: the main challenge is to achieve financially feasible management for the canals while relying on the existing stakeholders;
- ▶ Socio-cultural: improving activities relating to the network and the derived livelihoods, while maintaining the cultural heritage such as the Kuomboka ceremony;
- ▶ Environmental: safeguarding the fragile equilibrium between anthropogenic activities and functioning ecosystems such as wetlands

On the other hand, it appears that improved canals will enhance economic activities and livelihoods; the opportunity of operational canals with enhanced uses may also influence the local demography. The population, who fled the area during the last decades, may be interested in coming back and restart farming their abandoned land. In the meantime, this could negatively impact the plain both environmentally and culturally since the site is a candidate for World Cultural Heritage Site title and include highly valuable wetlands.

### 1.2.2 Summary description of works

#### MUOYOWAMO

The rehabilitation works proposed for Muoyowamo canal consist in the re-excavation of the canal, construction of two sluices and one sand trap.

#### NAMITOME

The proposed rehabilitation works of Namitome consist of the re-excavation of the canal and removal of bunds. The works only consists of earthworks.

#### LUBITAMEI

It is proposed to rehabilitate the Lubitamei canal by re-excavating it and building 2 sand traps, 3 Water Control Structures and one road crossing structure.

#### N'GOMBALA

Proposed rehabilitation or upgrading works for N'gombala consist in the re-excavation and opening of the canal. Only earthworks are proposed.

## NEBUBELA

The proposed rehabilitation works of the Nebubela canal consist in a re-excavation of the canal and removal of the sand banks. In addition a provision has been made for the removal of 15,000 m<sup>3</sup> of old spoil banks.

## FISHERIES

The proposed rehabilitation works of Fisheries canal consist in the excavation and deepening of the canal in order to allow navigation with motor boats throughout the year in between Namushakende harbour and the Zambezi. The works are hence limited to earthworks.

## MUSIAMO

The proposed rehabilitation works of Musiamo consist in a re-excavation and the construction of 5 road crossing structures and 7 Water Control Structures.

## SILTING BASINS

It is proposed to build 7 silting basins which are temporary structures. Those will facilitate the dredging of the sand banks generated each year at the junction of the canals and rivers.

## 1.3 OBJECTIVES THE PROJECT

The goal of the Project is to enhance human activities enabled by the canals systems, in a perspective of improving their resilience to climate change. In order to achieve this goal, a sustainable Canals Management Plan accompanied by the corresponding detailed design required for their restoration will be developed. Core preoccupations is to satisfy on the long term the human activities needs, in the respect of the fragile environment equilibrium of the Barotse RAMSAR Area and the socio-cultural background.

In that purpose, the project results in a multi-disciplinary approach, that integrates:

- ▶ The human framework, through the proposal of a Canals Management Plan that satisfies water uses anticipating the impacts of climate change, through the proposal of canals management evolution towards sustainability, and respecting the socio-cultural setting;
- ▶ The ecosystem constraints/requirements, recognizing the links that it may have with the historical human use of water and population livelihoods.
- ▶ The infrastructure rehabilitation and modernization to answer the needs for technical evolution highlighted by the plan.

The present study is an ambitious program whose level of complexity and innovation derives from a strategy that seeks collaboration and draws on the combined efforts of separate but inter-linked sectors – environment, natural resources management, agriculture, rural development, enterprise development and finance.

In the framework of the Project, BRLi/NIRAS Assignment is to produce:

- ▶ Technical reports:
  - Detailed conceptual design for canals management and rehabilitation (Assessment Report);
  - Operation and Maintenance Program;
- ▶ Bidding document (Procurement of Rehabilitation works of priority Barotse canals);

- ▶ Environmental and Social Impact Assessment (ESIA).

As required in the Environmental Protection and Pollution Control (Environmental Impact Assessment) Regulations, 1997, Regulations 9 (3), A Scoping report is a legal prerequisite to the ESIA and was produced and handed to ZEMA in 2013.

### 1.3.1 Objectives of the Assignment

The objective of the assignment is to assess how use of the targeted canals in the Barotse sub-basin can be strengthened to optimize their role in supporting the local population to become more climate resilient, taking into account the prevailing socio-cultural and environmental context. The assignment is divided in three major parts:

- ▶ Technical reports:
  - Detailed conceptual design for canals management and rehabilitation (Assessment Report);
  - Operation and Maintenance Program;
- ▶ Bidding document (Procurement of Rehabilitation works of priority Barotse canals);
- ▶ Environmental and Social Impact Assessment (ESIA).

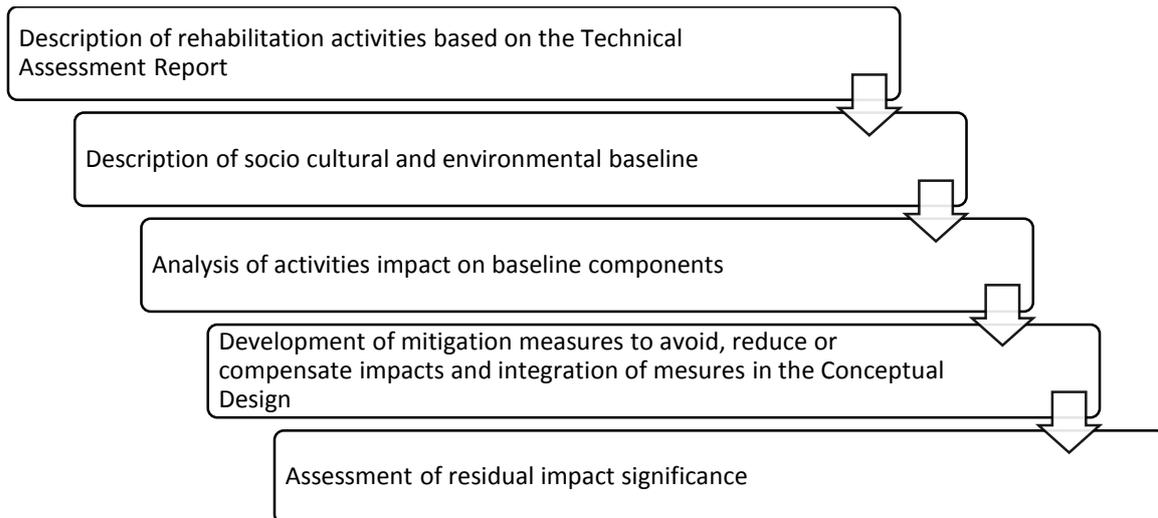
This report constitutes the Environmental and Social Impact Assessment.

It was written by:

- ▶ Eric Deneut (BRLi): ESIA montage, Environmental baseline and impact assessment, Project description.
- ▶ Charles Kapekele Chileya (NIRAS): Social baseline and impact assessment.
- ▶ Christophe Nativel (BRLi): support in social baseline report.
- ▶ Gordon Mudenda (NIRAS): Fish baseline and impact assessment.

### 1.3.2 Objective of the ESIA

The aim of the ESIA is to study sociological, economic and cultural baseline components as well as environmental components and to analyze the impacts brought by the Project on these components. Based on baseline and impact assessment, the ESIA proposes mitigation measures as well as compensation measures. Moreover, an Environmental and Social Management Plan (ESMP) is annexed to this ESIA to ensure proper implementation of measures. These measures, when necessary, influence the Conceptual Design.



The Technical Assessment Report proposed activities to improve canals conditions, impacts assessment is based on four components:

- ▶ Actions that Technical Assessment report have proposed, these are:
  - Prevention of sand erosion (removal of sand and stabilization);
  - Construction of sand traps;
  - Construction of gates to control flows and levels of water ;
  - Regular canal maintenance programme;
  - Vegetation control through machine dredging complemented by regular hand-clearing.
- ▶ Field works carried out during the two first weeks of September 2013 and bibliographical data;
- ▶ Social survey carried out in the Study area in 2013 and gathering on local communities opinion;
- ▶ Stakeholders opinion gathered during workshops.

This ESIA report intends to:

- ▶ Present findings of the baseline studies and workshops;
- ▶ Identify social, cultural, economical and environmental potential impacts of the Project whether they are positive or negative;
- ▶ Be iterative, since it will present possible mitigation, avoidance, and monitoring measures and will inform the Technical team in charge of the detailed conceptual design and the Operation and Maintenance Program of possible measures to implement;
- ▶ Take into account stakeholders' opinion on mitigation and compensation measures during the third workshop;
- ▶ Identify all actors and means to implement measures through the ESMP;
- ▶ Comply with National and World Bank requirements.

#### COMPLIANCE WITH WORLD BANK REQUIREMENTS

This report is an Environmental and Social Impact Assessment (ESIA) as required by the WB policy: Operational Policy 4.01: Environmental Assessment, 1999 - Revised February 2011.

The Project has been rated as Category B by the WorldBank classification.

- ▶ “Category B: A proposed project is classified as Category B if its potential adverse environmental impacts on human populations or environmentally important areas--including wetlands, forests, grasslands, and other natural habitats--are less adverse than those of Category A projects. These impacts are site-specific; few if any of them are irreversible; and in most cases mitigatory measures can be designed more readily than for Category A projects. The scope of Environmental Assessment for a Category B project may vary from project to project, but it is narrower than that of Category A Environmental Assessment. Like Category A Environmental Assessment, it examines the project's potential negative and positive environmental impacts and recommends any measures needed to prevent, minimize, mitigate, or compensate for adverse impacts and improve environmental performance”.

Terms of reference to this study are in annex 11.

## 1.4 BRIEF DESCRIPTION OF THE LOCATION

The Barotse is Zambia's second largest wetland. It is located in the Western Province, 600 km west of Lusaka. The main city within the Barotse is Mongu municipality. The Zambezi River crosses the area from North to South. The sub-basin is fed by high annual rainfall of up 1400 mm. As the area is very flat, the Zambezi water floods the plain 3 to 5 months per year, from January to June.

The Lozi people are the inhabitants of the Barotse, and derive diverse livelihoods from the floodplain. The traditional authority of the area is the “Barotse Royal Establishment” (BRE). This institution is led by the king, namely the Litunga (Owner of the Land) who is assisted by the ministers called Indunas. The Barotse is famous for its cultural heritage, and in particular for the Kuomboka ceremony, when the Litunga leaves his palace of Lealui in the plain to go to his palace of Limulunga on the upper land.

For its important biodiversity, the Barotse has been designated as Ramsar site since 2007. For its living culture and traditions, it has been proposed to become a Cultural Landscape site at the UNESCO World Heritage Center.

## 1.5 PARTICULARS OF SHAREHOLDERS/DIRECTORS

This section does not apply to the current Project.

## 1.6 PERCENTAGE OF SHAREHOLDING BY EACH SHAREHOLDER

This section does not apply to the current Project.

## 1.7 THE DEVELOPER'S PHYSICAL ADDRESS AND THE CONTACT PERSON AND HIS/HER DETAILS

This section does not apply to the current Project.

Institutional arrangements are not final. The Project through tender bid process will select a contractor to carry out work, and implement an Operation and Maintenance unit.

## 1.8 TRACK RECORD/PREVIOUS EXPERIENCE OF ENTERPRISE ELSEWHERE

This section does not apply to the current Project.

## 1.9 TOTAL PROJECT COST/INVESTMENT

The summary of the cost of rehabilitation works is presented in table below and amounts 7,051,783 US \$.

Table 1 Summary of rehabilitation works

Canal	Amount (US \$)
Muoyowamo	964 754.58
Lubitamei	2 268 671.26
Ngombalo	425 040.00
Nebubela	319 770,00
Fisheries	2 244 363.00
Musiamo	624 530.66
Namitome	204 653.91
Silting basins	88 872.00
<b>Total works</b>	<b>7 036 971.41</b>

It should be noted that the cost of work supervision is estimated at 3% to 4% of the works.

Annual canal maintenance is estimated to be as follow.

Table 2 Annual maintenance cost per canal

Canal	Length (m)	Cost of clearing (USD)	Cost of sand removal (USD)		Cost of civil struct. Maint. (USD)	Total annual (\$)
			sand trap	silting bas.		
Lubitamei u/s	26,650	10,837	4210.5		422	15,470
Lubitamei d/s	53,000	16,985	4210.5	1000		22,195
Musiamo	50,550	14,457			2,111	16,569
Muyowamo	19,466	8,099	4210.5	1000	4,117	17,427
Nebubela	5,918	4,614	4210.5	1000		9,824
N'gombala	8,411	3,420		2000		5,420
Fisheries	9,105	3,399		2000		5,399
Namitome	21,626	6,930				6,930
Annual maintenance		68,742	16,842	7,000	6,650	99,235

## 1.10 PROPOSED PROJECT IMPLEMENTATION DATE

Work will start in June 2015 and will finish before the rainy season in November 2015.

## 2. POLICY, INSTITUTIONAL AND ORGANISATIONAL FRAMEWORK

### 2.1 LEGAL FRAMEWORK

#### THE BAROTSELAND AGREEMENT OF 1964

This Agreement was signed, after the Independence, between the Prime Minister of Northern Rhodesia, the Litunga of Barotseland and the principal secretary of state for commonwealth relations and colonies.

The Agreement outlined a number of responsibilities some of which are:

- ▶ matters relating to local government;
- ▶ land;
- ▶ fishing;
- ▶ control of bush fires;
- ▶ Forest and preservation of trees for canoes;
- ▶ local taxation and matters relating thereto; and
- ▶ Barotse local festivals and ceremonies
- ▶ Traditional and customary matters relating to Barotseland alone including canal operation and maintenance

The Government of Zambia has general responsibility for providing financial support for the administration and economic development of Barotseland.

#### BAROTSE ROYAL ESTABLISHMENT ACT OF 1971

Customary land under the jurisdiction of the Barotse Royal Establishment (BRE) is regulated by the Barotse Royal Establishment Act of 1971 Section 6 (1) (B) which provides for traditional means of administration. Under this act, the BRE have the power and responsibility over land administration and natural resource utilization. This includes land allocation and demarcation, settling land-related disputes, collection of land taxes and royalties as well as enforcing associated rules and regulations governing access to natural resources such as water bodies, grazing land and forests.

This Act provides for the alienation, transfer, disposasiion and change of use of land. The Act also provides for compulsory aquisition of land by the President where as he is of the opinion that it desirable or expedient to do so in the public interest. When Government needs land for project development, they consult the traditional authorities and seek their consent to have the land transferred from customary to state land through the conversion of Titles Act.

#### OTHER REGULATORY REQUIREMENTS RELEVANT TO THE MAINTENANCE OF CANALS

The BRE regulations are complemented by other policies such as the National legislation and policies one hand and on the other World Bank safeguard policies as well as other international conventions treatise. These are catalogued in the table below.

Table 3 *Zambian laws and regulations*

Legislative Act/Regulation	Description	Links to the Barotse canals Projects
Environmental Management Act (EMA)	The Zambia Environmental Management Act (ZEMA) is the supreme environmental law in Zambia.	Ensure that the project canals and their hinterlands are registered, maintained in accordance to the country's Law and regulation Monitoring of water pollution and air quality control through ZEMA
The Zambia Wildlife Act, 1998	Provides for the conservation and management of ecosystems to protect them from impacts of human activities.	Control of poaching of wild life in the project area through ZAWA
Forest Act, Chapter 199	Provides for forest management, conservation and protection of forests and trees; and licensing and sale of forestry produce. In the amended form, the act now includes obligatory afforestation on titled land.	Provides control of deforestation upland thereby reducing siltation through the Forestry Department
The Natural Resources Conservation Act, CAP 315, 1970	Guides the management and use of natural resources outside forest reserves and national parks.	
Water Resources Management Act 2011	The Act provides for the management, development, conservation, protection and preservation of the water resource and it's ecosystems	Provides for Collection of hydrological data: water levels, water flows and service provision in water management, both superficial and groundwater
Local Government Act, Chapter 281, 1991	Provides for establishment of councils and prescribes the functions of the local government system. Functions include pollution control and environmental protection. Regulates the establishment of human settlements.	Provides for the establishment of sustainable area development committees (ADC's) to plan and implement local area plans (LAPS) under the Local Government and Decentralized Programme
Energy Regulation Act, Chapter 436	Provides for the establishment of the Energy Regulation Board, the licensing of energy undertakings and the handling of certain fuels.	Provides for Provision of electricity and renewable energy to settlements in the project area through REA and ERB
Public Health Act, Chapter 295, 1978	Prevention and suppression of diseases and regulation of all matters pertaining to public health.	Provides for monitoring and management of waterborne diseases in the project area in association with DMMU
The Lands Act of 1995	All matters pertaining to the management of land and land tenure ; and processing of title deeds.	Provides for the guidelines for handling of customary land which consists of the projects area

Legislative Act/Regulation	Description	Links to the Barotse canals Projects
National Heritage Conservation Commission Act, CAP 173, 1989	The Act defines the functions and powers of the commission and provides for the conservation of ancient, cultural and natural heritage relics; and regulates archaeological excavations and export of relics.	Provides for Inventory and maintenance of heritage assets Submission of Barotse as World Heritage Site through the NHCC
The Land Acquisition Act No. 2 of 1970	Provides for the compulsory acquisition of land and other property; provides for matters arising out of this, including compensation.	This is has to reconciled with the BRE traditional land practices
The Town and Country planning Act, Chapter 283, 1962	Land use management. The act provides for the appointment of planning authorities, establishment of a town and country planning tribunal, preparation, approval and revocation of development plans, the control of development and subdivision of land, the assessment and payment of compensation in respect of planning decisions and the preparation, approval and revocation or modification of regional plans.	
The Agriculture (Fertilizers and Feeds) Act	Provides for regulation and control of the manufacture, processing, importation and sale of fertilizers; and for maintenance of minimum standards for the same	Well maintained cals leads to increased agricultural and increased use of fertilisers
The Pesticides and Toxic Substances Regulations, Statutory instrument, 1994	Provides for registration and regulation of the manufacture, import and export of pesticides or other toxic substances. It also provides for the general handling, use and safety of these materials.	Improved canal is likely to lead to increased agricultural productivity and subsequent use of pesticides
The Hazardous Waste Management Regulations, Statutory Instrument No. 125, 2001	Provides for licensing of hazardous waste transportation and operation of a hazardous waste disposal site.	
Environmental Impact Assessment Regulations, 1997	Contains the framework for conducting and reviewing environmental impact assessment for any project and provides regulations for auditing project implementation.	
The Arbitration Act, No 19 of 2000	Provides for an arbitral procedure which is fair, efficient and capable of meeting the specific needs of each arbitration and redefines the supervisory roles of the courts in the arbitral process.	Provides for guidelines of handling disputes that may arise within stakeholders without necessarily involving court proceedings

#### WORLD BANK SAFEGUARD POLICIES

In addition to the national laws, there are several World Bank safeguard Policies that are triggered by the canals project. The table below illustrates the relevant safeguard measures.

Table 4 World Bank Safeguard Policy

Safeguard Policy	Relevance for Canal maintenance
Environmental Assessment (OP/BP/GP 4.01)	This is highly relevant as some activities in the canal maintenance program may lead to adverse environmental impacts for example, land management activities, decimation of wild plant and animal species that affects social livelihoods. An environmental assessment is required by the Bank.
Natural Habitats (OP/BP 4.04)	<p>This is highly relevant to siting of the project.</p> <p>As defined by OP 4.04, Natural Habitats, Annex A, Critical Natural Habitats are:</p> <ul style="list-style-type: none"> <li>▶ (i) existing protected areas and areas officially proposed by governments as protected areas (e.g., reserves that meet the criteria of the World Conservation Union [IUCN] classifications) or</li> <li>▶ areas initially recognized as protected by traditional local communities (e.g., sacred groves),</li> <li>▶ and sites that maintain conditions vital for the viability of these protected areas (as determined by the environmental assessment process); or</li> <li>▶ (ii) sites identified on supplementary lists prepared by the Bank or an authoritative source determined by the Regional environment sector unit (RESU). Such sites may include areas recognized by traditional local communities (e.g., sacred groves); areas with known high suitability for bio-diversity conservation; and sites that are critical for rare, vulnerable, migratory, or endangered species. Listings are based on systematic evaluations of such factors as species richness; the degree of endemism, rarity, and vulnerability of component species; representativeness; and integrity of ecosystem processes.</li> </ul>
Pest Management (OP/ 4.09)	<p>Non-applicable.</p> <p>However, if future agricultural activities are planned as part of a separate mandate, producers on irrigated land may use pesticides likely to harm the environment. The Bank encourages integrated pest management in its projects. In cases where chemical pesticides are used, selection and use is restricted according to specified bank criteria.</p>
Physical Cultural Resources (OPN 11.03/OP 4.11)	Relevant for location of project. Location should avoid objects, buildings, either moveable or immovable, or any other entity of cultural significance such as royal burial sites. Otherwise, measures should be proposed to mitigate adverse impacts, as part of the Environmental Assessment (EA) process.
Involuntary Resettlement (OP/BP 4.12)	<p>Applicable, since some structures such as silting basin and sand traps will necessitate economic displacement of population.</p> <p>Resettlement planning and implementation should be planned together with the affected communities.</p>
Forests (OP/BP 4.36)	Non-applicable as there are no forestry activities in the Plain and no forest.

Safeguard Policy	Relevance for Canal maintenance
Safety of Dams (OP/BP 4.36)	Non-applicable.
Projects in Disputed Areas (OP/BP/GP 7.60)	Non-applicable.
Projects on International Waterways (OP/BP/GP 7.50)	<p>Non-applicable.</p> <p>However, if future agricultural activities are planned as part of a separate mandate, this may become relevant in the case the Zambezi would be impacted (international water body). In that case, all concerned riparian states would need to be informed about the project. The necessary agreements need to be made among them for the efficient use of the international waterway, except in a few cases as outlined under the policy. The Zambezi river is a shared resource and other states may have to be consulted.</p>

## 2.2 ORGANISATIONAL FRAMEWORK

The Key players who are critical to in the operation and maintenance of the canals are presented in this section. The rehabilitation, maintenance and use of the Barotse project canals involve Governmental Organization, the Barotse Royal Establishment (BRE) and the local Communities.

### TRADITIONAL AND GOVERNMENTAL INSTITUTION

The Barotse Royal Establishment (BRE) through its networks, stretching from the household, village (munizi), silalanda, silalo(sub district), sikilili(district) up to the BRE Headquarters at Lealui/Limulunga and Government of Zambia through its departments at provincial, District and Sub District levels are the two key stakeholders in the restoration and maintenance of the Barotse Project canals. The following table shows the correspondance of the scales of intervention and institutions in the traditional and administrative systems.

The institutional structure of the Public Sector Ministries are generally the same. In all cases, the Ministries are overseen by Ministers and Deputy Ministers. The actual day-to day running of the Ministries at the Province level is the responsibility of the Permanent Secretary (PS). The PS supervises the work of various departments within each Ministry. At the District level, a District Commissioner is involved.

Table 5 Correspondence of the scales of intervention and institutions in the traditional and administrative systems

Traditional authorities		Government of Zambia	
Scale of intervention	Supervising stakeholder	Scale of intervention	Supervising stakeholder
Barotse	BRE Headquarters	Country	Government
		Province	Principal Secretary
Sikilili	Sikilili Induna	District	District Commissioner
Silalo	Silalo Induna	Constituency	
Silalanda	Silalanda	Ward	
Munzi	Village Headman	Village	

#### BAROTSE ROYAL ESTABLISHMENT(BRE)

BRE is the governing body of Western province customary institutions. It draws its mandate from the Barotse agreement of 1964 that includes general traditional governance, Natural resource Management and conservation, local taxation as well as canal operation and maintenance inter alia.

The BRE structure is hierarchical and has about 6 levels of governance. The supreme body of the BRE is the Barotse National Council which is headed by The Litunga. The next level is the Kuta which operates as a court followed by The Ngambela /Inete or the Prime Minister. There is then the District level BRE representative known as the district Induna and sub district BRE representative called the Silalo Induna. Finally the Village Headman represents the BRE at village level

As a totality, the BRE's activities regarding canal O&M include:

- ▶ Provision of guidance on canals development and maintenance policy
- ▶ Mobilize the community/canal users for canal maintenance
- ▶ Carrying out the canal maintenance of village canal
- ▶ We should state here that the BRE is a very important institutions which must at all costs be consulted and involve in any socio-economic development of the entire Western Province. This is acknowledged even by the Central Government in Zambia. We are of the view that the BRE be a key stakeholder in the PPCR project.

#### MINISTRY OF TRANSPORT, WORKS, SUPPLY AND COMMUNICATION(MTWSC)

The Department of Maritime and Inland Waterways of the Ministry of Ministry of Transport, Works, Supply and Communication (MTWSC) has the responsibility for the Operation and Maintenance (O&M) of canals. In the Western Province, the Department of Maritime is represented by the Harbor Master and his team. In the Western Province, 3,000 km of canals and waterways network are recorded, which includes the 660 km of canals in Mongu district. However, the Harbor Master and his team concentrate on the maintenance of the 900 km of canals and waterways which are navigable in Western Province (DDMC, 2012).For the rest of the main network (70%) meaning main canals dedicated to uses other than navigation maintenance is done by the riverine populations, under the supervision of to the District Disaster Management Committees (DDMC) that has been delegated this responsibility (BRLi, 2013, Harbor Master interview). The DDMC's report to the Disaster Management and Mitigation Unit (DMMU), which falls under the Office of the Vice President of Zambia.

The secondary and tertiary canals operation and maintenance is done by the riverine populations under the supervision of the Village Headmen.

The MTWSC is the Client of this project and therefore has the highest interest namely policy formulation regarding Navigation, allocation of funds and staff to the harbor master and securing of equipment for canal maintenance.

The Ministry is charged with the responsibility of facilitating the construction and maintenance of public infrastructure. It is also responsible for promoting the development of the transport and communication sector in order to contribute to the socio-economic development of Zambia. Further, it is responsible for the control of Government transport, office equipment and Government printing and also provides meteorological services.

Under the transport portfolio, The MTWSC hosts the Department of Maritime and Inland Waterways which are mandated to manage the countries maritime and waterways which include the Barotse Canals.

The MTWSC's structure has Ten (10) departments namely:

- ▶ Human Resources and Administration
- ▶ Civil Aviation
- ▶ Meteorology
- ▶ Maritime and Inland waterways
- ▶ Communication
- ▶ Transport
- ▶ Buildings
- ▶ Government printing
- ▶ Office equipment and maintenance services
- ▶ Planning and monitoring

The departments relevant to the canals projects are the Department of Maritime and Inland waterways and the Zambia meteorological Department. These departments receive an annual allocation of funds from the central government. The disbursements from MOF to either to the Ministry of transport HQ. Disbursements are also made through the provincial and/or administration. Drawing on the budget expenditure estimates.

Through the Department of Maritime and Inland waterways, the ministry offers

- ▶ Harbor/port Storage services
- ▶ Rehabilitation of canals including dredging
- ▶ Conduct patrols and enforcement of the relevant regulations
- ▶ Harbor rehabilitation

Through the Zambia meteorological Department, the ministry provides weather and climatology information services to other key stakeholders such as the department of water affairs in the Ministry of Mines, Energy and Water Development.

#### MINISTRY OF AGRICULTURE AND LIVESTOCK (MAL)

The Ministry of Agriculture and Livestock also has high interest and has a mandate to Plan and supervise Agriculture and Livestock. Their key function is the provision of agriculture-related services e.g. agriculture extension, fisheries, livestock, monitoring soil degradation and land use mapping including around the canal areas as well as supervision of Provincial Agriculture Officer and Senior Agriculture Officer.

The MAL's main responsibility is to promote farming systems which are economically viable, environmental sound with low economic risk.

To realize this mandate the Ministry has 10 main Departments namely

- ▶ Human Resources and Administration
- ▶ Policy and planning
- ▶ Agriculture Department
- ▶ Zambia Agricultural Research Institute
- ▶ Veterinary Services Department
- ▶ Livestock Department
- ▶ Fisheries Department
- ▶ Agribusiness and Marketing Department
- ▶ Co-operatives Department
- ▶ Veterinary and Livestock Development Research station

Six of the departments are relevant to the canals projects including Agriculture, Veterinary Services, Livestock, Fisheries, Agribusiness and Marketing, Co- operatives. These departments also have representation at district level.

Through the relevant departments, the ministry conducts the following typical activities:

- ▶ Veterinary services
- ▶ Livestock decrease data collection and analysis
- ▶ Aquaculture management and development
- ▶ Fish extension services, Fish monitoring, Capture fisheries management and development
- ▶ Entrepreneurship development and Market research
- ▶ Cooperatives promotion and development, Backstopping of cooperatives, Monitoring and supervision of cooperatives
- ▶ Routine seed testing, seed inspections and sampling
- ▶ Provision of Agricultural news and literature and information dissemination through print and electronic media

#### MINISTRY OF MINES ENERGY AND WATER DEVELOPMENT

The Ministry of Mines, Energy and Water Development has five departments namely Human Resource and Administration, Energy, Water Affairs, Mine Safety, Geological Survey; and Planning and Information.

Of these departments, the water affairs are the most relevant department regarding the canals project.

The department of Water Affairs like many other Government departments in Zambia is organized at three different levels namely headquarters in Lusaka the country's capital, provinces and Districts. The Headquarters of the Department of Water Affairs is based in Lusaka and has two divisions namely:

- ▶ Data collection and water resource planning
- ▶ Administration and finance

At Provincial and District levels the department of Water affairs organizational structure follows the same pattern as its headquarters but with declining authority and functions further down to the Districts and Water scheme or station levels, resulting in lack of responsibility and accountability at the lower levels. Following the water sector reforms, water supply and sanitation functions have been transferred to the Ministry of Local Government and Housing, and Local authorities who have established water and sanitation, to operate these services on their behalf.

Through the department of water affairs, the ministry plans and manages water resources of the country for various sectors and users based on the (quantitative and qualitative) information collected. More relevantly to the canals project, the ministry conducts the following among others:

- ▶ Water resources assessments (surface and groundwater) in order to provide
- ▶ Adequate advice to the users on issues of potential, availability and reliability
- ▶ Preparation and dissemination of hydrological forecasts;
- ▶ Establishment and supervision of hydrological networks;
- ▶ Designing and construction of new hydrometric stations;
- ▶ Training of hydrological technical staff and gauge readers
- ▶ DWA is also actively involved in the construction and rehabilitation of earth dams, weirs and protection of springs.
- ▶ Monitoring and appraising water resources
- ▶ Design and construction of irrigation of works.
- ▶ Monitoring of surface water through more than 200 hydrometrical stations which are found through the country including the Barotse plain.

#### MINISTRY OF LANDS NATURAL RESOURCES AND ENVIRONMENTAL PROTECTION (MLNREP)

The Ministry of Lands is charged with the critical responsibility of land administration on behalf of the people of Zambia and is responsible for the following portfolio functions as contained in Government Gazette Notice No. 547 of September 2004:-

MLNREP has about 8 departments namely:

- ▶ Human Resource and Administration
- ▶ Lands and Deeds
- ▶ Lands Department
- ▶ Survey Department
- ▶ Forestry Department
- ▶ Environment and Natural Resources Management Department (ENRMD)
- ▶ Planning and Information
- ▶ Zambia Forestry College

Relevant departments regarding the canals project are therefore the Forestry Department and Environment and Natural Resources Department

MLNREP operates through government agencies at local level. For the canals project, the relevant ones are forestry department and Zambia Environmental Management Agency. Through the FD, the ministry conducts monitoring and regulation of forestry resources including timber, charcoal etc additionally it conducts forest research and provides forestry extension services.

Through the ZEMA, the ministry conducts environmental pollution control, approval of various environmental assessments that precede developments. It also conducts environmental education from time to time.

#### DISASTER MANAGEMENT AND MITIGATION UNIT (DMMU)

The mandate of the DMMU is to manage disasters in order to minimize loss of lives, damage to property and environment through harmonization of national efforts. As disaster management and mitigation implies movement of relief goods and people during disasters such as floods, and that stagnant water in terms of reduced canal water flow is a precursor to malaria and other water borne diseases that are associated with disaster, the DMMU has interest in making sure the canals are maintained to enhance effective operations.

The Disaster Management and Mitigation Unit is a permanently established statutory government agency, forming part of the Office of the Vice President, charged with the responsibility of ensuring the achievement of the nation's disaster management objectives.

The National Disaster Management Structure has vertical and horizontal linkages as shown including

- ▶ Satellite Disaster Management Committee (SDMC). These are village level committees that respond to and coordinate the disaster risk reduction, mitigation and management issues. They send recommendations and collaborate with the DDMC at district level which is chaired by the DC. Since canals are key in effective functioning in disaster management, they will coordinate in association with other stakeholders such as concern worldwide canal maintenance operations. The Number of satellites will depend on the size of the area (geographical factors) and facilitation by DDMC. Composition of committees will be as provided for in the Disaster Management Policy of 2005.
- ▶ District Disaster Management Committees (DDMC). This is a sub-committee of the District Development Coordinating Committee (DDCC) which again is chaired by the DC and is responsible for the coordination all development function in the district. The secretariat of the DDCC is district administrative officer within the local authorities (Council Secretary).

DMMU'S Activities in the project area include:

- ▶ Community mobilization and monitoring of clearing of canals for disaster related works e.g. relief transport, Drainage for flood abatement
- ▶ Coordination of disaster management Works among all Stakeholders e.g. harbour master, NGOs, BRE

#### MINISTRY OF FINANCE (MOF)

The mandate of the MOF is to provide finance and development planning guidelines for project activities through the Treasury and the PPCR.

The MoF has 12 departments namely:

- ▶ Human Resources and Administration (HRA)
- ▶ Budget Office (BO)
- ▶ Government Stores (GS)
- ▶ Central Computerized Service (CCS)
- ▶ Finance Management and Administration (FMA)
- ▶ Investments and Debt Management (IDM)
- ▶ Central Statistical Office (CSO)
- ▶ Internal Audit (IA)

- ▶ Management Department (MD)
- ▶ National Planning the PPCR Secretariat (NP)
- ▶ Monitoring and Evaluation (M + E)
- ▶ National policy and Procurement Implementation (NPPI)

Apart from the CSO and National Planning Department the rest of the MFNP's departments have staff and offices at the National Headquarters in Lusaka, Provincial level and District level

MoF Activities related to the Barotse canals project include:

- ▶ Hosts the PPCR Secretariat which is in charge of the Barotse canals project. The PPCR Secretariat is a multi-sectorial climate change mitigation programme involving several Ministries and Agencies. It administers the implementation of the present project on behalf of the Ministry of Finance, and acts as a programme management unit;
- ▶ Inter-sectorial technical committees (ISTC) have been established under the PPCR to provide for coordination of mandates and functions of projects of participating Ministries. In this regard it is expected that the ISTC will facilitate faster collaboration and coordination of PPCR activities;
- ▶ Provision of funding for the project activities;
- ▶ Provision of management support to the Provincial Planning Unit (PPU) under the regional Planner whose activities in 2013 and 2014 budget used as updating Provincial development , profile, monitoring and evaluation promotions of public , private partnerships PPU's budget;
- ▶ Provision of socio – economic data produced by CSO needed by the project; and
- ▶ Through the PPU, Update provincial profits, monitoring and evaluation of projects productions of investment plans promotion of public, private partnerships.

#### CIVIL SOCIETY ORGANIZATIONS (CSOs) AND NON GOVERNMENT ORGANISATION (NGOs)

NGOs generally support different groups of people in organizing them, training and logistics.

Civil Society organizations have a presence at the Provincial and District level, though many of them are guided and supported by their national offices which are based in Lusaka.

In terms of operations, their work is mainly service provision at the community level. The larger NGOs such as Oxfam provide resources for training, community mobilization and extension support.

In the course of implementing their work, these organizations have had to take up the clearing of canals although this is not formally their mandate. They have developed capacity for canal maintenance mainly to ensure that they are able to access to the communities along the canals which they have selected to work with. Their priorities for maintenance are the small (tertiary and secondary) canals which flow into the main canals.

NGOs often get involved in O&M of canals because the institutions with the mandate to do so fail. As the NGOs' functions depends on the use of the canals, they remain with no option but to do the necessary canal maintenance on specific areas when service from government is unavailable

#### PRIVATE SECTOR INVOLVEMENT

Apart from the Financial Sector and Construction Industry, there is a very small private sector to talk about in Mongu District. Institutions that would qualify as entrepreneurs include; boat-makers, fish mongers, fish traders (marketeters), transporters and farmers. However, associations are nascent and are yet to emerge into fully-fledged associations.

Because of their nascent status, many of these organizations focus mainly on their internal growth challenges in the face completion and as such little capacity to respond to external demands such as contributing to the maintenance of canals. Therefore, the private sector contribution to the O&M of the canals is insignificant.

#### INSTITUTIONAL CAPACITY ANALYSIS FOR CANAL MAINTENANCE

The status of the canals has degraded over the last decades, because they have not been well-maintained. Despite this fact, the importance of canals is well recognized among the stakeholders, but the interest and commitment is limited to a few institutions, mainly the BRE, Department of Maritime and Inland Waterways (MTWSC), PPCR (MoF), DMMU and its associated committees (OVP), District Administration (DC) and Local Authorities (MLGH).

Of these that have interested stakeholders, some are involved in the actual O&M of the canals including the BRE, Department of Maritime and Inland Waterways, DMMU, Local authorities/ District administration and Civil Society Organizations.

The multiplicity of stakeholders involved reflects the multiple uses of the canals. However, the responsibilities for canals operation and maintenance and financial procedures are not well defined. The interventions focusing on the maintenance of the canals are often reactive and not planned well in advance: the operation and maintenance is decided without a global vision, depending on each institution's priorities:

- ▶ The Department of Maritime which is allocated funds from the MoF prioritizes navigation canals. The funds are distributed irregularly, and not at adequate periods for maintenance. This can be interpreted as a lack of interest and commitment.
- ▶ The DMMU, who is in charge of relief maize distribution, takes this opportunity to maintain canals through food-for-works contracts, but they target food insecurity wards, and not prioritized areas are canal reaches for maintenance. Within the wards, the Village Headmen, Satellites and DDMC orientate the maintenance towards their priority reaches;
- ▶ Within the context of their support to local communities, NGOs are involved in canals maintenance. The maintenance of the reaches of canals derive from the opportunity of the partnerships with some communities, and once again is distinct from a prioritization of hotspots of maintenance.
- ▶ The communities themselves have lost the consciousness and reflex of self-help: they are conditioning the clearing of canals to the release of foods or funds, although they are the main beneficiaries for the good maintenance of canals. Locally, communities also depend on the maintenance that has been done by the communities upstream and downstream (tragedy of the Commons). Thus, when a community does not do its own part of maintenance on a canal, other communities along this canal may suffer from the consequences.

Collaboration between the ministries is very weak. In same fashion, there is very little synergy between departments. For instance, a representative of the Department of Maritime and Inland Waterways admitted that the Department is unable to mobilize other relevant government departments and agencies to leverage available resources for canal O&M.

Mandated institutions have neither a canal master plan in place nor a specific institutional strategic plan that includes canal O&M. In the absence of these plans, it is not surprising that there is no alternative investment plan for the canals, instead the practice of over-reliance on government funding which appeared to be inadequate.

It can be concluded that there is a real need for planning of canals maintenance and coordination of the stakeholders, that could be done through a canal O&M plan and the creation of a coordination institution consisting of representatives of the main stakeholders.

In terms of technical capacity, there are no specialist skills in canal operations and maintenance in any of the key mandated institutions even in the Ministry of Transport, Works, Supply and Communications. In addition, the institutions lack maintenance guidelines, maps, design document and even ordinary tools (shovels, spades, picks etc). The only equipment available is the dredger, however without GPS and sufficient pipe length. Thus, there is also a need for further equipment and capacity building of both the technical staff and the key stakeholders involved in canal management.

## 2.3 INTERNATIONAL AGREEMENTS AND COVENTIONS

Zambia is a signatory to the following International agreements, conventions and/or treaties: These are agreements and conventions are very relevant to the canal rehabilitation project in the Barotse Flood Plain of the Western Province. Notable among these are the following:

International agreements, conventions and/or treaties	Relevance to the proposed development
1963- Treaty Banning weapon Tests in Atmosphere, Outer Space and underwater	Non-applicable
1967- Treaty on Activities of states in Exploration and use of Outer Space, including Moon and Celestial Bodies	Non-applicable
1971- Treaty, Prohibiting Emplacement of Nuclear and Mass Destruction Weapons on Sea-Bed and Ocean Floor and Subsoil	Non-applicable
1971- Ramsar Convention on Wetlands	Applicable, this ESIA recommend the development of a Wetland Management Plan
1972- World Cultural and Natural Heritage Sites	Applicable, see section on cultural heritage
1973- Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)	Non-applicable
1982- Convention on the Law of the Sea	Non-applicable
1985- Protection of the Ozone Layer	Non-applicable
1987- Montreal Protocol on Substances that Deplete the Ozone Layer	Non-applicable
1991- Bamako Convention on the Ban on Import into Africa and the Control of Transboundary Movement of all Forms of Hazardous Wastes within Africa	Non-applicable
1992- Convention on Biological Diversity	Applicable, this ESIA has developed measure to ensure that biodiversity is not impacted to an unacceptable level

International agreements, conventions and/or treaties	Relevance to the proposed development
1992- Framework Convention on Climate Change	Applicable, as the Project will help local communities to be more resilient on climate change
1994- Convention to Combat Desertification and Drought.	Non-applicable
At the regional level, Zambia has ratified the Action Plan for the Zambezi River. It is considering the Protocol on Shared Watercourse Systems in the Southern African Development Community (SADC) which was signed by eight SADC countries in August 1995 and International Conference on the Great Lakes Region (ICGLR of 2006).	Applicable

## 3. PROJECT DESCRIPTION

### 3.1 LOCATION

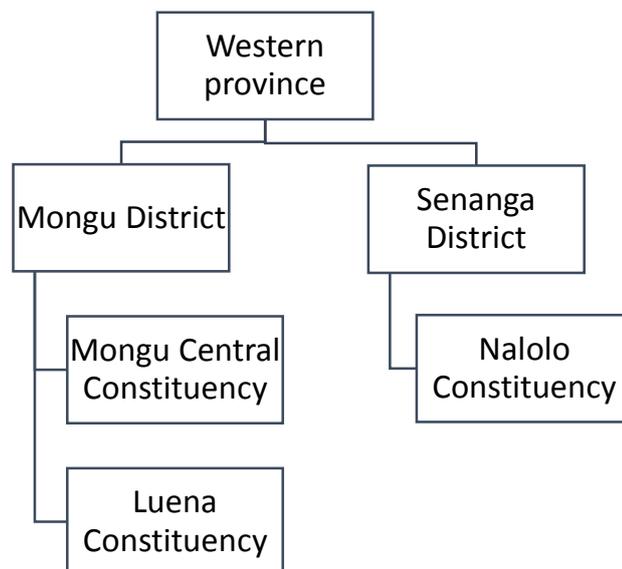
The majority of the Project takes place in the Mongu District which is situated between latitude 14°37' and 15°49' South and longitudes 22°49' and 24° East.

Mongu District serves as the provincial capital of the Western Province. The District is divided into constituencies. Lubitamei canal is located in Luena constituency; Musiamo, N'gombala and Muoyoamo are located in Mongu Central constituency.

Part of the Project also takes place in the Senanga District since section of the Musiamo and the Fisheries canals are in the Nalolo Constituency.

Constituencies are further divided in wards or Lilalo each headed by a Silalo Induna.

Figure 1 Administrative components of the Study area



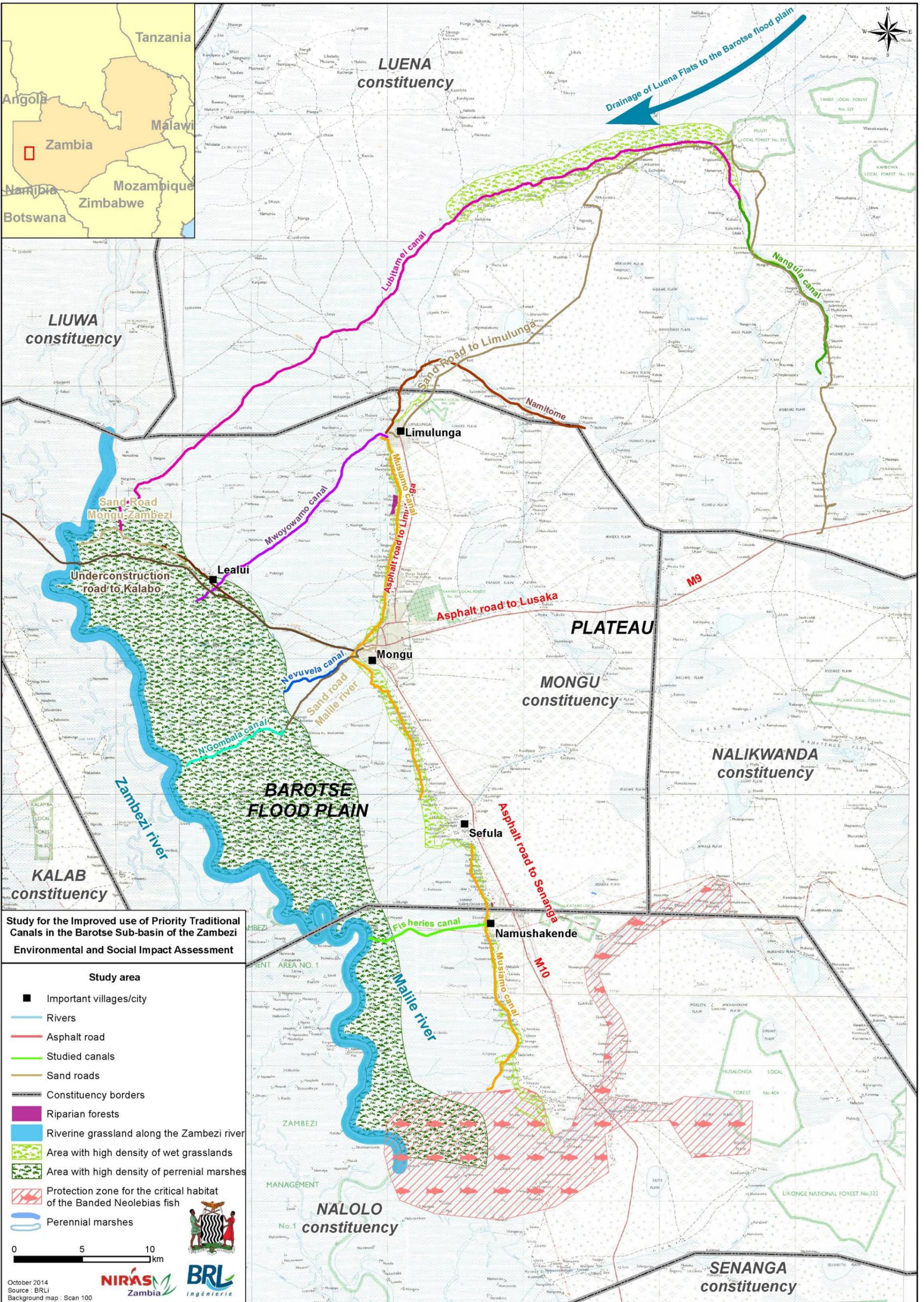
### 3.2 ESIA STUDY AREA

Several study areas will be defined as part of the Detailed conceptual design of canals management system rehabilitation.

For the Environmental and Social Impact Assessment, the Study area includes all 6 canals, wetlands that are hydrologically connected to these canals and villages that are dependent on these canals for their source of livelihood on the floodplain.

Wetland delineation was limited to the vicinity of the 6 canals.

The following map shows the Study area and the sensitive areas such as wetlands and the habitat of the critically endangered fish, the Banded Neolebias (*Neolebias lozii*) (see fish baseline section).



### 3.3 CANAL SYSTEM DESCRIPTION

Since the late 19<sup>th</sup> Century, a complex network of canals has been developed in the Barotse floodplain, which is the core subject of this study.

In the Western Province, 3,000 km of canals and waterways network are recorded, which includes the 660 km of canals in Mongu district.

The canals in Barotse are interlinked and form a complex network, composed of three main types of canals:

- ▶ Canals coming from the uplands, which were dug out from natural streams coming down from the uplands plateau. They are important for the drainage of dambos and agricultural land;
- ▶ Navigation canals from the edge of the plain to the Zambezi, that are also draining water from the edge of the plain to the Zambezi;
- ▶ Drainage canal on the edge of the plain (Musiamo), collecting water from the local network of secondary and tertiary canal for drainage, and draining water towards the canals connected to the Zambezi.

This study concentrates on six “priority canals” which have been selected by the PPCR and the BRE. Their main characteristics are summarized in the section below. In particular, the length and extent of the canals measured by the topographic team is displayed.

Canals enhance the use of natural resources, enabling multiple uses and livelihoods, which are critical for the economy of both the local people and fish traders coming from all over Zambia:

- ▶ Canals support the important function of navigation and transport in the Barotse plain where roads are few and almost non-existent during the flood period. Transportation is operated using mainly canoes (and marginally motor boats). Canals enable trading activities, people transportation, and is central in the Kuomboka ceremony that is assumed to bring increasing touristic revenues in the area.
- ▶ Canals facilitate early drainage of floodwaters from the plain.
- ▶ The floods of the Zambezi leave behind fertile alluvial soils for crop production and fresh pasture for traditional cattle herding, with canals and wetlands becoming watering points for cattle and water resource for irrigation. Both activities are key economic activities for most Lozi people of the Barotse Plains.
- ▶ The area provides natural habitats for wildlife and fishes, and fishing activities take place in the canals.
- ▶ Reeds and sedges are cropped for construction and handicraft.
- ▶ The area is recognized both for its cultural heritage and for biodiversity.
- ▶ Many canals are interlinked in the Barotse area. The present study will focus on the six priority canals, which have been chosen by the Client together with local institutions for their significance.

A field visit conducted during the tendering period enabled to characterize briefly the targeted canals as shown in the next table.



Table 6 Characteristics of studied canals

Canal	Extent	Length (km)	Main Function(s)	Navigability	Major Problems	Economic Potential
Muyowamo	From Limulunga to Lealui	18,80	- Navigation, particularly for Kuomboka ceremony; - Drainage of fields during floods - Irrigation	- Good – the canal is dredged annually - Can support motorised boats	- At the intersection with Mongu-Kalabo road, passage along Canal completely blocked by small culverts - Sand siltation especially near Nayumba harbour at Limulunga - Low water levels near Nayuma	- High tourist potential which can be extended beyond the two main traditional ceremonies of Kuomboka
Lubitamei	From Ndiki to Malile	76,60	- Drainage - Agriculture - Fishing	- Too narrow for motorised navigation - Canoe traffic	- Has not been maintained in last few years - Clogged with vegetation	- Provides crucial link between Usha in the north east and the rest of canal network which can spur agricultural productivity
N'gombala	From Malile to the Zambezi	8,50	- Dug for transport - Drainage - Fishing	- Too narrow and shallow for motorised navigation - Canoe traffic	- Has been hand-cleared recently but still clogged with vegetation	- Provide a short link between canal network and the main Zambezi
Nebubela	From Mongu to the junction with Malile	6,00	- Navigation	- Motorised navigation	-	-
Section of Malile	From the junction with Nebubela to the junction with N'gombala	4,00	- Navigation	- Motorised navigation	-	-
Musiamo	From Limulunga to Mongu	16,80	- Drainage - Agriculture - Fishing	- Too shallow for motorised navigation - Canoe traffic	- Has not been maintained mechanically in the last few years - Clogged with vegetation in several places which reduces drainage	- Apart from supporting agricultural/farming activities, this canal can provide a vital link from Limulunga, through Mongu (Mulamba)
	From Mongu to Sefula	14,60				
	From Sefula to Lwandala canal (close to Nasiwayo)	20,80				
	Total	52,20				
Fisheries	From Namushakende to the Zambezi	9,20	- Navigation - Drainage - Agriculture - Fishing	- Good for most parts - Was dredged recently (April-May 2012) - Can support motorised boats	- Sustaining water flows is difficult e.g. canoes cannot reach the new mini-harbour which is under construction at Namushakende	- Shorter link between Namushakende where a new mini harbour is under construction and the main Zambezi

Before the Independence of Zambia the Barotse canals were maintained using compulsory labor. After the independence (1964) the maintenance of canals has been transferred to the Department of Water Affairs. In 1991, the responsibility of maintaining the canals was given to the Department of Maritime, but according to the Harbour Master, insufficient funds were allocated, which impacted the quality of the maintenance and the canals network degraded.

Local people were to work on canal maintenance but the incentive was put on labor quantity without a vision on quality, and the results were not satisfying. Also, people were receiving incentives (food for work) to maintain the canals. Today, populations have lost of the sense of responsibility in canal maintenance that has lead to canal degradation.

Pictures below, illustrate the 6 canals.

#### MUOYOWAMO



All pictures are close to Lealui, Septembre 2013

#### LUBITAMEI



In Nangula village, septembre 2013 (left) and Lyomboko, septembre 2013 (right)



In Mutaba, septembre 2013 (left) and Ushaa, septembre 2013 (right)

**N'GOMBALA**



Junction between the Malile and N'gombala, Septembre 2013



In Kandiyana (between Malile and the Zambezi), Septembre 2013

**NEBUBELA**





Close to Mongu Harbour (January 2014)

MUSIAMO



In Walenga (between Limulunga and Mongu), Septembre 2013



South of Mongu, Septembre 2013

FISHERIES



6 km from Namushakende, Septembre 2013



Inception of the canal at Namushakende and fishing camp close to the Zambezi, Septembre 2013

### 3.4 NATURE OF THE PROJECT

#### 3.4.1 Raw materials (including hazardous materials and their storage on site)

Except for petroleum product for machinery, there will be no raw material. As mentioned in the impact assessment section (Best management practices for work near rivers), petroleum will not be stored nearby any wetlands.

#### 3.4.2 Process and technology

Non-applicable.

#### 3.4.3 Products and by-products

The Project will produce soil spoils as shown in the following table. There will no other by products.

Name of canal	Total volume of excavated material in m <sup>3</sup>	Destination of soil spoil
Muoyowamo	68,500	The spoil will be placed on the existing dikes of the canal.
Lubitamei	372,260	The spoil will be used to create dikes along the canal.
N'gombala	56,000	The spoil will be spread/scattered along the banks
Nebubela	40,500	The spoils will be spread/scattered along the banks
Fisheries	295,701	The spoil will be spread / scattered along the banks
Musiamo	97,996	The spoil will be placed on the western bank of the canal

Namitome	19,814	The spoils will be placed on both sides of the canal on the banks at a minimum set back distance of 3 m.
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### 3.4.4 Production capacity

Non-applicable

### 3.4.5 Schedule and life time of the project

Work shall start in June 2015 and finish in November 2015. Lifetime of the Project is not defined since with operation and maintenance activity canal will remain usable.

## 3.5 MAIN ACTIVITIES

### 3.5.1 Participative approach

Part of Project preparation involved extensive public consultation through three workshops. The rehabilitation work of the canals as well as the introduction of a new Operation and Maintenance Program were subject to major discussions with various stakeholders since rehabilitation may serve different interests. This was done to ensure social acceptability of the Project.

The Project relied on stakeholder's extensive knowledge of the area and their opinions were incorporated in the restoration/rehabilitation options for work. Three stakeholders' workshops were organized in Mongu:

- ▶ 1<sup>st</sup> stakeholders' workshop in September 2013. This workshop was made to present to stakeholders the Project and the participative process for developing the Project. The ESIA process and the various studies that were going to take place were also presented. For the ESIA, this workshop helped identified local population concerns, and the key players in socio-economic of the area. There were no specific concerns regarding the ESIA that are worth mentioning ;
- ▶ 2<sup>nd</sup> stakeholders' workshop in January 2014 : participative discussion on proposed work to carry out. During this workshop, the baseline and impact assessment section of the ESIA were presented to the public. There were no comments related to the ESIA baseline and impact assessment.
- ▶ 3<sup>rd</sup> stakeholders' workshop in March 2014:
  - Presentation of the Project and the ESIA;
  - Discussions and notice of stakeholders' issues and concerns to take into account in the final ESIA (and the final Conceptual Design);
  - Presentation of the Conceptual design proposals and obtain stakeholders' feedbacks on it;
  - To agree and complete consultant's proposals and discuss the detailed rehabilitation works and maintenance practices per canal;
  - Creation of new institutional arrangement for management of canals;
  - Creation of Canal User Associations (Water User Associations);
  - Presentation of the Operation and Maintenance program for canals.

During the third workshop, the ESIA was pre-final. One ESIA discussion group was formed to take into account any concerns. One person raised the issue of over drainage of the plateau land around Lubitamei if its drainage would be improved. This issue was dealt with in the conceptual design and measures were developed to avoid over drainage (see section on rehabilitation of Lubitamei). The proposed Wetland management plan (see section on cumulative impact on wetlands) was presented to participants. They agree that such plan is important with increase pressure on wetlands.

The list of participant for each workshop is presented in annex 10

### 3.5.2 Site preparation phase

Construction phase will not necessitate particular site preparation.

### 3.5.3 Construction phase

Presentation of the construction activities are based on the Conceptual Design report.

#### 3.5.3.1 Muoyowamo canal

##### PURPOSE

The proposed rehabilitation works of Muoyowamo canal aim at providing better navigation for the boats in the canal by recalibration of the canal and providing ship logs. Ship logs will enable to control water levels in such a way that during the Kuomboko ceremony boats can travel upstream.

##### WORKS

The proposed works for this canal are based on two major issues which are the water depth in the canal for the Kuomboka ceremony and the sand deposit mostly at Limulunga harbor. These two issues results in the following proposals:

- ▶ For the shallow draught it is proposed to recalibrate the canal and build ship lock structures in order to create separated canal sections with controlled water depth;
- ▶ For the sand deposit it is proposed to create a sand trap 1 km upstream in Namitome canal.

It is proposed to provide two sluices at the upstream reach, at chainages 13,793 m and 17,355 m. The purpose of these structures is to provide sufficient draught by increasing the depth of water upstream. The canal will be filled from the inflow coming from the Namimitome. The sluices will create retention of water and reduce flow velocity. The combination of two gates in one sluice reduces the volume of water required to increase the water level. In case of a single gated sluice the boat will have to wait 3 to 4 hours before the water level has increased by one meter. This will be reduced to 15 minutes in case of a double gated structure.

In order to maintain sufficient draught for the entire reach of the canal, it is proposed to recalibrate the river bed with a 6 m bed width cross section and 1/1.5 side slopes. The total volume of excavation is 68,500 m<sup>3</sup>. The water level at the upstream location is maintained. The spoil will be placed on the existing dikes of the canal.

The ship locks will facilitate navigation even when the water level in the Zambezi is lower.

The following graphs show the current situation and the situation after the works.

Figure 2 Longitudinal profile with water levels in Muoyowamo canal before upgrading works

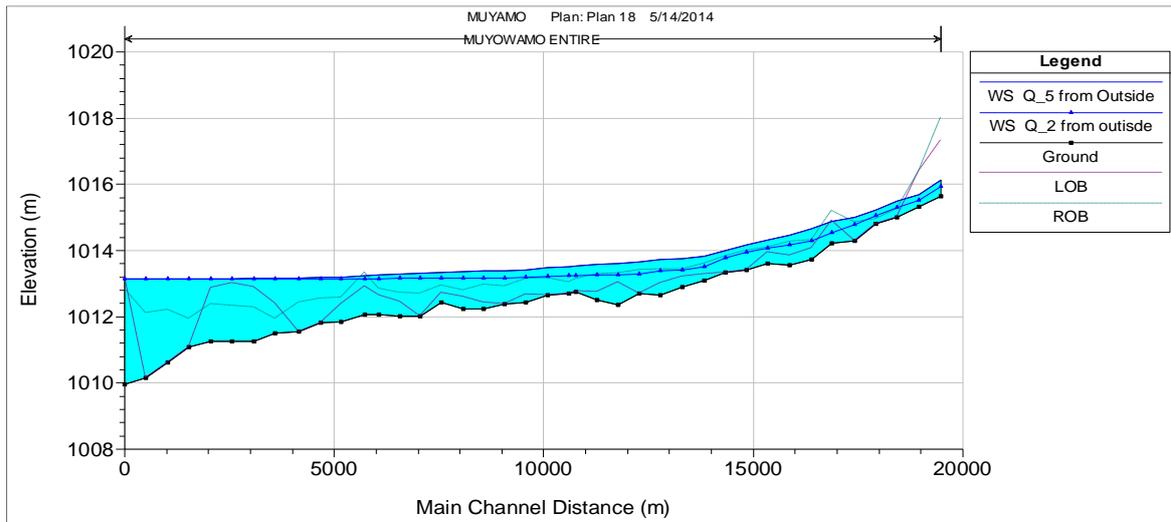
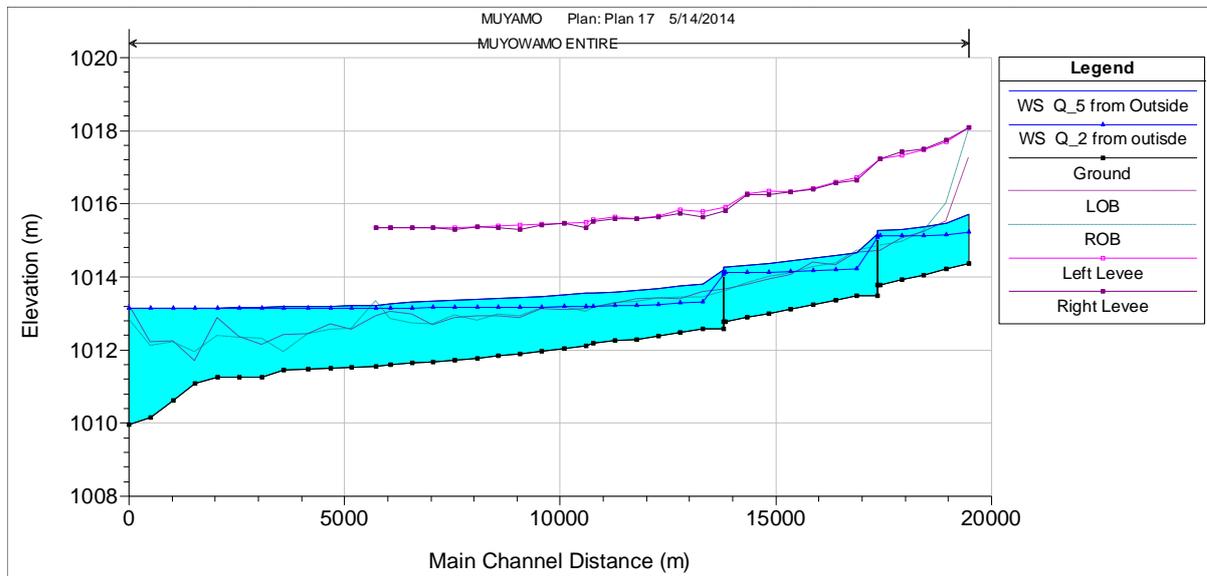


Figure 3 Longitudinal profile of the Muoyowamo canal after upgrading with 2 ship locks



ACCESS

There are no particular difficulties to access with excavators during the dry season at any place of the canal. The creation of a specific path or service road would anyway ease in future access and maintenance.

DESCRIPTION OF SHIP LOCK STRUCTURES

Ship locks are designed to maintain a water level in its upstream part and to allow as required the transit of the water from upstream toward downstream without significant flow speed. Each structure will be built in concrete, laying across the whole width of the canal. This width will allow the Royal Boat to cross the structure.

The closing gate between two canal section will be done either by a metallic flap gate operated from both side like drawbridge by metallic chain notched wheel with leverage and removable crank handle or by means of stop logs.

#### DESCRIPTION OF SAND TRAP

In order to catch the sand before it enters Muoyowamo it is foreseen to create a sand trap on the Namitome canal. It has been designed to catch the sand grain down to 0.1 mm for a discharge up to 5m<sup>3</sup>/s.

This sand trap will be located about one kilometer north of the confluence with Muoyowamo canal.

It will be cut at the foot hill close to the road. It is indeed absolutely necessary to have an access road for mechanical maintenance of the sand trap and evacuation of the sand by trucks. An access track will allow access to the sand trap in order to load and evacuate the deposit during maintenance operation.

The device will have the characteristics:

- Length: 70.00m
- Width: 40.00m
- Depth: 2.00m

### 3.5.3.2 Lubitamei canal

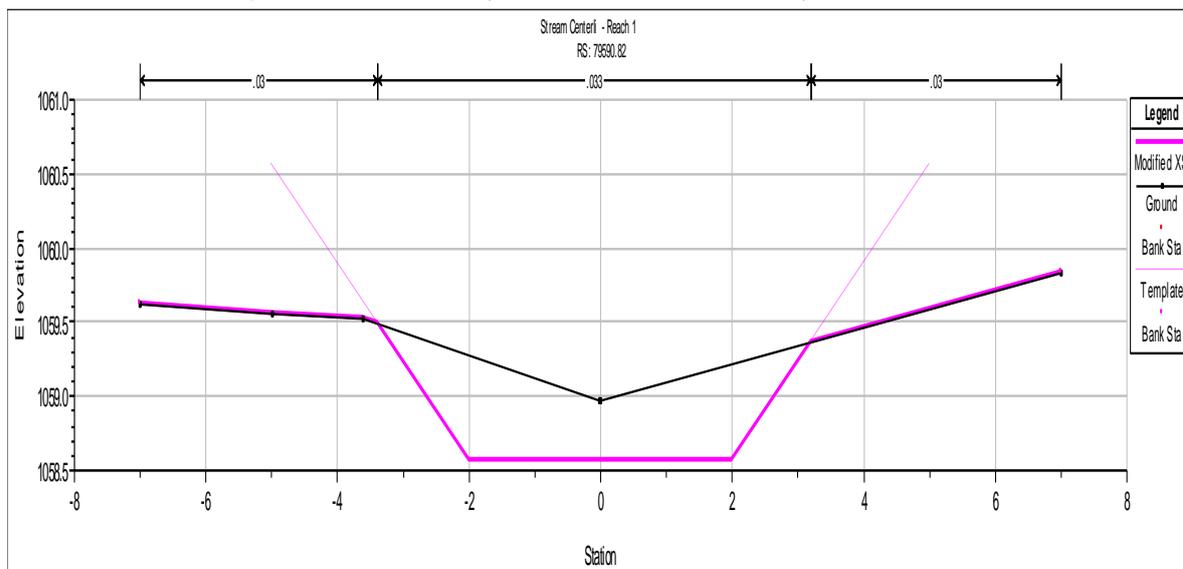
#### PURPOSE

The objectives for the rehabilitation of this canal are to improve drainage, fishery and transport along the Lubitamei. The rehabilitation of Lubitamei could facilitate fish spawning and migration, thus enhancing fishing activities in the canal and upstream dambos. Agricultural production could also be improved, and commercial farming could even take place. This would create incomes and employments which are really needed in this remote area.

#### WORK

The proposed cross section will have a bed width of 4m and a side slope of 1.5/1. The volume of excavation for this proposal amounts 372,260 m<sup>3</sup>. This includes the entire length of Lubitamei canal. The following graph shows the proposed work (in purple) and the existing condition (black line).

Figure 4 Lubitamei, Proposed canal section of the upstream reach



The rehabilitation works of Lubitamei canal consist in the re-excavation, building of dikes and providing one pipe culvert, three water control structures and two sand traps, one on each branch of the Lubitamei. The proposed design of sand trap is identical with the one proposed for Muoyowamo

One water control structure will be built where an important rice farm, some kilometres downstream Mangué school, derives water for irrigation. Two water control structures will be built each just downstream a dambo in order to control water levels and prevent the dambo from overdrainage, hence facilitating cultivation of flood recession crops.

Mangué School bridge, which is broken, will be re-built after demolition of the existing one. The new structure will be made with 7 concrete pipes with internal diameter 900 mm and 4 m length.

#### ACCESS

There are no particular difficulties to access with excavators during the dry season at any place of the canal.

### 3.5.3.3 N'gombala canal

#### PURPOSE

The design of N'gombala canal is made in order to improve navigation between the Malile and the Zambezi. The improvement is proposed to be made by connecting Zambezi and Malile rivers.

#### WORK

The canal will be reshaped so that it maintains the minimum draught depth required for navigation (1.5 m) and sufficient canal width for safe movement of boats (4 m). The proposed bed side slope will be 1/1.5. The bed level has been increased without impacting the minimum draught depth. This has decreased the velocity since the discharge also decreased.

## ACCESS

The site is not accessible for excavator due to the absence of bridge, dredger will be used.

### 3.5.3.4 Nebubela

## PURPOSE

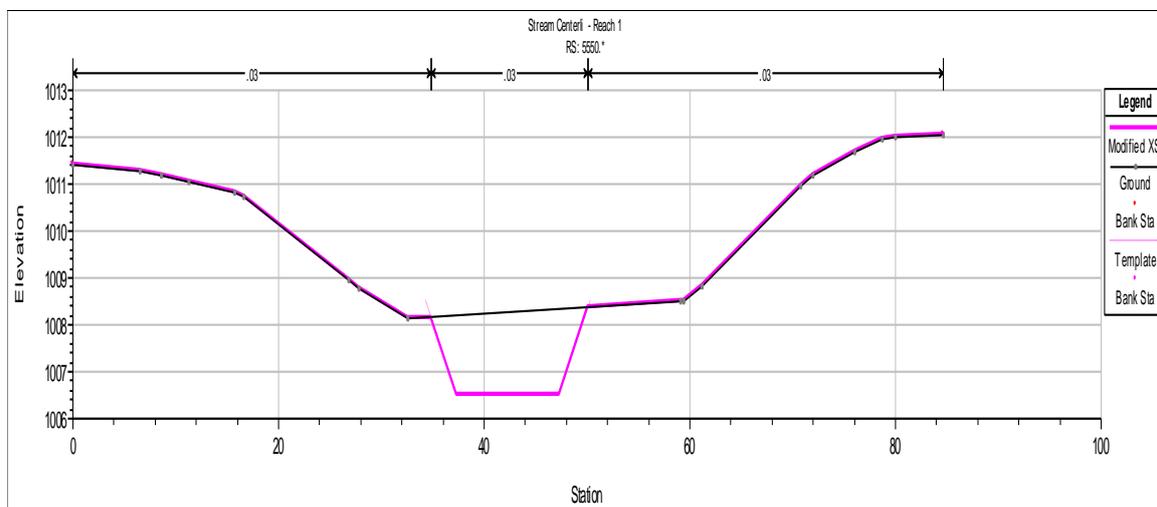
The design of Nebubela canal aims at improving navigation between Malile and Mongu harbour. The objective of the proposed rehabilitation works is to remove the sand banks in order to maintain the minimum draught depth required for navigation and sufficient canal width for safe movement of boats.

## WORK

The design of Nebubela canal requires provision of sufficient draught and width for the canal. The existing situation has nearly adequate draught and width for most of the reach. However, this requires removal of the sand banks on the bed and side slopes of the canal. The present design proposes to provide a canal bed width of 10 m and 1.5/1 side slopes. The total excavation of the proposed rehabilitation works amounts 40,500 m<sup>3</sup>. In addition it is proposed to remove about 15,000 m<sup>3</sup> of old spoil banks in order to improve the bank stability and prevent part of the materials to slide back into the canal.

The following graph shows the proposed work (purple) and the existing situation (black).

Figure 5 Proposed typical canal cross section for Nebubela canal



It is proposed to build a sand trap just upstream the harbor. The proposed design is identical with the one proposed for Muoyowamo.

## ACCESS

The site is not accessible for excavator or any land machinery due to deepwater level at all time of the year. Dredger will be used.

### 3.5.3.5 Fisheries canal

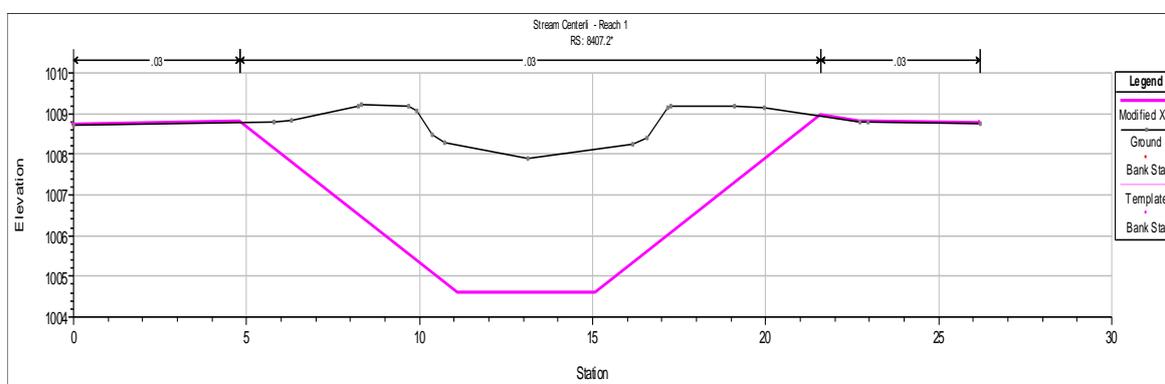
#### PURPOSE

The design of Fisheries canal upgrading works focused on the provision of improved navigation throughout the year.

#### WORK

The proposed canal section will have a 4 m bed width and 1.5/1 side slope. The design of Fisheries canal upgrading works focused on the provision of improved navigation throughout the year. The following graph shows the proposed work (in purple) and the existing condition (black line).

Figure 6 Fisheries canal - proposed cross section



#### CROSSING POINTS FOR CATTLE

It is proposed to build at the main cattle crossings of Fisheries an excavated path with a 10% slope in order to prevent bank erosion. Those paths will have a base width of 6 m and have 1/1.5 side slopes. The average length of one approach track will be about 35 m on each side of the canal. Provision has been made for including 3 cattle crossings.

#### Access

there are no particular difficulties to access with construction machineries during the dry season at any place of the canal except around the harbour at Namushakende. This zone is made mostly of peat soils and will require swamp excavator for earthworks and creation of specific trail for truck if soil evacuation is needed. Creation of a service road will ease maintenance works and monitoring.

### 3.5.3.6 Musiamo

#### PURPOSE

It is proposed to rehabilitate the Musiamo canal in order to enable both evacuation of excess water and control of water levels. In addition five crossing are proposed for facilitating access to the Barotse Plain.

## WORK

The rehabilitation works consist in re-excavation of the Musiamo canal in order to allow a water depth of 1 m, uniform longitudinal slopes and 1/1.5 side slopes. Current depth of canal is generally between 1 and 1.5 m. 3 m bed width has been adopted as this corresponds best with the present situation. The spoil will be placed on the western bank of the canal.

## CROSSINGS

From North to South we have selected 5 different sites to be rehabilitated to piped bridges with 2 concrete pipes of internal diameter of 900 mm and 4 m length. All of them are already used by the local population and connected to the road network. They are the following:

- ▶ Lyomboko road crossing
- ▶ Road crossing North of Mongu along the old Limulunga road
- ▶ Katongo
- ▶ Road crossing at the Namushakende Harbour
- ▶ Road crossing at Namangomba

## WATER CONTROL STRUCTURES

Water Control structures are proposed at 10 locations: 5 on the first reach of the canal, 3 on the second reach and 2 on the third reach.

## ACCESS FOR EXCAVATION

Access for excavator is limited in many areas due to deep peat bogs, excavation will be done by foot and dredging will be done manually.

### **3.5.3.7 Namitome canal**

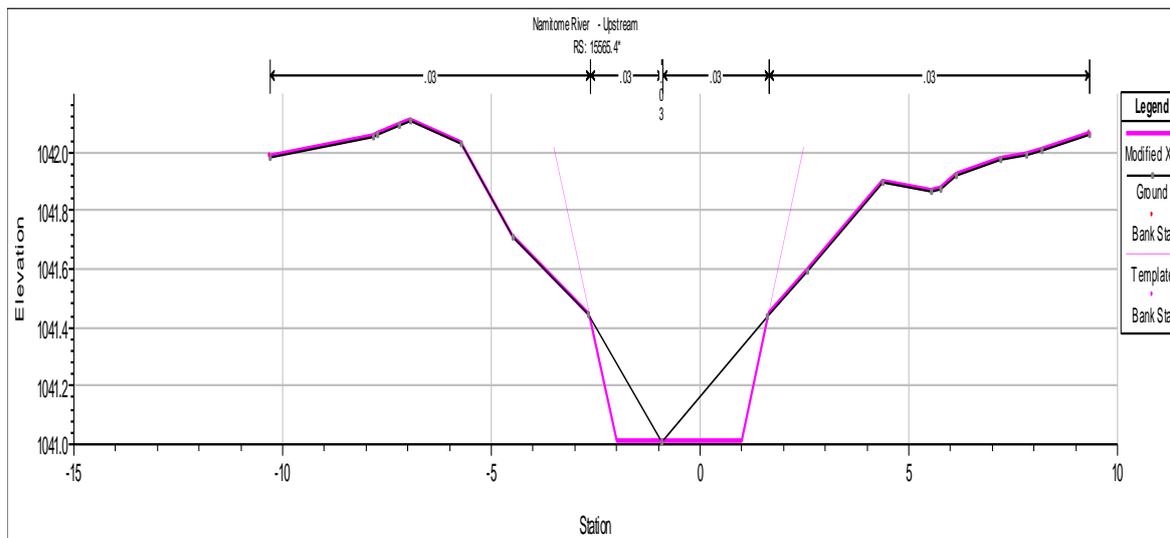
#### PURPOSE

The Namitome canal or river supplies the Muoyowamo canal with a regular flow. Part of the flows spills in the Barotse plain 10 km upstream of the Limulunga. As this river/canal is causing regular flooding water logging of the adjacent fields, it has been proposed to increase its flow capacity by removing the bunds in the river bed and increasing its width.

#### WORK

The volume of excavation of proposed rehabilitation works amounts 19,814m<sup>3</sup>. The proposed cross section of the canal will have a bed width of 3 m and side slope of 1/1.5. The following graph shows the proposed work (in purple) and the existing condition (black line).

Figure 7 Namitome Proposed Canal section up stream reach



#### ACCESS

There are no particular difficulties to access with excavators during the dry season at any place of the canal. The creation of a specific path or service road would anyway ease in future access and maintenance.

#### 3.5.3.8 Siltation basins

It is proposed to build 7 siltation basins for storing and desilting of the expelled mix from dredgers when they dredged the sand banks at the junctions of the canals and the rivers, more precisely:

- ▶ 1 at the junction of Nebubela and Malile
- ▶ 1 at the junction of Fisheries canal and Zambezi
- ▶ 1 at the junction of Fisheries with southern branch of Malile
- ▶ 1 at the junction of N'gombala and Zambezi
- ▶ 1 at the junction of N'gombala and Malile
- ▶ 1 at the junction of Muoyowamo and Malile

#### WORK

It is proposed to build temporary basins by removing the top soils by bulldozer and create a bund. The total area will be 1 ha. The total length of the bund will be 400 m and its height 1.5 m. The corresponding volume will hence be about 2 000 m<sup>3</sup>.

Once the siltation basin is filled and the levels are about 1 m higher the siltation basin should be abandoned. A new basin will be built aside. The plot having increased ground levels may become partially flood-protected and gain in value.

#### 3.5.4 Operation phase

The Project is not an industrial process, there is no operation phase. However, the Project will require maintenance, this maintenance will not necessitate additional activities from those already described.

## 4. PROJECT ALTERNATIVES

### 4.1 IDENTIFICATION OF ALTERNATIVES

There are no alternatives to the proposed Project since it is a rehabilitation project that aims at improving identified canals and identified structures (bridges, etc.). The rehabilitation works that are proposed in the conceptual design report are based on a participative approach meaning that they have widely accepted during workshops.

However, several alternatives were studied for Fisheries canal restoration:

1. Improved drainage by providing a regular and uniform bed slope;
2. Improved irrigation possibilities, by facilitating access of Zambezi water throughout the year all over its length, in addition to an improved drainage service. This option also enables navigation with canoes;
3. Improved navigation (with motor boats) from January till July, in addition to improved drainage service and irrigation possibilities;
4. Multipurpose : polder (dike providing flood protection throughout the year) enabling agriculture throughout the year as well as navigation from January till July. It has to be noted that this option would also require important investment for the polder development, that will not be detailed in the present study

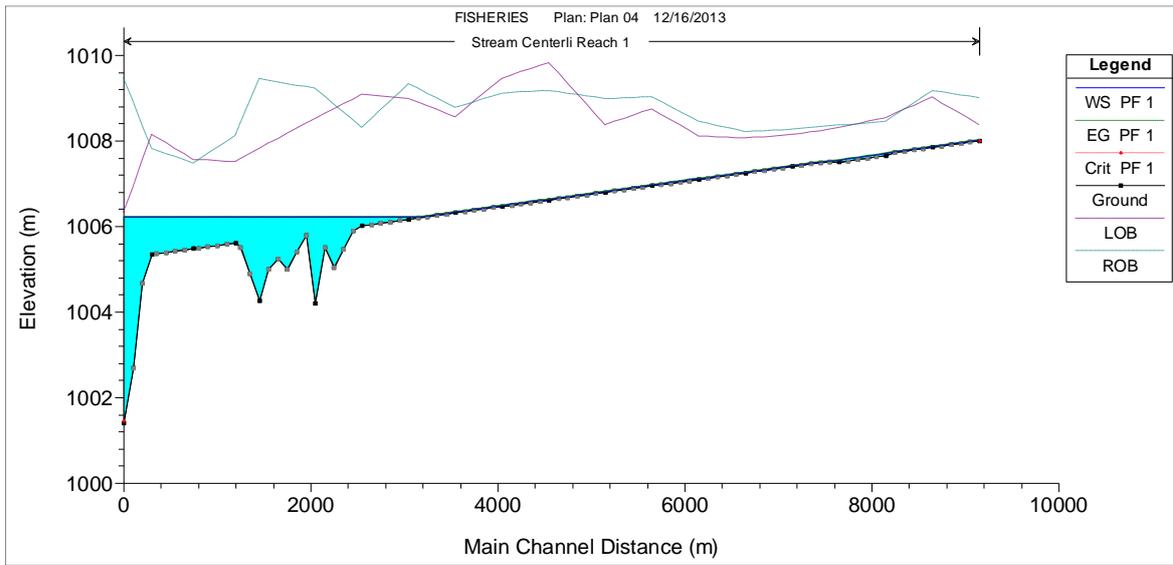
During the second workshop, one alternative was selected based on social acceptability.

### 4.2 ANALYSIS OF EACH OF THE IDENTIFIED ALTERNATIVES

#### OPTION 1 : IMPROVED DRAINAGE

The aim is to evacuate excess water with the canal to avoid stagnation of water in the vicinity of fisheries. Therefore, this option proposes to excavate/dredge the undulating bed of Fisheries so that water can easily drain to the Zambezi River. The total volume of excavation is 30,686 m<sup>3</sup>. In parallel it is proposed to provide 3 ford crossings.

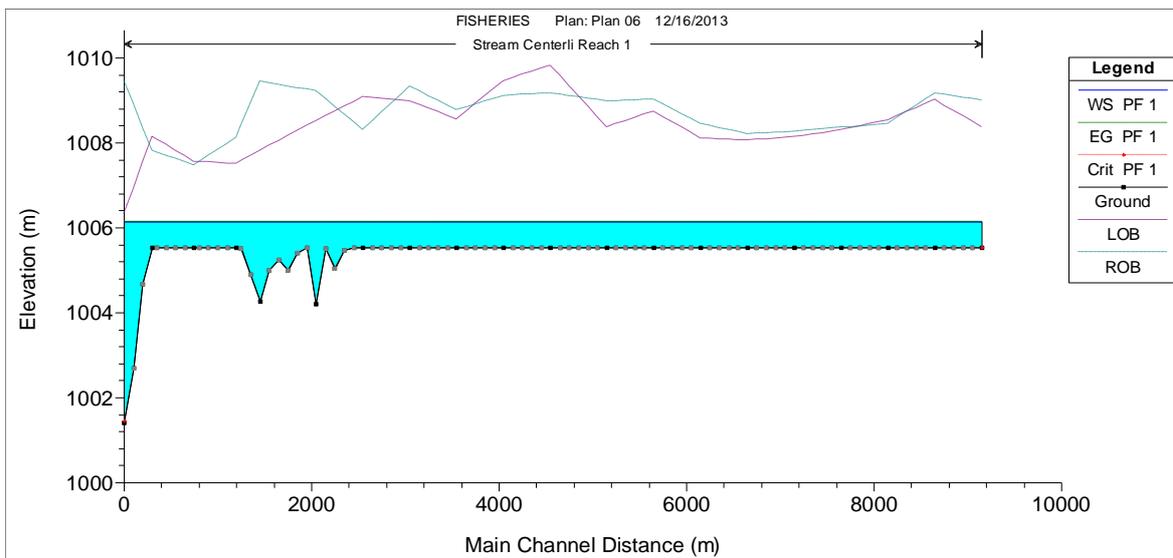
Figure 8 Water profile in Fisheries after option 1



OPTION 2 IMPROVED IRRIGATION AND DRAINAGE (AND NAVIGATION FOR CANOES)

In this option it is proposed to provide water throughout the year in the whole reach of the canal. The proposed bed level for improved irrigation at the outfall of fisheries canal is 1004.634 m. This bed level ensures a minimum of 0.6 m depth throughout the year for 4 years out of 5 (based on the Water level data of Matongo Plato, and October 2013 topo survey). The total volume of excavation for this option is 107,728m<sup>3</sup>. This is due to the deeper excavation so that to avail the water during low flow season to irrigation. The water levels don't enable navigation with motor boats throughout the year, but navigation with canoes is made possible at the condition that no bridges are built.

Figure 9 Water profile in Fisheries after option 2



**OPTION 3 : IMPROVED NAVIGATION (WITH MOTOR BOATS), IRRIGATION AND DRAINAGE**

This option proposes to excavate the canal 0.9 m deeper than the previous option (improved irrigation) level with the improved navigation and this will ensure a draught in January and July of 1.5m. The bed level will be 1004.6m. To enable navigation, bridges have not been inserted in the proposal. The total volume of excavation for this option is also 300,000m<sup>3</sup>.

**OPTION 4 : POLDER WITH SAME INSIDE BED LEVEL IDENTIC WITH OPTION 1 AND OUTSIDE BED LEVEL IDENTIC AS OPTION 3**

This option proposes building a flood dike to protect potential agriculture land from flooding (currently the land is made of wetlands and agricultural land), and thus enabling the cultivation of 4200 ha potential irrigated area throughout the year. The flood dike will require a freeboard of 0.9 m and a crest width of 3 m. The dike will be provided with a service road inside the polder. A regulator is proposed at the crossing of flood dike and fisheries canal. A pump station will have to be built here in order to enable both irrigation in dry season and drainage during high water levels in the Zambezi.

The canal bed maintains a 0.3 m / km slope upstream of the regulator and horizontal between the dike and Zambezi. The total volume of excavation for this option is 200,000 m<sup>3</sup>.

The design of the irrigation & drainage & road network is not part of this study.

**4.3 LIST OF CHOSEN ALTERNATIVES IN ORDER OF PREFERENCE**

Workshop participants have assessed the proposals of the Consultant, preferring option n°3 where both navigation with motor boat, drainage and irrigation are possible. This choice has been confirmed by focus group discussions held in Namushakende on the 1<sup>st</sup> of February 2014, within the framework of the social survey.

In terms of environmental impacts, the following options are classified by increasing order of adverse environmental impact:

- ▶ Option 1 is the most environmental friendly option since it involves light excavation
- ▶ Option 2 involves more excavation than option 1,
- ▶ Option 3 involves more excavation than option 2, and also allow for the use of motor boats in the canal.
- ▶ Option 4 is the most environmentally impacting option since it involves the construction of a dike that will completely severed water infeed to nearby wetlands and will involve conversion of wetland to agricultural lands.

**4.4 REASONS FOR CHOOSING THE PREFERRED ALTERNATIVES AND REJECTING THE OTHER ALTERNATIVES**

Social implication of each option gave preference to option 3. Workshops participants preferred option n°3 where both navigation with motor boat, drainage and irrigation are possible. This choice has been confirmed by focus group discussions held in Namushakende on the 1<sup>st</sup> of February 2014, within the framework of the social survey.

## 5. ENVIRONMENTAL BASELINE STUDY

Biophysical baseline is based on field visit by the ESIA and wetland specialist (Eric Deneut), bibliographical data and aerial photo interpretation. Wetland description is based on field visit.

### 5.1 CLIMATE

The climate in the study area is tropical with two distinctive seasons: a rainy season from October to April and a dry season the rest of the year.

#### 5.1.1.1 Sunshine

The total hours of sunshine per month is provided in the next figure.

Figure 10 Number of hours of sunshine per months



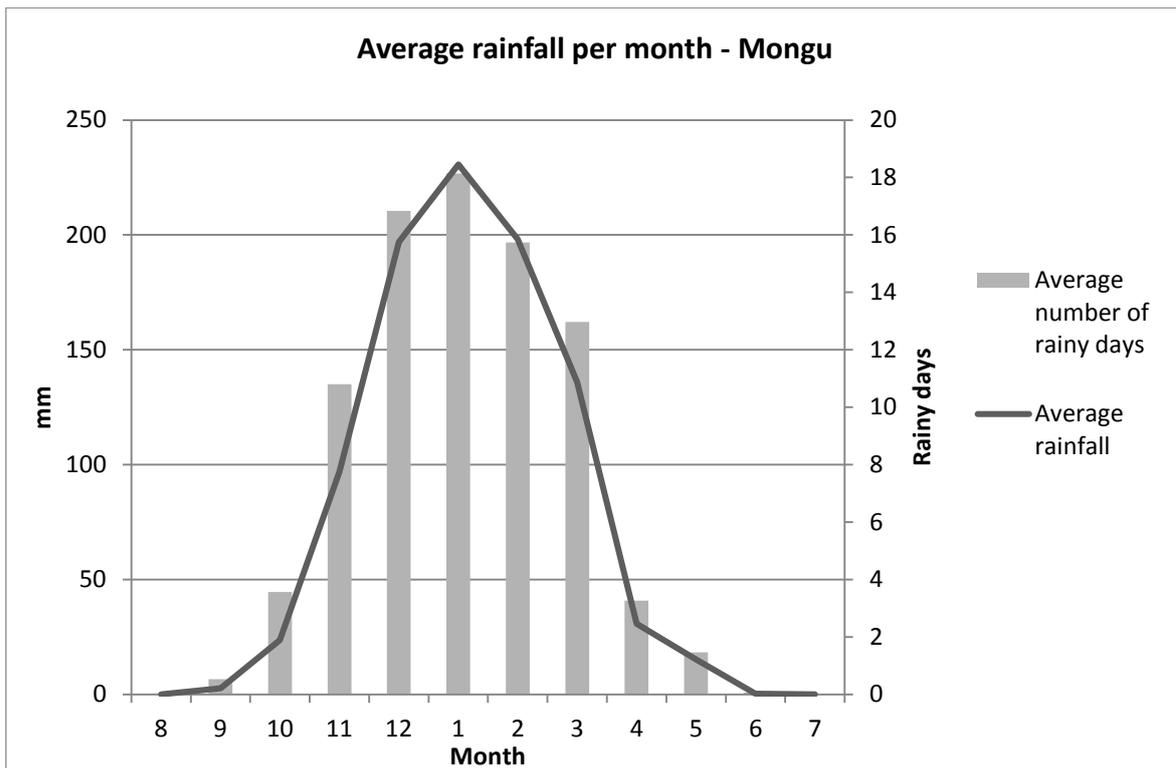
Source: World Weather and Climate information, 2014

#### 5.1.1.2 Mean temperature in the study area

September and October are the warmest months in Mongu with average low temperature of 18° (night temperature) and average high temperature of 36-37° (day temperature). Coolest months are from May to July where average low temperature are around 10° and average high are around 28-30°.

#### 5.1.1.3 Rainfall patterns

During a year, the rainfall is characterized by a rainy season from October to April. The maximum amount of rainfall per month is recorded in average in January (more than 200 mm at Mongu). June to August is the driest period with almost no rain. The following image illustrates the average rainfall per month for Mongu.



Source: BRLi, 2013

#### 5.1.1.4 Climate change perspectives

Analysis of climate trends over the past decades, undertaken by the Zambia Meteorological Department (ZMD) highlights at national scale:

- ▶ An increase in the frequency of extreme events such as by floods and droughts over the past four decades.
- ▶ An emerging tendency of a delayed onset of the rainfall and earlier cessation, thus resulting in a shorter season with a more intense rainfall.
- ▶ A trend towards an increase in temperature in both the cool (June, July, August) and warm season (September-October).

Different studies have been conducted about the possible effects of climate change in Zambia (Nkomok & al 1999; studies carried out by the IPCC, and as part of the UNDP climate change country profiles). They give consistent results regarding temperature but projection for future changes in rainfall are uncertain.

The mean annual temperature is expected to increase in a range of between 2°C and 4°C by 2075. The temperature might increase during all seasons, especially at the beginning of the rainy season (September-October-November). The Barotse is located in one of the areas in Zambia where the expected increase of temperature is highest.

Projection of future changes in rainfall don't always give consistent results. Depending on the Global Climatic Model used and on the greenhouse gases emission scenario considered, mean annual precipitation trends vary. The work of Nkomok et al 1999 projected a decrease in annual precipitation throughout Zambia by the year 2075, whereas the work undertaken in the UNDP climate change country profile concludes that projections of mean annual rainfall do not indicate large changes (simulations give projections of increase or decrease in precipitation depending on the emission scenario considered). However, for all scenarios, a decrease in rainfall is projected during the season (September-October-November).

Climatic models do not allow concluding on the change in frequency and magnitude of extreme events (no statistical significance). However, different studies mentioned an increase in climate change variability and change (El Niño/La Niña events and increasing variation in the migration of the Inter-tropical Convergence Zone (ITCZ)). Surveys carried out among people living in Barotse highlight the fact that populations feel that there is an increase in variability in seasonality of rainfall and flows. Moreover, an increase in occurrence of floods has been recorded during the past decades (see next table). It is not certain in which extend this increase is due to climate change, as it can also be explained by higher sensitivity (cultivation and new settlement created in flood-prone areas).

	1974-1983	1984-1993	1994-2003	2004-2013
Drought	2	1	1	1
Flood	1	1	5	10

Consequences for the population of Barotse are already observed and mentioned in different studies such as the LYVA project, and the Community adaptation to climate variability in the upper Zambezi floodplain, (Flint, 2008). These impacts could be worsened in the future by climate change, they include:

- ▶ Clearance of forests and other vegetation on the watershed area result in augmentation of stream flow both in volume and velocity. When combined with extreme rainfall events they can cause flash floods causing erosion and damaging crops and infrastructures.
- ▶ There has been a reduction in the number of annual inundations and an increased variability of weather including more frequent violent storms that have damaging impacts on human activities.
- ▶ Because the water from rainfall in the watershed areas arrives at greater speed and volume, and because the total precipitation is either less or little changed but appears to be taking place in a shorter rainy season (later onset), flood regression, once it commences, takes place much faster than previously: there is not a gradual transition from aquatic to terrestrial state. Therefore the limit of receding water, which in the past was slow, allowing considerable production of biota, now moves faster, taking with it some of the nutrient and silt to deposit downstream.
- ▶ Difficulties for the population to anticipate and loss of traditional landmarks due to heightened uncertainty and increasing unpredictability.
- ▶ Shortening of the cropping season due to the shortening of the period between the start and cessation of rain (Flint, 2008)

Climate change could also provoke:

- ▶ Increased incidence of floods as the incidence of heavy rainfall events increases
- ▶ Additional pressure on forest and desertification in the upstream part of the catchment due to drought and excessive temperatures, resulting in faster run-off and floods. This will cumulate with the impacts of deforestation and inadequate land management, and with the impact of extreme rainfall events.
- ▶ Increase prevalence of livestock disease due to increasing temperature.
- ▶ Increased risk of water pollution and decreased water quality due to erosion,

- ▶ Deterioration of health indicators. Higher temperature increase the range of the anopheles mosquito, the incidence of malaria and other vector-borne diseases
- ▶ Additional pressure on the fish population due to:
  - increased temperature leading to lower oxygen in the rivers and wetlands,
  - earlier receding of floods constraining the development of fishes and increasing fishery activities.
  - more violent flooding (flash floods) destroying habitat and breeding areas

## 5.2 AIR QUALITY

There are no data regarding air quality in the Study area. However, there are no known sources of industrial pollution in the Barotse plain.

## 5.3 HYDROLOGY

### 5.3.1 Orography of the area

The main feature of the orography in the area is the Barotse Flood plain which is 230 km long from North to South and 30 km wide (CGIAR, 2012). It is very flat plain with a very slight slope. The altitude at Lukulu being 1035 m and 1000 m at Senanga, the average slope of the plain is only 0.015 %.

Within the study area, the average height in the plain is 1012 m above sea level in Mongu district. The lowest points are at 1008 m close to the Zambezi, and the highest points are constituted of the artificial mounds where villages are built and maize is cultivated (*lizulu*). These mounds are 2 or 3 m above the average level of the plain, which enables them to be maintained above floodwaters. For example, the Royal Capital of Lealui is standing at 1015 m (Surveyor General, 1987 b).

Surrounding the flood plain are the sandy uplands (plateau), with an average height around Mongu of 1070 m above sea level. In the uplands, the high points are reaching 1105 m (between Mongu and Limulunga). The low points are found in the local deflation pans and dambos, whose bottom points are at 1050 m. The municipality of Mongu itself is at an average of 1040 m, with the harbor being at the plain level and the highest point at 1060 m (Surveyor General, 1987 a).

Between the plain and the plateau is a sandy slope that climbs 45 m (from 1015 to 1060 m above sea level) in 500 m, which gives an average slope of 9 %.

### 5.3.2 Natural water bodies

The Zambezi River is the main water body in the study area, it flows from north to south and floods the plains every year around January to June. The exact date, duration and intensity of the flood vary every year depending on the rainfall on the catchment area.

Due to the slight slope, the Zambezi flows in the plain with numerous meanders. As it has changed its bed in recent history, there are many oxbow lakes and even secondary river beds like the "Little Zambezi", (locally known as Malile) which is an arm of the main river connected both upstream and downstream.

There are several small tributaries to the Zambezi river coming from the uplands and crossing the study area, which have been more or less canalized for agriculture. We can mention from North to South:

- ▶ Nakalomo: a small stream coming from lake Makapaela, 12 km North East of Limulunga and feeding Lubitamei canal.
- ▶ Namitome: an important canalized stream which takes its source in a wetland 25 km East of Mongu, then crosses the Mongu / Lusaka road 10 km East of Mongu and goes North to Limulunga to feed Muyowamo canal.
- ▶ Kambule: a stream passing in the middle of Mongu town, then feeding Musiamo canal.
- ▶ Sefula: a stream, coming from a spring 10 km East of Sefula village, canalized to provide water for the Sefula Rice Scheme and then joining the Little Zambezi in the plain.
- ▶ Kataba: a stream coming from Lushi, Mumbwana and Mukangu lakes, 25 km East of Namushakende. It feeds Lwandala canal which joins the Zambezi river South of Nalolo.

There are also several wetlands on the uplands. Some are seasonal lakes, being flooded from January to June, others are year round lakes, like lake Makapaela.

### 5.3.3 Hydrology and hydraulics of the Barotse flood plain

The Barotse flood plain receives inflows from several tributary:

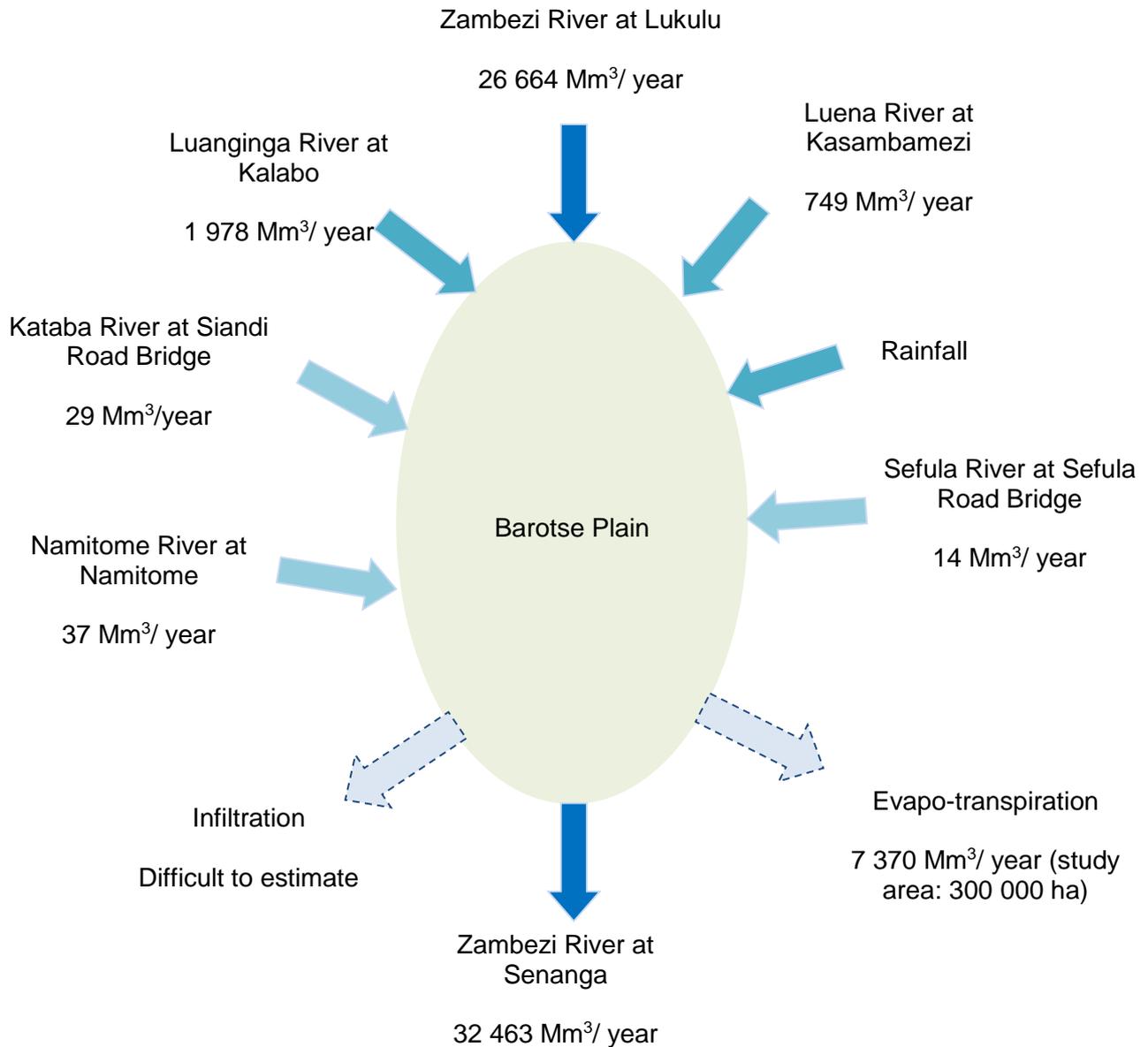
- ▶ Luanginga River (catchment area 34,600 km<sup>2</sup>), right bank
- ▶ Luena River (20,500 km<sup>2</sup>) (upstream it is called Luampa River), left bank
- ▶ Lueti River (8,575 km<sup>2</sup>),
- ▶ Lui (11,890 km<sup>2</sup>).

Lueti and Lui reach the Zambezi River in the downstream part after Senanga station so they don't influence directly the project area.

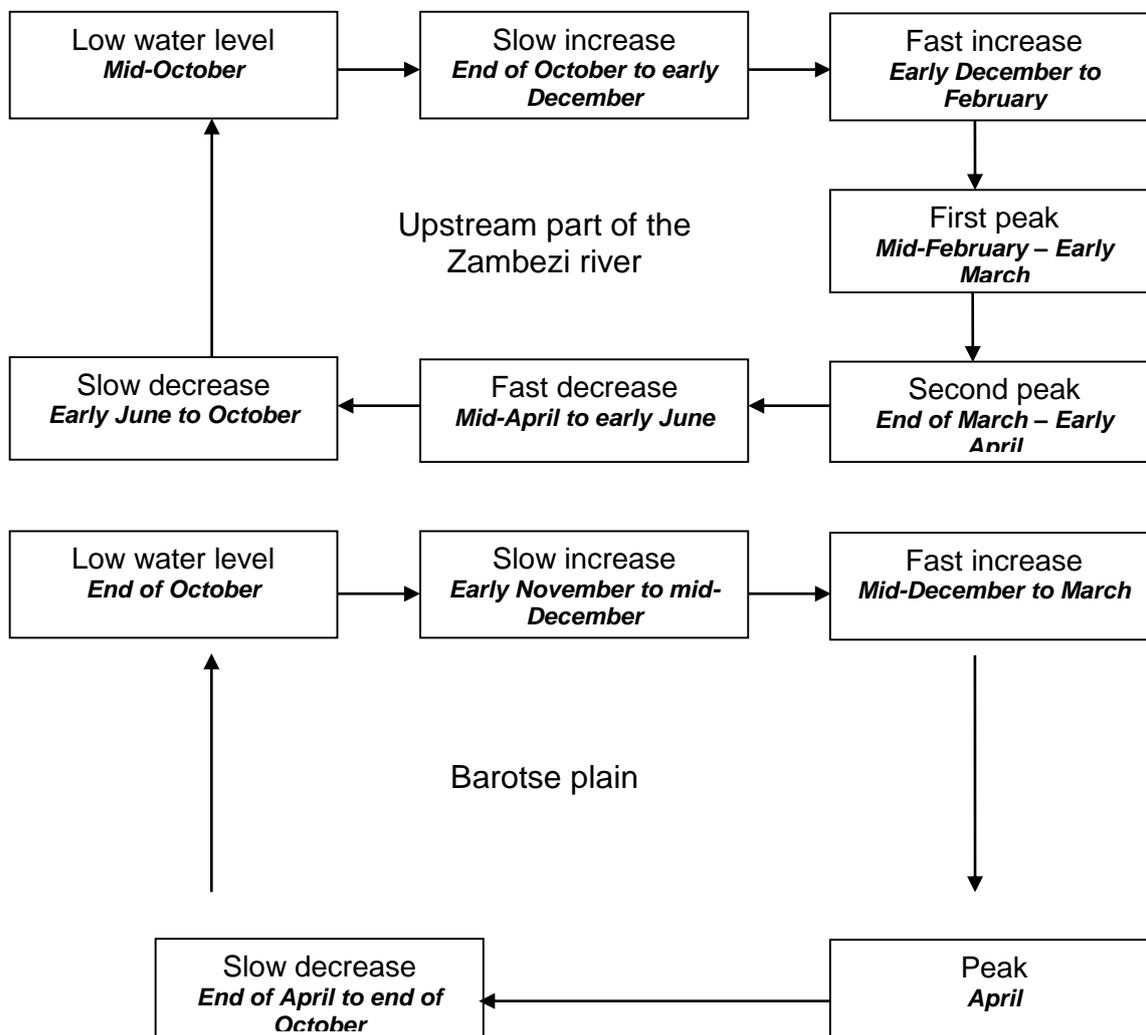
Other minor tributaries are connected to the Zambezi close to the project area, namely:

- ▶ Lubitamei, left bank, which drains part of the Luena flat water,
- ▶ Namitome, right bank,
- ▶ Sefula, left bank,
- ▶ Kataba, right bank.

The following image summarizes the inflow and outflow in Million of m<sup>3</sup> of the Barotse floodplain in the Study area.



The hydrology of the Zambezi River can thus be summarized as follows:



Source: BRLi

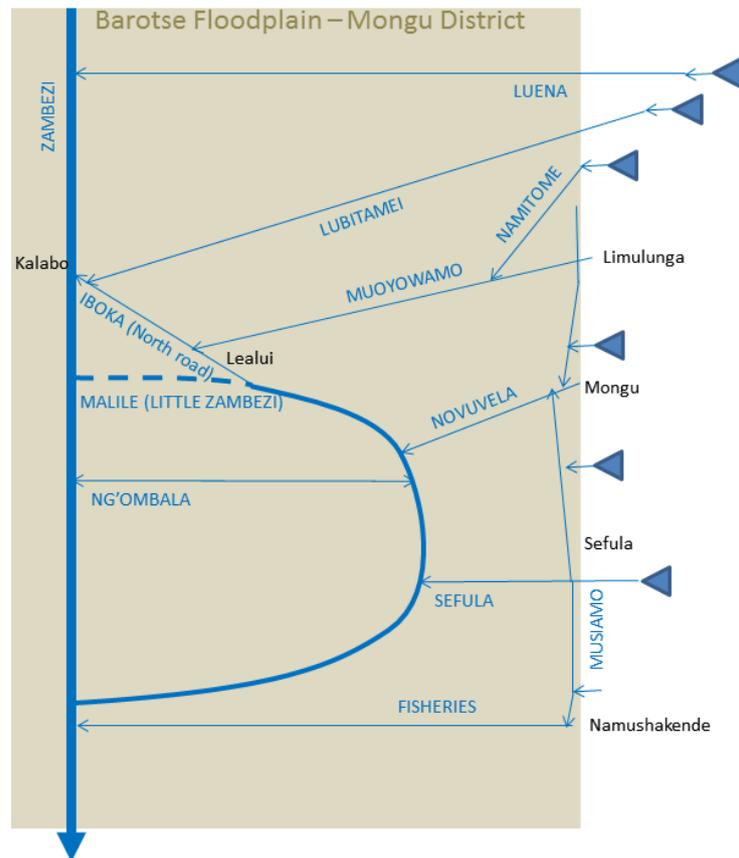
### 5.3.4 Hydraulic functioning of the canals

Several canals follow the natural thalwegs that have been recalibrated, rectified and maintained for an optimized human use. The following figure shows the Mongu district main canals:

- ▶ Lubitamei and Namitome canals can be considered as rivers in their upper course, as their bed seems quite natural. They are draining dambos in the upland. Lubitamei canal is contributing to the drainage of the southern part of the Luena flats.
- ▶ Most of canals located in the floodplain (Muoyowamo, Nebubela, Fisheries, downstream part of Lubitamei, etc.) are draining water from the edge of the floodplain to the Zambezi or the Little Zambezi. Some of them are used for navigation;

- ▶ The Musiamo canal is collecting water at the edge of the plain and feeds the other canals for evacuating water in the Zambezi;
- ▶ The N'gombala canal has been dug as a shortcut between the Zambezi and the Little Zambezi but is not really operational

Figure 11 Schematic representation of the canals system



#### MUYOWAMO CANAL

Muyowamo joins the two royal capital of Barotseland: Limulunga on the uplands and Lealui in the plain. It starts at Limulunga harbor, runs in almost straight line to the South West for 18.8 km then ends when joining Malile, 1 km South of Lealui. It is fed with water by Namitome stream coming from the upland and several secondary canals bringing water from Musiamo. In Lealui, the Royal harbor is called Nayuma, it is constituted of a 100 m stretch perpendicular to the main canal, where the Kuomboka ceremony starts from. The Muoyowamo canal is currently interrupted for navigation by the construction of the Mongu-Kalabo road downstream of Lealui harbor. The hydraulic continuity has been maintained through culverts.

#### MUSIAMO CANAL

Musiamo is running from North to South on 52.2 km on the edge of the plain, between 100 and 500 m from the bottom of the slope. This particular area is naturally waterlogged by the groundwater seeping. Musiamo was built to allow agriculture on these soils by draining the plain edge's at the bottom of the slope. Musiamo starts from Limulunga (300 m South of the harbor) and ends close to Nasiwayo school, where it connects with Lwandala canal. The role of this canal is crucial for the agriculture and the food security of the whole region, as the drainage allows farming on fertile soils.

Musiamo has the particularity of not being a continuous canal, it is interrupted in Mongu and Namushakende by the harbors and in Sefula by the rice Scheme. It is also connected with numerous secondary canals which evacuate the drained water to the Muyowamo canal (North of Mongu) and to the Malile (South of Mongu), which then join the Zambezi river. Thus, the water is not flowing in the same direction all along the way.

#### LUBITAMEI CANAL

Lubitamei is an agricultural waterway dug from a natural stream in Nangula valley. Its role is to drain this valley to facilitate agriculture and to avoid its flooding. The flow is sustained by the outlet of several wetlands such as Miulwe located 4 km North of the Mongu / Lusaka road 30 km East of Mongu. The Canal itself starts from Ndiki heading North and passes through the locality of Nangula. Then at Lyomboko, it is joined by a tributary called Nakweti coming from the South West which is clogged with vegetation.

After Mangu the valley becomes wider as Lubitamei reaches the South of the Luena flats. Close to Kate school, Lubitamei has been blocked and the water is diverted to supply a large commercial farm in Muye. In consequence, the water flows North while the rest of the canal is totally dry. Lubitamei then heads Westwards, passes close to Oosha, reaches the flood plain, then turn South West to end joining Malile 10 km North West of Lealui. As this canal is very long, some local people call it Nangula canal on the first stretch from Ndiki to Kate and then Nonge canal from Kate to the end (BRLi, 2013, interview with DC Limulunga).

#### FISHERIES CANAL

Fisheries canal starts at Namushakende. It is fed by Musiamo which collects the water from several springs in the Namushakende area. It flows in straight line to the West for 9 km and reaches the Zambezi close to a fishing camp called Umeniu.

#### N'GOMBALA CANAL

N'gombala canal joins the Little Zambezi (Malile) to the main Zambezi. It was dug to shorten distance for navigation. It starts 7 km South West of Mongu and runs 8.5 km joining natural lakes before reaching the Zambezi. According to the riverine populations, as it is connecting two water bodies with similar dynamics, its flow pattern is switching with season and water level: when water levels are raising in Zambezi and Malile, water is coming from both ends into the N'gombala canal and is flooding a wetland in the middle. However, during the recession period, N'gombala canal is draining the wetland, through both ends.

#### NEBUBELA CANAL

This canal which is about 9,1 km long connects the Mongu harbor with the Malile river. It is the first part of the Mongu-Kalabo waterway.

The soil is made of clayey material. A path allows access to Malile river from Mongu, but it does not follow the canal. This path is hence useless for maintenance.

There is no particular bank stability problem on this canal.

## 5.4 HYDROGEOLOGY

Kalahari sands are not uniform deposit but contain silt and clay layers so that although rainfall is immediately absorbed, percolation underground is delayed and perched water table are common. However, in the flood plain, ground water recharge by rain is insignificant in comparison with the input from the annual flood which influences groundwater level. In the flood plain, there are groundwater seepage at the edge of the plateau.

Ground water quality has not been assessed in the area, it is however believed to be free of pollutants since the use of fertilizer and pesticide is limited in the plain.

## 5.5 TOPOGRAPHY

Around Mongu, the 20 to 25 km wide floodplain lies at an altitude of 1013-1015 masl (meter above sea level). The edge of the Plateau toward Mongu has a slope of around 1.5 %, leading to a plateau at a height of around 1090 masl. Musiamo canal, at the plateau edge lies slightly lower than the plain, which partly explain the long water retention in the vast peat bogs (see Wet grasslands description).

Luena flats, to the North lies around 1030 masl, the slope to the plateau is around 0.5 %, Lubitamei canal lies slightly lower which could also explain the long water retention in this wetlands (see Wet grasslands description).

The whole Barotse flood plain has a southerly slope of less than 0.1%.

Figure 12 Luena flat topography

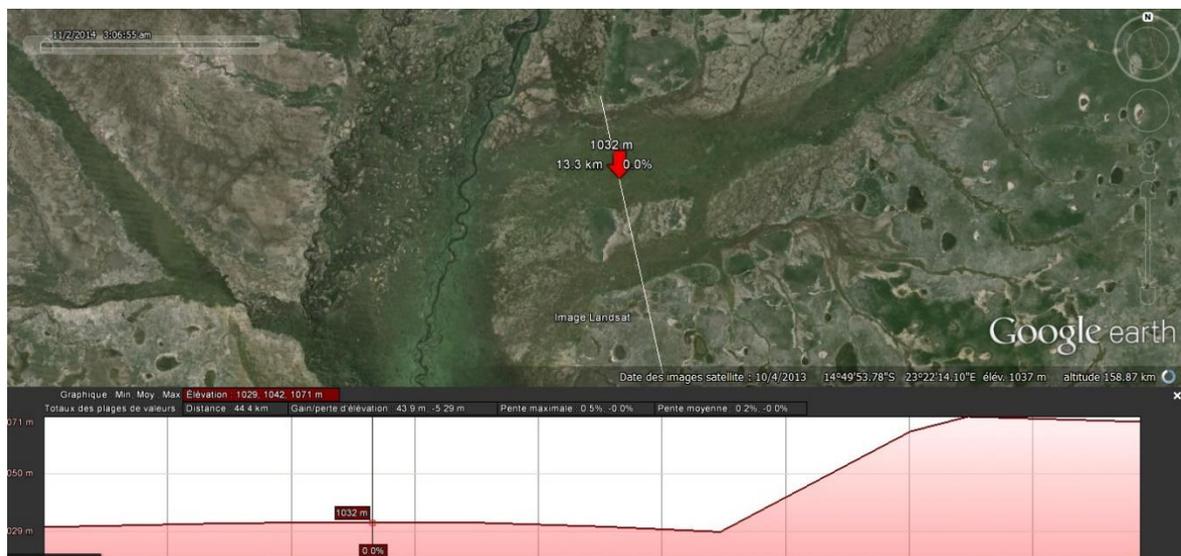
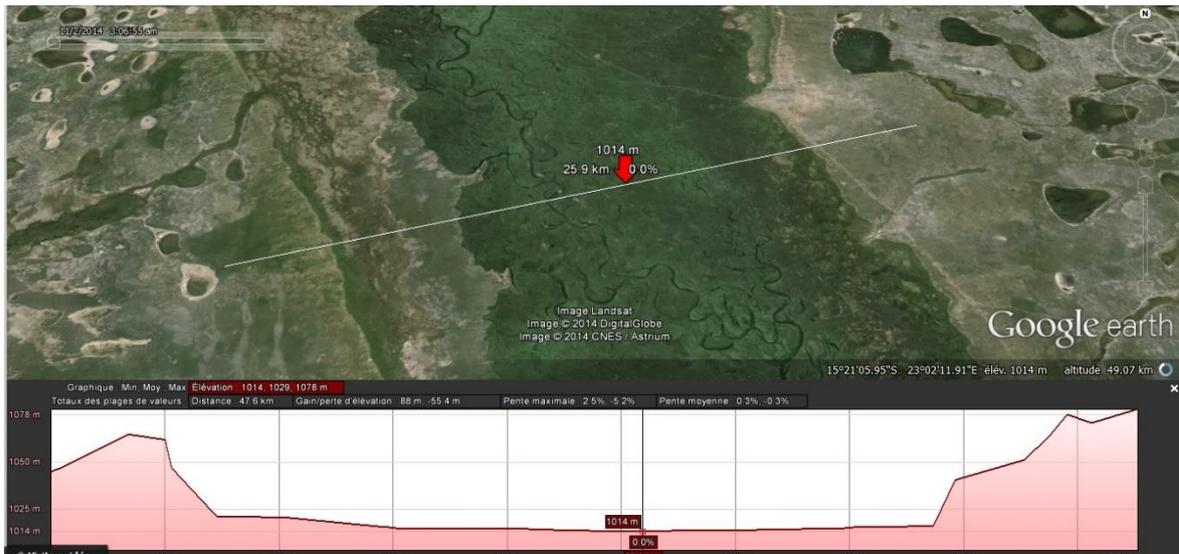


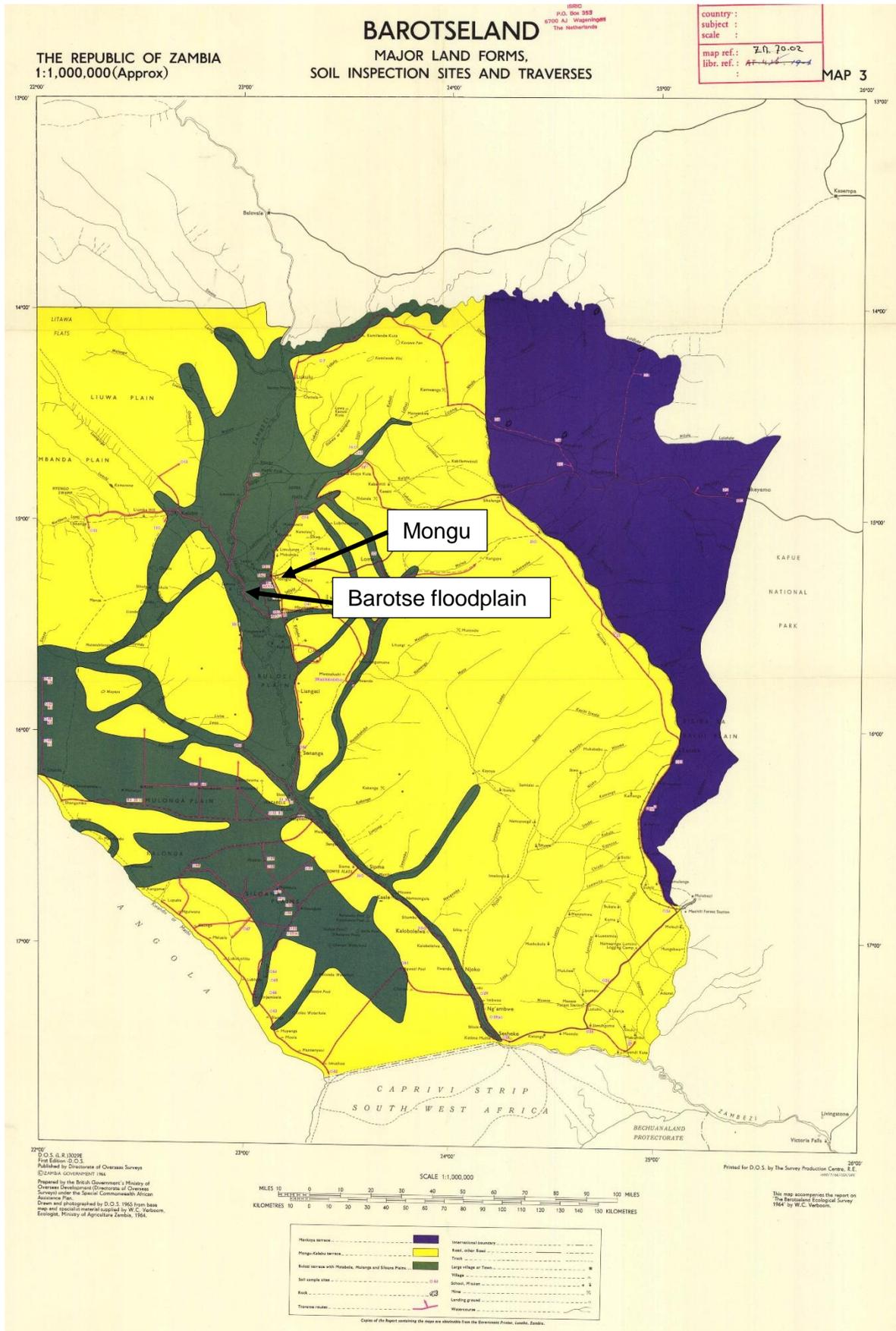
Figure 13 Barotse floodplain topography



## 5.6 GEOLOGY AND SOILS

Geology of the study area is characterised by Kalahari sand (also called Barotse sand) deposit on Mongu plateau and Alluvium deposit in the floodplain

Soils of the Barotse flood plain consist of the Bulozhi terrace (in green in next figure), outside of the flood plain soil are part of the Mongu-Kalabu terrace (in yellow) as shown in the following image. The Bulozhi terrace is made of the Zambezi Alluvium (seasonnaly flooded sands and clays called Gleysol with some mineral hydromorphic soils). Around Lubitamei source, soil are Podzols (Barotse sands). Around Musiamo, peat bogs soils (organic hydromorphic soils) are overlying deposit of sand and silt, this is the seepage zone.



## 5.7 LAND USE AND LAND TENURE

The interaction between the people inhabiting the Barotse Plain and their environment has given rise to a variety of land use systems that have enabled social and economic survival. Through an elaborate process of land reclamation involving piling of soil brought in from the upland, people formed mounds for purposes of habitation, agriculture and burial. In due course some of the mounds were abandoned and are now used as burial places while others continue to be habited and maintained with soil being heaped onto existing ground to raise the ground level.

Customary land under the jurisdiction of the Barotse Royal Establishment (BRE) is regulated by the Barotse Royal Establishment Act of 1971 Section 6 (1) (B) which provides for traditional means of administration. The Act legitimizes the traditional system of administration. Under this act, the BRE has the power and responsibility over land administration and natural resource utilization except at household level. This includes land allocation and demarcation of boundaries, settling land-related disputes, collection of land taxes and royalties as well as enforcing associated rules and regulations governing access to natural resources such as water bodies, i.e. lakes, rivers, streams, grass, plains, forests, dambos, lagoons, grazing land and forests. There is also a national land Policy and Act that provide for State-owned land and Traditional land. Under this Act all the land in the Barotse Floodplain falls under the traditional authority of the Barotse Royal Establishment. The government allowed the BRE to run the land outside the council areas.

To access traditional land, an application is made to a Senior Headman in the area (Silalanda), who conveys the application to the Litunga through a Silalo Induna. Once approved, the applicant can apply to the Chief for a traditional title deed at a small fee. This practice is widely practiced in Western Province. The power to approve the application and issue a permit lies with the Litunga. When an individual is granted land, he does not really own it but has exclusive access to it for as long as he/she occupies his position within the village. The individual can delineate the land in question to family members, but not sell or mortgage it. Land is also passed on to family members through inheritance. The gender dimension entails that the land is passed on to the first-born child regardless of the sex, making females eligible to land (non-gender biased system of land tenure). This practice has resulted in a long tradition of land inheritance along kinship lines. The BRE representatives can only allocate land that no longer belongs to a particular family. Whilst instances of dispossession are rare, there are a number of land disputes and conflicts, which are usually resolved by the immediate headman, or the higher court of Indunas at the royal palace.

If a man re-locates to another village with all his family members, the abandoned piece of land is re-allocated to other people by the Silano Induna. Because of an increase in population and climate change-related effects, both habitable and arable land in the Barotse Floodplain is dwindling. Because of this, some sections of society perceive the Lozi land tenure system rather cumbersome, that it creates bottlenecks in the allocation of land for development activities such as road construction, and that it prevents access by new comers and returnees. Some development writers on the land tenure in the Western province have tended to caution the land tenure system in the province therefore.

Land allocation in this traditional system provides de facto ownership to the applicant, though there is no de jure ownership thereby preventing the sale of the land or its use as surety for a loan. When new land is allocated from the customary authority, it is common for water bodies to be used as boundaries for land plots to maximize the number of water users (Chileshe et al., 2005).

On the other hand, interviews with some members of the project-affected communities indicate that the prevailing customary land tenure system in the Barotse Flood Plain is preferred to the leasehold tenure system on account of the fact that it allows equal access to the canals, ox-bow lakes and grazing lands by all cattle owners. Most people interviewed indicated that as long as one belonged to a land-owning family then the land will be passed on to future generations.

In fact during the consultative meeting on 12<sup>th</sup> September 2013 between the Kuta, the team of consultants, Induna Katema, who is in charge of land administration for the Barotse Royal Establishment (BRE) summarized the position of traditional authorities on land tenure as follows: "The issue of land tenure system brought on the fabric of our existence as a people. If you destroy our land tenure system, you destroy our people. With this system, everyone in Barotse land has access to land. There are neither poor landless people nor rich who can buy a lot of land. Our system of land tenure guarantees land ownership, so no one should temper with our land."

There is a national land Policy and Act that provide for State-owned land and Traditional land. Under this Act all the land in the Barotse Floodplain falls under the traditional authority of the Barotse Royal Establishment. The government allowed the BRE to run the land outside the council areas.

Lessons from the Sefula and Namushakende Rice Irrigation Schemes, where irrigation infrastructure is not used to its full potential, points to problems related to the traditional land tenure system. Farmers only have access to the land and do not own it so they do not have access to credit needed to commercialize cultivation. Lessons learned from the Sefula and Namushakende irrigation schemes is that with the rice farming systems, women have significant roles to play in land clearing, planting, harvesting and marketing and therefore, new irrigation projects promoting rice schemes ought to analyze the important role that women play in growing rice so that efforts are made to lessen their burden.

#### LAND TENURE KEY ISSUES

As far as local inhabitants are concerned there have been no serious land conflicts in the areas of study.

However, in some areas, discussions with communities also revealed that the land tenure system prevailing in the area does not favour the people because members of the royal family own most of the arable land and local people have only access to portions of it but have no control over it. These communities are not happy with the arrangement as they feel like caretakers only.

One other issue that was raised during social surveys and workshops is the fact that lands are allocated for life to people by the customary authority. People own land regardless if they use it or not. This leads to issue regarding the maintenance of canals since some owners do not feel concerned by canal maintenance because they are not using land for crop. People have mentioned that segments of canals would remain un-maintained or that some people would be opposed to canal maintenance because they were not using land for agriculture and did not see the incentive to clean their sections of the canal.

#### ADAPTATION TO CHANGE ASSESSMENT

In order to characterize impact on sociological component, develop mitigation measures and assess resistance to change of a component (see next chapter), it is important to describe people's perception of their land tenure system.

- ▶ how do local communities value/perceive their land tenure system?

The land tenure system is one of the main political and economical issues in the Barotse area. It is still under the strict control of the BRE, which is very attached to this control. In fact, it is the only real power remaining under the BRE. This can explain why the land tenure is very important for this institution. During every workshop and meeting held during this study, the BRE representatives insisted on the importance of keeping the traditional land tenure system. They emphasize on their refusal of selling the land to any company or non-Lozi investor, as to keep the land for the livelihood of the local farmers.

- ▶ do local communities and NGOs engage in activities in order to improve land tenure system?

Some private companies and investors are willing to change the land tenure system in order to be able to buy land and create industrial farms. They are encouraged in this direction by the Central Government, which has the will to develop a more productive and profit oriented agriculture in Western Province.

NGOs and the Local Government do not want to engage in any activities which would directly aim at changing the land tenure system. Because by doing so they would enter in frontal conflict with the BRE, which they have to avoid if they want to continue working in the area.

The communities as a whole do not complain about the land tenure because they see it as protecting their right to a free access to the land, and prevent them from land grabbing by private or public institutions.

Some young individuals complain that the only land that they can access through the BRE are very remote and unproductive land on the upper land, as all the fertile fields in the plain are already attributed. Due to the gerontocratic structure of the traditional power, the youth have very few ways of changing the land tenure system.

- ▶ are people ready in terms of human resources and technical capacity and are there willing to adapt to changes regarding land tenure system?

It was clear from the discussion during the second stakeholder workshop that there is really two radically opposite opinion within the people on the land tenure issue. On one side the majority of the rural people and the BRE, who are not willing to change or to adapt to change regarding the land tenure system. On the other side a minority of urban and business oriented people wants to change the system, so they can buy land to build commercial, industrial or farming infrastructures. Presently the BRE is still powerful enough to keep this position, but the situation can change in future years. With population growth and the attraction of the people to consumerism, the pressure on land might increase, forcing the BRE to change the system.

The Sefula rice scheme is a good example of a project which partly failed because of resistance to change on the land tenure issue.

In conclusion, local communities and the BRE are highly resistant to change regarding land tenure system.

## 5.8 BUILT ENVIRONMENT : INFRASTRUCTURE IN THE FLOODPLAIN

### 5.8.1 Mongu Harbour

In the floodplain, Mulambwa Harbour handles goods destined for Kalabo as well as incoming goods that include fish, milk and other products from the Barotse Plain.

### 5.8.2 Roads

#### MONGU-KALABO ROAD

The Mongu-Kalabo all weather road (34 km long) is a major under-construction infrastructure which starts from Mulambwa Harbour crossing the Zambezi River at Liyelele Harbour and ending in Kalabo district in Tapo where it will join with the existing road to Kalabo. It is also envisaged that the same road will be linked to the Kalabo/Sikongo and it is hoped this will open the trade links with Angola.

The road at first was being constructed by a Kuwait Contractors who has since been relieved of the contract on lack of technical experience of managing roads in such conditions like Barotse Flood Plain. This project is reported to be the biggest and longest embankment road in Zambia after the Tuta Bridge on the Luapula River in Central and Luapula Provinces. Currently, there is a motorized pontoon at Liyelelo servicing the east and west banks of the Zambezi River while the Matongopontoon on the Limulunga-Libonda Road is out of service.

This road was subject to an Environmental Impact Statement in accordance with Zambian regulations.

#### MONGU - LUKULU ROAD

There are plans to build the Mongu-Lukulu all weather road through the plain via Ushaa and Limulunga along the Barotse plain edge.

#### MONGU- SENANGA ROAD

The existing 103 km bituminous road that links Mongu to Senanga follows the plateau parallel to the floodplain.

This road was subject to an Environmental Impact Statement in accordance with Zambian regulations.

#### CITY ROADS

Mongu township roads cover 46.8 km of which 14.8 km are bituminous whilst 30 km are earth and sand and 2 km are gravel roads.

#### SAND ROADS

There are many sand roads in the floodplain that are used by local population. These roads are in poor condition and are only accessible by four-wheel drive vehicles.

The vast area between the Malile and the Zambezi is inaccessible by vehicles as there is no bridge.

### 5.8.3 Other canals and waterways in the area

Besides the six major canals that the Project focuses on, there are other canals which link settlements. These are Namitome, Sefula Main, Lewanika, SefulaMusindi, Sibata, Kilaka, Litondo, Kandala, Lole, Sanjali, Kama, Limangula and Mutalaeti.

The major waterway is the Mongu-Kalabo canal which starts at Mulambwa Harbour and is maintained by the Ministry of Transport, Works, Supply and Communication. The harbour is currently the second busiest harbour in Zambia after Mpulungu. With the establishment of an official border crossing at Sikongo, it is envisaged that there will more trade between Zambia and Angola. Hence, Mulambwa Harbour would be able to receive goods through the Kalabo/Luanginga waterway that ends up at Mulambwa Harbour.

Currently in the absence of all-weather roads, the Mongu-Kalabowaterway is the only direct link between the west and east banks of the Zambezi River for now.

## 5.8.4 Telecommunication

In terms of telecommunication, it was observed that Mongu District has three major mobile phone companies providing services, namely ZAMTEL, MTN and Airtel. The services remain poor in some areas of the Floodplain due to the topographic constraints. In other areas like Lwatile, Nalusa, Matongo and Lealui networks can be accessed on higher ground such as mounds.

## 5.9 NOISE AND VIBRATION

There are no data regarding noise and vibration in the Study area. However, there are no known sources of industrial activities in the Barotse plain.

## 5.10 FAUNA

### 5.10.1 Terrestrial and wetland species

#### 5.10.1.1 Mammals

##### LARGE HERBIVORE AND AQUATIC MAMMALS

The following table presents the common mammals present in the Barotse floodplain according to the Wildlife Department in Mongu. However, herbivores such as the Zebra, Wildebeest and the Hyena were reported by local population to be absent from the eastern side of the Barotse plain. Such wildlife is common the Liuwa Plain National Park and likely to be present in the West Zambezi Game Management Area, large terrestrial mammals found in the Barotse floodplain would most likely be immediately hunted by local population. The study area is not located in a migratory corridor for large herds of herbivores.

Table 7 common mammals present in the Barotse floodplain according to the Wildlife Department in Mongu

English name	Scientific name	Lozi name	IUCN status/population trend
Hippopotamus	Hippopotamus amphibius	Kubu	Vulnerable/decreasing
Sitatunga	Tragelaphus spekii	Sitatunga	Least concern/decreasing
Red Lechwe	Kobus leche	Lizwii	Least concern/stable
Reedbuck	Redunca sp.	Mutobo	Least concern/stable
Spotted-necked otter	Lutra maculicollis	Nibi	Least concern/decreasing
African clawless otter	Aonyx capensis	Mbao	Least concern/stable
Zebra	Equus quagga	Mpizi	Least concern/stable
Wildebeest	Connochaetes Taurinus	Kokomu	Least concern/stable

English name	Scientific name	Lozi name	IUCN status/population trend
Hyena	Crocuta crocuta	Sitongwani	Least concern/decreasing

The study area offers valuable habitats for water dependent mammals. During field visits carried out in September 2013, Hippopotamus and Spotted-necked Otters were observed (directly or through traces). Hippopotamus occupy riverine grassland along the Zambezi and otters occupy rivers and large perennial wetlands.

The following tables summarize herbivores, aquatic mammals and habitat characteristics and assess their values.

Level of intactness is also described in the next table, this will help in describing impacts in the next chapter. Level of intactness refers to existing disturbances in the Study area.

Three threshold levels are defined: Low, Moderate and High value components.

Herbivores	Explanation
Ecological value of the study area for herbivores	
Low	There is no large number of herbivores in the study area, since it is not a protected area. Also, human illegal subsistence hunting and poaching greatly limits the possible presence of such animals. The area is not a migratory corridor for any large mammals.
Level of intactness of herbivore habitats	
Low	The study area characteristic does not allow for human-large herbivore cohabitation (hunting, poaching, etc.).

Aquatic mammals	Explanation
Ecological value of the study area for aquatic mammals	
High	The Barotse floodplain is rich in wetland diversity and riverine wetlands are home of a large number of Hippos. Perennial wetlands are valuable habitat for otters.
Level of intactness of aquatic mammals habitats	
High	Riverine wetlands are difficult to access and human encroachment is limited to few grazing and fishing activities. Perennial wetlands, habitat of otters are not utilized by human and are not fragmented.

#### SMALL MAMMALS

According to Timberlake (1998) only few small mammals (insectivores, rodents) are present in the Barotse flood plain, probably due to regular fire, human depredation for food and the annual flood. Another explanation could come from the absence of trees and thickets limiting shelter for small mammal and increasing depredation by birds of prey (especially by the Black Kite, frequently observed in the plain). The following table presents the small mammals potentially present in the study area.

Table 8 Potential small mammals in the barotse floodplain

English name	Scientific name	IUCN status
Damara molerat	Cryptomys damarensis	Least concern/stable
Water rat	Dasymys incomtus	Least concern/unknown
Pouched mouse	Saccostomus campestris	Least concern/stable
Bushveld gerbil	Tatera leucogaster	Unknown

Source: Timberlake, 1998

The following table summarizes small mammals and habitat characteristics and assesses their values.

Small mammals	Explanation
Ecological value of the study area for small mammals	
Low	The Barotse flood plain does not offer many valuable habitats for small mammals, the lack of thickets and forest restrain their distribution. In the mean time they suffer from subsistence hunting.
Level of intactness of small mammals habitats	
Low	Small mammals in the study area occupy human anthropogenic habitats.

#### BATS

Regarding bats, Timberlake (1998) has noticed the attractiveness of wetlands for bats, especially when trees are present such as Dambos sites. In total, 26 species have been reported in the Barotse flood plain along the eastern edge of the flood plain during a two week survey in 1998 (Timberlake). Floodplain edge is planted with mango trees and a few native trees are present. Rotting fruits attract insects making it an interesting hunting ground for bats. Inside the floodplain, trees where bats can roost are rare and the few trees present are around villages making bats prone to persecution, their diversity must be lower moving away from the edge. The list of observed species is in Annex 5. None of the species has a vulnerability status (IUCN, 2013).

The following table summarizes bad and habitat characteristics and assesses their values.

Bats	Explanation
Ecological value of the study area for bats	
Moderate	The few trees on the Barotse flood plain do not offer much roosting habitat for bats. However, wetlands nearby the edge of the plain are the most valuable habitats for bats as they offer hunting ground and nearby mango trees and human structures offer shelters and food for bats
Level of intactness of bat habitat	
Moderate	Bats rely on anthropogenic structures for shelters (roofs, abandoned houses and building) and food (mangos). The quality of wetlands offer them a steady sources of insects.

### 5.10.1.2 Herpetofauna

The Barotse being covered with wetlands and grassland is a habitat rich in herpetofauna biodiversity. According to Timberlake (1998), there are three categories of reptiles and amphibians:

- ▶ purely aquatic species, dependent on a certain permanent water level;
- ▶ wetland species, dependent on a certain level of humidity;
- ▶ savanna species, living on dry land and retreating with the floods.

The Barotse floodplain has the richest aquatic/flood plain herpetofauna in the Zambezi basin with a total of 89 species with 3 species of terrapins/tortoises, 19 lizards, 4 worm-lizards, 30 snakes, the crocodile, and 32 species of frogs and toads (Timberlake, 1998). The complete list of species is provided in Annex 7.

Water dependent reptile and amphibian are sensitive species in the study area. So far, the lack of mechanized agriculture, the lack of pesticide usage and the relative intactness of many wetlands have allow a great diversity of amphibians and reptiles to thrive. In the mean time, these species are very sensitive to change, being less mobile and dependent on water quality.

Few information is available on life cycle of reptiles, some of them lay their eggs in November-December, eggs hatch in January-March. More information is available about amphibians: males start their calling songs when the rainy season starts (Timberlake, 1998).

The following table present the common herpetofauna species present in the study area according to the Wildlife Department in Mongu.

English name	Scientific name	Lozi name
Nile crocodile	Crocodilus Nileticus	Kwena
Water Monitor	Varanus salvator	Hopani
Serrated hinged terrapin	Pelusios Sinuatus	Kulu
Python	Python natalensis	Mboma
Swamp viper	Bitis nasicornis	Sibili
Red toads	Schismadermacarens	Simbotwe

An endemic frog species with very limited range, the Mongu shovelnose frog (*Hemisus barotseensis*) is known from the site (Leonard, 1998). It is classified as “data deficient” from the IUCN Red List of Threatened Species since it has only recently been discovered, only a few specimens have so far been found and its population status is not clear (IUCN, 2014). It has been recently described and, although its range has been delineated with limited information, it covers the study area and the species presumably occurs in Liuwa Plain and Lochinvar Parks (IUCN, 2013). This wetland species is a burrowing frog living most of his life underground. Eggs are deposited in a burrow, tadpoles are released when the nest floods toward the mud surface to water (Channing & Broadley, 2002).

Figure 14 Mongu shovelnose frog



*Hemisus barotseensis* (source : Channing & Broadley, 2002)

The following tables summarize wetland, aquatic and savanna species and habitat characteristics and assesses their values.

Level of intactness is also described in the next table, this will help in describing impacts in the next chapter. Level of intactness refers to existing disturbances in the Study area.

Three threshold levels are defined: Low, Moderate and High value components.

Aquatic and wetland species	Explanation
Ecological value of the study area for aquatic and wetland species	
High	Wetlands and rivers are all highly valued habitat for herpetofauna (see wetland section)
Level of intactness of aquatic and wetland species habitat/current issues/resilience level	
Moderate to high	Riverine wetlands and perennial marshes are highly intact while wet grassland are moderately intact (see wetland section)

Terrestrial species	Explanation
Ecological value of the study area for terrestrial species	
Low	The study area offers vast grassland for terrestrial species. However, the annual flooding limits the number of species.
Level of intactness of terrestrial species habitat	
Low	Constant grazing and grassland fires, and human persecution greatly reduces the value of the study area for terrestrial species.

### 5.10.1.3 Wetland dependent insects

Insects of the Barotse floodplain have been poorly studied and few information was found regarding their diversity. Odonates such as damselflies and dragonflies are wetlands dependent and many species have been observed in the plain by the ESIA Expert. Some butterflies (Lepidoptera) are also wetland dependent. Timberlake (1998), has carried out Odonata and wetland Lepidoptera surveys in the Barotse floodplain. They are presented in Annex 8.

Many wetland dependent insects find part of the life cycle linked to water. For example, Odonata lay their eggs clinging on leaves in the water and their larval stage takes place in the water. Wetland emergent plants are important for Odonata as they provide perches sites and sites where juvenile moult into adult. It has been estimated that to maximize Odonata diversity a buffer zone around wetland of 20 meters of emergent wetland plant must be protected from destruction when implementing a Project (Samways & Steytler 1996 quoted by Timberlake, 1998). Odonata are also very sensitive to wetland pollution from agricultural activities.

Odonata population trend vary according to the annual flood, many species thrive at the beginning of the wet season, however when water overflows rapidly, many cannot survive fast flowing waters. Mating of Odonata has been observed by the ESIA Expert during the dry season, when emergent plant are fully available and water temperature adequate for eggs. However, very limited information has been found regarding sensitive periods of the life cycle of Wetland dependent butterflies. It seems that some wetlands dependent butterflies are at their butterfly stage in late spring early summer.

Wetland dependent butterflies rely on host wetland plants as larval food such as the Polygonum, however, unlike Odonata their life cycle does not involve water.

The following tables summarize wetland dependent insects and habitat characteristics and assesses their values. Level of intactness is also described in the next table, this will help in describing impacts in the next chapter. Level of intactness refers to existing disturbances in the Study area.

Three threshold levels are used: Low, Moderate and High value components.

Wetland dependent insects	Explanation
Ecological value of the study area for aquatic and wetland species	
High	Wetlands and rivers are all highly valued habitat for water dependent insects (see wetland section)
Level of intactness of aquatic and wetland species habitat	
Moderate to high	Riverine wetlands and perennial marshes are intact while wet grasslands are moderately intact (see wetland section). These habitats are the important for water dependent insects since they are occupied by tall grasses where Odonata reproduction and moult take place. Many wetland plant species are larval food source for butterflies.

### 5.10.1.4 Identification of species with special status

According to Timberlake (1998), some species in the Barotse floodplain are rare, regional-endemic or have an IUCN protection status. The following table summarizes information of these species and describes their habitat requirements. Species highlighted in grey are the only one that are really of concerns because of their very limited range, their IUCN protection status and because their habitat may be affected by the Project.

Table 9 Species with special status

English name	Scientific name	Status	Habitats
<b>Bat</b>			
Chapin's Free-tailed Bat	Chaerephon chapini	Rare in the Barotse but Least concern according to IUCN due to wide distribution	Savanna habitats and river valleys and intact woodland
Dark-winged Lesser House Bat	Scotoecus albigula	Rare in the Barotse but Least concern according to IUCN due to wide distribution	Roost in houses, hunt along stream, poorly known species
Botswana long-eared bat	Laephotis botswanae	Rare in the Barotse but Least concern according to IUCN due to wide distribution	Dry and moist savanna in the vicinity of rivers. prefers habitat at higher elevation
Melck's pipistrelle	Pipistrellus melckorum	Rare in the Barotse but Data deficient according to IUCN	Dry and moist savanna, roosts under building roofs
Kuhl's pipistrelle	Pipistrellus kuhli	Rare in the Barotse but Least concern according to IUCN due to increasing population and wide distribution	Forages over a variety of habitat including agricultural areas, usually associated with human settlement
<b>Reptiles &amp; amphibians</b>			
Chobe Dwarf Gecko	Lygodactylus chobiensis	Endemic to the Zambezi Basin	Moist savanna, abundant on tree trunks such as acacia
Barotse Burrowing Skink	Typhlacontias gracilis	Endemic to western Zambia	Lives under leaf litter of sandy area
Spotted-neck Snake-eyed Skink	Panaspis "maculicolliis"	Northwestern range extension for this small species	Inhabits dry savanna and is found under rocks and logs.
Barotse Legless Skink	Typhlosaurus jappi (syn. Acontias kgaladi)	Endemic to Barotseland	Unknown
Barotse Snout-burrowing Frog Also named Mongu shovelnose frog	Hemisus "barotseensis"	Supposedly Endemic to Barotseland	Typically inhabiting floodplains
<b>Wetland dependent butterflies</b>			
	Mylothris bernice overlaeti	Vulnerable	Marshes, food plant: Polygonum sp.
Dark Marsh Acraea	Acraea mirifica	Vulnerable	Riverine grassland
	Acraea periphanes	Vulnerable	Wet grassland
Beautiful Zebra Blue	Leptotes pulcher	Rare	Marshes
Fontain's Gem	Zeretis fontainei	Vulnerable	Dambos
Scarce Gem	Zeretis sorhagenii	Vulnerable	Dambos

Adapted from Timberlake, 1998

## 5.10.2 Fish

This section describes fish species present in the Barotse flood plain and the importance of fishes in the studied canals. It also studies fishery activities.

Information regarding fishes and fisheries were provided by Gordon Mudenda, Fish expert.

Three methods were used to study fish and fisheries that include literature review; site visits to the canals; and conducting structured interviews with key stakeholders fishermen operating in the vicinity of the canals. There is limited published literature on the Upper Zambezi Fishery. Most of the documents reviewed are commissioned consulting study report for the Upper Zambezi Fishery.

A site visit to the project areas was conducted from September 16th to September 21st 2013 during which all the canals that are designated for rehabilitation were inspected. During this period, discussions were also conducted with fisheries officials based in Mongu in order to get an impression with regard to what is taking place in the fishery. Interviews were conducted with fishermen operating in the vicinity of the canals at the following villages: Kataka; Luaala; Mwandi; Nalumino; Nalusa; Namuka and at Wandu.

### 5.10.2.1 Fisheries

Even though Zambia is landlocked, fisheries are important for the national economy because of the relative abundance of water resources. Fishing also contributes significantly to employment and food production. Fisheries in Zambia contribute about 3 percent of the Gross Domestic Product. Current estimates indicate that over three hundred thousand persons directly or indirectly obtain part of their income from the fisheries sector. Fish is a major food item in the diet of Zambia. According to the Central Statistical Office Living Conditions Survey 2006, fish accounts for 29 percent of the animal protein supply. Fish is an important source of protein for the low-income group because of its relative affordability, in comparison with other animal protein sources such as beef, chicken and pork. In parts of the country without significant livestock, fish is often the only legitimate source of animal protein available.

Annual fishery production in Zambia ranges between 65,000 to 70,000 tonnes, the upper Zambezi representing approximately 10% of Zambia fisheries. (See Annex 3) Annual aquaculture production in 2008 was 6,960 tonnes. Most natural fishery areas either are fully or overexploited, making it difficult to significantly increase fish production to meet the demands of increasing population now estimated at 120,000 tonnes per year.

#### FISHERIES OF THE BAROTSE FLOODPLAIN

Fisheries of Zambia may be divided into three categories: major fisheries; minor fisheries; and fisheries of small water bodies. Major fisheries are: Bangweulu Lakes and Swamps Complex; Kafue Flood Plains; Lake Kariba; Lukanga Swamps, Mweru-Luapula; Lake Mweru wa Ntipa; Lake Tanganyika; and the Upper Zambezi Floodplain. Minor fisheries include Lake Itezhi-tezhi; Lake Lusiwashi; and the Lower Zambezi. Fisheries of small water bodies include several small rivers; seasonal streams and small reservoirs scattered throughout the country. Aquaculture output could be considered as component under this category.

The Upper Zambezi Fishery is one of the major fishery areas of Zambia. Its annual catch is usually ranked from third to sixth depending on catches from other fishery areas in a year.

The Upper Zambezi Fishery is divided into five strata. This division is to facilitate collection of fisheries statistical data aimed at estimating total annual fish catches:

- ▶ Stratum 1 is situated in the northern part of the fishery and covers areas around Lukulu.
- ▶ Stratum 2 covers the areas around Mongu and some parts of the stratum are in Kalabo district.

- ▶ Strata 3 and 4 are located in Senanga district and
- ▶ Stratum 5 covers the Southern parts of the fishery, the area around Sesheke and Mwandji. This stratum lies on the boarder between Zambia and Namibia.

The canals that were the main component of this investigation are located in stratum 2.

The highest catches are recorded in stratum 2 of the fishery. This situation is considered to be influenced by the fact that this part of the Upper Zambezi has the highest population density.

#### FISHING PRACTICES AND CRAFT

According to observation during 2013 site visit and discussions with fishermen, fishermen on the Barotse Floodplains use the following fishing methods and gears: gill netting using nets of different meshes; beach seining at limes using shade material (locally known as sefasefa); hooks; traps; fishing baskets and at times spears are used. The following fishing craft are used in the area and include dugout canoes; plank boats; fibreglass boats sometimes referred to as banana boats and metal boats.

According to the Department of Fisheries, the importance of each type of fishing crafts in the Upper Zabezi Fishery is as follow.

*Table 10 Number of different types of fishing craft, fishing villages and fishermen between 1975 and 2012*

Year	Canoes (#)	Plank boats (#)	Fibre glass boats (#)	Metal boats (#)	Total number of boats	Fishing villages (#)	Fishermen (#)
2012	1,268	71	37	20	1,396	142	1,056
1996	1,359	-	9	-	1,368	270	1,225
1993	1,997	47	7	-	2,051	324	2,292
1987	2,618	1	9	2	2,630	400	2,929
1976	2,100	56	1	-	2,157	593	3,209

Source: Department of Fisheries: Reports of the Statistics Unit

The dugout canoe is the most common fishing boat used in the fishery. Numbers of all types of fishing boats used in the fishery have decreased since 1976. There has also been a decrease in the number of fishermen and fishing villages. Fish catches have however increased during the same period (see next section). This may show that fishermen have increased their efficiency over the period. Another explanation is that the Barotse fishery is highly seasonal and the number of fishermen that are surveyed during a frame survey depends on the period when they are enumerated. During the wet season, for instance, fishermen tend to abandon the fishing villages and camps as the floodplains are flooded. During the dry season, most fishermen return to their fishing camps. When the catches begin to decrease significantly, they slowly begin to leave the fishing camps.

The following table shows the different types of fishing crafts per district in the Upper Zambezi Fishery.

*Table 11 Number and different types of fishing craft, fishing village and fishermen recorded in the Upper Zambezi Fishery in 1996 by district*

District	Canoes (#)	Plank Boats (#)	Fibre Glass Boats (#)	Fishing Villages (#)	Fishermen (#)
Senanga	700	28	-	96	742

Lukulu	232	-	-	85	403
Sesheke	501	1	5	49	512
Mongu	245	18	2	37	279
Kalabo	319	-	-	57	356
<b>Totals</b>	<b>1,997</b>	<b>47</b>	<b>7</b>	<b>324</b>	<b>2,292</b>

Source: Chitembure 1998

Fishing in the Upper Zambezi River fishery is not evenly distributed. Some parts of the fishery are more fished than others. Fishing pressure is largely influenced by the population size in a district and accessibility to urban markets. Senanga and Sesheke recorded highest numbers of fishermen and canoes. This could be attributed largely to how accessible fishermen operating in these areas are to urban markets. The small number of fishermen in Mongu is due to the small area of the floodplain in this district.

The following table shows that between 1993 and 1996, the number of gill nets has almost triple in the region. This device causes decline in fish population as it enables fishermen to catch juveniles.

Table 12 Number of different fishing gears recorded in sections of the Upper Zambezi Fishery in 1993 and 1996

Stratum	Gill Nets (#)		Seines Nets (#)		Hooks (#)*		Traps (#)*		Baskets (#)*	Spears (#)	
	1993	1996	1993	1996	1993	1996	1993	1996	1993	1993	1996
1	1,852	5,302	37	56	0	95	117	50	564	557	13
2	620	1560	26	282	11	8	-	217	2	20	47
3	1,486	925	169	144	160	74	81	100	39	22	18
4	1,169	1168	31	180	-	34	20	118	-	15	22
5	501	2584	1	130	5	142	-	5	-	3	69
<b>Totals</b>	<b>5,633</b>	<b>11,539</b>	<b>264</b>	<b>792</b>	<b>176</b>	<b>353</b>	<b>218</b>	<b>490</b>	<b>605</b>	<b>617</b>	<b>169</b>

Source: Chitembure 1998 ; \* Number of hooks traps baskets and spears used for fishing are obviously underreported.

According to the records provided by the Department of Fisheries, gill nets are the most commonly used fishing gear in the fishery. However, other fishing gears, some of which are destructive and illegal are common in the fishery. Gill nets, baskets and seines fishing gears are illegal fishing equipment according to the Fisheries Act but are very common in the fishery as shown in the previous table.

The 1996 frame survey indicated an increase in the number of commonly used fishing gears such as gill nets and seines. Between 1993 and 1996, total numbers of gill nets, seines, hooks and traps increased by more than 100 %. Such a drastic increase confirms that the increased number of catch per fisherman is caused by increasing numbers of fishing nets.

The frame survey of 2011 (Department of Fisheries Frame Survey, 2011) results reveal that gillnets are still the major fishing gear used on the fishery and there are 14,804 gillnets of which 13,440 are currently being used. The highest number (57%) of these gillnets were recorded in Stratum 2, where most of the canals to be rehabilitated are located, followed by Stratum 5 with 27% while the lowest is Stratum 1 represented by 2%. The second popular gear on the fishery after Gill net is Seine net, while the least are baskets. 45% out of 14,804 gillnets are illegally used for fishing.

The 2011 frame survey shows that fishermen on the fishery use gill nets with mesh size ranging from 1 mm to 5.5 mm. However, according to the Fisheries Regulations of 2012, Gillnet of a mesh size less than 3.0 inches (76 mm), monofilament net of a mesh less than 5.0 inches (127mm) are prohibited fishing nets in the Upper Zambezi fishery. Mesh size has decreased causing over fisheries and higher catch of smaller juveniles and smaller species.

Supply of fishing nets is generally regarded as a problem in the fishery as they are supplied by marketers. Baskets and seines fishing gears are illegal fishing equipment according to the Fisheries Act.

The presence of high numbers of illegal fishing gears show that management of the fishery is weak. In addition, programmes that are expected to collect data required for better management of the fishery are not implemented. There is need for collecting this type of data from the fishery from time to time or once every year. Resources made available to the Department of Fisheries seem inadequate to facilitate implementation of such a programme.

## CATCH

The following table shows the estimated annual catch per boat and per fisherman.

*Table 13 Estimated total number of boats, annual catch, catch per boat and catch per fisherman*

Year	Total Number of Boats	Annual Catch (tonnes)	Annual Catch per Boat	Annual Catch per fishermen
2012	1,396	-	-	-
1996	1,368	6,785	4,963	5,539
1993	2,051	9,240	4,505	4,031
1987	2,630	8,358	3,178	2,853
1976	2,157	5,995	2,779	1,868

Source: Department of Fisheries: Reports of the Statistics Unit

According to the table, there is an increase in the annual catch per boat from 2,779 tonnes in 1976 to 4,963 tonnes in 1996. This is largely due to decrease in the number of boats and fishermen during this period. The results also mean that the number of illegal fishing nets is on the rise.

By combining data from the reported catch with the number of gill nets and seines nets and the catch per year, it is obvious that over the years, the catch per net has considerably declined by a very large margin (see table below). This drop suggests over exploitation of the fisheries resources of the area. The large margins by which catch rates have declined should be of major concern to fisheries management.

*Table 14 Number of gill nets and seine nets combined with an estimate of catch per net in a year*

Year	Reported Catch	Number of Gill Nets & Seines nets	Catch per net per year in kg
1996	6,785	12,331	550
1993	9,240	5,897	1,567

Source: Chitembure 1998

The following table illustrates Fish species composition caught by fishermen' gillnets by number and weight in the Barotse Floodplain.

*Table 15 Fish species composition caught by fishermen' gillnets by number and weight*

Species	#	Percent by Number	Species	Weight (g)	Percent by weight
<i>Clarias ngamensis</i>	26	9.7	<i>Clarias ngamensis</i>	1615	21.96
<i>Cyphomyrus discorhynchus</i>	16	5.97	<i>Cyphomyrus discorhynchus</i>	535	1.73

Species	#	Percent by Number	Species	Weight (g)	Percent by weight
<i>Hepsetus odoe</i>	9	3.36	<i>Hepsetus odoe</i>	573.1	5.51
<i>Hydrocynus vittatus</i>	3	1.12	<i>Hydrocynus vittatus</i>	780	1.48
<i>Labeo lunatus</i>	3	1.12	<i>Labeo lunatus</i>	1365	3.11
<i>Marcusenius macrolepidotus</i>	66	24.62	<i>Marcusenius macrolepidotus</i>	5510	6.44
<i>Marcusenius macrolepidotus</i>	22	8.21	<i>Marcusenius macrolepidotus</i>	1126	2.28
<i>Momyrus laceda</i>	2	0.75	<i>Momyrus laceda</i>	1354	3.13
<i>Oreochromis andersonii</i>	8	2.99	<i>Oreochromis andersonii</i>	863.6	7.67
<i>Oreochromis macrochir</i>	6	2.24	<i>Oreochromis macrochir</i>	4793	5.44
<i>Parauchenoglanis ngamensis</i>	1	0.37	<i>Parauchenoglanis ngamensis</i>	150	0.32
<i>Petrocephalus catostoma</i>	7	2.61	<i>Petrocephalus catostoma</i>	371	0.74
<i>Sargochromis codringtonii</i>	4	1.49	<i>Sargochromis codringtonii</i>	157	2.13
<i>Scilbe intermedius</i>	1	0.37	<i>Scilbe intermedius</i>	80	0.08
<i>Serranochromis robustus</i>	7	2.61	<i>Serranochromis robustus</i>	435	5.4
<i>Synodontis macrostoma</i>	27	10.08	<i>Synodontis macrostoma</i>	186.2	3.44
<i>Synodontis nigromaculatis</i>	1	0.37	<i>Synodontis nigromaculatis</i>	20	0.6
<i>Synodontis nigromaculatus</i>	31	11.57	<i>Synodontis nigromaculatus</i>	1923	4.32
<i>Synodontis woosnami</i>	6	2.24	<i>Synodontis woosnami</i>	784	0.63
<i>Tilapia rendalii</i>	16	5.97	<i>Tilapia rendalii</i>	1082.9	19.11
<i>Tilapia sparmanii</i>	6	2.24	<i>Tilapia sparmanii</i>	1382	4.49
Total	268			25085.8	

Source: Mudenda 2007

None of the fish presented in the table above has a UICN status.

The most important fish caught in term of weight are *Clarias ngamensis*, *Tilapia rendalii* and *Oreochromis andersonii*. The most important fish caught in term of abundance are *Marcusenius macrolepidotus*, *Synodontis nigromaculatus* and *Synodontis macrostoma*.

#### CLOSING SEASON

Closing season to allow fish to mature is implemented from December to February. There are no fisheries in the plain at that time.

#### SURVEY RESULTS

This section presents the results of the interviews conducted and discussions conducted in the Barotse Floodplains in 2013 for the purpose of the ESIA. The main objective of the interviews conducted was to demonstrate the importance of the canals in relation to fishing.

Among the 14 fishermen that were interviewed, there was a wide range in the age groups. The youngest interviewed was 25 years and the oldest was 65 years old. The average age was estimated 47 years indicating that most of the fishermen have relatively long experience in the industry. The number of years of fishing ranged from 2 to 36 with an average of 17 years. Most of the fishermen interviewed have spent most of their time fishing on the Barotse Floodplains only two have fished on other water bodies such as the Kafue Floodplains.

It was also observed that none of the fishermen interviewed had a fishing license. In addition, they did not receive any short courses in fishing, offered by the Department of Fisheries. Fishermen obtain permission for their fishing operation from the local Induna. This is an indicator of the weaknesses in the current management system for the fishery. It is also an indicator that if the management of the fishery should work, the BRE should actively be involved in the formal management of the fishery.

Most of the fishermen interviewed are completely dependent of fishing for their livelihood. Only 6 out of the 14 fishermen interviewed were involved in other activities which included: growing crops; rearing animals; producing charcoal; and selling groceries in fishing camps.

The number of fishermen that were interviewed is relatively small to provide a true picture of what is taking place in the fishery. It is, however, clear that farming is the main other source of livelihood. One fisherman interviewed was involved in farming crops and owns fifty head of cattle. A few fishermen were involved in trading and farming vegetables.

All the fourteen fishermen that were contacted had illegal fishing gears in their possession, nets that are prohibited in the fishery. They had nets with small mesh sizes and in addition out of the fourteen interviewed, five had seine nets another fishing gear not recommended for use in the fishery.

When asked to indicate the major problem in the area, fishermen pointed out that low fish catch rates was the most important problem in the fishery. They also pointed out that prices offered by buyers for fish and theft of fishing gear are some of the problems in the area. Theft of nets is a problem mainly because most the areas that were surveyed were close to Mongu and easily accessible. The situation could be slightly different in remote parts of the area.

Concerning the use of the canals by the fishing industry, all the fishermen interviewed gave similar responses. The canals are important for the fishing industry in the area for facilitating of fishermen to the fishing grounds and transporting the fish to the markets. Canals are also important in the fishery because traders are able to come to fishing camps in the area.

According to interviewed fishermen, rehabilitation of the canals is not going to negatively impact their fishing operations. Many of them believe that the proposed rehabilitation of the canals is going to enhance their fishing operations and improve their livelihoods.

#### CURRENT FISH ISSUES IN THE STUDY AREA

In Barotse land, the natural resources are traditionally managed by the BRE. According to the law, some Governmental structures should have taken the responsibility for this management, but in fact the BRE still has a strong power. Regarding to environmental protection this traditional management has pro and cons.

To keep the traditional land tenure system, the BRE strongly refuses to sell the land to any company or private investor. This system has prevented the implantation of any industries or large-scale farming activities in the area. By doing so, it has preserved the area from any major source of pollution or industrial environmental damage. The area is still in a relative good state, with few heavy infrastructures damaging the natural landscape.

On the other hand, the enforcement of regulation on fishing and hunting is also ensured by the BRE. The Zambian Wildlife Authority (ZAWA) and the Fisheries Department are the Governmental institution supposedly in charge of this enforcement, but they have very little power on the ground. The Indunas in charge of this enforcement do not have any budget to operate, so are very prone to corruption to ignore the fishermen using illegal gears. This situation led to poor enforcement of the regulation, with overfishing and the majority of the population doing illegal practices, like fishing with mosquito net. This uncontrolled situation has rapidly led to the depletion of resources and today fish stocks have reached a critical low point.

### 5.10.2.2 Fishes

The Upper Zambezi, as is the case with the rest of Zambia has three seasons: a hot dry season from August to October; a cool dry period from May to July and a rainy season from November to April. From September to November the Upper Zambezi has its minimum water level and the waters of the Zambezi are confined to the main river channel. High water levels are usually observed between March and May. The flood peak is usually recorded in April.

The Upper Zambezi Fishery is a typical flood plain fishery. Spawning of the fish is normally stimulated by the first rains and breeding of the fish takes place when water levels are rising. The high water levels provide an ideal nursery areas facilitating survival of larval and juveniles. During the flood, canals become channels to reach spawning grounds throughout the plain. Areas with emergent tall grasses are favoured.

From March to May, the Barotse Floodplains are flooded. At the beginning of the flood, fishes move from the Zambezi and Malile into wetlands and canals where they spawn. The high floods offer protection to the growing fry in the fishery. This is therefore the period when the fish both juveniles and adults suffer little mortality from predation and fishing because of the protection from high water levels.

The low water seasons is classified as the sensitive period because during this period, fishes are confined to reduced water volumes. During this period of low water levels, predation can be considered to be high and fishing operations are more effective compared to periods of high water levels.

In comparison with other fishery areas of Zambia, there has been little effort to investigate the fish biodiversity of the Barotse Floodplain. Fish species of the Barotse Floodplains were first described by Weiss in 1970. Other documents that provide a description of the fishermen of the Barotse floodplain include Sketon 1993, 2001 and SAIAB reports of 2002 and 2003.

The Upper Zambezi fishery has rich fish diversity and one hundred and three species of fish have been recorded with Cichlids and Cyprinids contributing to the largest number of species.

A list of fish species of the Upper Zambezi is provided in this report in Annex 2. Fishery areas in Zambia where fish species of the Upper Zambezi are found are also listed. Compilation of the list of fish species of the Upper Zambezi is based on Jackson (1961) Skelton (2001) and Utsugi and Mazingaliwa (2002).

The following table presents the number of fish families in the Barotse flooplain based on Weiss (1970) and SAIAB (2002, 2003) and Skelton (2001).

Table 16 Number of fish species recorded from the Barotse Floodplains by family

Family	Number of species	Percentage by Species number
Mormyridae	6	5.83
Kneriidae	1	0.97

Family	Number of species	Percentage by Species number
Characidae	6	5.83
Citharinidae	3	2.91
Cyprinidae	30	29.13
Clariidae	5	4.85
Mochokidae	9	8.74
Bagridae	9	8.74
Cichlidae	29	28.16
Mastacembelidae	1	0.97
Malapteruridae	2	1.94
Schilbeidae	2	1.94
Total	103	

Twelve fish families are represented in the Barotse Floodplain as indicated in the table above with a total of 103 species of fish. Families with the largest number of species are Cyprinids followed by Cichlids. Other common species in the area belong to the families Mochokidae, Bagridae, Characidae and Clariidae. Cyprinids are fish species associated with river environments and Cichlids prefer relatively calm waters. The complete list of species is provided in Annex 2.

An observation that may be made by examining the fish composition of the Upper Zambezi Fishery is that the dominant fish families particularly the Cichlids are resistant and should be able to withstand harsh environmental conditions such as increased silt, turbidity and reduced oxygen concentrations. In fact, most species of the Upper Zambezi Fishery are also found in other major water bodies where water quality is of poor quality such as the middle and Lower Zambezi and the Kafue Floodplains.

#### FISH HABITAT

There has not been a fish sampling programme on the Barotse floodplains whose objective was to determine if the some species of fish prefer the canal environments compared to other habitats of the floodplains. However, experience from other fish sampling programmes, indicate that river channels, with relatively fast flowing waters are poorly inhabited with fish. Fishes of such floodplains prefer lagoons with vegetation.

Table 17 Fish families and their habitat

Month	Presence in canal during the dry season	Period of work Restriction											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
<b>Fish Groups</b>		Spawning		High water Levels				Low water levels				Spawning	
Mormyridae (Snoutfishes)	no	Fishes of this family prefer calm and relatively deep waters. Very unlikely to be present in canals with fast flowing waters.											
Kneriidae (Kibnrias)	no	Very rare family in southern Africa. One species, Kneria polli, considered present in the Upper Zambezi river system otherwise this a rare family in the area.											
Characidae (Characins)	yes	Fishes of this family are strongly riverine and are good hunters. It is very likely that these species can dominate canals hunting for prey fishes											
Citharinidae (Citharines)	no	The family is relatively more common in the lower and middle Zambezi. In the Upper Zambezi, it is represented by the genera Hemigrammocharax and Nonnacharax											
Cyprinidae (Labeos and Barbs)	no	This group consists of fish of river environments. The family prefers relatively fast waters. Unlikely to be present in canals since flow is low, species prefer fast flowing water and rivers											
Clariidae (Catfishes)	yes	The group is composed of powerful hunters that can survive in dirty, poorly oxygenated waters. Its likely to be very common in canals and other parts of floodplain											
Mochokidae (Squeakers)	yes	The family is common in slow moving and vegetated waters such as canal. Unlikely to be common in canals where vegetation has been removed											
Bagridae (Bagrids)	yes	The family is common in slow moving and vegetated waters such as canal. Unlikely to be common in canals where vegetation has been removed											
		Spawning		High water level				Low water level				Spawning	
Cichlidae (Cichlids / Breams)	no	Cichlids prefer calm waters. They are thought to be the main species of African lakes. They are likely to be present in canals with slow moving waters											
Mastacembelidae (Spiny eels)	no	Lives in vegetation along margins of flowing rivers. Very rare species and unlikely to be common in canal systems. One species of the family Aethiomastacembelus frenatus considered present in the Barotse Floodplains											
Malapteruridae (Electric catfishes)	no	Common in the middle and lower Zambezi. It is considered that same species are present in the Upper sections of the Zambezi.											
Schilbeidae (Butter Catfishes / Silver Barbel)	yes but not abundant	Shoals in standing slow flowing open waters with emergent or submerged vegetation. Likely to be present in the study area but not abundant in canals.											
			Critical period		Sensitive period			Less sensitive period					

### VALUE OF THE CANALS FOR FISHES

The ecological value of each canal relating to the fishery was assessed based on the number of fishing camps that a canal services and the size of the canal as well as the connection between the canal and natural rivers such as the Malile. From the fisheries perspective, and size of the canal, it was therefore considered that the Fisheries canal in its section connected to the Malile River is the most important fish habitat. The Lubitamei is considered the least important fish habitat.

Studied canals are not important as spawning grounds, this can be explained because fishes of floodplain tend to prefer lagoons that have emerging vegetation and this is not the case with most area of studied canals.

The following tables assess ecological values of each canal.

Level of intactness is also described in the next table, this will help in describing impacts in the next chapter. Level of intactness refers to existing disturbances in the Study area.

Three threshold levels are used: Low, Moderate and High value components.

<b>Fisheries canal</b>	<b>Explanation</b>
Ecological value of Fisheries canal for fishes	
High	The fisheries canal is directly connected to the Malile river; therefore, it is an important fish habitat.
Level on intactness of Fisheries canal for fishes	
Moderate	The canal gets small towards the main lands and is silted on the eastern side.

<b>N'gombala canal</b>	<b>Explanation</b>
Ecological value of N'gombala canal for fishes	
Low	N'gombala canal is poorly connected to both the Malile and the Zambezi since it is not well maintained, this poor connection reduces the fish habitat quality of the N'gombala canal.
Level on intactness of N'gombala canal for fishes	
Low	Poor connectivity (siltation, etc.) and encroachment by cattle and farming activities has considerably degraded the potential fish habitat of the canal.

<b>Nebubela canal</b>	<b>Explanation</b>
Ecological value of Nebubela canal for fishes	
High	Along the Malile River, there are many perennial marshes with emerging vegetation that provide quality-spawning grounds in the Malile. Along the Zambezi, there are also highly valued spawning grounds.
Level on intactness of Nebubela canal for fishes	
Moderate	This fish habitat is affected by human activities being a navigable route close to Mongu, used by many boats and fishermen. However, the canal is in a relatively good state.

<b>Musiamo canal</b>	<b>Explanation</b>
Ecological value of the Musiamo canal for fishes	
Moderate during flooding period, low in the dry season	Runs on the edges of the Barotse floodplains an area where there are few fishing camps. Many emergent leaved plants in wetlands are spawning ground during the flood. However, the canal distance to natural water bodies gives it a limited value for spawning. During the dry season, there is no continuity of the canal with natural water bodies, reducing its ecological value.
Level on intactness of the Musiamo canal for fishes	
Low	The edges of the floodplain are more heavily inhabited, the canal has many impassable obstacles for fishes movement (small weirs, etc.)

Libutamei canal	Explanation
Ecological value of the Libutamei canal for fishes	
Low	For most part of the year, the canal has no fisheries except for basket fisheries. During the time of the field visit, no fishermen camp was recorded in this canal. This area is, therefore, believed to be of low ecological value for fishes. Also, there is weak continuity of the canal with natural water bodies, reducing its ecological value. Interviews with local population have revealed that only “bubble fishes” are known to occupy Lubutamei and their numbers are declining due to lack of connectivity with nearby lakes.
Level on intactness of the Libutamei canal for fishes	
Moderate	Most parts of the canal are filled with sediments, many obstacles reduces the connectivity with lakes.

Muoyowamo canal	Explanation
Ecological value of the Muoyowamo canal for fishes	
Low, especially close to Limulunga	This canal is mainly used for transportation between Lialui and Limulunga. At the time of the visit, there were a fishing camp near Lialui none was seen near Limulunga. The connection between the canal and the Malile River has many impassable obstacles for fish movement. This area is, therefore, believed to be of low ecological value for fishes.
Level on intactness of the Muoyowamo canal for fishes	
Moderate	In some sections, the canal embankments have collapsed and there are low water levels which limits habitat quality for fishes

Skelton (2001) describes the status of 33 species according to the IUCN Red List for freshwater fishes. None of the species indicated on this list are those present in the Barotse Floodplain. However, this does not mean that all species are of least concern for conservation purposes. There are two possible explanations for this absence of species of special status: most fish species of the area are also present in other fishery areas particularly the Kafue Floodplains, such species that have a wide geographic distribution are unlikely to be endangered or threatened. Another reason could be that there has not been enough investigation and sampling to determine the true status of the species in the area.

### 5.10.2.3 Identification of species with special status

None of the fish identified or observed in the Study area has a protection or UICN status.

However, the Banded Neolebias (*Neolebias lozii*), a critically endangered fish (according to IUCN red list), is present nearby the Study area in two waterbodies: the Kataba River and its tributary the Siandra stream (right outside of Musiamo canal at its southern tip, 40 km south of Mongu see previous map). It has not been observed elsewhere in the area, even though intensive sampling campaign were carried out (Tweddle, 2007 cited by IUCN, 2014).

Its habitat consists of small streams, in seasonally flooded plains and dambos, the species occurs under floating mats of vegetation and dense emergent vegetation. The species potential habitat range include the whole of Barotse floodplain (Tweddle, 2007 cited by IUCN, 2014).

Where canal were dug on Kataba River, the fish disappeared from the canalized stretch of the River. Agriculture in the dambos also poses a threat to the species. Fertilizer and herbicides run-offs are also potential threat to the species.

The previous map showing environmental sensitive area illustrate the Kataba River and Siandra stream, and a protection zone around the fish known habitat. According to World Bank terminology and the OP 4.04 Natural Habitat, this area is a critical natural habitat.

## 5.11 AVIFAUNA (BIRDS)

This section describes birds species present in the Barotse flood plain.

The study area is an important waterbird habitat, open grasslands, with many trapped fishes in wetlands, with few human settlements and a diversity of habitats is highly attractive for many waterbirds.

### COMMON SPECIES

Over 740 bird species have been recorded in Zambia (Leonard, 1998). In the Barotse flood plain, there is one Important Bird Area called "Barotse flood-plain ZM006". This IBA covers 600 000 ha. Key species of the IBA are presented in the table below.

Table 18 IBA and common species

Key species	English name	Scientific name	Breeding	Non-breeding	IUCN status	Population trend (IUCN)
A1 criteria	Slaty Egret	<i>Egretta vinaceigula</i>		visitor	Vulnerable	Decreasing
	Pallid Harrier	<i>Circus macrourus</i>		visitor	Near Threatened	Decreasing
	Lesser Kestrel	<i>Falco naumanni</i>		passage migrant	Least concern	Stable
	Wattled Crane	<i>Bugeranus carunculatus</i>	Probably breeds	145+	Vulnerable	Decreasing
	Great Snipe	<i>Gallinago media</i>		300+	Near Threatened	Decreasing
A4i criteria	Reed Cormorant	<i>Phalacrocorax africanus</i>	Breeds	5,000+	Least concern	Decreasing
	Cattle Egret	<i>Bubulcus ibis</i>		10,000+	Least concern	Increasing
	African Openbill	<i>Anastomus lamelligerus</i>	Breeds	1,000+	Least concern	Decreasing
	African Spoonbill	<i>Platalea alba</i>	Breeds	150+	Least concern	Stable
	Spur-winged Goose	<i>Plectropterus gambensis</i>	Breeds	3,750+	Least concern	Increasing
	Wattled Crane	<i>Bugeranus carunculatus</i>	Probably breeds	145+	Vulnerable	Decreasing

Key species	English name	Scientific name	Breeding	Non-breeding	IUCN status	Population trend (IUCN)
	Common Pratincole	Glareola pratincola	Probably breeds	1,000+	Least concern	Decreasing
	Kittlitz's Plover	Charadrius pecuarius	Breeds	1,000+	Least concern	Unknown
	Caspian Plover	Charadrius asiaticus		200+	Least concern	Decreasing
	Ruff	Philomachus pugnax		20,000+	Least concern	Decreasing
	Great Snipe	Gallinago media		300+	Near Threatened	Decreasing
	African Snipe	Gallinago nigripennis	Probably breeds	500+	Least concern	Unknown
Least concern in the Barotse floodplain	Grey-headed Gull	Larus cirrocephalus	Probably breeds	1,000+		Stable
	Whiskered Tern	Chlidonias hybrida	May breed	150+	Least concern	Stable
	White-winged Tern	Chlidonias leucopterus		2,000+	Least concern	Stable
	African Skimmer	Rynchops flavirostris	Breeds	100+	Near Threatened	Decreasing
Restricted to the Zambezi biome	Dickinson's Kestrel	Falco dickinsoni			Least concern	Stable
	Coppery-tailed Coucal	Centropus cupreicaudus			Least concern	Stable
	Hartlaubs Babbler	Turdoides hartlaubii			Least concern	Stable
	Chirping Cisticola	Cisticola pipiens			Least concern	Stable
	White-breasted Sunbird	Nectarinia talatala			Least concern	Stable
	Brown Firefinch	Lagonosticta nitidula			Least concern	Stable
	Sharp-tailed Starling	Lamprotornis acuticaudus			Least concern	Stable

A1: The site regularly holds significant numbers of a globally threatened species, or other species of global conservation concern

A4i: The site is known or thought to hold, on a regular basis, at least 1% of a biogeographic population of a congregatory waterbird species.

Source: (Leonard, 1998), IUCN, 2013

The size of the Barotse flood plain enables it to support large numbers of waterbirds. As shown in the previous table, it holds the A4i criteria for several birds, as many congregations of birds represent more than 1% of their total population. The area becomes attractive for birds when water retrieves in June creating many wetlands.

Among the waterbird present in the Zambezi flood plain, the African Skimmer, Great Snipe, Wattled Crane, Slaty Egret are considered threaten or vulnerable due to agricultural activities (burning fields), cattle grazing and poaching. Their populations are also decreasing (IUCN, 2013).

The nearby Liuwa Plain National Park is also an IBA (ZM005) that offer similar wetlands habitats for birds.

#### BIRD BEHAVIOR

Timberlake (1998), has described 133 waterbird species in the Barotse flood plain among which 25 birds are palaeartic migrant meaning that they breed in the northern hemisphere in the northern summer (May-August) and spend the northern winter (October to April) in Africa as a non-breeding migrant. The list is provided in Annex 6.

At the beginning of the flood (December), when shoreline habitat disappears, waders such as plovers and sandpipers leave the Barotse flood plain, in the mean time palaeartic migrants arrive, since they are not breeding in the flood plain, they are more tolerant to floods and can move out of the plain once the water level is too high. During the annual flood, bitterns, rails and flufftails are also present.

Bird behavior in the plain is linked to the annual flood that dictates habitat loss due to drying-out or flooding. Some species concentrate around wetlands for foraging created by retrieved water in June, as the dry season settles many species disperse across the continent.

Most birds, except for the African Skimmer, breed during the rainy season.

The following table summarizes bird population and bird habitat characteristics and assesses their values.

Level of intactness is also described in the next table, this will help in describing impacts in the next chapter. Level of intactness refers to existing disturbances in the Study area.

Three threshold levels are defined: Low, Moderate and High value components.

Birds	Explanation
Ecological value of the study area for birds	
High	Being an IBA, the site is highly valued for is great number of waterbirds.
Level of intactness of bird habitats	
High	Bird habitat is in fairly good condition, the pattern of the annual flood is currently not negatively influenced by human construction, except locally by the road to Kalabo. Bird migration to the site is not threaten by human activity.

#### 5.11.1 Field survey of bird species

During field visit in September 2013, several waterbirds were regularly observed by the ESIA expert (Eric Deneut) as shown in the following table.

Table 19 Observed birds during September 2013 field visit

English name	Scientific name	Habitat
Pied Kingfisher	<i>Ceryle rudis</i>	Perennial marshes
African Pygmy-Kingfisher	<i>Ispidina picta</i>	Perennial marshes
African Jacana	<i>Actophilornis africanus</i>	Perennial marshes
Coppery-tailed Coucal	<i>Centropus cupreicaudus</i>	Perennial marshes
White-cheeked Bee-eater	<i>Merops variegatus</i>	Perennial marshes
Blacksmith Plover	<i>Vanellus armatus</i>	Low grass land adjacent to wetlands and seasonal wetlands
African Openbills	<i>Anastomus lamelligerus</i>	Low grass land adjacent to wetlands and seasonal wetlands
Little Egret	<i>Egretta garzetta</i>	Perennial marshes
Black Egret	<i>Egretta ardesiaca</i>	Perennial marshes
Squacco Heron	<i>Ardeola ralloides</i>	Perennial marshes
White Pelican	<i>Pelecanus onocrotalus</i>	Rivers and perennial marshes
Black Kite	<i>Milvus migrans</i>	Canals
Pied Crow	<i>Pelecanus rufescens</i>	Canals
Long tailed Cormorant	<i>Phalacrocorax africanus</i>	Perennial marshes, Canals

### 5.11.1.1 Identification of species with special status

According to Timberlake (1998), some species in the Barotse floodplain are rare, regional-endemic or have an IUCN protection status. The following table summarizes information of these species and describes their habitat requirements. These waterbirds have either very limited range, an IUCN protection status or their habitat may be affected by the Project.

Table 20 Species with special status

English name	Scientific name	Status	Habitats
<b>Waterbirds</b>			
Slaty Egret	<i>Egretta vinaceigula</i>	Visitor, Vulnerable (IUCN), population decreasing	River floodplains, marshes, and seasonal shallow wetlands, preferring areas where water levels are receding from their seasonal peak with emergent vegetation. Sedentary moves seasonally within wetlands in response to changing water level. Its preferred breeding habitat is Phragmites reedbed. The species shows high nest-site fidelity

English name	Scientific name	Status	Habitats
Wattled Crane	<i>Bugeranus carunculatus</i>	Probably breeds, Vulnerable (IUCN), population decreasing	Inhabit seasonal wetlands and are irregularly nomadic in response to water availability. Preferred nesting sites are where grass and sedge marshes are bordered by drier, flat to sloping grassland meadows
Great Snipe	<i>Gallinago media</i>	Palaearctic Migrant, Near Threatened (IUCN), population decreasing	Marshlands and short grass or sedges but also on drier habitat such as sand dunes
African Skimmer	<i>Rynchops flavirostris</i>	Near Threatened (IUCN), population decreasing	Vast calm water for feeding. It breeds during the dry season along broad rivers on large, dry sandbars that are largely free from vegetation

Adapted from Timberlake, 1998

## 5.12 FLORA

### 5.12.1.1 Introduction

This section includes a description of environmental features of the Study area with, in annex, lists of potential species. This section focuses on habitat as well as species value description.

Ecological value of studied canals is presented in the Fish section.

The Study area does not have any protected zones or game reserve. It is, however, within the boundary of a RAMSAR "Zambia Zambezi Floodplains".

In the study area, natural habitats are made of the following plant category:

- ▶ Herbaceous plants:
  - facultative wetland plants: are plants that require a minimum level of wetness to grow, however they cannot tolerate to be all year-round with their feet in the water;
  - obligate wetland plants: are plants that require year-round wetness, they can either be submerged aquatic plants or emergent-leaved plants;
  - terrestrial plants: are plants that will grow in well drained soil and sandy soils and cannot tolerate permanent wetness.
- ▶ Ligneous plants: shrubs and trees. Forests and thickets are almost absent of the Barotse flood plain due to the annual floods. Forest patches are present in the Luena flats on higher grounds.

According to Timberlake (1998), there are 403 registered plants in the Barotse flood plain, among which:

- ▶ 92 are emergent-leaved plants (obligate wetland plant),

- ▶ 33 are submerged aquatic plants (obligate wetland plant),
- ▶ 14 are shrubs,
- ▶ 11 are trees

Facultative wetland plants were not distinguished by Timberlake, however the vast majority of sedges are either obligate or facultative wetland plants.

Tall grass (Poaceae) and sedges (Cyperacea) represent 45% of all plants species in the plain. In terms of ground coverage, tall grass and sedges cover the vast majority of the Barotse flood plain.

Reeds (phragmites) and Papyrus (Cyperacea) are used by local population to build mats, fences and for tying in construction.

According to Timberlake (1998), there are 21 obligated wetland Poaceaa (tall grass) species and 18 obligated wetland sedges species. Along canals, the fern *Thelypteris confluens* is very common, this plant is a good indicator of wetness. Diversity of ferns and allies (Pteridophyta) is very low in the Barotse flood plain due to the lack of shade. According to Timberlake (1998), there are only 7 species of ferns and one horsetail in the Barotse floodplain.

Only 16 of all plants in the Barotse flood plain have a limited distribution range to the Zambezi catchment (4%). The majority of plants are found across much of the Afrotropics (including East & West Africa), or pantropical (265 plants or 65%); 59 plants (15%) are found over a large part of southern Africa (South Africa to Southern Tanzania), the rest of the plants have unknown distribution ranges.

Plants form associations that can be described as habitats. Wetland and terrestrial habitats (drylands) are described in the following sections.

The list of recorded plants in the Barotse flood plain is provided in Annex 4.

The annual flood bring to the plain great changes to which wildlife have to adapt, many species abundance and wildlife composition fluctuate with this flood. The most mobile such as birds leave the plain when the flood covers it, others colonize new areas such as fishes and crustaceans in search of spawning grounds. The flood also kills many less mobiles species such as insects, small terrestrial reptiles and small mammals.

### 5.12.1.2 Study limitations

During the course of the Study, wetland assessment was carried out to delineate them and to assess their value in the Study area, this exercise was done for other components (birds, insects, etc.). However, due to the size of the Study area and the very vast surface area of wetlands and canals, no detailed surveys of plants and wildlife were carried out. Throughout the baseline and impact assessment, some uncertainties remain regarding location of these species.

### 5.12.2 Wetland species

This description is based on the Wetland Specialist fieldwork carried out in September 2013, photo interpretation and bibliographical data.

In the study area, two distinctive locations are commonly referred as wetlands: the Barotse flood plain directly west of Mongu plateau and the Luena flats where the Lubitamei canal runs (see map of the Study area). Both areas are in the Barotse flood plain. The flood plain occupies the lowest topographical position in the area.

The Barotse flood plain is delineated by the plains around the Zambezi River and its tributary rivers. It corresponds to the flooded area during the rainy season. In Mongu and Kalabo this floodplain abruptly stops with rising plateaus. Luena flats is the area where many wetlands are created by the end of Luampa River, a seasonal tributary of the Luena River, east of Lukulu. Luena River is a tributary of the Zambezi River.

The entire Barotse flood plain is culturally and commonly considered a wetland since water cover its entire area from January until May/June. The floodplain is also classified as a RAMSAR site since 2007 (RAMSAR site n° 1662 Zambia Zambezi Floodplains). In a purely biological sense, is broadly accepted to be considered a wetland, an area that shows hydrophilic vegetation and/or hydromorphic soils. Whether the entire floodplain is inundated long enough to be considered a wetland in the biological sense is unknown and full wetlands inventories have never been carried out (Timberlake, 1998). The Project's Wetland specialist has broadly defined wetlands in the Barotse flood plains with the following criteria: areas with actively-growing herbaceous vegetation observed in September (during the ESIA field visits) are to be considered wetlands. September being at the end of drought, any living grass at that time finds moisture from a steady water source.

In the Study area many wetlands, in the biological sense, have been identified during ESIA field visits:

- ▶ Perennial marshes;
- ▶ Seasonal marshes (pans);
- ▶ Wet grasslands;
- ▶ Riparian forests;
- ▶ Riverine grasslands;
- ▶ Dambos;
- ▶ Plateau lakes and their associated plains

Most of these wetlands have a direct or indirect hydrological connection with several canals as shown in the Study area map.

The following sections will study in depth all types of wetlands. The map of the Study area, also shows valuable wetlands.

#### PERENNIAL MARSHES

Perennial marshes are year-round inundated wetlands. In these wetlands, water level is high enough to limit tall grass colonization to their margins. Usually these wetlands are located close to permanent rivers such as the Malile or Zambezi river, and show hydro-connectivity with them. These wetlands have been created by the progressive shifting of meanders of the Zambezi or Malile rivers, there are remnant meanders (also called oxbow lake). Part of fisheries, N'Gombala and Muyowamo are located close to perennial marshes.

In some areas, canal banks are so degraded that they have evolved as perennial marshes with stagnant water (such as the N'gombala canal). Water lilies occupy these wetlands as well as many tall grasses from the Poaceae family and sedges (Cyperaceae) such as the *Cyperus papyrus*. Papyrus is a good indicator of perennial marshes as it necessitates standing water all year-round.

Due to their high water mark, these wetlands are not intensively used as drinking points by cattle and diverse wildlife inhabit their water. After the annual flood, when water recedes, many big fishes are trapped in these wetlands attracting Spotted-necked Otters, Pied Kingfishers, African Pygmy-Kingfishers, Black and Little Egrets, etc. Other typical wetland birds and fish eating birds occupy these wetlands such as the African Jacana and the Copper-tailed Coucal.

Spear fishing is common in perennial marshes during the dry season. The main target species is the large catfish *Clarias gariepinus* (Peel et al., 2013).

Potential threats to these wetlands could come from severing their hydro-connections to rivers (earthworks, embankment, etc.) which feed wetlands with water.



Pictures from top left to bottom right Spotted-necked otters, typical example of perennial marsh, Pied Kingfisher, African Pygmy-Kingfisher, African Jacana, Blue-breasted bee-eater (BRLi, September 2013)

The following aerial photograph from Google Earth dating October 2005, shows a good example of perennial marshes hydroconnected to the Malile River.



1 to 4, hydro-connected wetlands to 5: Malile River

The following table summarizes perennial wetlands characteristics and assesses their values. Value assessment is based on Expert's knowledge on the component, field surveys, etc. Value analysis does not take into account foreseen impacts, it is purely based on the component intrinsic value. Level of intactness is also described in the next table, this will help in describing impacts in the next chapter. Level of intactness refers to existing disturbances in the Study area.

Three threshold levels are defined: Low, Moderate and High value components.

Perennial marsh characteristics	Explanation
Ecological value	
High	Although plant diversity is rather low, perennial marshes' quality, relate to their habitat feature for animals. These wetlands are high quality spawning grounds for fishes, thanks to their emergent vegetation and their hydro-connectivity with rivers (Malile and Zambezi). Being connected to rivers, many fishes are trapped in them when water retrieves attracting fish eating birds and mammals. They create a buffer zone between terrestrial, human impacted areas and the rivers.
Level of intactness	
High	Due to their high water level, these wetlands are less utilized by grazing cattle and less impacted by human. Habitat is not fragmented and there is no source of pollution.
Total approximate surface in the Study area	
An approximate surface of 40 274 ha between the Zambezi and the Malile has a high concentration of perennial wetlands. Wetland delineation was limited to the Study area, this wetland continues further outside the study area.	
Hydrological connection with studied canals	
Muyowamo, N'gombala, Fisheries	

### SEASONAL MARSHES (SEASONAL PANS)

Seasonal marshes, also called pans, are topographic depression where water accumulates to a certain level during the seasonal flood or due to high water table, however due to their distance and lack of connectivity with rivers, most of them dry up sometimes during the dry season. Water stays long enough to allow for colonization of hygrophilous plant species, usually their diversity is rather low and they are intensively used by cattle as drinking point which limit uses by wildlife. Some plants are opportunistic settlers such as the *Phragmites mauritanus* and the *Polygonum senegalense*. These two plants use wetlands as starting point and can colonize drier areas. These plants are good indicators of seasonal marshes since they cannot tolerate high water level for long periods and are facultative wetland species. Birds such as the Blacksmith Lapwing, African Openbills, and Cormorants are very common in these wetlands.

The main threat to these wetlands comes from intense grazing and encroachment from cattle. Also being seasonal, these wetlands could be destroyed if not properly identified and delineated prior to activities and earthwork.



Pictures from top left to bottom right Blacksmith Plover, African Openbills, colonization of *Phragmites* and *Polygonum* and intense grazing and encroachment of seasonal wetlands (September 2013, Deneut)

The following aerial photograph from Google Earth dating October 2005, shows a good example of an isolated seasonal marsh.



1: isolated seasonal marsh

The following table summarizes seasonal marshes characteristics and assesses their values.

Seasonal marsh characteristics	Explanation
Ecological value	
Low	Vegetation diversity is rather low, seasonal marshes offer limited habitat characteristics for wildlife since they are isolated. However, they represent good watering point for birds and bats
Level of intactness	
Low	These wetlands are intensively used by cattle as watering point. Local population also uses them for bathing, clothes and car washing.
Total approximate surface in the Study area	
The whole study area include scattered seasonal marshes, their total surface is unknown.	
Hydrological connection with studied canals	
None	

#### WET GRASSLANDS

Wet grasslands are year around inundated wetland with low water level (less than 60 cm) allowing for intense tall grass (*Poaceae*) colonization. In the study area, these wetlands are located far from rivers giving them a limited value for fish. They are found at the edge of the floodplain being fed by the seasonal flood, runoff from the plateau during the rainy season, from nearby natural water sources emerging out of the plateau foothills (seeps) as well as emerging water table.

Localization of these wetlands, close to human settlements along the edge of the floodplain has made them vulnerable.

Along Musiamo, many agricultural land were reclaimed from these wetlands (i.e.: rice fields in the Sefula area) and canals web were dug to drain them toward the Musiamo canal.

In the Luena flats, this type of wetland follows loosely the Lubitamei canal; soil in this area is not peaty. Along Libutamei, wetlands reclaimed their space over agriculture lands due to degradation of the canal drainage function. The bubble fish is the only fish present, it used to spawn in the wetlands and the Lubitamei, however according to villagers they are declining due to lack of connectivity between the Plateau Lake and the wetlands along Lubitamei.

These wetlands intense tall grass coverage does not allow much wildlife to thrive, however they are valuable habitats for herpetofauna and small passerine birds. Typical plants are in the Poaceae, Typhaceae and Cyperaceae families. The presence of large colonies of *Drosera madagascariensis*, a small carnivorous plant, and the deep dark organic soil indicate the presence of peaty soils (the depth of peat deposition was however not assessed during baseline studies). Peat soils are important micro climate regulators cooling and moisturizing the air at ground level allowing for amphibians such as salamanders to thrive. Peat soil are important store of soil carbon and sink for atmospheric carbon dioxide and are sources of atmospheric methane. The sequestering function of peat bogs for carbon dioxide outweigh the release of methane, peat bogs are therefore net GreenHouse Gas sink (International Peat Society, 2014). In Zambia, the estimated coverage of peatland is between 11,060 km<sup>2</sup> and 12,201 km<sup>2</sup>, making it the African country with the most peat lands (Page et al., 2010). The extent of peatland in the whole Barotse is unknown. Looking at different soil maps do not reveal the presence of peat, making it difficult to assess the extent.

The most important current threat to wet grassland is the burning of peat soil to fertilize the soil (by releasing phosphorus) and to reduce its acidity. However, this practice is not only detrimental to the wetland but also is not sustainable since peat can retain great quantity of water, removal of peat creates water logging which lead to abandonment agricultural activity.



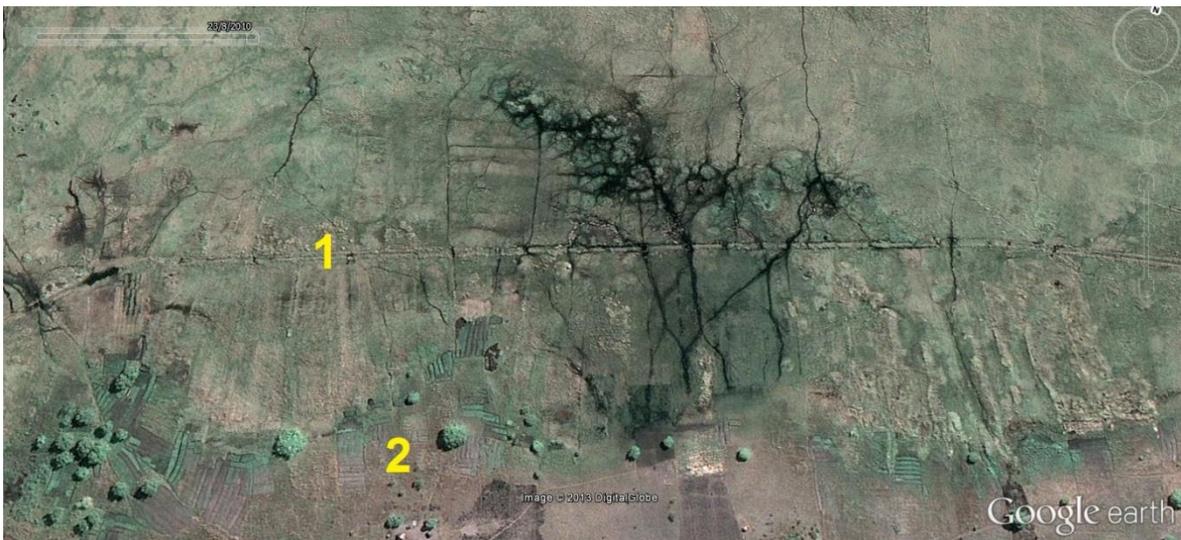
Picture from to left to down right: *Drosera* carnivorous plants, a typical wet grassland, small scale drainage canal and large scale drainage canals (name unknown) (September 2013, Deneut).

The following aerial photograph from Google Earth dating September 2005, shows a clear example of the strip of wet grassland along the edge of the plateau. In the peak of the dry season, this area, rich in peaty soil, remains wet.



Barotse flood plain: 1: Plateau, 2: wet grassland, 3 rest of the barotse wetland (September 2005, Google Earth)

The following aerial photograph from Google Earth dating August 2010 shows wet grasslands from the Luena flats.



Luena flats: 1: Lubitamei canal draining surrounding wetlands, 2: Dryland

The following table summarizes wet grasslands characteristics and assesses their values.

Wet grassland characteristics	Explanation
Ecological value	
High in the Barotse floodplain (along Musiamo)	These wetlands have peaty soils (they are in fact peat bogs) indicating long term wetness and allowing for particular plant diversity to thrive as well as offering high quality habitats for salamanders, passerine birds and carnivorous plants. Peat soils are also GHG sinks. Spawning activity is limited in this area due to the remoteness from the Malile and the Zambezi.
Moderate in the Luena flats (along Libutamei)	These wetlands offer good quality habitat for herpetofauna. Vegetation is less diverse than its Barotse counterpart. Spawning activity is limited in this area due to the isolation from the Malile and the Zambezi. Bubble fish present in Plateau Lakes used to spawn in these wetlands, however according to villagers they are declining.
Level of intactness	
Moderate	These wetlands are impacted by agricultural activities and burning of peat deposits as they are located close to villages at the edge of the plain. Thanks to low use of fertilizers and pesticides in the area, pollution is limited. Drainage to Musiamo and Lubitamei affects and fragmentizes these wetlands, however some areas remain relatively intact.
Total approximate surface in the Study area	
In the Barotse floodplain: 2 986 ha. Wetland delineation is limited to the Study area, this wetland continues further South	
In the Luena flats: 4 764 ha. Wetland delineation is limited to the Study area, this wetland continues further North	
Hydrological connection with studied canals	
Lubitamei and Musiamo	

## RIPARIAN FORESTS

Riparian forests are very rare in the study area since populations have extensively cleared them probably to replace them with mango trees. However, some unwelcoming riparian forests remain thanks to their swampy appearance and their difficulty of access. Other are protected and valued by local villagers such as the one in Namushakende (see map of the Study area).

According to Timberlake (1998), Namushakende riparian forest is occupied by *Syzygium owariense* (Sinungu), *S. cordatum*, *Ficus verruculosa* and *Gardenia imperialis* trees. Some valued ferns are also present such as the climbing fern *Lygodium microphyllum* and the royal fern, *Osmunda regalis*. A few pineapples are underplanted in these forests. During the field visit by the Wetland Specialist, only two riparian forests were identified, one in Namushakende and one in Walenga. Water clogging has created the riparian forest in Walenga, thanks to poor drainage and poor maintenance of canals and culverts. Other few areas along the edge of the plain show good potential for presence of such forests, however mango tree plantation has, throughout history, replaced almost all riparian forests in the Barotse floodplain.

Threats to riparian forests could come from the Project itself, if any culvert and bridge are improved and drainage of Musiamo reestablished, some of them could be affected.



Picture from left to right: Walenga and Namushakende riparia forest (BRLi, September 2013)

The following aerial photograph from Google Earth dating September 2005 shows the riparian forest at Namushakende.



The following table summarizes riparian forests characteristics and assesses their values.

Riparian forest characteristics	Explanation
Ecological value	
High	Riparian forests are rare in the study area; shade from the canopy and constant humidity from the soil allows many plants to thrive. Trees present in these forests are locally rare.
Level of intactness	
Low	These wetlands are remnant forests reduced to small isolated patches, mango tree plantation have replaced riparian forest. Pineapple plantation has affected the non-ligneous diversity.
Total approximate surface in the Study area	
Namushakende forest: 7 ha	
Walenga forest: 42 ha	
Hydrological connection with studied canals	
Musiamo	

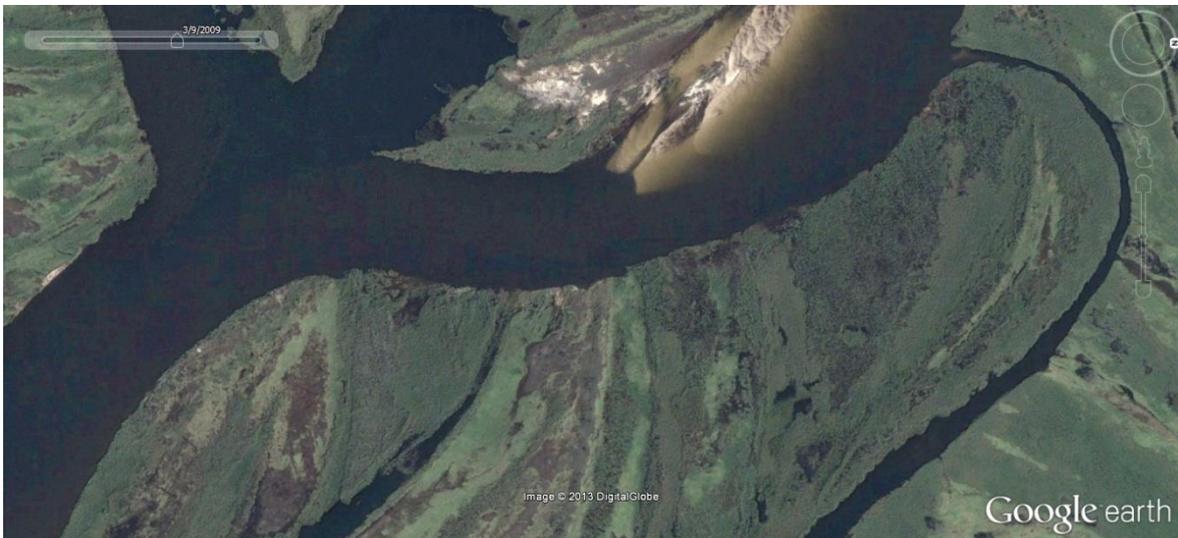
## RIVERINE GRASSLANDS

Along the Zambezi, lies a large line of grassland (Poaceae) emerging from the water and constantly with their feed submerged. This type of wetland is a continuity of the river's bed where bank are not well defined. *Echinochloa*, *Leersia*, *Oryza Acroceras*, *Paspalum* and *Panicum repens* and *Vossia cuspidata* are dominant species (Timberlake, 1998), plant diversity is rather low since it is limited by the high water level. These wetlands are highly valued for their role in offering spawning grounds for many fish species and feeding grounds for hippopotamus. This type of ecosystem is absent along studied canals. A few riverine grasslands along the Zambezi, where water level is not too high, are grazed by cattle.



Example of riverine grassland along a branch of the Zambezi River (September 2013, Deneut)

The following aerial photograph from Google Earth dating September 2009, shows the dense riverine grassland at the Zambezi Rivers (in green).



The following table summarizes riverine grasslands characteristics and assesses their values.

Riverine grassland characteristics	Explanation
Ecological value	
High	These wetlands have low plant diversity, however their value as spawning ground and hippo habitat is high.
Level of intactness	
High	These wetlands are only accessible by canoe. Being the first area to flood during the rainy season, human encroachment is limited to fishermen and few grazing areas. The habitat is not fragmented.
Total approximate surface in the Study area	
1778.4 ha, this type of wetland continues outside the Study area all along the Zambezi River	
Hydrological connection with studied canals	
N'gombala, Fisheries	

### DAMBOS

Dambos are broad valleys that are waterlogged for some months during the wet season, they are fed by rain water or sometimes by ground water. The high water table, with little lateral movement, causes anaerobic conditions in the subsoil, thus precluding most woody species (except for underground dwarf trees called geoxylic suffrutices. Underground trees are dwarf ligneous plants where the above ground flowerings shoots only live for a short period of time and die during droughts. The vegetation consists of grassland with scattered termitaria (Timberlake, 1998). Dambos are moisture-determined habitats, however in some cases water does not stay long enough to allow hygrophilic plant to thrive these are non-wetland Dambos. Dambos geomorphology differs from rivers as they do not form bed channels.

The dry heads of dambos are invaded by pioneer woodland species such as *Burkea africana*, *Erythrophleum africanum*, *Terminalia sericea* and *Parinari curatellifolia* (Timberlake, 1998).

In the Study area, some wetlands could fit the definition of Dambos. They drain plateau lakes. One Dambo is located along the Lubitamei in its lower reach. This Dambo is covered by grasses such as Sedges and Poacea, grass biodiversity is rather low. In dryer areas, termitaria cover the area. According to local populations, it used to be covered by agricultural plots. Dambos are valuable fish habitat when they are connected with natural rivers and, in the case of the Study area, they are of Moderate ecological value due to previous agricultural activities.

The following aerial photograph from Google Earth dating May 2013 shows dambos in the Study area.



1,2 Dambos close to Lubitamei

The following table summarizes Dambos' characteristics in the Study area and assesses their values.

Dambos characteristics	Explanation
Ecological value	
High	Dambos are valuable fish habitat as spawning grounds, dambo close to Kakubelwa host an critically endangered species the Banded Neolebias.
Level of intactness	
Moderate	Abandoned agricultural activities in Dambos of the Study area have allowed for grass to recolonize the site, however it is a modified habitat by limited plant diversity
Total approximate surface in the Study area	
Unknown	
Hydrological connection with studied canals	
Lubitamei	

Major Dambos are located close to Kakulubelwa along the Siandra and Kataba water courses (38 km from Mongu) and South of Mwangala (47 km from Mongu).

The following aerial photograph from Google Earth dating April 2013 shows the two major Dambos close to the Study area.



Dambos: 1: Kakulubelwa; 2: South of Mwangala

#### PLATEAU LAKES AND THEIR ASSOCIATED PLAINS

Many permanent or temporary lakes are located on the Plateau, East of Mongu and South of the Lubitamei canal. These lakes and their associated plains are wetlands. Many of these plains are drained into the Lubitamei canal. These wetlands are not dependent on the annual flood. Being out of the scope of study of this Project and since they will not be directly affected by canal improvement, their ecological values have not been assessed. However, some of these lakes being indirectly connected to studied canals may undergo drainage due to canal drainage improvement. This issue was raised during the third workshop and is dealt with in the impact assessment section. The map of the floodplain shows the most important plateau lakes and their associated plains.

The following aerial photograph from Google Earth dating September 2013 shows plateau lakes and their associated plain South of Lubitamei canal



Plateau lakes: 1, plain: 2

#### RAMSAR CLASSIFICATION OF THE ZAMBEZI FLOODPLAIN

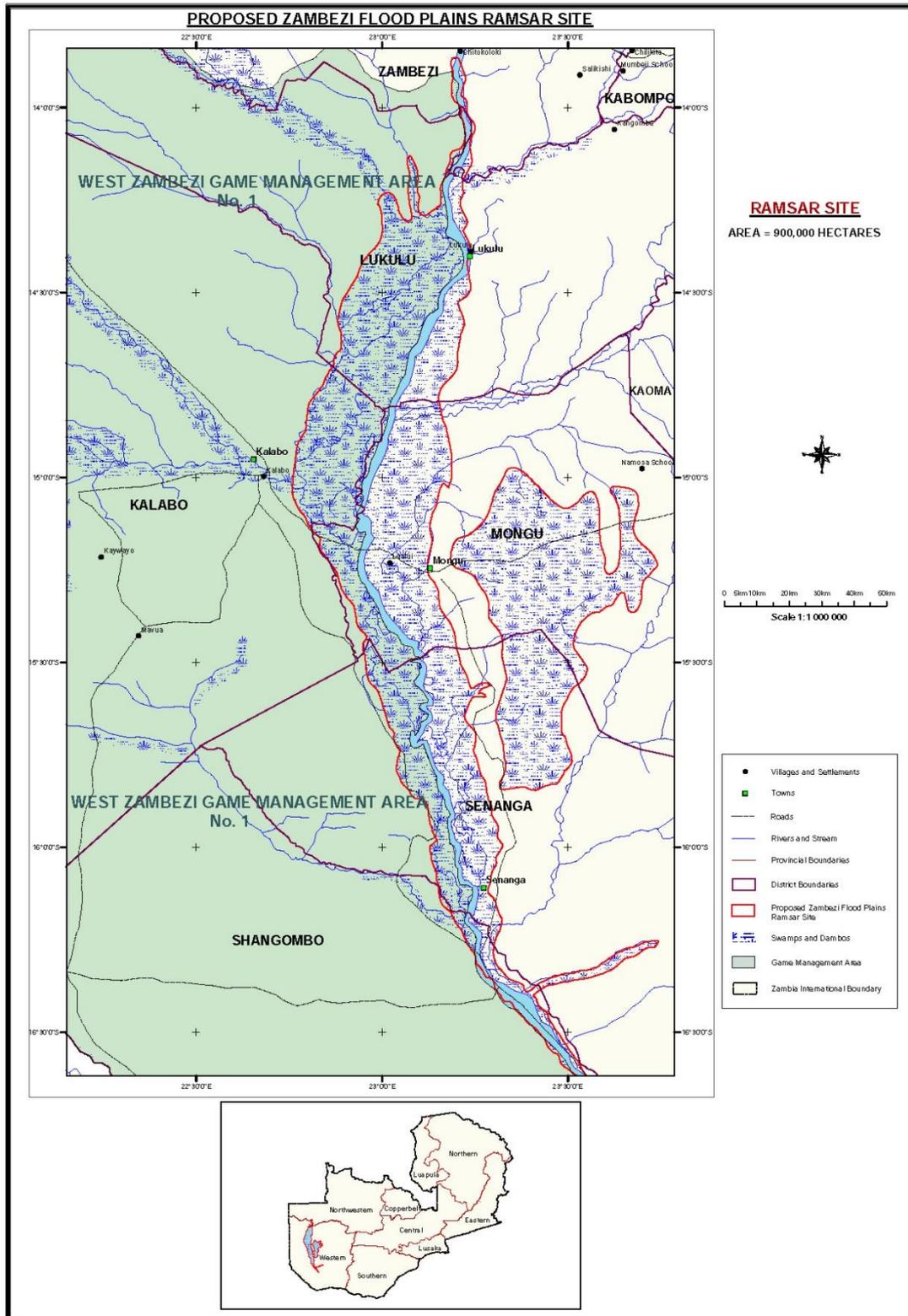
The Zambezi floodplain is classified as a Ramsar site since 2006, its Ramsar number is 1662. This site covers 900,000 ha. A bite more than half of its size is occupied by the Barotse floodplain.

The Ramsar criteria for the Zambezi floodplain are as follow (source Information Sheet):

- ▶ Criterion 2: A wetland should be considered internationally important if it supports vulnerable, endangered, or critically endangered species or threatened ecological communities.
- ▶ Criterion 3: A wetland should be considered internationally important if it supports populations of plant and/or animal species important for maintaining the biological diversity of a particular biogeographic region.
- ▶ Criterion 4: A wetland should be considered internationally important if it supports plant and/or animal species at a critical stage in their life cycles, or provides refuge during adverse conditions.
- ▶ Criterion 6: A wetland should be considered internationally important if it regularly supports 1% of the individuals in a population of one species or subspecies of waterbird.
- ▶ Criterion 8: A wetland should be considered internationally important if it is an important source of food for fishes, spawning ground, nursery and/or migration path on which fish stocks, either within the wetland or elsewhere, depend.
- ▶ Criterion 9: A wetland should be considered internationally important if it regularly supports 1% of the individuals in a population of one species or subspecies of wetland-dependent non-avian animal species.

According to the Information Sheet on Ramsar Wetlands, one of the main threat to wetlands within the Ramsar site is dredging of canals. Zambia Wildlife Authority is the management authority of the Ramsar site. The Ramsar delineation as shown in the figure below does not include wetlands along the Libutamei canal, as well as some of the Plateau Lakes north of Mongu.

Figure 15 Ramsar site limits



Source: Ramsar (2014)

### 5.12.3 Terrestrial species: dry lands

Dry lands refer to habitat with a majority of terrestrial plants in opposition to wetlands where facultative and obligate wetland plant species dominate.

Outside of wetland habitats and few patches of forested areas, the study area has low plant diversity. Grazing of cattle, grassland fires to improve pastures, and wood clearing affects the floodplain plant diversity.

#### TREES OF THE PLAIN

In the Barotse flood plain, trees are scarce and rare due to the constant seasonal flood. There is no forest in the flooded area, therefore only patches or individual trees play an ecological role. Mango (*Mangifera indica*) is very common especially at the edge of the flood plain. Apple-ring Acacia (*Faidherbia albida*) grows mostly on elevated sites such as villages. All other indigenous species are occasional to rare. They include *Syzygium cordatum*, *Borassus aethiopum*, and the shrubs *Acacia hebeclada* subsp. *chobiensis*, *Rhus quartianus*, *Grewia retinervis* and *Keetia venosa*. Large flood-season islands, such as Lealui, have a greater variety of planted species (Timberlake, 1998)



Apple-ring Acacia with weaver nests and Acacia in the Barotse flood plain (BRLi, 2013)

The following table summarizes flood plain trees characteristics and assesses their values.

Level of intactness is also described in the next table, this will help in describing impacts in the next chapter. Level of intactness refers to existing disturbances in the Study area.

Three threshold levels are defined: Low, Moderate and High value components.

Trees of the plain	Explanation
Ecological value	
Moderate	Trees in the flood plain do not form forest or corridors limiting their functions for terrestrial wildlife. However, being so rare, their role for roosting and hunting by bats are important. Many passerine birds use trees and thickets for nesting and as shelter.
Level of intactness	
Low	Most trees in the plain are planted (in villages) or affected by clearing for fuel wood.

## CHANNEL BANKS

In areas where river or channel banks are well defined and higher than the normal water level, many facultative wetland species such as *Phragmites mauritanus* and the *Polygonum senegalense* and terrestrial plants thrive. Other plants as the *Hibiscus diversifolius*, *Urena lobata* (Malvaceae) are also present (Timberlake, 1998)

In some areas, sand bars are formed along rivers bank such as the Zambezi and the larger tributaries. They are colonized by *Acacia hebeclada* subsp. *chobiensis*, *Grewia retinervis* and *Rhus quartiniana*, which form thickets capable of surviving complete submergence (Timberlake, 1998). *Phragmites mauritanus* and the *Polygonum senegalense* extensively colonize sand bars. These sand bars being quickly drained are not wetlands in a biological sense. They represent habitat for many shoreline birds such as waders such as plovers and sandpipers but also the African Skimmer (IUCN Near Threatened species).

The following aerial photograph from Google Earth dating October 2010 shows an example of channel banks with a few sand bars.



1-3: sand bars



Channel bank along the Malile River (BRLi, 2013)

The following table summarizes channel banks characteristics and assesses their values.

Channel banks	Explanation
Ecological value	
Moderate	Channels banks use for wildlife is limited, they represent roosting area for small shoreline birds. However, there are breeding sites for the African Skimmer (IUCN Near Threaten species). The sandy substrate only offers limited opportunities for plant and their diversity is rather low.
Level of intactness	
Low	Erosion and cattle encroachment affects channel banks.

### GRASSLAND SAVANNA

The large strip between the wet grasslands at the toe of the plain slopes and the wetlands associated with the rivers (perennial marshes, riverine grasslands) lies a vast grassland savanna intensively grazed and where the majority of villages are located.

Grassland savanna are flooded during the rainy season, however they are probably the first areas were water retrieve. During the dry season, grassland savannas are not fed with water and quickly become dry.

According to Timberlake (1998), pasture weeds occurring on the Plain include *Lantana camara*, *Senna occidentalis* and *Tribulus terrestris*.

The following aerial photograph from Google Earth dating October 2006 shows an example of grassland savanna in the Barotse floodplain.



1: Riverine and perennial wetlands; 2: Grassland savanna; 3: Wet grassland; 4: Plateau



Savannah grassland in the Barotse floodplain (left) and Luneia flat (right) (BRLi, 2013)

The following table summarizes grassland savannas characteristics and assesses their values.

Grassland savanna	Explanation
Ecological value	
Low	The nature of this ecosystem does not allow for high biodiversity (lack of water, etc.). Being constantly grazed, these grassland are not spawning grounds during the floods.
Level of intactness	
Low	Constant grazing and regular fire limit the level of intactness of this ecosystem. This area has higher population density than other areas in the plain.

#### 5.12.4 Aquatic plant species

All plant identified in canals are wetland species, see previous section.

#### 5.12.5 Identification of species with special status

According to Timberlake (1998), some species in the Barotse floodplain are rare, regional-endemic or have an IUCN protection status. The following table summarizes information of these species and describes their habitat requirements. Species highlighted in grey are the only one that are really of concerns because of their very limited range, their IUCN protection status and because their habitat may be affected by the Project.

Table 21 Species with special status

English name	Scientific name	Status	Habitats
<b>Herbaceous plants</b>			
No English name	Harpochloa pseudoharpechloa	Limited distribution range to the Zambezi catchment	River bank and flood plain grassland, sandy soil
	Loudetia angolensis	Limited distribution range to the Zambezi catchment	Marshes and margins of drainage canals

English name	Scientific name	Status	Habitats
	<i>Microchloa annua</i>	Endemic to the Mongu area	In the savanna grassland, at the edge of woodland and on road side
	<i>Lapeirousia zambeziaca</i>	Limited distribution range to the Zambezi catchment	In peaty grassland of the plain (described as wet grassland in the report)
	<i>Pandiaka carsonii</i>	Limited distribution range to the Zambezi catchment	Dambos
	<i>Emiliella drummondii</i> Torre	This variety is limited to the Mongu district	Canals
	<i>Acacia hebeclada</i> ssp. <i>chobiensis</i>	Limited distribution range to the Zambezi catchment	Shrub found in sandy banks
	<i>Nesaea rautanenii</i>	Limited distribution range to the Zambezi catchment	In sandy areas of the flood plain
	<i>Rotala longistyla</i>	Limited distribution range to the Zambezi catchment	Submerged aquatic plant
	<i>Dissotis falcipila</i>	Limited distribution range to the Zambezi catchment	In marshes along rivers
	<i>Dissotis gracilis</i>	Limited distribution range to the Zambezi catchment	In marshes along rivers
	<i>Ficus pygmaea</i>	Limited distribution range to the Zambezi catchment	emergent-leaved aquatic, suffrutex underground shrub forming thickets in moist sandy soil of the flood plain
	<i>Syzygium guineense</i>	Limited distribution range to the Zambezi catchment	Riparian forest, tree
	<i>Sesamum calycinum</i>	Limited distribution range to the Zambezi catchment	Savanna grassland, road side, common
	<i>Jamesbrittenia elegantissima</i>	Limited distribution range to the Zambezi catchment	Unknown
	<i>Grewia schinzii</i>	Limited distribution range to the Zambezi catchment	Shrub near river or open bush and woodland

Adapted from Timberlake, 1998

## CONCLUSION ON ENVIRONMENTAL BASELINE

The Barotse flood plain with its annual flood has allowed the creation of wetlands habitats that are valued for many wildlife species including fishes. Only few human settlements are present in the plain, which has help to preserve many habitats, population concentration along the edge of the plateau has however created environmental pressure of nearby wetlands. The study area is poorly occupied by herbivores, probably due to high incidence of subsistence hunting by local population. In fact, large mammals are believed to be totally absent of the eastern side of the Barotse plain. Bird presence in the plain are adjusted to the annual flood pattern, with receding water many wetlands are created that allows for great flocks of birds to forage. When the dry season is at its peak, many seasonal wetlands disappear and bird population decrease or concentrate along perennial wetlands and the rivers.

Between the Zambezi-Malile area, with high density of wetlands, and the wet grassland along the edge of the plateau lies a large strip of grassland savanna. This area is more occupied by human, with settlements and grazing cattle. It is the area with the lesser environmental value. In the plain trees are scares and there is no forest, the main reason being the annual floods. Along the edge of the plateau, riparian forests have been extensively replaced by mango tree culture leaving only few relictual riparian forests.

In terms of plant species with special status, the area is not rich neither in endemicy nor in protected species.

A few waterbirds have a special status, as well as other wetland dependent insects and amphibians such as the Mongu shovelnose frog.

Fishes are specialized in slow moving and turbid water as found in canals. Important spawning grounds are located in riverine wetlands along the Zambezi and perennial wetlands close to the Malile. Fishes spawn in their emergent-leaved grasses.

The following tables sums up all components value and level of intactness in the Study area. Highly valued component are all linked to wetlands and their habitats for wildlife. The value assessment will be used to analyze intensity of impact in the impact assessment section.

Table 22 Habitat value in the Study area

Name of habitat	Ecological value	Level of intactness
<b>Wetlands</b>		
Perennial marsh	High	High
Seasonal marsh (pan)	Low	Low
Wet grassland in the Barotse floodplain	High	Moderate
Wet grassland in the Luena flats	Moderate	Moderate
Riparian forest	High	Low
Riverine grassland	High	High
Dambos	High	Moderate
<b>Dry lands</b>		
Trees of the plain	Moderate	Low
Channel banks	Moderate	Low
Grassland savanna	Low	Low

Table 23 Ecological value of the Study area for wildlife

Group of animals	Ecological value of the study area for wildlife	Level of intactness of wildlife habitat
Fish, Muoyowamo canal	Low	Moderate
Fish, Musiamo canal	Moderate	Low
Fish, Lubitamei canal	Low	Moderate
Fish, Fisheries canal	High	Moderate
Fish, N'gombala canal	Moderate	Low
Birds	High	High
Herbivores	Low	Low
Aquatic mammals	High	High
Small mammals	Low	Low
Bats	Moderate	Moderate
Aquatic and wetlands herpetofauna	High	Moderate to high
Terrestrial herpetofauna	Low	Low
Wetland dependent insects	High	Moderate to high

## 5.13 ARCHAEOLOGICAL AND CULTURAL ENVIRONMENT

The Consultants reviewed the history of the canals as presented in the technical meeting held in theKuta on September 12<sup>th</sup>, 2013 at Lealui. The history as presented by Indunas is that canal development was first initiated by King Lewanika around 1885 after the civil war based on his economic plan for agriculture, fisheries, transportation in order to ensure the kingdom's food security. Records at Nayuma Museum verified this information. The canals are reported to have been constructed using compulsory labour.

Table 24 History of the six target canals

Name of Canal	History
Lubitamei	The name means 'passing water'. It runs from Kala to Tembo. The canal is known as Kembe where it originates. The canal is believed to have been dug during the reign of King Lewanika (1885-1916)
Musiyamo	The name means to "lean against the edge" and was built in the 1930s. It runs from Lukulu to Senanga.
Muoyowamo	Constructed between 1887 and 1889 during the reign of LubosiLewanika, it was meant to link Lealui and Limulunga and to supply water to Lealui. The canal was constructed using communal labour. The government has been maintaining the canal since 1964.
N'gombala&Nebubela	Named after LitungaN'gombala, the canal was constructed by government in 2002 using communal labour with the sole purpose of linking Kama and Mongu.
Fisheries	Constructed by the Fisheries Department in 2004 for fish breeding purposes.

### 5.13.1 Lealui, Limulunga, Libonda and Nalolo Palaces

Within the Barotse floodplain, many sites of cultural importance and interest are found. Sites of cultural importance include palaces such as Lealui (summer capital of the Litungas), Limulunga (the winter capital for the Litungas), Libonda (summer capital of Chieftainess Mboanjikana) and Nalolo (summer capital of Chieftainess Makwibi). Makono village plays another important role in the Barotse Kingship succession as the enthronement of a new Litungabegins here. Makono is regarded as the place where the first Litunga, Mbuyawamwambwa is buried. These areas are regarded as important and play significant roles in the Barotse Kingdom. Nayuma Museum in Limulunga is part of the national heritage of the country as it houses traditional relics connected to the installation of the Litunga. Lealui was a political and administrative centre where the signing of the Lockner Concession took place, a treaty between King Lewanika and the British South African Company (BSA), under which the Lozi Kingdom became a British Protectorate in 1890.

### 5.13.2 Royal Burial Sites (Sitinos)

According to Lozi culture and custom, each Litunga chooses his burial site as soon as he ascends to the throne. The graves link the past and present generations. The dead Kings are consulted through offerings of meat and libations with the grave attendants (Li Ng'omboti) as medium. During the Kuomboka, the Li Ngo'mboti sees off the royal barge (Nalikwanda) as it sails to Limulunga. An important significance of the Barotse Floodplain is its usage as burial grounds for the Lozi Kings (Litungas) as records from Nayuma Museum show. The graves of past kings, called Sitino, are managed and conserved by Li Ng'omboti. Ling'omboti act as Priests between the dead Kings and the communities in the Barotse Flood Plains. The graves are within the perimeters of the respective villages and they are not inundated during the floods.

The graves are dotted around the Barotse plain in different villages along the eastern bank of the Zambezi River that do not get inundated during the floods except for that of Lewanika II whose Sitino is in Sikongo on the west bank. Except for the Lake Nakatondo-Wa-Situlu site, damaged during the construction of the Mongu-Kalabo road, all the burial sites are in reasonable condition.

#### MBUYUWAMWAMBWA BURIAL SITE

This site is located in Makono village on the western side of the Zambezi River near Nanjulwe Island. Mbuyuwamwambwa, who founded the Lozi Kingdom, abdicated the throne in favour of her son Mboo Muyunda, the first male ruler to have used the title Litunga. The title means "King of the Land".

#### MBANIKELAKO BURIAL SITE

This is the burial site for Litunga Lubosi Lewanika. The site is located in the middle of a village compound. King Lewanika ruled the Barotseland during the time when colonialism and the Frank Lockner Concession were being implemented in Central and Southern Africa and he also ruled Barotseland when the then North-Western Rhodesia was being administered from Lealui. He ruled from 1878 to 1884 before he was briefly deposed then reinstated in 1885 until his death in 1916.

#### OTHER BURIAL PLACES

Having described the best-known burial sites, the table below presents other burial sites (Sitinos) for all the past Litungas for ease of reference.

*Table 25 Past Lozi Kings and their burial sites*

Name of Litunga	Reign	Burial Site/village
Mbuyawamwambwa	No record	Makono
MbooMuyunda	No record	Imwambo
Inyambo	No record	Namanda
Ngalama	No record	Kwandu
YetaNalute	No record	Nandopu
N'gombala	No record	N'undi
Yubiya	No record	Namayula
Mwanawina I	No record	Lieneno
Mwananyanda	No record	Kashiko
Mulambwa	1780-1830	Lilundu
Silumelume	1830-1840	Unknown
SipopaLutangu	1864-1876	Unknown
Mwanawina II	1876-1878	Sikongo
LubosiLewanika I	1878-1884	Nanikelako
TatilaAkufuna	1884-1885	Unknown
LubosiLewanika I	1885-1916	Nanikelako
LitiyaYeta III	1916-1945	Malumbo
Imasikulmwiko I	1945-1948	Naloyela
Sir Mwanawina III	1948-1968	Sikuli
LewanikaMbikusita II	1968-1977	Lishekandinde
IluteYeta IV	1977-2000	Ndowana

The villages where the Litungas are buried have a very significant role in the Lozi society and the Ng'omboti (Grave Care Takers) has a lot of influence within the Barotse Royal Establishment (BRE).

### 5.13.3 Lwatile Church

Francois Coillard, the French Missionary belonging to the Paris Evangelical Missionary Society (PMS) built Barotseland's first church at Lwatile near Lealui in 1893. The Church, though in disrepair, still stands and remains one of the most memorable cultural relics in the Bartose Flood Plain. The church played a fundamental role in the establishment of educational institutions at Sefula and other areas of Western Province. Coillard is reputed for having brought Christianity to Barotseland, helped to abolish witchcraft and slavery in accordance with the spirit of the Frank Lockner Concession of 1890. It is an accepted fact that African education in Zambia started in Western Province as evidenced by the schools built by the Paris Evangelical Missionary Society around 1890.

In the history of Barotseland, Lwatile Church stands out as one of the historic architectural buildings/structures in Western province including the Old Boma site described below.

### 5.13.4 Old Boma Site

The old Boma site was another significant cultural site in Barotseland that has been a part of Lozi History. The Frank Lockner Concession was signed at this site in 1890. Frank Lochner was the representative of the British South African Company owned by Cecil Rhodes. The concession provided protection to King Lewanika from an internal power struggle, the Portuguese and Arab slave traders. Through this Concession, Queen Victoria of England stationed a representative in Lealui (Mainga and Mutumba, 1973).

Sir Robert Thorne Corydon was the first representative of Queen Victoria in Barotseland in 1897 and he set up the Old Boma on the outskirts of Lwatile Mission before shifting the Boma to Kalomo in 1905. Records show that the Old Boma Site, located near Lwatile Church, was the first Capital of North-Western Rhodesia.

In the recent past, the site has been taken over as a residential area and has therefore lost its historic significance.

### 5.13.5 Lealui Royal Palace and village

Litunga Lubosi Lewanika established Lealui, the summer capital and home to the Nayuma sacred site, in 1878. There is a palace known as Kwandu that was built in 1890, a probation centre called Kamona built in 1878 and a visitor's pavilion. The probation centre serves as a waiting house where a newly installed Litunga waits to receive instructions before occupying the royal palace. The royal pavilion, the Kashandi was built in 1908. The materials used for the construction of the royal compound were sourced from every part of the Kingdom including the west bank of the Zambezi River. There is a Queen's residence, called Nanda, which was built in 1906. Adjacent to the Queen's residence is another royal pavilion, the Njimba, where she receives her dignitaries and guests. To the east of the royal compound are houses for the King's children and Kingdom officials such as the Ngambela (Prime Minister).

### 5.13.6 Survey on cultural heritage sites

During social surveys, villagers were asked if they were aware of any physical cultural resources (PCR). Their answers are shown in the following table.

Table 26 Survey on cultural heritage sites

Musiamo canal	
Namboata Village (central place) and included Nasisholo, Kembu and Nakalenge villages	There are no known burial site or site of cultural importance along the canal that might be affected by rehabilitation works
Situlu Village	There are no known burial site or site of cultural importance along the canal that might be affected by rehabilitation works
Mikuyu Village	There are no known burial site or site of cultural importance along the canal that might be affected by rehabilitation works
Muoyowamo canal	
Natwale Village	The Muoyowamo has only one cultural site at Leauli where Nalikwanda passes through the canal during the Kuomboka.
Lubitamei canal	
Nalwela Village	There are no known burial site or site of cultural importance along the Lubitamei canal from Kate to Mbanikelako.
Ndiki Basic School with representatives from Namusa, Iyoo, Sitendo, Nakalenge, Kakulo, Kashiko, Kaole Ole, Nalufumo Villages	There are no known burial site or site of cultural importance along the canal that might be affected by rehabilitation works
Nangula Village	There are no known burial site along the canal that might be affected by rehabilitation works.  During social surveys, villagers of Nangula along Libutamei canal revealed the presence of a small lake called Lito Iya ndiki in which it is believed a small animal known as Kapuwe lives. Local people believe that the water in the lake heals sick people if they drink it. The lake, is not hydrologically connected to Libutamei canal.
Isambai Village	There are no known burial site or site of cultural importance along the canal that might be affected by rehabilitation works.
N'gombala & Nebubela Canals	
Mwandi Village	There are no known burial site or site of cultural importance along the canal that might be affected by rehabilitation works
Sipolota and Taisei Fishing camps	
Litondo, Sipai, Nakalenge, Kundiana, Mungongo and Namakomena Village	

Fisheries Canal	
Nakatoya Village (Central place) and included seven other villages of Namuku, Loyana, Nasinandi, Nyambe, Lilami, Kashumba and Nashikundu	There are no known burial site or site of cultural importance along the canal that might be affected by rehabilitation works

## 5.14 SOCIAL-ECONOMIC SET UP

### STUDY APPROACH

A variety of methods were employed in the collection of data for the Socio-economic and cultural baseline as presented below.

In this section the terms “local communities”, “Project Affected People (PAP)” and “villagers” all designate people that live in the Study area and that will be affected positively (or negatively) by the Project.

### LITERATURE REVIEW

The consultants first reviewed documents collected in both Mongu and Lusaka in order to obtain a detailed understanding of the Study area. Documents reviewed included anthropological writings about the Lozi people, Barotse Jurisprudence and The Barotse Economy by Professor Max Gluckman; writings of Francois Coillard, the French Missionary of the Paris Missionary Society (PMS); Central Statistical Office (CSO), Ministry of Health, Ministry of Education and Ministry of Community Development and Social Services publications; and Concern WorldWide-Mongu Office data on canal rehabilitation works. Other documents reviewed were Environmental Guidelines for Road Rehabilitation and Maintenance works (RDA, 1997).

### FIELD VISITS TO THE PROJECT AREA TO BE AFFECTED

During field visits, data was collected through observations and interviews with stakeholders around the six target canals, namely, Fisheries, Lubitamei, Musiamo, Muoyowamo, and N’gombala to establish their usage and state. A checklist focusing on housing, water supply, road infrastructure, education facilities and services, health facilities and services and socio-economic profile was prepared and used during the survey by the consultants. As much as possible efforts were made to take pictures of the socio-economic activities and infrastructure available in the Barotse Flood Plain.

The process promoted inter-sectoral linkages between various government departments in the project areas, in addition to ensuring full participation of affected stakeholders and interested parties in the project areas.

## SOCIAL SURVEYS

Open-ended discussions were held with key informants who included people living in the floodplain, farmers, fishermen, fish traders, and members of staff of selected government institutions and Non-Governmental Organizations within Mongu District and the newly created district of Limulunga. A series of spontaneous scoping meetings were held with people living along the six target canals.

Focus group discussions along the six major canals were held with groups of the key stakeholders ranging from 5 to 30 people depending on the village size. Fifty-five (55) villages were covered during the focus group discussions as presented below:

- ▶ Musiamo : Sikuyu, Namboata, Nasisholo, Kembu, Nakalenge, Situlu and Mikuyu Villages;
- ▶ Muyowamo & Namitome : Ikakuyu, Likomokelo, Nalutimbo, Nateo, Katoya, Nandopu, Muchumbu, Nanjeko, Kandiyana, Kazauli, Kasibi, Kabula, Mabuto, Litongo, Katongo, Libula and Natwale Villages;
- ▶ Libutamei : Nalwela Village, Nangula at Chief Lubindatanga palace, Ndiki, Namusa, Iyoo, Sitendo, Nakalembe, Kakulo, Kashiko, Kaole Ole and Nalufumo Villages ;
- ▶ N'gombala & Nebubela : Mwandu Village, Taisei, Sipolota, Litondo, Sipai, Nakalenge, Kundiana, Namakomena and Mungongo Villages ;
- ▶ Fisheries : Situnda Village, Nakatoya, Namuku, Loyana, Nasinandi, Nyambe, Lilami, Kashumba, Nashikundu and Namutondo Villages.

During the survey, scoping meetings were held with groups of people from the local communities along the selected six major canals to be rehabilitated. These people are likely to be directly or indirectly affected by the proposed rehabilitation works. Consultations were also held with district technical staff and local administrators of the project area. Issues of focus in the consultations involved people's views, fears and expectations.

The method adopted for community and stakeholder consultations was open-ended discussions based on a checklist.

The goals of these social surveys were to present the Project to communities and to gather their opinions regarding canal current states and canal maintenance needs. Meeting with local communities has also enabled the Consultant to describe the socio-economic baseline of the study area including the gender aspects, sources of livelihood, community's challenges, youth challenges, etc.

Minutes of focus group discussion are presented in Annex 1.

## STUDY LIMITATIONS

During the social survey period, 30th November early 2014, it was practically impossible to reach some of the points of the six targeted canals due to heavy rains. The social survey team only managed to visit settlements along the Lubitamei, N'gombala, Musiamo and Muoyowamo canals but failed to traverse the whole length of the Fisheries canal as the road was flooded and slippery. However, major findings of the survey are presented in this report.

### 5.14.1 Population

The Lozi ethnic group have been living in the Barotse Plain since their migration from the Kola Kingdom in the now Democratic Republic of Congo (DRC) in the 1600s. Queen Mwambwa led them out of Congo. Upon Mwambwa's death, her daughter, Mbuyuwambwa, became queen and after her death, her son Mboo Muyunda ascended to the throne as first King (Litunga). Mboo expanded the Lozi kingdom by conquest. During the 18th Century, the fourth Lozi King, Ngalama, initiated the process of unification, which was completed by Mulambwa, the 10th Litunga. Lozi historians, including missionaries and anthropologists such as Francois Coillard and Professor Max Gluckman, report that the Lozi people have inhabited the Barotse Plain for a long time and that about 1830 civil war broke out following the death of Litunga Mulambwa. Shortly after the civil war, the Sotho-speaking Makololo from the Bafokeng region of South Africa led by Sebitwane, invaded Barotseland and conquered the Lozi. The Makololo ruled Barotseland from 1840 until 1864 when they were overthrown following a Lozi revolt led by Sipopa Lutangu, the 12th Litunga. This important chapter in Lozi history is preserved in the Nayuma Museum archives at Limulunga as part of the National Heritage Commission data bank.

Lozi is the common language spoken in much of the Barotse Flood Plain, although some inhabitants speak other Bantu languages as well. Lozi is a Bantu language of the Benue-Congo Family, within the larger Niger-Congo Group. The Lozi language is largely derived from the Sotho language spoken by the Kololo although it exhibits some modifications in phonetics and vocabulary.

The distribution of human settlements in the Barotse Floodplain is influenced by natural resource availability (water bodies for fishing, water for human and livestock use, land for agricultural use, settlement and grazing), accessibility and flooding pattern. Settlements/villages are clusters of households whose members are related. These settlements are usually located on higher ground near to fishing bodies' and ample land for livestock grazing and growing crops.

In the study area, population repartition fall in three categories according to topographical characteristics:

- ▶ Floodplain people,
- ▶ Plain fringe people,
- ▶ Plateau people.

The majority of people that depend on the floodplain as sources of livelihood live in the plain fringes close to the Musiamo canal. This population does not have to migrate during the flood; however water inundates most of the land in front of their villages restraining access to some of their sources of livelihood as they are mainly located in the plain. Most of people living on the Plateau do not depend on the plain for their sources of livelihood, except for those working at Mongu Harbour.

According to the 2010 Census of Population and Housing, the population density for Western Province was 7.1 persons per km<sup>2</sup> an increase in density of 1.0 person per km<sup>2</sup> from 2000. Mongu is the most densely populated district with 17.8 persons per km<sup>2</sup> with Kalabo with 7.1, Kaoma and Senanga with 8.1, Lukulu with 5.3, Sesheke with 3.4 and Shang'ombo with 6.5 persons per km<sup>2</sup>.

The table below shows population distribution in the Study area, part in Mongu District, part in Senanga District. For district boundaries see map of the Study area.

Based on this table it is obvious that the male population is lower in the Barotse floodplain than women. This population pattern is found across Zambia, in both rural and urban areas (2010 Census of Population and Housing).

The 2010 Census of Population and Housing estimates that 86.3 percent of the provincial population lives in rural areas, a similar proportion as in 2006 at 86.0 percent. This means that there is no significant migration of youths from rural areas including the Barotse Floodplain to urban areas. This is confirmed by information generated from focus group discussions that show that the few young persons who have left villages are those pursuing post-secondary education. However, there is a reported temporary migration into the floodplain by fish traders and upland inhabitants who have access to agricultural land between the months of August and December.

#### SEASONAL MIGRATION

During the dry season, the bulk of local production, economic activities and settlement are focused in the floodplain area. As the plain becomes inundated, most of the population moves to the uplands and plain fringes. This annual relocation of people and cattle including the Litunga in a highly-celebrated ceremony has become a national and international tourism event.

There is a seasonal migration of the cattle owners living in the plain. Cattle usually graze in the plain, but owners have to bring the herd to the upland during the flood. At this moment, there is grass on the upland thanks to the rains. The cattle are kept by people in the upland who receive payment in milk and calves for this service. A strong relationship is built between cattle herder from the plain and upland, through this system. This system is called "mafisa" in Lozi

Table 27 Population distribution in the Study area (District, Constituency and Ward level)

Constituency & Ward	Number of Households	2010 Population			Percentage Distribution	
		Male	Female	Total	Male	Female
<b>Mongu District*</b>						
Mongu Central Constituency	18,410	42,616	46,211	88,827	47.98	52.02
Namushakende	1,120	2,512	2,916	5,428	46.78	53.72
Yeta	1,455	3,324	3,378	6,612	50.27	49.73
Kama	608	1,452	1,459	2,911	49.88	50.12
Lumbo	954	2,145	2,413	4,558	47.06	52.94
Katongo	2,164	4,558	5,219	9,770	46.65	53.35
Kanyonyo	2,425	5,521	5,919	11,440	48.26	51.74
Kambule	1,921	4,543	5,009	9,552	47.56	52.44
Lewanika	659	1,478	1,526	3,004	49.20	50.80
Mulambwa	1,908	4,684	5,129	9,813	47.73	52.27
Imwiko	3,300	8,113	8,854	16,967	47.81	52.19
Leauli	1,038	2,422	2,388	4,810	50.76	49.24
Mabumbu	496	1,083	1,124	2,207	49.07	50.93
Kaande	362	871	877	1,748	49.83	50.17
Luenta Constituency	10,180	24,219	26,522	50,741	47.73	52.27
Limulunga	2,921	6,682	7,517	14,199	47.06	52.94
Mabili	789	1,995	2,011	4,006	49.80	50.20
Ikwichi	734	1,615	1,818	3,433	47.04	52.96
Namboma	1,097	2,501	2,675	5,176	48.32	51.68
Nangula	2,442	5,895	6,341	12,236	48.18	51.82
Ushaa	990	2,504	2,744	5,248	47.71	52.29
Simaa	920	2,310	2,598	4,908	47.07	52.93
Ndanda	287	717	818	1,535	46.71	53.29
<b>Senanga District*</b>						
Nalolo Constituency	10,841	26,558	29,011	55,569	47.79	52.21
Lyamakumba	2,261	5,719	6,258	11,977	47.75	52.25

Constituency & Ward	Number of Households	2010 Population			Percentage Distribution	
		Male	Female	Total	Male	Female
Silowana	1,326	3,300	3,590	6,890	47.90	52.10
Shekela	1,417	3,581	3,700	7,281	49.18	50.82
Makoka	1,254	3,036	3,464	6,500	46.71	53.29
Kambai	1,292	3,171	3,479	6,650	47.68	52.32
Kataba	906	2,220	2,366	4,586	48.41	51.59
Muoyo	1,032	2,317	2,594	4,911	47.18	52.82
Nanjucha	1,353	3,214	3,560	6,774	47.45	52.55

Source: 2010 Census of Population and Housing. \* Both Districts have other constituencies outside of the Study area.

## 5.14.2 Growth rate, population density and distribution

There has been a marginal increase in the population of Mongu district in the 20-year period between 1990 and 2010 as shown by census data. In 1990, the population of Mongu district was 150,129 growing to 162,002 in 2000 (0.8%) then to 179,585 in 2010 (1% increase). Taking into account births, this may imply that migration in and out of the district was not significant. However, the Living Conditions Monitoring Surveys of 2006 and 2010 show that the Western Province in general had the highest proportion of migrant households moving from one rural area to another (rural to rural migration) at 51 percent in 2006 and 50 percent in 2010. The major reason for this migration is the desire to change from one rural settlement to another in a bid to acquire bigger arable land.

Mongu Constituency has a total population of 88,827 of which 48 percent are male and 52 percent are female (CSO, 2010).

## 5.14.3 Administration

According to Max Gluckman, the Lozi political organization has a long centered system based on a monarchy, whose reigning head is the Paramount King called Litunga whose meaning is "keeper of the earth". Further, records in the Nayuma Museum show that the current Litunga, Lubosi Imwiko II, is the 23rd ruler from the time the Lozi Kingdom was established.

Max Gluckman and the Missionary Francois Coillard noted in their writings that the Lozi society was highly stratified, with the Litunga at the top and the Ngambela next in line of authority with vested responsibility of overall administration of the Barotse Kingdom in close liaison with headmen known as Indunas. The traditional authority is known as the Barotse Royal Establishment (BRE). The Lozi people have preserved their culture, tradition and beliefs over the centuries leading to the candidacy of the Barotse Flood Plain as a UNESCO World Heritage Site. Discussions are still on-going between the BRE and the Zambian government.

## 5.14.4 Social services and amenities

### 5.14.4.1 Housing, water sources, sanitation and electricity

#### HOUSING

The traditional hut is the most common type of house in the flood plain although there has been an increase in the number of improved traditional huts. According to the 2010 Living Conditions Monitoring Survey an estimated 74.9% of the population in Western Province lived in traditional huts and 15.4% in improved traditional huts. The traditional hut has walls constructed of wooden poles, reeds, mud with a grass thatched roof while the improved hut has corrugated iron sheets for its roof.

A few well-to-do households live in permanent improved housing constructed of bricks or cement blocks with corrugated iron roofing and these were observed in places like Matongo, Situlu, Nalusa, Lealui, Lwatile and Imbowa. The floodplain and plain edge has a small proportion of people, usually the poor and fishermen, living in temporary shelters known as “Maongo” made of reeds and grass.



Traditional hut (left), and improved traditional hut (right).



Temporary shelter (Maongo) (left), and Permanent improved housing

## WATER SOURCES

The main sources of water for people living around the six target canals are un-protected wells, boreholes, water bodies such as canals and ox-bow lakes, Zambezi River and protected wells. The Living Conditions Monitoring Survey of 2010 indicates that in Western Province an estimated 41.3 percent of households obtained their water from un-protected wells, 25.1 percent from boreholes, 10 percent from rivers/streams/canals/lakes/scooping hole, and 6.8 percent from protected wells.

Schools, Rural Health Centers, and their surrounding communities access water from boreholes with Indian Mark 2 pumps.

It is important to note that the World Health Organization (WHO) only regards protected wells and boreholes as safe sources among the different water sources.

## SANITATION

Sanitation remains one of the biggest challenges in the Barotse Plain and many adjacent areas of the uplands. This is largely attributed to the sandy nature of the soil and absence of building stones within the district. According to the Living Conditions Monitoring Survey of 2010, the Western Province in general had the lowest level of sanitation status with only 7.4 percent households having access to improved/adequate sanitation facilities and 49.9 percent of households are without pit latrines. Where pit latrines exist they are temporary and made of reeds or grass

The issue of water and sanitation was reported to be in a deplorable state as the temporal pit latrines built with grass usually collapse during the rainy season and it is possible that these toilets contaminate nearby water sources used for humans thereby causing diarrhea diseases. During social surveys, people claimed that they do not dig pit latrines because they easily collapse due to the sandy nature of the soil and because burnt bricks and cement to stabilize these pits were costly.

#### ELECTRICITY

The Urban part of Mongu district (on the plateau) is connected to the national grid of ZESCO 66KV running from Victoria Falls Power Station.

The flood plain villages are not connected to the grid except for Lealui thanks to the 11KV power line running through the Barotse Plain from Mongu to Kalabo via Libonda.

#### FUEL

Fuel (diesel, petrol, paraffin and lubricants) is supplied by major oil marketing companies (Puma, Total, Engen and Kobil).

#### 5.14.4.2 Health facilities

Table below shows health facilities accessed by people living along the project canals and immediate surrounding settlements. The distance patients have to cover to reach a health facility ranges from 0 to 26 km.

Investigations revealed that the health sector has a challenge in the Barotse Plain. The distances from the existing settlements to the health facilities tend to be long and most of them have inadequate admission facilities. However, the health services offered appear to be adequate (see next section).

Table 28 Distances of health facilities

Name of Facility	District	Distance from District Center (Km)	Distance from furthest catchment village (Km)	Number of Beds	Population served
Sefula RHC	Mongu	19	18	20	8,000
Namushakende	Mongu	24	09	18	5,267
Mabumbu RHC	Mongu	09	12	03	3,280
Limulunga RHC	Mongu	0	21	20	7,141
Lealui RHC	Mongu	17	15	12	5,920
Mulambwa UHC	Mongu	02	09	0	15,302
Liyoyelo RHC	Mongu	05	07	0	10,201
Ikwichi RHC	Limulunga	27	08	06	4,029
Itufa RHC	Senanga	30	25	16	6,433
Muoyo HC	Senanga	72	26	15	8,870

Source: The 2012 List of Health Facilities in Zambia, MOH.

### 5.14.4.3 Health services

Project affected communities are able to access the following health services from facilities. As the table below indicates, all health facilities in and around the Project area provide HIV-AIDS Counseling and Testing (HCT) as well as Prevention of Mother to Child Transmission (PMTCT). In addition to services indicated in the table, Lewanika General Hospital provides other services such as dentistry and X-ray.

Table 29 Provided treatments in health services

Name of facility	HCT	PMTCT	Delivery	TB diagnosis	Common disease treatment
Ushaa RHC	x	x	x	N	x
Namushakende	x	x	x	x	x
Mabumbu RHC	x	x	x	N	x
Limulunga RHC	x	x	x	x	x
Lealui RHC	x	x	x	N	x
Mulambwa UHC	x	x	N	x	x
Liyoyelo RHC	x	x	x	N	x
IkwichiRHC	x	x	x	N	x
Itufa RHC	x	x	x	x	x
Litambya HC	x	x	x	x	x
Muoyo HC	x	x	x	x	x

Source: The 2012 List of Health Facilities in Zambia

### 5.14.4.4 Access to School

Besides education being a basic human right, it is of cardinal importance to social and economic development. Education directly contributes towards economic growth, local and national productivity, innovation and social cohesion.

The Zambian Education Policy provides for free primary education in line with the Second Millennium Development Goal that aims to achieve universal primary education for all boys and girls by 2015 (UN, 2000). There are many factors though that affect the attainment of this goal, the most important being location of educational facilities in relation to settlements and availability of trained teachers. There are 24 Basic schools 4 Secondary schools from which project-affected communities access educational services and these are given below.

Table 30 School enrollment and staffing in Mongu District

Name of School	District	Number of staff	Enrolment	Boys	Girls
Kalungu Basic	Mongu	10	338	178	160
Lealui Basic	Mongu	11	480	245	235
Liande Basic	Mongu	05	310	184	126
Likutwe Basic	Mongu	07	247	134	113
Limulunga Basic	Mongu	36	1,156	552	604
Limulunga Day Secondary	Mongu	32	680	360	320
Liumbo Basic	Mongu	06	292	143	149
Liunga Basic	Mongu	11	350	175	175
Lourdes Basic	Mongu	09	314	148	166
Lyaluo Basic	Mongu	04	148	78	70
Mabumbu Basic	Mongu	09	434	222	212
Makuku Basic	Mongu	06	232	144	88
Malengwa Basic	Mongu	44	1,587	806	781

Name of School	District	Number of staff	Enrolment	Boys	Girls
Mombo Basic	Mongu	11	1,559	273	286
Mupatu Basic	Mongu	20	1,034	537	497
Mutwiwambwa Basic	Mongu	12	466	220	246
Nakayuwe Basic	Mongu	04	253	135	118
Mamachaha Basic	Mongu	09	255	141	114
Namushakende Basic	Mongu	34	906	442	464
Salondo Basic	Mongu	03	120	60	60
Sefula B/Blind	Mongu	11	80	27	53
Sefula Basic	Mongu	33	786	386	400
Kambule Secondary	Mongu	37	778	234	544
St. John's Secondary	Mongu	25	602	214	388
Muoyo Day Secondary	Senanga	19	244	140	104
Itufa Basic	Senanga	13	435	216	219
Mukukutu Basic	Senanga	14	394	199	195
Nasiwayo Basic	Senanga	13	347	170	177
Total			14,827	6,763	8,064

For many of the children living in the Barotse Plain, the annual flooding poses a big challenge to their education. The movement of people including teachers to the upland disrupts children's attendance at school between the months of January and June and the flooding itself reduces accessibility to schools as canoes become the only means of getting to and from school. This impacts negatively on girl pupils as most are not able to navigate dugout canoes.

It was also reported during the interviews we had with some of the people in the Barotse Flood Plain that school places were limited in the existing schools the people in the plain use.

Mongu also has institutions offering tertiary education. These are University of Barotseland, a newly established private University, Mongu Teachers Training College, Lyambai College of Education and Lewanika School of Nursing.

Data in previous table indicates that there are more girls than boys enrolled in schools.

Access to school in the urban areas is not gender biased as all pupils walk short distances to schools. For rural areas, the situation is different as it is difficult for girls to travel an average 10 km to schools every day. From the social surveys, it became apparent that school performance suffers greatly for the girls and many of them drop out of school early due to their overwhelming household chores. In addition, social surveys have revealed that many villagers prefer to send the boy child to school because education for the girl child is perceived as preparation for marriage. In the plain, social surveys revealed that there are more boys than girls going to school.

Girls complained that their counterparts in urban areas walk to the schools within 15 to 20 minutes whilst the shortest distance for most villages surveyed was 3 hours. The challenge of long distances results in children enrolling for primary school late and dropping out.

During the rainy season, when shallow wells are washed away, girls walk long distances to fetch water after knocking off from school and assist their mothers in household chores. The survey noted that as a result many school girls are exhausted and not able to concentrate in class and do not have extra time to study at home.

For poor young girls going to school in the rural and remotest parts of the Barotse Flood Plain, it is household chores which constitutes the major reason for lateness to school, while they second to sickness as a factor causing absenteeism. Further, data and evidence collected from the scoping meetings and the social survey clearly shows that some parents prefer to send their male children to school because the see education for the girl child is perceived as preparation for marriage. Such social attitudes, are very prevalent among the rural parents and those with limited education as well as those households in which girls perform such roles as selling at the market and along the streets. In such households, there is a traditional view that investing in the boy child is more profitable than investing in the girl child remain quite profound (World Bank, 2004).

## 5.14.5 Water uses and navigation

### 5.14.5.1 Type of boats in use in the flood plain

Boats are widely used throughout the Barotse flood plain for transportation of goods and passengers, and for fishing.

Table 31 Number of boats in use in the Barotse floodplain in 2012

Canoes	Long Boats (wood planks)	Banana Boats (fibre glass)	Metal Boats
1,268	71	37	20

Source: Department of Fisheries: Reports of the Statistics Unit

#### CANOES

These traditional boats have been used for centuries. They are carved out of a single piece of wood. The actual length range from 2 m for short fishing canoe to 8 m for transportation canoes. Their advantage is a low draught (0.3 to 0.5 m) which allows them to pass even in shallow waters. Deforestation rarefies big trees, which makes the big canoes becoming scarce.

They are usually used for fishing or personal transport for the family living in the plain. During the flood, the canoes are the main means of transport for people in between villages. During the dry season, they are used to cross the canals and rivers. They are narrow, and cannot transport a heavy cargo (maximum 10 bags of 50 kg). When loaded, the gunwale is just a few centimeters above the water level, which induces risk of sinking or capsizing when crossing a motor boat.

#### LONG BOATS

They are built with assembled wood plank, and made waterproof with tar. Lengths are ranging from 8 m to 15 m, with 2 paddlers for the boats under 10 m and 3 paddler or an outboard engine of 25 to 50 HP for the longer ones. Their draught is 0.7 m if used with paddles, 1.5 m if used with an outboard engine.

#### BANANA BOATS

Banana boats are a modernized version of the long boat. Banana boats are made of fiberglass, which makes them lighter, more maneuverable, and easier to repair than wood. Their draught is 0.5 m. They can be used with paddlers or a small outboard engine.

As for the long boats, they are used mainly for transportation of goods and passengers.

### SPEED BOATS

Speedboats are made of welded steel or fiberglass, they are equipped with 50 to 90 HP engine and can achieve high speed.

They are mainly used by the government (Ministry of health, Ministry of education...) for inspection in the flood plain. Due to the engine, they have a draught of 1.5 m and are only used during the flood season.

### METAL BARGE

Made of welded steel plates they can transport heavy loads of up to 30 tons, with inboard engines or push by another vessel. Due to their draught of 2 m they are used only during the flood season.



Canoe (left) and Long boat (right)

#### 5.14.5.2 Mongu Harbour

The harbour at Mongu, known as Mulamba Harbor, is the main hub for transportation of both goods and passengers from the upland to the plain (Lealui, Nalolo) and beyond (Kalabo, Angolan border). It is also the starting point for the new Mongu-Kalabo Road under construction. The infrastructure is composed of four docking bay and a warehouse controlled by the Harbor Master to store goods which are offloaded from heavy trucks before they are loaded on boats or lighter 4\*4 trucks which will go in the plain. A second warehouse, reportedly under the control of by the BRE, also exists.

Keeping marine traffic records and tax collection is in principle the responsibility of the the Harbour Master, but reliable figures for traffic do not exist and there is no data from the warehouse controlled by the BRE. Moreover, the harbour is not fenced, thus many goods escape the Harbour Master's reach and do not therefore get taxed.

#### 5.14.5.3 Navigation on Muyowamo canal

During the dry season, Muyowamo is very shallow, with only 20 cm of water in October. This limited depth only allows small canoes to navigate Muyowamo during the dry season, mainly personal transport for family living along the canal. A counting in September 2013 assessed an average traffic of less than 10 canoes per day.

During the flood season from December to June, navigation is more intense. The main use is still the Kuomboka ceremony, which attracts 40 000 people each year (NHCC, 2013). It is important for the Lozi to participate to the ceremony with their own canoe and long boat to form a convoy of up to 300 vessels to escort the Nalikwanda (Royal Barge).

#### **5.14.5.4 Navigation on Nebubela canal**

Nebubela is a 6 km canal that links Mongu harbor to the rest of the canal network, so the traffic on this canal is equal to the traffic at the harbor (cf. above). It is deep enough to allow motor boats to navigate throughout the year. The main issue for navigation on this canal is the junction with “Malile”, the Little Zambezi. A sand bank often forms at this junction, requiring frequent dredging.

#### **5.14.5.5 Navigation on Fisheries canal**

Fisheries Canal was originally a navigation canal. Despite having been dredged in 2011, Fisheries canal is currently not navigable during the dry season because of insufficient water levels.

The department of Maritime started digging a harbor with 3 docking bay at the beginning of the canal in Namushakende, with the idea of transferring some activities from Mongu Harbor to there after the completion of the Mongu / Kalabo road (Nativel, 2013, Harbor master interview). This harbor is not yet used.

#### **5.14.5.6 Navigation on N’gombala canal**

N’gombala is a recently dug canal as it was started on the initiative of the Maritime Department in 2002 (BRLi, 2013, 1<sup>st</sup> Stakeholder workshop). The initial design was to make it a navigation canal linking both sides of the plain, but its construction has not been completed. The part on the west bank of the Zambezi has not even been started. It is currently too shallow to be navigable all year round, even for canoes. It is used at the beginning of the flood from January to March, then in March and April the all area is flooded so boats can pass anywhere. Then the canal is used again when the water recedes from May to July.

People living close to the canal and boat captains expressed the strong necessity of completing this canal to facilitate transportation. Even if the population density is low, that area as an important production of milk and rice which needs to be given an access to the markets in Mongu (Nativel, 2013, Interviews).

#### **5.14.5.7 Domestic uses**

##### **SANITATION**

There is no sanitation network in Mongu District. Thus, sewer effluence and domestic waste are washed away by surface runoff into the canals and then into the Zambezi River. Thus, the quality of water in canals may not be suitable for domestic purposes near the urban centers.

##### **CAR WASH**

Full time car wash activities take place in the Kambule stream down town Mongu, this stream is directly connected to Musiamo. This would appear to be an important income generating activity for young men. On average 100 cars are washed every day, with an approximate water use of 200 L (10 bucket) per car (interviews, BRLi, 2013). This activity is a source of pollution with detergent and hydrocarbons for Musiamo canal and Nebubela stream.

Point-source car wash is also done in Musiamo close to Mongu harbor and in Namitome, the main tributary to Muyowamo, in Limulunga.

#### LAUNDRY / DISHWASHING

The washing of laundry and cooking utensils in the canals is one of the water uses. Households along the six canals extensively use canals for these purposes. The water drawn from the canals is estimated at 100 litres per day per household. Water at the end of the canals is most likely contaminated by washing detergents.

Women interviewed while doing their laundry in Musiamo canal complained about the cleanliness of the water around Mongu. Musiamo receives the wastewater from the activities listed above coming from upslope Mongu and the harbor. This underlines the need for development of a proper sanitation treatment plant and sewage network.

#### BATHING

All six canals are used for bathing by nearby people. The main issue is children bathing in Mongu harbor, which is very polluted by the numerous pigs and pit latrine directly surrounding the harbor.



Laundry washing in Musiamo close to Mongu Harbour (left) and children bathing in Muyowamo canal (right)

#### DRINKING WATER

People living along the N'gombala, Muoyowamo, Fisheries and Lubitamei canals use the canals as sources of drinking water. Most of the time, people drink the water directly without boiling it (BRLi, 2013, interviews). Water is transported from canals to homesteads by women and children in 10 or 20-liter buckets.

Musiamo canal is not normally used as a source of drinking water because of the poor quality of the water due to other uses that tend to cause pollution such as car wash, domestic effluence, etc. In addition, groundwater is easily available, and boreholes with manual pumps and protected wells have been provided in some villages along the plain edge to provide safe drinking water.

SOAKING OF CASSAVA

Musiamo and Lubitamei canals are used to soak the cassava to remove the bitterness, which is cultivated on the upland. The objective of this process is to remove the toxic cyanide component present in raw cassava (FAO, 1990). The cassava tubers are put in bags and left in the canal for three days when the temperature is high, and up to one week when the weather is cold (June-July). After soaking, the cassava is peeled then dried. Dried chips are later packed in 50 kg bags and sold or stored.

WATER CONSTRAINTS

Despite that the canals were initially built for one main purpose (either navigation or drainage), they are currently used for multiple purposes as shown in the following table.

Table 32 Water constraints

	Use	Jan.	Feb.	March	Apr.	May	June	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.
Muoyowamo	Navigation				need for 1,5m depth								
	Drainage												
	Irrigation												
	Cattle watering								crossing needed every km				
	Fishing												
	Domestic	Drinking water, bathing, laundry											
Fisheries	Navigation				need for 1,5m depth								
	Drainage												
	Irrigation												
	Cattle watering								crossing needed every km				
	Fishing												
	Domestic	Drinking water, bathing, laundry											
Musiamo	Navigation				need for 1,5m depth								
	Drainage												
	Irrigation												
	Cattle watering								crossing needed every km				
	Fishing												
	Domestic	Car wash, sanitation, bathing, laundry, soaking of cassava											
N'gambala	Navigation				need for 1,5m depth								
	Drainage												
	Irrigation												
	Cattle watering								crossing needed every km				
	Fishing												
	Domestic	Drinking water, bathing, laundry											
Lubitamei	Navigation				need for 1,5m depth								
	Drainage												
	Irrigation												
	Cattle watering								crossing needed every km				
	Fishing												
	Domestic	Car wash, sanitation, bathing, laundry, soaking of cassava											
			Flooding period										

It has to be noted that some constraints linked to the different uses seems difficult to conciliate:

Navigation and animal crossing: for navigation, the water level needs to be at least 1.5 m, although animal crossing require a ford passage;

The quality of water required for some domestic uses (drinking water, soaking of cassava) is incompatible with polluting uses (car wash, sanitation).

#### 5.14.5.8 Canal users from social surveys

Below are some of the comments obtained during our social survey interviews with the local inhabitants in the six selected priority canals on the uses and importance of the canals in the Barotse Floodplain.

Table 33 Canal uses

Name of Canal	Uses
Lubitamei	Irrigation, basket fishing and watering cattle The inhabitants along the canal are involved in vegetable gardening.
Musiyamo	Interception of water from the uplands, drainage, watering livestock, transportation, irrigation, bathing, washing clothes and basket fishing. Communities also soak cassava in the canal.
Muoyowamo	Transportation from upland to the plain, Kuomboka and Kifuluhela ceremonies, fishing (women and children use the canal for fishing with baskets) and water source for humans and livestock. Transportation of goods and building materials. The canal is also a source of drinking water, bathing and laundry, washing utensils, fishing and soaking cassava.
N'gombala&Nebubela	Transportation of people and crops, bathing, washing clothes and watering livestock. Rice (with supa, blue bonnet, xiang Zhou as varieties), local maize, pumpkins and gourds are the most important crops grown along the N'gombala canal.
Fisheries	Fish breeding and fisheries development, washing and bathing and transportation of charcoal and fire wood.

The study noted that canals were constructed for the purposes of delaying inundation of agricultural lands by flood waters so as to allow winter crops to mature, provide irrigation water, to reclaim the fertile strip of land along the plain edge (Musiyamo) and as a source of water for livestock; for water transport (N'gombala, Muoyowamo); and fishing (Lubitamei, Fisheries). According to floodplain inhabitants, canals facilitate access to fishing grounds, transportation of fish to markets and enables fish traders to reach fishing camps.

#### PEOPLE INVOLVEMENT IN CANAL MAINTENANCE AND SUGGESTIONS FOR FUTURE MAINTENANCE

During social surveys, people from the surveyed villages were asked whether they were involved in canal maintenance and what should be done to maintain canals. The following table summarizes people's answer.

Table 34 People involvement in canal maintenance

Musiamo
<p>People along the Musiamo canal are involved in the clearing of their part of the canal and therefore would like to have the labour-based approach to clearing the canal. However, they would need the appropriate tools and guidance to reach the appropriate depth. Useage of the machines should be in just opening up the blocked portions. The people proposed that necessary tools be provided to the Disaster Management Committee at local level, which coordinates development projects on the ground.</p> <p>People would not do the rehabilitation for free but they should be paid by the project and in future, the modalities for voluntary cleaning and clearing will be agreed upon by the BRE and the local people. For this reason, the BRE ought to be part and parcel of the planning process for the rehabilitation of the Musiamo canal.</p> <p>People have reported having been involved in the clearing of the Musiamo canal in the recent past through the food for work programme. They were engaged to work on the canal in exchange for maize, beans and cooking oil by the Vice President's Office Disaster Management and Mitigation Unit (DMMU). They were using shovels and hoes to clear the canal.</p>
Muyowamo
<p>All the villages living along this canal are mobilized by the local Indunas to help in the clearing and the BRE plays a very significant role in the mobilization of the village headmen. The BRE punishes villages with monetary fines if absent. However, according to some communities, getting paid for canal maintenance is in line with the abolition of compulsory labour principles.</p> <p>The communities living along the Muoyowamo think that the BRE has a lot of influence in mobilizing local people. It was felt that given its political connections, Muoyowamo is one of the few canals that is well maintained by both the government and the BRE.</p> <p>Women reported that they are also involved in canal clearing. They use cycles to cut the grass while their men use shovels and picks to remove the sand.</p>
Libutamei
<p>Women are involved in clearing the Lubatamei only for the portions of their field if they are cultivating rice.</p> <p>Communities along Lubitamei, as many communities, pointed out the necessity to use machinery to dredge the canal.</p> <p>No one in the area was willing to get involved in the canal's maintenance without paid salaries, this would interpreted as forced labour. Also, the government should provide tools for maintenance works.</p>
N'gombala
<p>The community has never been involved in the clearing of the N'gombala canal except in 2010 when Fisheries Department came to deepen the confluence of the canal. Some young men and women were employed by the Fisheries Department.</p> <p>N'gombala canal was last maintained by hired labour that was paid for with cash or fish contributed by fishermen and fish traders living in Taisei and Sipolota fishing camps. Some communities are also willing to provide free labour for canal maintenance.</p>

Fisheries
<p>The Fisheries Department dredged the canal in the past.</p> <p>The community is of the opinion that local inhabitants should be responsible for future maintenance of canals under the supervision of the BRE. However, they are not willing to maintain canal without getting paid. They also expressed willingness to take responsibility after the government has carried out major rehabilitation works with machinery.</p>

The consultants observed that local people would not willingly maintain the canals unless the government maintained the system of food for work or cash for work programmes. These are practices employed by the office of the Vice-President under the Disaster Management and Mitigation Unit (DMMU) and by Non-Governmental Organizations (NGOs) involved in canal maintenance in the province.

#### HISTORICAL CANAL MAINTENANCE

Information emanating from the meeting held between headmen (Indunas), representing the BRE, and Consultants at Lealui in September 2013 indicates that before independence the canals were maintained by local people with or without token payment from the Barotse Native Treasury. The system of canal maintenance worked reasonably well under traditional authority as people felt duty-bound to clear their part of the canals. Traditional authorities are known to have regulated fishing in the canals by way of prohibiting the use of small-meshed fishing nets and imposing a fish ban during the month of December.

After Zambia's independence in 1964, the government took over the responsibility of canal maintenance through the Ministry of Water Affairs. Canal maintenance became mechanized for major navigation canals and people were recruited to maintain the other canals and were remunerated financially. Currently, the Government is not able to fulfill its mandate due to budgetary constraints and many stakeholders are calling for a return to the old system. However, this poses a challenge due to the fact people are now used to being paid for any labour contributions to developmental activities. The government system of canal maintenance is claimed to have destroyed the spirit of self-reliance and is expected to take time and effort for the local communities to get back to offering free labour in the six selected priority canals or indeed any canals in the Barotse Flood plain.

#### ADAPTATION TO CHANGE ASSESSMENT

In order to characterize impact on sociological component, develop mitigation measures and to assess resistance to change (see next chapter), it is important to describe people's willingness to change the way they perceive canal maintenance.

how do local communities value/perceive their actual canal maintenance system?

For most of the communities living along the canals, the present maintenance is not adequate. The canals are clogged, which is preventing the water from flowing normally. As the canals are important for agriculture (Musiamo and Lubitamei) and transport (Fisheries and N'gombala) the clogging is impacting directly their livelihood. In consequence, the present maintenance system for the canal is not well understood and is perceived negatively. (BRLi/ Niras, 2014 interviews).

For Muyowamo and Nebubela the maintenance is mentioned as being adequate.

do local communities and NGOs engage in activities in order to improve canal conditions?

Some communities are more conscious than others of the importance of canals for drainage of their land. So along a small portion of stretches of Musiamo and Lubitamei canal, communities mobilize to clear the canal (and secondary network) by themselves. On some other parts, the people only clean their tertiary canals (going to their fields) but wait for assistance to clear the main canal.

NGO's (Concern, PPS...) and the DDMC are also providing food or cash for work for the clearing of some stretches of the agricultural canals. However, this action is not coordinated, which lead to some stretches of canal being cleared but not the whole length, which does not really help drainage.

are people ready in terms of human resources and technical capacity and are there willing to adapt to get involve in canal maintenance?

For Musiamo and Lubitamei, most people are willing to contribute to work on the canal, but wish to receive something (cash for work or food for work) to compensate for the work. They also complain that they lack the necessary equipments (tools). They have the capacity for removing weeds and small amount of silts but cannot calculate the slope or evaluate the amount of silt to remove. Neither can they do the coordination between all the different communities on the different stretches of the canals. So the tools, technical advise, supervision and coordination must come from the canal management institution.

Navigation canals are too deep to be cleared with manual work, so the dredging machine will be used. The communities agreed on this principle.

In conclusion, local communities are open to be more involved regarding canal maintenance, but not without some form of payment.

## 5.14.6 Livelihood and market availability on various commodities

### OVERVIEW

The Barotse Flood Plain plays a very significant role in the livelihoods of its inhabitants. The main sources of livelihoods include fishing, livestock rearing, and cropping as well as natural resource exploitation (reeds for construction or crafts). Throughout the social survey, respondents reported the importance of canals in the provision of food security, water source and transportations.

During the dry season, the Barotse floodplain is extensively used for communal grazing of cattle; the canals are used for fishing, they enable to maintain the water table at a level that enables cultivation, and are source of irrigation water for vegetable production and drinking water for cattle. Some canals are also used for transportation of people and goods. During the rains, canals are used for evacuating flash floods from the fields and reducing the risk of crop failure. During the flooding period, many activities concentrate on the uplands (rainfed crops, charcoal burning, grazing of bush...), whereas transport and fishing still occur in the flooded plain.

According to World Fish (2012), sources of livelihood of the Barotse Floodplain inhabitant can be divided in four categories:

- ▶ Crop based : Rice, Maize, Cassava, Sorghum
- ▶ Livestock based: Cattle, Goats, Pigs, Chicken
- ▶ Fish and fisheries: Fresh fish, Dried fish
- ▶ Forestry based: Timber and non-timber product (on the plateau), Honey, Reeds and Papyrus products

During social surveys, local communities believe that the standards of living will improve with improvement in navigation and irrigation opportunities

## AGRICULTURE

The Study area for the project within the Barotse Flood plain is characterized by two farming seasons, namely the winter and rain season cropping. During winter, cultivated areas include Flood Plain edges and dambos in upland river valleys. Crops grown include maize, groundnuts and sweet potatoes planted after the receding of the flood. These grow on residual moisture, while vegetables are irrigated. Rainy season crops include rice grown on selected flood plain sites, maize and other vegetables on Mazulu (mound) in the flood plain and cassava on the upland. These crops are grown for both sale and consumption.

Floodplain farming systems are diverse, and include raised gardens (Lizulu), rain-fed gardens (Litongo), seepage gardens (wet Litongo), drained seepage gardens (Sishango), lagoon gardens (Sitapa) and riverbank gardens (Litunda).

The large percentage of the Mongu District population have land holding of less than 0.5 ha as shown in the next table.

Table 35 Average land holding size

	Less than 0.5 ha	0.5- 1 ha	1-2 ha	2 ha and above
Zambia	45.9	11.7	20.6	21.8
Mongu district	74.5	7.8	9.9	7.8

Source: World Fish, 2012

The major agricultural activities in the Barotse Floodplain are cattle rearing; rice, maize, sugar cane, sorghum (*kuyuma*), sweet potatoes (*ngulu*), pumpkins (*mipushi*) and vegetables are the commonly grown crops; reeds (*Mataka*) and fish (*Litapi*) are the most exploited natural resources. The widely planted crop varieties include Blue Bonnet and Supa for rice, local and short maturing hybrids for maize and Nalumino for cassava. To transport paddy rice ox cart are hired, which cost K50 per trip for 60 Kg bag of paddy rice.

Permanent settlements along the edge of the plain are dotted with mango trees whose fruit does not easily reach the markets in Mongu because of poor transportation.

The table below provides an insight of rice production in Mongu District as a whole. About 80 percent of this production takes place on the Barotse Flood Plain, predominantly in Limulunga, Mongu Central and Ushaa agricultural blocks. Nerica and Supa are the common varieties for rice as noted above.

Out of the estimated 280,000 hectares arable land in Western Province, about 10% is found in the floodplain. The main growing season is from November to April with cultivation taking place on raised ridges in the wet plain edges known as Shishanjo and un-flooded areas known as Mazulu. After floodwaters have receded (July/August) moist shallow areas called Sitapaare are planted with winter maize (local and hybrid varieties) and vegetables (rape, spinach and tomato).

Table 36 Rice production in Mongu district

Season	Area Planted (Ha)	Estimated Production (Tons)
2008/2009	5,893	7,075
2009/2010	7,285	8,881
2010/2011	6,915	6,026
2011/2012	4,536	5,292

Source: MAL, Agriculture Statistics and Early Warning Unit

The table below provides an insight of Maize production in Mongu District.

*Table 37 Maize production in Mongu district*

Season	Area Planted (Ha)	Estimated Production (Tons)
2008/2009	10,219	6,190
2009/2010	8,388	8,836
2010/2011	7,869	5,726
2011/2012	8,053	2,987

Source: MAL, Agriculture Statistics and Early Warning Unit

It is important to note that the area planted to cereal crops tends to fluctuate from season to season and production levels are too low to satisfy household needs. For part of the year, households in the floodplain depend on food purchases. These are also the major challenges that inhabitants are faced with in the Barotse Flood Plain.

During the period of the said shortage, the households in the Barotse Flood Plain basically tend to increase the fish trade, small shops around the major routes and selling any other products they lay their hands on. Other households with cattle tend to increase their milk production and make sour milk (Mabisi) which fetches more money as opposed to fresh milk.

It must be emphasized that the vast majority of the people who live along the Barotse Flood Plain depend on the canals for their livelihood as they depend on irrigation, farming, drainage and fishing.

#### FISHERIES

Fish also plays a very significant role in the provision of household protein. Although it is lucrative, it is a seasonal activity that takes place during the dry season (July-December). Fishermen are known to abandon their fishing camps when the Floodplains begin to get flooded and retuning immediately after the floods have receded. Basket fishing by women in canal shallow waters is also common.

The fisheries sector is one of the most important sectors in Western Province. It is mainly concentrated on the floodplains of the upper Zambezi, especially the Barotse floodplain. It plays a significant role in the provision of fish protein in the diets of the people of the province and the entire country.

#### LIVESTOCK REARING

Most of the cattle population in Western Province is concentrated along the Barotse Floodplain and adjoining plains. They are one of the most productive cattle rearing areas in the country. Over 200,000 cattle graze on the Barotse Floodplain, the bulk of it managed under a system of transhumance, spending the months of January to July on the uplands and the remainder of the year on the floodplains. Primarily driven by the seasonal availability of pasture, annual transhumance is also important for the distribution of manure. In the floodplain, there is a strong interaction between herding, cropping and fishing activities.

The table below provides cattle population estimates for Mongu District during the last three years.

Table 38 Cattle Population estimate for Mongu district

Year	Cattle Population
1996	118,553
1997	121,055
1998	124,676
1999	125,460
2000	112,148
2001	109,904
2002	99,904
2003	84,020
2004	83,330
2005	82,500
2010	64,749
2011	62,257
2012	60,685

Source: Ministry of Agriculture and Livestock

During interviews with inhabitants of the Barotse Floodplain it was reported that cattle are generally owned by men and are critical in paying for bride price or dowry.

#### INCOME

The major sources of income are fishing, selling cattle, selling milk and crops (rice and vegetables) in that order. It is estimated that fish generates over ZMW 3.5 million per annum with cattle sales generating over ZMW 0.6 million per annum. Minor sources of income include sales of paddy rice and reeds, beer brewing and trading.

It is envisaged that the opening of the new Mongu-Kalabo road, the PPCR intervention and the rehabilitation of the six canals will give impetus to increased socio-economic developments in the Barotse Floodplain. Local people expect that the upgrading of the Limulunga-Lukulu road will bring about socio-economic development.

The Barotse plain poses many challenges among which the most pronounced are limited time for productive use of agricultural lands as they are flooded for about half a year, poor accessibility, limited access to safe water supplies and health facilities and lack of ox-drawn implements like harrows.

#### ECONOMIC VALUE OF WETLANDS

Local communities receive direct benefits from wetlands in the floodplains. At the household level, wetlands generate an average net financial return of 405 \$. The most valuable wetland products are fishes that represent 73% of household cash income, floodplain grazing representing 29%, and crop production 22% (IUCN, 2003). Other wetland-sources of income are shown in the following table.

Table 39 Economic value of wetlands

Per household (\$/year)	Cattle	Crops	Fish	Wildlife	Reeds & papyrus	Palms	Grass	Clay	Total
Net financial value	120.4	88.7	174.1	0.41	10.72	0.27	8.07	2.33	405
Gross cash income per household (\$/year)	11.5	6.1	52.6	0.01	1.61	0.04	0.30	0.02	72

Source: IUCN, 2003

#### OTHER ECONOMIC ACTIVITIES ON THE PLATEAU

Notable economic activities found in Mongu District are APG Milling Limited, located in Wenela area, APG Rice Mill along Limulunga Road, ZAMBEEF abattoir off Senanga Road, Kembe abattoir in Limulunga, Star Butchery abattoir, Mongu Joinery, Mumwa Crafts which specializes in the production of such crafts as baskets, walking sticks, mats, and wooden plates just to mention but a few. Mongu is also home to the Zambia Cashew Company that now operates on a very small scale.

Other economic activities include Food Reserve Agency (FRA) Crops and fertilizer Shed, Ngulu Hotel and ten operational Lodges, ZANACO, Standard Chartered Bank, BancABC, Zambia National Building Society, Finance Bank and Investrust Bank have branches in Mongu and provide various financial services to the local inhabitants. Shoprite Checkers has established a Super Market in the town, there are local shops providing similar services. Mongu also has a public library and a small airport that handles small aircrafts.

#### LIVELIHOOD KEY CHALLENGES

Fish stocks in the Zambezi River and its basin are declining and efforts of the government and NGOs in promoting fish farming (aquaculture) both in the plains as well as along the plain edge have failed to bear fruit. The reasons for this failure have been attributed to technical factors such as soils being sandy and socio-economic factors such as people not being able to afford the high cost of feed for fish. The blockage in the flow of canals has also negatively affected fish breeding and consequently reduced the importance of canals as sources of fish. As fishing is a major source of household income in the Barotse Floodplain, any decrease in the levels of fishery impacts on the local economy.

Climatechange is another challenge that has tended to affect the livelihood systems in the Barotse Flood Plain. Farmers have been farming without the understanding of the effects of climatechanges that are affecting the entire globe. There are no practices for climateresilience by most small-scale farmers resulting in low crop yields due to the changing weather pattern manifested in excessive flooding and late onset of rains. Farmers do not have access to climate smart crop varieties and practices.

Many of the canals in the Barotse flood plain provide alternative means of access to markets and social services as the existing roadnetwork becomes impassable during the period between December and July when the plain is flooded. Impaired flow of water in the canals is therefore an important constraint in terms of transport to the floodplain inhabitants.

## ADAPTATION TO CHANGE ASSESSMENT

In order to characterize impact on sociological component and (see next chapter), it is important to describe people's adaptation to change regarding their sources of livelihood. Several parameters are described:

- ▶ how do local communities value/perceive their sources of livelihood?

The sources of livelihood are perceived as very important by the communities, as they know their survival depends on them. However, due to direct day to day necessity, the people don't often think on the long term when it comes to resources management. This lack of long term vision leads to poor decision and make people sources of livelihood vulnerable to change.

- ▶ do local communities engage in activities in order to improve their sources of livelihood?

Some communities try to increase and diversify their source of livelihood, but always with taking minimum risks. Sometimes, activities and decisions are done collectively, but in the vast majority of cases, these are done on an individual or familial scale.

- ▶ are the livelihood activities sustainable?

Some activities are sustainable (agriculture, livestock keeping...) but, due to immediate needs, some are fastly depleting resources and are threatened at short term (fishing, charcoal burning...).

are people ready in terms of human resources and technical capacity and are there willing to change their lifestyle to improve their livelihood?

Due to low level of education in the rural area, people are highly resistant to change when it comes to their sources of livelihood. Technological innovation or new resources management techniques take time to get in the habits of people and very often fail when external actors impose them. The youth and urban people are more willing to change and try new sources of livelihood than the rest of the population. In addition, the strong attachment to customary land tenure system does not allow to any major advancement in term of land and natural resources uses.

In conclusion, local communities are highly resistant to social changes regarding their sources of livelihood.

## 5.14.7 Literacy levels, health and gender equity

### 5.14.7.1 Education level

According to the 2010 Census of Population and Housing, the Western Province as a whole has the second lowest literacy rate for adult population (15 years and older) at 72.5% against the national rate of 83% and for youth population (15-24 years) at 82%. This could be attributed to low attendance as only 29.6% of the population (5 years and older) were reportedly attending school and only 41.2% and 21% completed Grade 7 and 12, respectively.

### 5.14.7.2 Diseases

The most common diseases recorded in the settlements along the target canals and surrounding areas during our open-ended discussion with Ministry of Health Staff are respiratory infections (Pneumonia and non-pneumonia including HIV), muscular skeletal and connective tissue disorders, malaria, diarrhea, skin infection, throat infection, non-infectious digestive disorders and Intestinal worms. A typical disease prevalence scenario for the first quarter of 2013 as recorded at Mulambwa Urban Clinic whose catchment area covers parts of the Barotse Plain is given in the table below.

Table 40 Common diseases in Mulambwa Urban Clinic

Disease	Number of patients attended to			
	January	February	March	Total
Respiratory infections (Pneumonia & non-Pneumonia)	2,320	2,006	546	4,872
Muscular skeletal and connective tissue disorders	224	1,207	1,128	2,559
Malaria	920	939	689	2,548
Diarrhea	246	172	258	676
Skin infection	270	79	146	495
Throat infection	169	116	183	468
Non-infectious digestive disorders	99	76	115	290
Intestinal worms	0	82	119	201

Source: Mulambwa Urban Clinic Report for January-March, 2013

Available district-level medical records collected over a period of eight years (2000-2007) show that of the most prevalent diseases, more deaths were actually attributed to HIV-AIDS (1,081), followed by Malaria (928) and Pneumonia (519).

The incidence of HIV/AIDS in Mongu District appears to have been rising in the last decade as table below indicates for the period 2000 to 2007. Data for the period 2008 to date on the HIV/AIDS is being analyzed and would be produced soon by the Ministry of Health. However, the health workers at Mulambwa Urban Clinic noted that with the availability of the Anti-Retroviral Therapy (ART) to the HIV/AIDS patients, the incidence of death among the patients is reducing among the affected.

Along the N'gombala canal, it was reported during social surveys that many fish traders come into the fishing areas and stay for a long time and that some of them tend to engage in extra marital affairs that might have an effect on the HIV/AIDS infection rates. According to the Zambia Human Development Report of 2007, the incidence of HIV/AIDS for Mongu district was 22.2%. This was 8 % higher than the national level (14.4%). Mongu being located along a transportation route could be another explanation of this high incidence.

Table 41 HIV/AIDS incidence in Mongu District (2000-2007)

Year	Total Diagnoses	In-patient deaths
2000	240	17
2001	268	30
2002	781	118
2003	399	71
2004	510	90
2005	925	233
2006	1,290	249
2007	2,175	273
Total	6,588	1,081

Another source of illness is the distillation of local brew "Kachacu" common in the project area. The issue is that boiling temperature of this distillation is not controlled. The final product contains a high proportion of unhealthy component (methanol...) causing intoxication and blindness.

### 5.14.7.3 Gender equity

Females constitute an estimated 52.7 percent of the population in Western Province while the male make up 47.3 percent (CSO, 2010). It is important to note that similar female/male ratios are observed in other provinces of Zambia.

Traditionally, men are responsible for livestock rearing including milking and milk sales, most of the fishing and much of the pre-planting agricultural activities while women carry out most of the post-land preparation activities, minor fishing in canals and riverbanks using fishing baskets, which fish, is mostly consumed within the household. Women also do most of the domestic chores like food preparation, getting water, washing family linen, childcare and keeping the house and surroundings clean. Some of these chores are aggravated by the lack of equipment such as hammer mills to prepare maize or cassava.

There are expectations that rehabilitation of the canals will bring about increased levels of irrigated rice production and this will increase the women's workload, as they are traditionally responsible for breaking clods with hand-hoes once men using oxen have plowed the fields. This will be a challenge to women if there is no deliberate effort to introduce labour-saving tools.

Male children are mostly responsible for herding cattle, part-time fishing and harvesting crops while female children are involved in drawing water, household chores, harvesting crops and helping to look after their siblings. Daily calendars for the period of September to November obtained from the social surveys indicate that women put in an average twelve hours (12) of work each day for six days a week compared to eight hours (8) per day for the men. Women in the plain wake up around 5am and go to bed between 9pm and 10pm after end of chores. September to November is a period during which land preparation for rice and weeding the winter maize crop takes place. This pattern applies to most adult men and women living along the six canals (Lubitamei, Muoyowamo, Musiamo, Fisheries and N'gombala).

All the women interviewed indicated that they are over-loaded with work. Sundays were reportedly resting days for most of the men and women in the six project canals. Women are the main producers and processors of food for household subsistence and grow a wider range of crops that include maize, sorghum, millet, groundnuts, pumpkins, sweetpotatoes and groundnuts. Women are also responsible to collect firewood to prepare food, which in the plain can be a real challenge.

The survey observed that men ploughed the land with oxen and left the fine tilling to women who use hoes for this laborious task. Most of the women in the floodplain do not own oxen and ox-drawn implements. This contributed to the heavy workload experienced by women. Women wished they could have access to loans for ox-ploughs and implements. Because of low literacy levels and financial insecurity among women-headed households, there is an observed limited capacity to venture into high value crop production and large scale production.

In addition to the agricultural work in the field, women process and prepare food for all household members as well as looking after younger children. Women were reported to be responsible for fish processing (salting, sun-drying and smoking). Like most parts of rural Zambia, the women's workload is relatively heavier than that of men in the Barotse Floodplain.

Under Lozi tradition, women have the same inheritance rights as men when it comes to land and such assets as cattle left behind by their parents. Inheritance inequalities in general are not pronounced. However, new land allocation is gender biased, as a male applicant for a new parcel of land tends to be given priority over a female applicant (Chileshe et al., 2005). Further, women are excluded to land ownership in their husband's village of residence.

According to the African Development Bank (2006), agriculture and health in the Barotse floodplain is characterized by gender disparities. Women-headed households tend to be the poorest, having poor access to credit, being vulnerable and prone to malaria and STDs. Alcohol use, poverty and/or the desire for economic advancement are the key factors that influenced risky sexual behavior among women in Mongu District (Singh et al., 2011).

Alcoholism is issues in the plain, surveyed women were worried at the high rates of drinking problem among males, this situation poses a danger to the health and also to labour availability and productivity. In several visited places during social surveys, many men were heavily engaged in the consumption of locally brewed wine.

Surveyed women-headed households have mentioned that HIV in the plain is affecting them as they have additional responsibility to look after children left behind by sons and daughters who died from HIV/AIDS-related illnesses. Also, they are not able to afford the high fertilizer prices and do not access to subsidized inputs under the Farmer Input Support Programme (FISP) reportedly because they cannot afford membership shares demanded by cooperative societies and the 50% cost of inputs. The only prominent women group available is the Programme Against Malnutrition (PAM) group in the area. There is also a women's Savings and Credit Association in Namushakende to which most of the village women belong. Most village surveyed did not have any women associations to enhance their welfare.

Access to school is also gender biased as presented in previous section.

#### ADAPTATION TO CHANGE ASSESSMENT

In order to characterize impact on sociological component and develop mitigation measures (see next chapter), it is important to describe people's adaptation to change regarding gender aspects. Several elements have to be described:

- ▶ how do local communities value/perceive women and gender aspects?

Even if there are Princesses and village headwomen who have a certain power in the BRE, the perception is that gender inequality is more pronounced in the rural area where the traditional power is still strong. In Mongu town, as the level of education and responsibilities for women are higher the inequalities are less visible. Even though, in urban area, the percentage of women at managing positions in the public and private institutions is still very low.

Most people are aware of gender inequalities, but the resistance to change is quite strong. Even if in theory everybody agrees that more equality and shared tasks could be better, in fact men tend to keep their privileges.

- ▶ do local communities and NGOs engage in activities in order to improve women condition?

All NGOs in the area are engaged in activities to improve women condition, either by direct project or as a part of broader actions.

Within the communities some formal and informal women group exist, but there is no broad movement.

- ▶ are people ready in terms of human resources and technical capacity and are there willing to change their perception about women?

The change in perception on the gender question is very deeply rooted in the everyday life and habits so it will not change in a short time. It will rather take a generation as the level of education for girls increase and more women have high responsibilities in the society.

The current resistance to change regarding gender aspects is moderate but will continuously improve with the next generations.

## 5.14.8 Traditional and religious practices and rites

### THE KUOMBOKA/KUFULUHELA CEREMONIES

Lozi culture is strongly influenced by the annual flood cycle, locally known as Lyambai, of the Zambezi River. It is characterized by an annual migration of people from the floodplain to the uplands during the rainy season. The most important of these activities is the Kuomboka ceremony in which the King moves from Lealui, the winter capital in the flood plain, to Limulunga, the summer capital on the upland. The term Kuomboka simply means “emerging from out of waters”. Depending on the flooding regime, the Kuomboka ceremony takes place between the months of February and March.

Kuomboka has been an annual event on the ancestral calendar. When the plains are fully flooded the Litunga sails away in a flotilla of royal boats in a colourful ceremony characterized by an orchestra of traditional music and dance all the way to the uplands in Limulunga. Most of the people living in the flood plain also move. The main Kuomboka is then followed by mini-Kuombokas involving Chieftainess Makwibi who moves from Nalolo to Moyo and Chieftainess Mboanjikana who moves from Libonda to Mapungu.

After the floods have receded, the King and his people return to the floodplain in a ceremony known as Kufuluhela. During both ceremonies, the King moves on the royal barge known as Nalikwanda accompanied by a flotilla of small boats. The Kufuluhela ceremony on the other hand is not so pronounced and publicized.

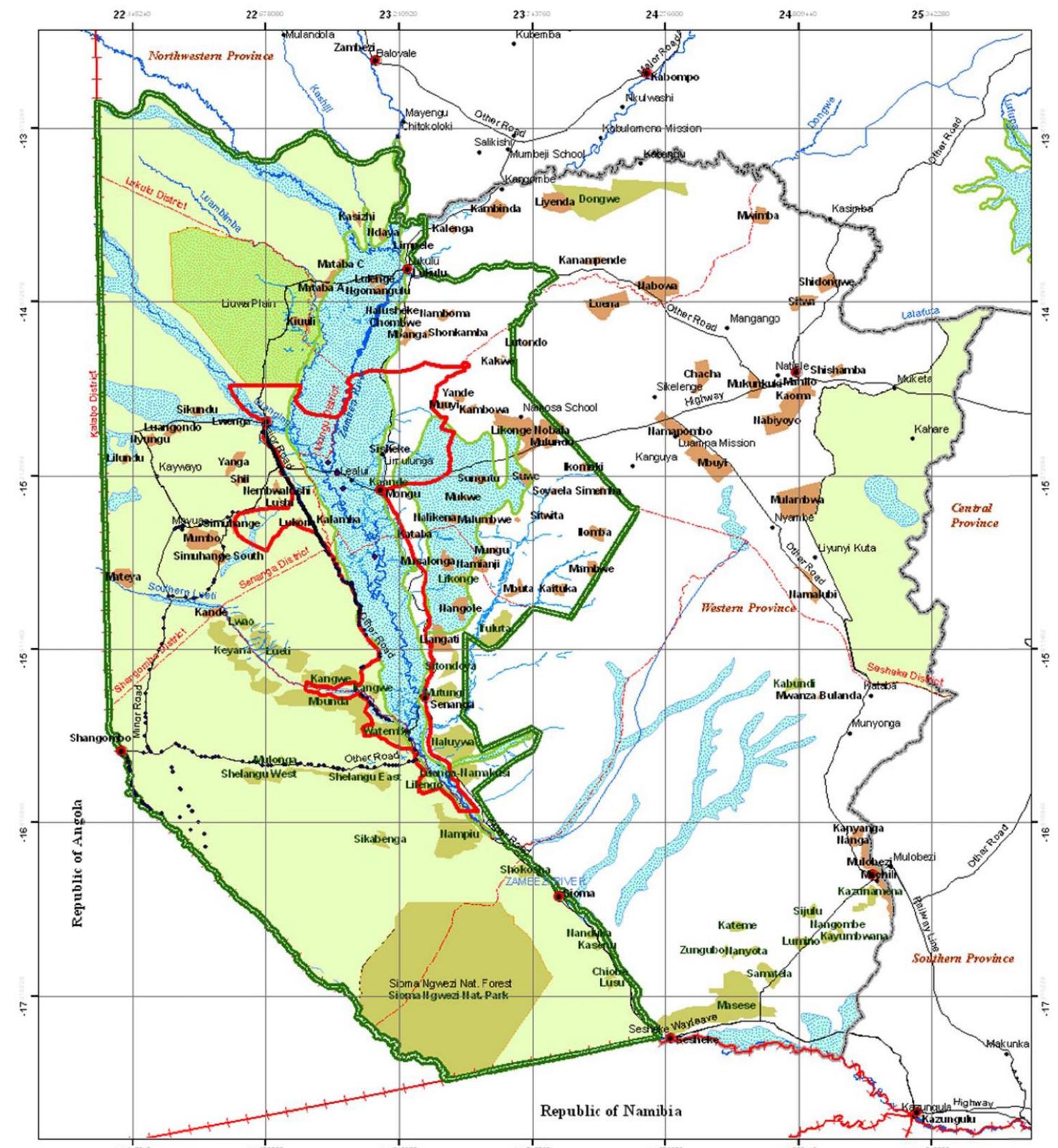
Anthropologists and sociologists have tended to conclude that the Kuomboka ceremony could be traced back to some period in time when there was an exceptional flooding referred to as Meyi-a-lungwangwa, but folklore has it that the ceremony started around 1800 during the reign of Mulambwa.

The Kuomboka Ceremony now attracts international and local tourists to Mongu year in March or April. There are efforts by the National Heritage Commission in collaboration with the Barotse Royal Establishment (BRE) to have the Barotse Floodplain declared as a World Heritage Site under UNESCO due to its uniqueness. This initiative is reported to have the support of some sections of society including the BRE, the government and the Litunga.

Interviewing the Director of the National Heritage Conservation Commission (NHCC) in Lusaka during this study, he noted that the idea has been well received by the BRE including the Litunga and the local inhabitants in the plain. It is reported that at a workshop for members of parliament held in the province in 2013 there was full support for the idea of a World Heritage Site. The NHCC is continuing with a series of sensitization meeting in the Barotse Flood Plain with all concerned parties. More of these meetings are planned for the various stakeholders before the final implementation of the initiative. The Director reckons the commission will need funds for sensitization of the local people during the construction of the canals. There was a recent evaluation team from UNESCO some months ago and the idea has been pushed forward to Cabinet office. In a recent twist of events, members of parliament from the Western Province were reported to have objected to the initiative (Post Newspaper, 14<sup>th</sup> February 2014).

The issues surrounding the declaration of the Barotse Floodplain as a heritage site appears not to have been dealt with adequately by the various stakeholders i.e. the BRE, local people and their political representatives. It would be a very good idea to recognize the Barotse Flood Plain including the Kuomboka ceremony as unique features.

The following figures shows the proposed boundary of the Word Heritage site application.



Location Map of the Proposed Barotse Cultural Landscape Property



**Legend**

- Towns
- Royal Burial Mounds
- GMA Settlements
- Village Centres
- World Heritage Site Boundary
- Barotse CL/WHIS Buffer
- International Boundary
- Provincial Boundary
- District Boundary
- RAMSAR Site
- Major Road
- Canals
- Major Rivers
- Rivers
- Other Rivers
- Barotse Local Forests
- National Parks
- Wetlands
- National Forest
- Wes Zambezi GMA



## 5.14.9 Assessment of vulnerability and/or need for resettlement and compensation

### 5.14.9.1 Vulnerable people

#### MARGINAL FARMERS

One of the most important groups of vulnerable people in the Barotse is the marginal farmers. Marginal farmers can be defined as persons with few resources and few capital assets. According to Concern Worldwide (2008), many farmers face serious challenges in the Barotse floodplain that contribute to their general state of poverty:

Exclusion from policy and decision-making processes: many farmers lack confidence in the Government as it has no clear system to involve farmers in such processes.

Access to farming inputs and credit is weak, most prices for inputs are too high. Access to farming credit is often gender biased.

Poor agriculture extension service leads to inadequate input delivery, technical advice and information. Due to low number of agriculture extension officers, many farmers in remote areas of the plain are not reached, farmers seeking advice have to go to officer's office and advice is given without any on-field expertise.

Remoteness and lack of storage facility near farming or markets, this situation restricts market activity.

Lack of transparency regarding farmers' fund used by the Government.

Flooding, droughts and climate changes aggravate flood plain farmers' situation and vulnerability.

HIV and AIDS among farmers reduce labour force. Access to health services in remote areas of the plain makes HIV positive farmers even more vulnerable.

Marginal farmers facing these challenges are often trapped in a circle of poverty as most farmers are not able to rely on income from farming to survive (Concern Worldwide, 2008).

#### ORPHANS

An orphan is defined as any person up to 20 years of age who has lost at least one parent. According to the Central Statistical Office, the prevalence and levels of orphanhood are a direct consequence of mortality among adults in the population rather than abandonment.

According to the 2010 Census of Population and Housing, the Western Province had the second highest level per capita of orphans at 18.6% of the population after the Copperbelt Province which had 19.2%. It is also one of the poorest provinces in terms of incidence, depth and severity of poverty in the country.

### PHYSICALLY CHALLENGED PEOPLE

The overall statistics for physically challenged people in the Western Province is 25,768 as at 2010 (CSO, 2010) representing 2.85 percent of the population. The Government has, in recent years, developed a policy for them that provides for social safety nets through which the vulnerable access assistance. The most visible ones are the social cash transfer scheme (SCTS) administered by the Ministry of Community Development, Mother and Child (MCDMC), educational bursaries administered by the Ministry of Education and the Programme Against Malnutrition (PAM).

Mongu is also home to Cheshire Home International that houses about 200 physically challenged children. The Cheshire Home is working closely with the government in assisting the disabled in Western province. It was reported that the Cheshire Home International covers the entire province in terms of catering for physically challenged children.

The Mongu Cheshire Home is aiming at improving quality of the physically challenged children in Mongu District. It has 200 children now through its residential care, rehabilitation, surgery and outreach programmes that offer support to them in the western province and in the wider rural districts of the province.

The Home currently maintains assistive devices such as wheel chairs, crutches and calipers and has a small school attached to it.

Mongu Nutrition Group (MNG), an NGO established by the Roman Catholic Church is also working to help vulnerable people by improving health and nutrition status of vulnerable rural communities in Mongu. It promotes rice production in the district including a loan scheme to assist farmers with inputs.

### MIGRANT FISHERMEN

There appears to be a social problem associated with migrant fishermen who come to the Barotse Floodplain after recession of the floods in June or July and leave at the beginning of December when the mandatory government ban on fishing comes into effect. It is reported that these fishermen are responsible for some of the social ills like spreading HIV/AIDS among financially insecure inhabitants and marriages of convenience that contribute to the observed increase in the number of female-headed households and promiscuity. Any increase in fishing activities is likely to contribute to such social ills, which are not easy to eradicate as long as women remain financially insecure.

### CHALLENGES FOR YOUNG PEOPLE

Zambia's National Youth Policy defines a youth as any person aged 15-35 years. The number of youths in the total national labour force as at 2010 was 2,487,764 representing 58.4 % of the population. Of these, 56.9 % were male and 43.1 % were female.

Of the youths in the labour force, 16.7% were unemployed. The highest youth un-employment rate was in the age group 20-24 years at 23.5 % while the lowest rate was in the age group 30-35 years at 10.2 %. Western Province recorded a 10.1% youth un-employment rate, ranking 7<sup>th</sup> when compared to the other nine provinces. The high level of un-employment can largely be attributed to a small industrial base and limited opportunities in the town of Mongu.

Despite the limited employment opportunities in the floodplain there are no statistical figures that suggest serious youth migration to urban areas. The youth in the Barotse Floodplain are engaged in the informal sector such as fishing, cattle rearing, trading, and transportation of goods by ox-cart or canoe. Providing financial and entrepreneurship empowerment for expanding the local informal sector would contribute to alleviating the un-employment pressure being experienced in the Barotse Plains in particular.

During social surveys, young peoples from the fifty-five surveyed villages shared their grievances and challenges in the floodplain. They reported that they would not move out of the plain as there are no job prospects in urban centers, only those pursuing college education were leaving. Some young seasonally migrate to the Zambia Sugar Company's Nakambala plantation in Mazabuka for cane cutting. Some also temporary migrate between December and April every year, coinciding with the annual fish ban.

#### POVERTY SITUATION

Most districts in Western province continue to be amongst the poorest in Zambia with poverty rates estimated at 83% and Human Development Index below 0.38% (AAS Zambia Fact Sheet, 2012). AAS Zambia Fact Sheet further points out that people in Western province are vulnerable to poor health and nutrition as reflected in an estimated 56 % stunting growth rate among children under the age of 5 years and rising HIV/AIDS prevalence.

Consistent with the overall trend in Zambia, the Western province recorded decline in the proportion of population without access to improved water sources failing from nearly 60% to 56% between 2006 and 2010. Similarly, compared to other provinces, the Western province has the lowest proportion of its population using pit latrines and flush toilets. It is a fact that large population in Western Province is going without safe water and sanitation services in poor urban areas and rural areas. The effect of a combination of these factors is most severe on the poor. Power water supply and sanitation services in poor rural areas have been the cause of annual outbreaks of water borne diseases during the rainy season, which not only puts a heavy economic burden on the already impoverished communities, but also strains the public health services. Poor operation and maintenance of urban and rural water supply facilities not only restricts services to a small number of consumers, but also leads to relatively high water charges for the urban poor in the Western Province.

In rural areas of Western Province where communities rely on rain-fed agriculture, crop failure and decrease in livestock herds, and results in unaffordable food prices and starvation invariably follow failure of the rain season.

The most affected and vulnerable people in Western Province are the female-headed households, who have limited social and economic opportunities. Most of the female-headed households are also looking after large numbers of orphans.

The recent Living Conditions Monitoring Surveys (2010) showed that Western Province has the highest incidence of poverty in Zambia. 80.4% of the population were classified as poor compared to the national average of 60.5%.

*Table 42 Incidence of poverty*

	Total Poor	Extremely Poor	Moderately Poor	Non Poor	Total Population
All Zambia	60.5	42.3	18.2	39.5	13,013,152
Rural	77.9	57.7	20.2	22.2	8,512,301
Urban	27.5	13.1	14.4	72.5	4,500,851
Western Province	80.4	64	16.4	19.6	886,500

### 5.14.9.2 Land requirement

The Project involves recalibration of existing canals and will require additional land on each side of canal (a few meters on each side). In addition, the 7 Silting basin and 4 Sand traps of about 300 m<sup>2</sup> each will require land, this economic displacement will have to be addressed in a Resettlement Action Plan, which is a separate mandate from the ESIA.

The Project will not involve physical resettlement of people.

### 5.14.9.3 People's knowledge about the Project

From our social survey, it was important to gauge the inhabitants' knowledge on the project for the improved use of priority traditional canals in the Barotse Sub-Basin. In the six selected canals four canals most inhabitants knew about the project. These were, Muoyowamo, Musiamo, Lubitamei and Fisheries canals. Many of the inhabitants along the Ngo'mbala canal were not aware of the Project. The reason might be associated to the fact that N'gombala is running from the Zambezi River at Mwandu village, a fishing point whose inhabitants are mainly migrant fish traders and fishermen who come and go. The inhabitants that are permanent along the Ngo'mbala are close to Sefula Mission that is on the plain edge. The other reason could be that part of the Ngo'mbala canal is almost dry (has the appearance of a wetland) and has not been in use recently. If rehabilitated, Ngo'mbala is one of the most commercially viable canals that has potential for increasing movement of fish catches from the Zambezi River to fish markets.

In the other canals, women exhibited knowledge about canals including their importance to their communities. At the plain edge end of the Fisheries canal at Namushakende, women interviewed alluded to the fact that the canal was important to the communities living around the new harbour being constructed as fish traders have established a fish market and the local inhabitants do not have to travel the 13 kilometre-distance to the Zambezi River to buy fish. Rehabilitation of this particular canal would enhance transportation of fish by fishermen and fish traders. Equally, the local people are looking forward to the completion of the planned harbour.

Further, the inhabitants along all the six selected canals are eagerly looking forward to job opportunities during the implementation of the rehabilitation project.

#### PEOPLE GRIEVANCES

During social surveys, people from the fifty-five surveyed villages shared their grievances, whether project-related or not. Grievances toward the proposed canal rehabilitation project mainly relate to the fact that canal maintenance is a major activity that cannot be effectively be carried out by manual labour alone. The people have the feeling that involving them for minor regular maintenance activities could be the best option once major works have been carried out by the use of machines. They also have the feeling that local traditional leadership is not fully involved on maintenance works. Many also questioned the effectiveness of the actual dredger that only deposited dredged silt on the banks and which material is then washed back in the canals during the rainy season.

Many communities also complain about poor sanitation. During the rainy season, water becomes contaminated by overflowing pit latrines leading to incidences of diarrhea.

In addition to these grievances, women also raised many gender-related grievances; they are presented in the "gender aspect" section.

Table 43 People grievances raised during social surveys

Musiamo
<p>Efficient dredgers should be used so that a good depth is attained and to ensure the dredged sand and silt are not left on the canal edges but spread a distance away. According to surveyed villagers, some sections of Musiamo canal have mud and may require the use of dredging machines since they have muddy soils that are difficult to work using hand tools. These sections are at Nasisholo, Kembu, Namakomena and Namakeka Villages.</p> <p>The Project is welcome especially if it reduces impact from flood by improving drainage, which would lead to more rice production. They also foresee that the Musiamo will have fast flowing water and will also contribute to more land being drained for farming. Villagers hope that this will increase agricultural productivity in the village.</p> <p>Fishing activities will increase in the villages, as the water will be flowing from very far.</p> <p>Poor sanitation and housing are major problems for the communities. There are no safe water points where to draw water for their homesteads. People get water from the blocked Musiamo canal or the scoop wells that they dug along the canal. The animals, cattle, pigs and dogs also use these water sources.</p> <p>Due to the poor water villagers drink, there is a lot of malaria and diarrheal in the village.</p> <p>According to many people, if canals are restored, it is important that bridges are provided for allow people and livestock to cross restored canals. There is also a need to stop people from blocking the Musiamo with fish traps called "Malelo". This type of fishing is blocking the flow of water in the Musiamo canal.</p> <p>Local communities expect to get some employments from the Project.</p> <p>The problem of the lack of rice market was reported.</p>
Muyowamo
<p>A professional with proper equipment to dredge the canals should be hired as currently the Maritime Department is using a very basic dredger from Finland known as Water Master which throws the dredged soil and silt just a few meters from the bank. Materials are then washed back when it rains.</p> <p>Local communities expect to get some employment from the Project.</p> <p>There is also a need to stop people from blocking the Muyowamo with "Malelo" fish traps. This type of fishing is blocking the flow of water in the canal.</p> <p>The issue of poor sanitation is also common along Muyowamo, diarrhea incidence is high in villages due to collapsing latrines during the flood. With improved water flow in the canals, people expect the breeding of mosquitoes to reduce with an associated reduction in the incidence of malaria.</p>
Libutamei
<p>The community expects that during canal rehabilitation, some form of temporarily employment shall be provided to the local people and that they will not accept imported workforce from outside Lubatamei canal.</p>

There is the feeling that once the canal is rehabilitated flooding will stop or reduce and therefore more land will be available for cultivation.

Some people have proposed that Ikwichi Bridge be rebuilt and expanded during the rehabilitation of the Lubitamei canal, according to them this will allow maximum flow of water from the uplands. Local communities would also like to have footbridges.

According to communities, the canal is too wide to be maintained by hand and that there is a thick sand layer that prevents effective deepening by manual labour. Communities proposed that the usage of machines be considered during the rehabilitation of the Lubitamei canal as it needs some good depth and good width to sustain the transportation of poles and timber from the upland to the flood plain for construction as it was in the past.

Communities expect to have more fishes in the canal.

The government should empower traditional authorities through headmen to oversee management and maintenance after dredging. It was also suggested that satellite Disaster Management and Mitigation Committees in collaboration with traditional leadership be given the responsibility of overseeing canal maintenance.

Poor housing and sanitation were also challenges for Lubitamei inhabitants, for example, the local well for water is very dirty and leads to diarrhea diseases.

People have to travel great distance to schools and health clinic.

#### N'gombala & Nebubela

During the rehabilitation, the community expects the canal to be widened and deepened to allow navigation of large boats and canoes. They expect that canal restoration will shorten the distances fish traders have to travel to buy fish.

The communities expect that village headmen and women will be involved during the rehabilitation of the canals and its maintenance thereafter. The people hope that this time around all the silt and sand deposits dredged should be disposed off far from the banks of the canal to prevent their being washed back into the canal by floods.

The expectation of the communities is that local people will be given priority over those from outside areas of Mongu and Namushakende when it comes to employment.

The community was of the view that headmen should be in the forefront of canal maintenance.

The type of housing and toilets are not encouraging and the people use the bush than temporary pit latrines. The sanitation situation is even worse during the rainy season. Also, being located in the middle of the plain, obtaining firewood is a major challenge for communities.

According to farmers, it is important to understand the social fabric of the Lozi people, and that failure in involving the BRE in leadership for canal maintenance could lead to poor mobilization of villagers for maintenance tasks. According to them, this is one of the reasons why the Sefula irrigated rice scheme is performing poorly. Failure in involving all stakeholders during design phase of the scheme is another reason.

#### Fisheries

The people in the village expect that during canal rehabilitation local villagers will be accorded employment opportunities. Many people also hope that business will increase once the harbour completed, this harbor will increase chances of the establishment of a permanent market structure in the area.

Some villagers believe that Fisheries canal is too deep.

Communities have mentioned that excess flooding of rice due to poor water control, drought in the recent past, rice pests which include mice and fish has affected crop production.

Some villagers wish to have a programme that can provide cement to build permanent toilets on self-help basis.

#### 5.14.10 Conclusion on socio economic and cultural set up

The use of floodplain resources was in the past managed according to traditional systems, under the customary authority of the Litunga. Today, although formal control over natural resources has been passed over to central and provincial government, the Barotse Royal Establishment (BRE) maintains a great influence on natural resource use and regulation. The Lozi people are also known as the "plains or water people", and local livelihoods and cultural traditions are linked closely with seasonal flooding.

During the dry season, the bulk of local production, economic activities and settlement are focused in the floodplain area. As the plain becomes inundated, most of the population moves to the uplands and plain fringes. This annual relocation of people and cattle including the Litunga in a highly-celebrated ceremony has become a national and international tourism event.

Most of the population in the Barotse Flood Plain depends on a mixed livelihood strategy, combining crop farming, livestock keeping, fishing and natural resource exploitation. This diversity of livelihood components, many of which depend on wetlands and canals, is an effective strategy for spreading risk, and income and subsistence sources vary at different times, especially according to season. The rural economy is for the most part subsistence-based, and is subject to high levels of uncertainty and variability.

The Barotse Flood plain is characterized by two farming seasons, namely the winter and rain season cropping. During winter, cultivated areas include Flood Plain edges and dambos in upland river valleys. Crops grown include maize, groundnuts and sweet potatoes planted after the receding of the flood. These grow on residual moisture, while vegetables are irrigated. Rainy season crops include rice grown on selected flood plain sites, maize and other vegetables on Mazulu (mound) in the flood plain and cassava on the upland. These crops are grown for both sale and consumption.

Floodplain farming systems are diverse, they include raised gardens (Lizulu), rain-fed village gardens (Litongo), seepage gardens (wet Litongo), drained seepage gardens (Sishango), lagoon gardens (Sitapa) and riverbank gardens (Litunda). Most of the cattle in Western Province are found along the Zambezi floodplain and adjoining plains. The Barotse Floodplain is known to be one of the most productive cattle areas in the country. Over 200,000 cattle are pastured on the Barotse floodplain, the bulk of it managed under a system of transhumance, spending the months of January to July in the floodplain and the remainder of the year in the uplands. Primarily driven by the seasonal availability of pasture, annual transhumance is also important for the distribution of manure, and in the floodplain there is a strong interaction between herding, cropping and fishing activities.

The fisheries sector is one of the most important sectors in Western Province. It is mainly concentrated on the floodplains of the upper Zambezi, especially the Barotse floodplain. It plays a significant role in the provision of fish protein in the diets of the people of the province and the entire country.

## 6. IMPACTS

This section studies all modifications to baseline that will be brought by the Project's foreseen activities.

Impact assessment does not study cumulative impacts since projects impact are limited to the Study area and that there are no known sources of direct impacts on wetlands other than traditional agricultural activities in the Plain.

Discussions with stakeholders were done during the third workshop in June 2014 to gather people opinion and concerns on potential impacts based on the presentation of the Conceptual Desing report. Issues are addressed in this final ESIA version.

### ESIA IMPACT ASSESSMENT METHOD

Environmental Impact Assessment uses the following method. Thresholds are defined for each component.

Impact assessment is based on the integration of 6 factors:

- ▶ identification of impact sources
- ▶ determination of affected components' value
- ▶ Impact duration
- ▶ Impact extent
- ▶ Impact intensity
- ▶ Impact occurrence probability

Points 2 to 5 enable to determine impact significance. Point 6 enables to assess the probability that the impact will occur. This helps separating "risks" from "impacts" (that are actually going to take place).

### CRITERIA #1 IDENTIFICATION OF IMPACT SOURCES

An impact identification matrix (see next section) presents activities (in lines) as well as components (in columns) and identifies all sources of impacts. The impact identification matrix differentiates positive from negative impacts.

### CRITERIA #2 ENVIRONMENTAL AND SOCIAL COMPONENTS VALUE

Each component of the natural environment are analyzed according to their value in the study area (see baseline chapter). Value assessment is based on Experts' knowledge of the component, field surveys, public consultation, etc.

Value analysis does not take into account foreseen impacts, it is purely based on the component intrinsic value. Protection status, symbolic importance, cultural value, significance for the World Bank, etc. are all influencing the component value.

Three threshold levels are used: Low, Moderate and High value components.

Values of each component are presented in the Baseline section.

### CRITERIA #3 IMPACT DURATION

Each impact is identified according to its duration. Temporary and permanent impact can be distinguished based on their reversibility: temporary are reversible and permanent are irreversible (or will last all through the Project lifespan).

### CRITERIA #4 IMPACT EXTENT

Each impact is defined by its geographical extent. Three levels will be established: point-source impact, local impact and regional impact.

Point-source impacts affect a component on a very small scale of the study area, i.e. a small proportion of the study area wildlife population or plants.

Local impacts affect a component on the entire or the majority of the detailed study area in opposition to regional impacts that affect a component on a larger scale such as the entire Study area or outside its boundaries.

### CRITERIA #5 IMPACT INTENSITY

Impact intensity refers to level of disruption on the component based on its level of intactness. Impact on highly intact ecosystems is usually more intense than on weakly intact ones.

Disruption of natural component refers to death of species, displacement, fragmentation and loss of habitats. Three threshold levels of intensities are utilized: Minor, Moderate and Major.

### IMPACT SIGNIFICANCE DETERMINATION

Impact significance is based on the four previous criteria. The following table presents the impact importance determination.

Positive impact are assessed using the same criteria.

Table 44 Negative impact assessment

Intensity	Extent	Duration	Environmental and Social Component value		
			Low	Moderate	High
High	Regional	Permanent			
		Temporary			
	Local	Permanent			
		Temporary			
	Point-source	Permanent			
		Temporary			
Moderate	Regional	Permanent			
		Temporary			
	Local	Permanent			
		Temporary			
	Point-source	Permanent			
		Temporary			
Low	Regional	Permanent			
		Temporary			
	Local	Permanent			
		Temporary			
	Point-source	Permanent			
		Temporary			
Negative Impact significance	Major				
	Moderate				
	Minor				
	Negligible				

Table 45 Positive impact assessment

Intensity	Extent	Duration	Environmental and Social Component value		
			Low	Moderate	High
High	Regional	Permanent			
		Temporary			
	Local	Permanent			
		Temporary			
	Point-source	Permanent			
		Temporary			
Moderate	Regional	Permanent			
		Temporary			
	Local	Permanent			
		Temporary			
	Point-source	Permanent			
		Temporary			
Low	Regional	Permanent			
		Temporary			
	Local	Permanent			
		Temporary			
	Point-source	Permanent			
		Temporary			
Positive Impact significance	Major				
	Moderate				
	Minor				
	Negligible				

Major negative impacts represent high level of perturbation of the component usually irreversible, these impacts are seldom mitigable and most of the times require compensation or offsets, followed by measurable monitoring measures.

Moderate negative impacts represent noticeable perturbation of the component, however these impacts can be mitigated and need to be monitored.

Minor impacts most of the time only require mitigation measures without the need for monitoring. Negligible impacts do not require any particular measures.

**CRITERIA #6: IMPACT OCCURRENCE PROBABILITY**

Assessment of the probability that an impact will take place is based on the expert's experience on similar assignments and the type of activity that generate the impact.

Three thresholds are used as shown in the following table.

<b>High probability</b>	Analysis of the baseline coupled with Project characteristics concludes that the impact will take place.
<b>Potential occurrence</b>	Based on previous experiences, it is possible that the impact will occur.
<b>Risk (low probability)</b>	Analysis of baseline coupled with Project characteristics only reveals a risk of impact occurrence.

**6.1 BIOPHYSICAL ENVIRONMENT**

The Project is, in its essence, a "social project" which ultimate aim is to improve people's livelihood, therefore it is typical to have a majority of socio economic positive impacts. However, with foreseen activities being located in or nearby wetlands (see baseline section), improvement of people livelihood in a wetland is, by definition, weakly compatible with environmental conservation and will inevitably lead to some form of wetland degradation. Therefore, there are only few positive environmental impacts. However, proposed measures will aim at finding balance between economic development and wetland protection.

Since the Project is a development project, most impacts are related to modifications of the natural environment and there are no impact assessment of the operation phase. Impact assessment does not study the probable increase of agriculture activities in dried out wetlands because of improved drainage.

Impact on physical environment is presented in the following sections:

- ▶ Impact on local hydrology and soils: impact on wetland and impact on fishes
- ▶ Impact on water quality: impact on fishes

**IMPACT IDENTIFICATION MATRIX**

Impact assessment is based on the changes that Project actions will bring on environmental components presented in the baseline.

The following table is an impact identification matrix. The matrix crosses foreseen activities with each components. The impact identification matrix differentiates positive (+) from negative impacts (-). Regular canal maintenance activities will have similar impact than initial reshaping and deepening of canals.

Table 46 Impact identification matrix for environmental components

Proposed activities from Assessment Report / Conceptual Design	Environmental components							
	Wetlands	Dry lands	Fish	Birds	Wetland mammals	Herpetofauna	Wetland insects	Species with special status
Reshaping and deepening of the bed level (dredger or excavator)	-		-		-	-	-	-
Strengthening of flood dikes	-					-	-	
Building of sand traps			+					
Building of silt basins			+					
Installation of water control structures with stop logs	-		-		-	-	-	
Installation of canal crossings								
Rehabilitation of low water crossings			+					

### 6.1.1 Environmental impact assessment study limitation

There are two study limitations. First, there is limited available secondary scientific data, most of them come from Timberlake (1998) report called "Biodiversity of the Zambezi Basin Wetlands, Review and preliminary Assessment of Available Information Phase 1, Final report" and this document is rather old. The second limitation comes from the fact that rare or protected plant species and Mongu shovelnose frog distribution in the plain are unknown, since the area has not been extensively surveyed. Therefore, this ESIA could not assess whether they will be impacted or not.

### 6.1.2 Impact on wetland habitats

The most serious concern regarding the Project implementation is its potential impacts on wetlands due to reshaping of canals for improved drainage. According to the Information Sheet on Ramsar, wetlands canal drainage is one of the biggest identified threat to Zambezi floodplain Ramsar site.

The following activities will impact wetlands:

- ▶ Reshaping of canals with excavation (dredger or excavator) along the following canals:
  - Musiamo (manual labour since )
  - Lubitamei
  - N'gombala
  - Fisheries
- ▶ Installation of water control structures along the following canals:
  - Musiamo
  - Lubitamei

#### EXCAVATION AND WATER CONTROL STRUCTURES WILL AFFECT WETLANDS HYDROLOGY IN MANY WAYS

- ▶ Many canals because of flow blockage and poor maintenance have created small wetlands or feed nearby wetlands. This is particularly the case along N'gombala canal where many perennial marshes are located. Improving flow due to excavation of canals will therefore reduce the available water for adjacent wetlands and lead to their draught. Installation of water control structures will allow for modification of canal hydrology as well (retention of water during the dry season and release of water during the wet season). Water control structures will therefore control connected wetlands water level. Impact significance will be Moderate as shown in the following table.

Impact significance	Moderate
Affected component's value	Perennial marshes are highly valued
Duration	Impact will be permanent
Extent	The extent of the impact is local
Intensity	Impact intensity will be moderate, since improved navigation of N'gombala will increase partial drainage of perennial wetlands hydrologically connected to it. An estimate, based on Google Earth imagery, predicts disturbance of approximately 25 ha of perennial marshes. Fortunately, this type of ecosystem is present on a large scale in the study area (in the Study area an area of 40 274 ha has high concentration of perennial wetlands). Observation on site from the wetland specialist has revealed that papyrus is commonly harvested in these wetlands; therefore, the impact on environment also has a minor negative consequence on people livelihood since papyrus requires constant level of water. In addition, spoils from dredger or excavator, if deposited in wetlands, will disturb them. The excavator could also transport invasive plant species from one area to another.
Impact occurrence probability	This impact has a high probability to take place.

- Dredging, will improve canal flow and will drain nearby wetlands. Installation of water control structures will allow for modification of canal hydrology as well. This is particularly the case along Musiamo and Lubitamei canals where wet grassland are located. Plant composition could also change because of improved drainage, with less water accumulation and longer periods of draught, many obligate wetland species will be replaced by facultative wetland species and bushes, this situation will also lead to decrease in plant diversity. Both canals follow closely wet grasslands, they will therefore be the most impacted wetlands. Impact significance is Moderate for the wet grasslands along Musiamo as well as along Lubitamei. Impact significance is Minor along Fisheries.

Impact significance	Moderate along Musiamo and Lubitamei Minor along Fisheries
Affected component's value	Wet grasslands are highly valued
Duration	Impact will be permanent
Extent	The extent of the impact is local
Intensity	Along Musiamo and Lubitamei, the impact will be of moderate intensity, since the activity will only improve an existing function of drainage, it will not affect a pristine ecosystem but rather an ecosystem already affected by human activities such as peat soils burning and agricultural activities. In addition, drainage will be controlled with water control structures (stop logs) to avoid complete draught of wetlands. However, the impact is still significant because in the Barotse floodplain: 2 986 ha of wetlands (peatland) will be drained (along Musiamo) and in the Luena flats: 4 764 ha will be drained (along Lubitamei). The amount of peatland that will be drained (2 986 ha) represent between 0.24 and 0.27 % of the total estimated peatland in Zambia (between 11 060 and 12 201 ha) (see baseline), but represent the totality of the peatland in the Study area. As mentioned in the baseline, the extent of peatland in the Barotse floodplain is unknown.

	<p>In the past, human attempt to dominate peatlands along Musiamo were always lost against their strong resilience, many sources of water were feeding them (seepages, etc.), and the annual flood was a major constrain to development. With dredging, peatland will retain less water. In addition, spoils from excavator, if deposited in wetlands, will further disturbed them. Excavation of Musiamo and Libutamei will be done with an excavator that will inevitably encroach in the wetlands since both canal are running in the middle of the wetlands. In addition, the excavator could transport invasive plant species from one area to another. Along Fisheries, impact from dredging will be of low intensity since the canal crosses limited surface area of wetlands.</p>
Impact occurrence probability	This impact has a high probability to take place.

#### EXCAVATION AND WATER CONTROL STRUCTURES IN PEAT BOGS WILL ALLOW FOR RELEASE OF GREENHOUSE GASES

Peat soil are important store of soil carbon and sink for carbon dioxide and are sources of atmospheric methane. The sequestering function of peat bogs for carbon dioxide outweighs the release of methane, peat bogs are therefore net GHG sink.

Drainage induce peat oxidation, since peat soils are exposed to oxygen (aerobic decomposition), this action releases CO<sub>2</sub>.

Existing drainage from Musiamo and smaller canals and regular peat bogs fire has already initiate release of GHG from the peat bogs. It is therefore difficult to assess the amount of GHG that will be released from improved drainage.

Based on the 2013 Supplement to the 2006 Intergovernmental Panel Climate Change (IPCC) Guidelines for National Greenhouse Gas Inventories, for tropical drained wetlands grassland made of organic soil, the emission factor for CO<sub>2</sub> is 9.6 tonnes per hectare per year and 7.0 kg CH<sub>4</sub> per hectare per year (using the Tier 1 method). Tier 1 method use the default emission factors when detailed specifications are missing. Under the Tier 1 method, if the typical range of mean annual water table levels of drained organic soils for each landuse category is unknown, the default is that the organic soil is deep-drained. Using Tier 1 method, there is no differentiation between CO<sub>2</sub> emissions from long-term drained organic soils and organic soils after initial drainage or where drainage is deepened. This element further makes it difficult to assess the amount of GHG that will be released due to improved drainage.

#### EXCESSIVE DRAINAGE OF PLATEAU LAKES DUE TO IMPROVED CANAL DRAINAGE

Some participants of the third workshops raised the issue of excessive drainage of plateau lakes through dambos due to improved drainage of Lubitamei and Namitome canals. According to them, these issues would affect agricultural productivity by creating dryer conditions.

This issue is addressed in the latest version of the conceptual design that proposes to install additional water control structures at lake drainage key points to allow local users to control drainage hence facilitating cultivation of flood recession crops. This ESIA also proposes to implement a Canal User Association in the plateau area that is drained by Lubitamei and Namitome canals.

This indirect impact significance is difficult to assess. However, it will be monitored since the conceptual design has developed a monitoring and evaluation plan, which objectives is to give a methodology to measure the effects of the project and to evaluate its efficiency and to provide a quality service provided to Canal User Associations.

## CUMULATIVE IMPACT ON WETLANDS

Impact assessment does not study in-depth cumulative impacts since Project impacts are limited to the Study area. The only known source of direct impacts on wetlands other than traditional agricultural activities in the Plain is the under-construction Mongu-Kalabo road. This road creates serious impacts on wetlands on both their hydrology and their ecological continuity. The presence of a causeway across the plain and the numerous borrow pits along it has left a permanent impacts on wetlands and wetland dependent wildlife. Once in operation, this road will fragmentize wildlife habitat for amphibian, birds and fishes.

Mongu-Kalabo ESIA road has poorly assessed impact on ecological components it is therefore difficult to assess cumulative impacts.

## MEASURES

### Avoidance

Unfortunately, impacts on both ecosystems are unavoidable since dredging and excavating are the Project rationale.

### Mitigation

Mitigation measures can be implemented to minimize encroachment in wetlands:

- ▶ For all work, it strongly suggested to avoid importing soil for embankment construction, but rather use excavated soil from canal bed for embankment. In addition, excavated soil shall be directly reused without creating large soil deposits. This is particularly important with peat soils where direct reuse will allow plant revegetation and ecological function recovery.
- ▶ For wet grassland along Musiamo (peat bog): if embankment are required, it is suggested to directly use the excavated peat soils for embankment rather than importing soils. This will allow for providing habitats for wetland plant and herpetofauna and quick ecological recovery. If embankment is not necessary, all peat soils shall be spread on a uniform layer on the western side of the canal.
- ▶ For wet grassland along Libutamei: excavated soil shall also be reused as embankment. If not possible, it shall be given to local farmers to be reused locally. The canal runs in the middle of the wetland, avoiding encroachment by machinery will not be possible.
- ▶ For perennial marshes along N'gombala: the canal bed is sandy, the excavated material will not serve any ecological purposes. It will be forbidden to spread the sandy material close to perennial wetlands.

These mitigation measures, are rather best management practices for work in wetlands, they will not mitigate "per say" long terms impacts on wetlands.

### Compensation

The surface of wetlands disturbed by canal improvement is:

- ▶ Libutamei canal: 4,764 ha of wet grassland;
- ▶ Musiamo canal: 2,986 ha of wet grassland (peat bog);
- ▶ N'gombala canal: 25 ha of perennial marshes.

Compensation areas for these losses are not required by national law, however this section present a few reflections on compensation and offsets areas.

Conservation areas are sites where human activities are restricted or prohibited in order to fully safeguard ecological functions of an area.

In the context of the Project, it is difficult to designate conservation areas along affected canals since it is impossible to selectively drain one area along Musiamo, Lubitamei and N'gombala and not the other. This would create inequalities between communities who would get advantages from drained lands.

This section will study different options:

- ▶ Designate offsets areas instead of conservation areas. Offsets areas are site outside the Project scope of impact set for restoration or protection. The principle would be to protect wetlands for the losses of other wetlands.
- ▶ Compensate the impact by designating a fish protection area along wetlands;
- ▶ Compensate the impact by implementing a wetland management plan.

### **Wetlands for wetlands**

Offsets are based on the principle of designating an area that has equal or superior ecological value to compensate for the losses, in the case of the current Project, large areas of wet grassland will be lost and would require offsets.

Perennial marshes along the Malile and Zambezi could be good offset area. These marshes occupy oxbow lakes, and are sometimes located close to human settlements and are at risk of impacts from new settlement due to the presence of the Mongu-Kalabo road. The advantage of these wetlands is that they covers a relatively large area, a large ratio of offset to damaged area would therefore be possible. A total of 40,274 ha between the Zambezi and the Malile has a high concentration of perennial wetlands (see baseline map). However, the principle of offsets, to achieve ecological equivalence in a separate location, will only be achieved for the 25 ha of perennial marshes impacted. For the disturbances of wet grasslands, the principle of offsets will not be achieved, wet grasslands and perennial marshes do not have the same ecological functions. Perennial marshes are quality habitat for fish, fish eating birds and water dependent mammals but have low plant diversity while wet grassland offer quality habitat for passerine birds, herpetofauna and have high plant diversity. The following table recap the ecological functions of both types of wetlands (as presented in the baseline section). Both wet grassland along Musiamo and perennial marshes are high quality habitat.

Perennial marshes	Wet grassland
Although plant diversity is rather low, perennial marshes' quality, relate to their habitat feature for animals. These wetlands are high quality spawning grounds for fishes, thanks to their emergent vegetation and their hydro-connectivity with rivers (Malile and Zambezi). Being connected to rivers, many fishes are trapped in them when water retrieves attracting foraging fish eating birds and mammals. They create a buffer zone between terrestrial, human impacted areas and the rivers.	<p>Along Musiamo: These wetlands have peaty soils indicating long term wetness and allowing for particular plant diversity to thrive as well as offering high quality habitats for salamanders (and all herpetofauna), passerine birds and carnivorous plants. Peat soils are also important GHG sinks. Spawning activity is limited in this area due to the remoteness from the Malile and the Zambezi.</p> <p>Along Libutamei: These wetlands offer good quality habitat for herpetofauna. Vegetation is less diverse that its Barotse counterpart. Spawning activity is limited in this area due to the isolation from the Malile and the Zambezi. Bubble fish present in Plateau Lakes used to spawn in these wetlands, however according to villagers they are declining.</p>

One other option would be to protect and restore a peat bog outside of the influence of Musiamo. A good example of restoration would be to select peat bog that was previously cultivated and abandoned. To improve habitat quality, existing local drainage canals could be blocked using small peat dikes to raise the water table. The advantage of this type of compensation is that it will enable to achieve ecological equivalence for the losses of wet grassland since an identical ecosystem would be protected. However, it would be difficult to apply a ratio lost wetland – compensated wetland since the vast majority of wet grassland peat bogs in the vicinity will be impacted by Musiamo improved drainage and that available land is limited due to multiple agriculture use of wet grasslands.

Based on these explanations, in addition to the tremendous land tenure issues, and long process of consultation with communities in setting land aside for full protection, the proposed designation of offsets areas based on the principle of wetlands for wetlands would be rather difficult.

### **Fish Protection Area**

One candidate for compensation could be the riverine grasslands area along the Zambezi. Fisheries in these wetlands suffer from illegal use of fishing gears, this issue could be the subject of aimed actions.

One program actually exists to manage fishery activities in the floodplain: World Fish (a research center part of the CGIAR) in partnership with Namibia Nature Foundation is currently starting the creation of Fish Protection Area in the plain. The objective would be to create a safe haven for the animal to breed and grow, which will then enable them to restock the rest of the plain. To achieve this goal, the priority is to reinforce the capacities of ZAWA and Department of Fisheries, and their cooperation with the BRE. These links are enabled by the Zambian Fisheries Act under the “co-management” system. A good cooperation with the community will enable the different stakeholders to efficiently control the hunting and fishing methods and enforce the regulations.

In order to implement this compensation, discussions between the Project proponents (Zambian Ministry of Transport, Works, Supply and Communications) and World Fish/Namibia Nature Foundation need to be established in order to:

- ▶ Study the possibility of including riverine grasslands of the Study area in the Fish Protection Area. This would necessitate developing aimed activities that will ensure positive effects in the Study area.
- ▶ Study the possibility of co-financing the declaration of a Fish Protection Area based on the inclusion of riverine grassland in the protected area (through the PPCR).

This compensation would be implemented by World Fish since they have the technical expertise and there are the proponent of the Fish Protection Area in the plain. Zambian Ministry of Transport, Works, Supply and Communications would be the co-funding organism of this Fish Protection Area.

### **Wetland Management Plan**

Instead of offset areas, compensation could be in the form of a Comprehensive Wetland Delineation, Zoning and Management Plan.

Being a Ramsar site, such a plan could be useful. Although Management plan is not a requirement for Ramsar sites, it is a recommended management tool as mentioned in Article 3-1 of the Convention “*The Contracting Parties shall formulate and implement their planning so as to promote the conservation of the wetlands included in the List, and as far as possible the wise use of wetlands in their territory*”.

As mentioned in baseline, the Ramsar site delineation does not include wetlands along the Libutamei canal (Luena flats) as well as the critical habitat of the Banded Neolebias (*Neolebias lozii*), a critically endangered fish (according to IUCN red list). Since these wetlands are all hydrologically connected, it is recommended to add them to the management plan.

Such plan has to follow the “Guidelines on Management Planning for Ramsar Sites and Other Wetlands”. According to these guidelines, there are three sections in the Management plan:

- ▶ Description of the site including description of social indicators and sources of people livelihood, flora and fauna.
- ▶ Evaluation and objectives:
  - Evaluation is the assessment of the major feature of the site. In the case of the Zambezi floodplain, a special focus could be paid to wetlands delineation. This delineation would be based on botanical and pedological criteria rather than water coverage during the annual flood. It will necessitate fine characterization of each wetland system including the inventory of rare and protected plants and wildlife and fine description of the hydrology of wetlands. In addition, local knowledge of uses and ecological functions of wetlands shall be gathered through consultations and integrated in the assessment. Fine description of wetlands will enable to understand the synergy between wetlands and potential direct and indirect threats.
  - Objectives have to be measurable. Long term and operational objectives shall be defined in the plan. Long-term objectives should aimed at conservation and sustainable use of natural resources; it will necessitate commitments from stakeholders. The plan will quantified the human and financial resources required to achieve objectives. The overall objective of such plan would be to implement actions to improve the state and knowledge of wetlands and to implement a zoning of the plain in order to define acceptable activities.
- ▶ Action plan/prescriptions:
  - Actions shall aim at improving the state of the wetlands. The plan will include management measures for valued habitats: including a zoning of the Ramsar site that will based on a value system recognizing wetlands hydrological, ecological and socio-economical functions and defining zones of protection, zone of sustainable activities, buffer zones, etc. Based on the zoning, the plan would develop activities that aim at improving the state of wetlands.
  - The plan will include species management measures: the site is home of several valued or protected species who will necessitate aimed management activities.
  - The plan zoning will define acceptable usage of natural resources.
  - The plan will define actions such as educational activities, communication with stakeholders and research.
  - etc.

The current management of the Ramsar site is under the responsibility of the Zambia Wildlife Authority (ZAWA). The management plan and its objectives could be under the responsibility of a join-partnership between ZAWA, Fisheries Department, Department of Water Affairs and the BRE (Barotse Royal Establishment) as it represents the customary authority in charge of traditional management of canals in the plain. Capacity building and funds would be necessary to ensure long-term management of such plan.

A management plan would need to be carried out by a consultant with experience in biodiversity management plan. It will also require capacity building and training for the Zambia Wildlife Authority in order to implement recommended measures. Consultation with the BRE and local communities would be required in order to establish the management plan and to reach agreements on the plan actions, objectives and zoning.

Development of the management plan could also involve local scientific knowledge to carry out on-field flora and fauna surveys. Such knowledge could come from the University of Barotseland for monitoring activities (if they have capacities to carry out fauna and flora surveys). Fauna and flora surveys would aim at wetland dependent species to fill the serious gap in terms of scientific knowledge in the plain. As mentioned before, one serious limitation to the environmental impact assessment is the lack of up-to-date scientific data in the plain.

The plan and its zoning must be in line with the valued cultural elements identified in the “Application for inclusion of the Barotse cultural landscape on the World Heritage List”.

Funds shall be gathered to implement such plan and to achieve and maintain good management of the wetlands.

Once approved, the plan shall be a legal document, involving enforcement of measures.

This measure seems to be the most adequate and feasible one, and would bring many positive impacts to the plain. This measure is required in order to ensure that wetlands in the Barotse are well managed.

#### Best management practices for work near wetland

Best management practices apply to construction phase:

- ▶ Prior to all work, the work contractor must be aware and sensitized about the following topics:
  - He must be in possession of the map showing areas with high concentration of wetlands (see study area map).
  - The ecological and economic value of the wetlands to limit encroachment.
  - The interdiction to pick bird eggs or chicks, fish or any wildlife.
  - The interdiction to refuel in or near wetlands.
  - The use of booms in case of spills and the procedure for decontamination
- ▶ Machinery must be in good operating condition and free of leaks.
- ▶ If soil is needed to backfill, only clean soil shall be used
- ▶ After machinery has finished its work, land shall be left with the same grade and elevation as it was in its original state
- ▶ Refueling and maintenance of machinery, including washing machinery and storing fuel is strictly prohibited in wetlands (except for dredgers).
- ▶ Machinery operating in or near wetland must be equipped with oil spill containment equipment such as floating boom.
- ▶ In case of oil spill, the area of the spill must be confined with booms and the water inside the boom must be pumped or the contaminated soil excavated. Contaminated water or soil must be removed from the project area.

#### RESIDUAL IMPACT

The following table shows the residual impact significance.

Wetland habitats	Impact significance before mitigation	Impact significance after mitigation
Perennial marshes	Moderate	Moderate since poorly mitigable
Seasonal marshes (pans)	Nil	Nil
Wet grasslands	Moderate	Moderate since poorly mitigable
Riparian forests	Nil	Nil
Riverine grasslands	Nil	Nil
Dambos	Nil	Nil
Plateau lakes and their associated plains	Not qualified	Not qualified

### 6.1.3 Impact on dry land habitats

Dry land habitats, such as trees, channel banks, grassland Savanna will probably impacted to some extent along all canal by reshaping activities of canals with excavation (dredger or excavator).

The following activities will impact dry land habitats:

- ▶ Reshaping of canals with excavation (dredger or excavator) along all canals.

Excavator as well as their passage in the plain are likely to affect dry land habitats. Dredge material deposit will be favoured in dryland rather than wetland which will affect them to some extent. Channel banks will be modified due to dredging and reshaping of channels and passage of machinery will affect grasslands. Impact significance on dryland is of Minor significance.

Impact significance	Minor
Affected component's value	Trees of the plain : Moderate Channel banks: Moderate Grassland savanna : Low
Duration	The impact will be temporarily
Extent	The impact will be local
Intensity	The intensity of the impact will be low
Impact occurrence probability	This impact has a high probability to take place. However, impact on trees have a low probability to take place since trees will most likely be avoided by excavators and dredgers.

#### MEASURES

##### Avoidance

During activities, it is recommended to avoid cutting trees, since they are scares in the flood plain, there are resting and nesting areas for passerine birds.

##### Mitigation

There are only few mitigation to reduce impact on dryland ecosystem, one would be to limit as much as possible to build large sand deposit.

##### Compensation

No compensation are necessary since impact significance is Minor.

#### RESIDUAL IMPACT

The following table shows the residual impact significance.

Dryland habitats	Impact significance before mitigation	Impact significance after mitigation
Trees of the plain	Minor	Minor
Channel banks	Minor	Minor
Grassland savanna	Minor	Minor

### 6.1.4 Impact on fishes

Two different situations have to be presented to analyse impact on fishes: as mentioned in the baseline sections, during the annual flood, fishes occupy the entire floodplain in search for spawning grounds, emergent tall grass are favoured by fishes. During the flood, canals become channels to reach spawning grounds throughout the plain.

During the dry season, canals are less frequented by fishes as mentioned in the baseline, the presence or absence of fishing camps along canals reveals the level of habitat quality for fishes.

The following activities will impact fishes:

- ▶ Reshaping of the canal with excavation (dredger or excavator) of all canals, with N'gombala likely to be dredged during the flood season.
- ▶ Strengthening the flood dikes of Muyowamo
- ▶ Installation of water control structures of Muyowamo, Musiamo, Lubitamei
- ▶ Building of sand trap and/or silt basin along Muyowamo, Nebubela, Fisheries, N'Gombala and Lubitamei
- ▶ Rehabilitation of low water crossings along Lubitamei

These activities will all impact fishes in a similar manner: temporary disturbances of fishes during construction due to earthwork creating high turbidity in water (sediment release) and positive impacts on some fishes thanks to increase flow and deeper channels, long term potential negative impact on fishes that rely on canal and wetland vegetation to spawn late in the flood season.

Building of a control structure (barrel) at downstream outfall of N'gombala will probably not impact fishes since, during the flood (high water level), this structure will be submerged and therefore will not severed ecological continuity for fishes.

The first table presents the negative impacts during activities on canals.

Negative impact will be of Minor significance for all canals.

Impact significance	Minor
Affected component's value	Fisheries canal: High
	N'gombala canal: Low
	Nebubela canal: High
	Musiamo canal: Moderate during flooding period, low in the dry season
	Libutamei canal: Low
	Muoyowamo canal: Low, especially close to Limulunga
Duration	The negative impacts will be temporary
Extent	The impact will be local
Intensity	The intensity will be moderate, most activities (except for N'gombala) will take place in the dry season reducing pressure on fishes. Turbidity created by the dredger or excavator could hinder fish movement during spawning period, also suspended silt can clog spawning ground.
Impact occurrence probability	The impact will potentially take place (potential occurrence)

On the long term, improvement of canals will probably have some form of positive impacts on some fishes since new areas will have permanent water. This positive impact will only take place as long as depth of water is not too shallow following canal enlargement. Shallow water will restrain fishes in their movement.

Fishes that spawn in wetlands late in the flood season (such as Cichlidae (Cichlids / Breams), Mastacembelidae (Spiny eels), Malapteruridae (Electric catfishes), Schilbeidae (Butter Catfishes / Silver Barbel) could however be disadvantaged as improved drainage will accelerate run off from wetlands. Overall, impact is therefore neither positive nor negative.

#### MEASURES FOR NEGATIVE IMPACTS

##### Avoidance

All work in canals involving excavators must be avoided during the rainy season between December and April. It is also suggested to avoid starting works once the rainy season starts, around late October. Baseline has highlighted the critical periods for fishes. The following table summarizes these critical periods that need to be avoided.

Table 47 Critical period for fishes

Period of work Restriction											
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Spawning		High water Levels					Low water levels				Spawning
Mormyridae (Snoutfishes), Kneriidae (Kibnrias), Characidae (Characins), Citharinidae (Citharines), Cyprinidae (Labeos and Barbs), Clariidae (Catfishes), Mochokidae (Squeakers), Bagridae (Bagrids)											
Spawning				High water level			Low water level				Spawning
Cichlidae (Cichlids / Breams), Mastacembelidae (Spiny eels), Malapteruridae (Electric catfishes), Schilbeidae (Butter Catfishes / Silver Barbel)											
Critical period		Sensitive period			Less sensitive period						

##### Mitigation

No mitigation measure can be implemented, starting excavation and dredging in the upstream-end of canals would allow startled fishes to move to downstream areas with clearer water. However, since canals are fed by springs this would create floods if work begins at upstream end of canals.

##### Compensation

Impact significance is Minor, no compensation measures are necessary. If riverine grasslands are included in a Fish Protection Area as presented in previous sections, general state of fishes may improve in the area.

#### **Discussion on large-scale aquaculture in the plain**

In order to mitigate the rapid depletion of fishes in the plain, large-scale aquaculture in the plain could represent a valuable measure; however, several arguments are rather opposed to such measure:

- ▶ Wild fishes are much more efficient at reproducing naturally if they are given habitat protection. In fact naive, pond-reared fingerlings are easy targets for predators, whereas wild-reared fish learn predator avoidance from their parents;
- ▶ There is a risk of introducing diseases such as EUS with intensively pond-reared fish;
- ▶ There is a risk of introducing invasive species such as the Tilapia;
- ▶ Potential for aquaculture is limited in the Plain due to the annual flood and the sandy nature of the soil;
- ▶ Implementing aquaculture diverts attention away from the need to look after the wild brood stock if fishers think they can catch everything as the waters will be restocked artificially.

More successful are fish ranching in areas away from naturally-restockable waters, such as temporary pans and borrow pits, where fingerlings can be introduced when the pans fill during the rains, and resultant pan-sized fish can be harvested when the pans start to dry out a few months later. Such fishponds exist along the Musiamo canal.

Development of fishponds is out of the scope of this ESIA since impacts on fishes are either of minor significance or positive, large-scale aquaculture is also not proposed in this ESIA.

#### Best management practices for work near rivers

Best management practices apply to construction phase for work in or near the Zambezi and the Malile:

- ▶ If needed, backfill material shall be certified free of pollutants.
- ▶ If soil or riprap is needed to stabilize channels, only clean material shall be used. Riprap shall be free of silt and other debris.
- ▶ Machinery shall operate from watercourse bank without disturbing bank stability.
- ▶ Refueling and maintenance of machinery, including washing machinery and storing fuel is strictly prohibited in a 100m radius from rivers.
- ▶ Machinery operating in or near rivers must be equipped with oil spill containment equipment such as floating boom design for fuel and oil containment.
- ▶ Machinery must be in good operating condition and free of leaks.
- ▶ In case of oil spill, the area of the spill must be confined with oil booms and the water inside the boom must be pumped or the contaminated soil excavated.
- ▶ Raw concrete and concrete washwater shall never be release in any waterbody, including canals but shall be stored in washout containers and evacuated by road tanker to be treated outside the plain. Concrete washwater from cleaning concrete trucks drums could also be reused as batch water to make fresh concrete. The washout container cannot be installed less than 100 m from any waterbody.

#### RESIDUAL IMPACT

The following table shows the residual negative impact significance.

Fishes	Impact significance before mitigation	Impact significance after mitigation
Fisheries canal	Minor	Minor
N'gombala canal	Minor	Minor
Nebubela canal	Minor	Minor
Musiamo canal	Minor	Minor
Libutamei canal	Minor	Minor
Muoyowamo canal	Minor	Minor

## MEASURE TO ENHANCE POSITIVE IMPACT

Regular maintenance activities in canal could ensure long-term positive impacts for some fish species in the Study area (however, as mentioned earlier improved drainage can locally give disadvantage to some species due to accelerated drainage of wetlands). These maintenance activities will be described in the Design report. Nevertheless, improved habitat quality for fishes will probably attract more fishermen and as long as illegal fishing gears are used, this positive impact will only momentary. As mentioned in the social impact assessment, the rehabilitation of the six canals will hopefully enable the Department of Fisheries to enforce the fish ban and implement the Fisheries Co-Management program.

### 6.1.5 Impact on birds

As mentioned in the baseline, many birds behavior in the plain are linked to the annual flood that dictates habitat loss and availability. During rising and receding waters, sensitivity is higher for birds since most of them strongly rely on wetland functions for foraging.

This section does not analysis impact on birds with special status, a specific section will study impact on each special status birds.

The following activities will impact birds:

- ▶ Reshaping of canals with excavation (dredger or excavator) along all canals

Impact during construction is related to the disturbance of waterbirds caused by the machinery. This impact is of Minor significance as presented in the next table.

Impact significance	Minor
Affected component's value	Birds are highly valued in the plain
Duration	Impact are temporary (limited to construction activities).
Extent	Impact is local
Intensity	Birds will be disturbed by excavator and dredger noises and spoils deposition. Drainage of wetlands will require birds to forage elsewhere. Impact intensity is low, since there are many areas that will remain untouched where birds will move during dredging and excavating activities (they are readily mobile). Birds mortality is foreseen if trees are cut as they are used by nesting weaver (passerine birds). Birds of prey will not be impacted by activities.
Impact occurrence probability	This impact has a high probability to take place.

## MEASURES

All measures to mitigate impacts on wetlands will help reduce impacts on birds.

### Avoidance

All work in canals involving excavators must be avoided all work during the rainy season as it the breeding season of most waterbirds. However, the African Skimmer, an IUCN near threatened bird, breeds during the peak of the dry season. Specific mitigation for species with status are presented in a separate section.

As mentioned before it is strongly recommended to avoid cutting any trees to preserve the few nesting areas of passerine birds.

Mitigation

No specific mitigation measures are proposed.

Compensation

Impact significance is Minor, there is no need for compensation.

## RESIDUAL IMPACT

The following table shows the residual impact significance.

Birds	Impact significance before mitigation	Impact significance after mitigation
Waterbirds, passerine and birds of prey	Minor	Minor

**6.1.6 Impact on mammals**

The Project will not have any impact on herbivore since as mentioned in the baseline section they are not present in the Study area. Impacts on small mammals such as rodents and bats will also be insignificant since activities are not likely to modify their habitats. This section will therefore focus on impacts on aquatic mammals.

The following activities could impact aquatic mammals:

- Reshaping of canals with excavation (dredger or excavator) at junctions between the Nebubela and N'gombala and the Malile and Zambezi.

The two species at stakes are hippos and otters since they inhabit the Zambezi and the Malile. One hippo is present at the junction between the Nebubela and the Malile. They will not be impacted by any activities outside the junctions between these two canals and natural watercourses. The possible impact is of Minor significance.

Impact significance	Minor
Affected component's value	High
Duration	Temporary
Extent	Point-source as impact will be localized at junctions
Intensity	Low, the chance of collision between a hippo or an otter and the dredger or the excavator is almost nil, these animal may be disturbed by activities. There is also a risk that spoil from dredgers and excavator be deposited in perennial wetlands and affect otters.
Impact occurrence probability	Risk, there is only a small chance that aquatic mammals will be affected by dredging and excavation

## MEASURES

Avoidance

No particular avoidance measure can be implemented.

### Mitigation

Extreme care has to be made not to deposit any spoils in perennial wetlands along the Zambezi or the Malile. These wetlands are confirmed habitats of Spotted-necked Otters.

The hippo at the junction between the Malile and the Nebubela will normally be startled by the presence of a dredger; however, special precaution will have to be paid not to harm the animal (if it is still there during construction).

### Compensation

No particular compensation measures is necessary since the impact is of Minor significance.

### RESIDUAL IMPACT

The following table shows the residual impact significance.

Mammals	Impact significance before mitigation	Impact significance after mitigation
Hippos and spotted-necked Otters	Minor	Minor

## 6.1.7 Impact on herpetofauna

As mentioned in the baseline section, few information is available on life cycle of reptiles, some of them lay their eggs in November-December, eggs hatch in January-March. More information is available about amphibians: males start their calling songs when the rainy season starts (Timberlake, 1998). Mating season is the most vulnerable time of the year during which impacts on herpetofauna will be stronger.

The following activities will impact herpetofauna:

- ▶ Reshaping of canals with excavation (dredger or excavator) along all canals.

Impact on herpetofauna is a key issue when carrying out work in canals since they are confined to small territories or home ranges, they are not very mobile and slow giving them little ability to escape from construction activities and making them vulnerable to obstacles and pollution. Moreover, amphibians are in contact with water, any oil spill from excavator or dredger will have deleterious effects on amphibian. Many canals, thanks to their level of bank degradation, low current and clogging from emergent grasses, have evolved as wetlands, offering quality habitat for amphibians. Degraded canals ave gentle slopes allowing for passage of herpetofauna, with reshaping of canals, there is a risk that steep slopes will create impassable obstacles for many species.

Impacts can be summarize as follow:

- ▶ Disturbance of wetlands, habitat of many herpetofauna species,
- ▶ Startle of species,
- ▶ Mortality of species due to collision,
- ▶ Entrapment of turtles and amphibians in canals and potholes created by machinery,
- ▶ Risk of oil spills affecting amphibians.

Impact significance is Moderate for aquatic and wetland species and Minor for terrestrial specie as shown in the following table.

Impact significance	Moderate for aquatic and wetland species Minor for terrestrial species
Affected component's value	High for aquatic and wetland species Low for terrestrial species
Duration	Construction activities will be temporary
Extent	Impact will be local
Intensity	Intensity will be moderate, mortality is expected and disturbances of habitats and oil spills could take place, especially during refueling of engines. The most sensitive area is along Musiamo since the area offers quality habitat for amphibian (thanks to peat bogs)
Impact occurrence probability	This impact has a high probability to take place. Oil spills are a risk and have a low probability of occurrence.

## MEASURES

### Avoidance

It is strongly suggested to avoid all work during the rainy season, from December to May to avoid disturbing reproduction.

### Mitigation

In order to mitigate impacts on herpetofauna, it is strongly suggested to avoid creating steep slopes while reshaping canals; gentle slopes allow for colonization of vegetation, and will allow for movement of amphibians and turtles.

Since herpetofauna are very sensitive to oil spills, it is recommended to sensitize dredger operator and excavator how to avoid oil spill while refueling.

Other mitigation measures presented in the wetland section could help mitigation impacts on herpetofauna. However, the main source of impact, which is disturbance of wetlands, is not mitigable since improvement of canals is the project rationale. Impact significance after mitigation will therefore remain the same.

### Compensation

Compensation for wetland losses (as presented in the wetland section) will be beneficial to herpetofauna.

## RESIDUAL IMPACT

The following table shows the residual impact significance.

Herpetofauna	Impact significance before mitigation	Impact significance after mitigation
Aquatic and wetland species	Moderate	Moderate
Terrestrial species	Minor	Minor

### 6.1.8 Impact on wetland dependent insects

As mentioned in baseline, removal of emergent wetlands and riparian vegetation is a source of impact on Odonata and wetland dependent Lepidoptera. By opposition to other groups of animals, wetland dependent insects mate during the dry season.

The following activities will impact herpetofauna:

- ▶ Reshaping of canals with excavation (dredger or excavator) along all canals.

During reshaping activities, removal of emergent vegetation will impact Odonata since wetland plants are important in the life cycle of such insects. For example, Odonata eggs are laid on wetland plants, larval stage (nymph) take place in the water. Nymphs climb up emergent leaves and to become adults. Impact of activities on Odonate is of Moderate significance.

Regarding butterflies, their life cycle are not linked to water. Knotgrass (*Polygonum*) are important for larvae, fortunately, these plants often grow at some distance from permanent water sources during the dry season. Dredging and excavating are not likely to affect Knotgrass. Therefore, the impact of activities on such insect is of Minor significance.

Impact significance	Minor of butterflies Moderate for Odonata
Affected component's value	High
Duration	Impacts on wetlands dependent species will be temporary
Extent	The impact will be local
Intensity	For Odonate, the intensity will be moderate, some mortality of larvae and eggs are foreseen due to water work, disturbances on mating and eggs deposition is foreseen since work will take place during the dry season, which is the mating season. For Lepidoptera (butterflies), the intensity will be low as the group is not directly dependent on water.
Impact occurrence probability	This impact has a high probability to take place

#### MEASURES

##### Avoidance

No avoidance measure can be proposed since it is best to avoid all work during the rainy season. Work in dry season will inevitably impact Odonata.

Avoiding clearing wetlands plant is rather impossible.

##### Mitigation

Mitigation measures proposed for herpetofauna and wetlands will contribute to mitigate impacts on insects.

However, the main source of impact, which is disturbance of wetlands, is not mitigable since improvement of canals is the project rational. Impact significance after mitigation will therefore remain the same.

##### Compensation

Compensation for wetland losses (as presented in the wetland section) will be beneficial to insects.

## RESIDUAL IMPACT

The following table shows the residual impact significance.

Wetland dependent insects	Impact significance before mitigation	Impact significance after mitigation
Odonata	Moderate	Moderate
Lepidoptera	Minor	Minor

### 6.1.9 Impact on species with special status

As presented in the baseline sections, the following table recap species that are really of concerns because of their very limited range, their IUCN protection status and because their habitat may be affected by the Project.

English name	Scientific name	Status	Habitats
<b>Plant</b>			
No English name	Microchloa annua	Endemic to the Mongu area	In the savanna grassland, at the edge of woodland and on road side
	Emiliella drummondii Torre	This variety is limited to the Mongu district	Canals
<b>Fish</b>			
Banded Neolebias	Neolebias lozii	Endemic and critically endangered	Dambo, wetlands, river and stream of the Barotse floodplain
<b>Waterbirds</b>			
Slaty Egret	Egretta vinaceigula	Visitor, Vulnerable (IUCN), population decreasing	River floodplains, marshes, and seasonal shallow wetlands, preferring areas where water levels are receding from their seasonal peak with emergent vegetation. Sedentary moves seasonally within wetlands in response to changing water level. Its preferred breeding habitat is Phragmites reedbed. The species shows high nest-site fidelity
Wattled Crane	Bugeranus carunculatus	Probably breeds, Vulnerable (IUCN), population decreasing	Inhabit seasonal wetlands and are irregularly nomadic in response to water availability. Preferred nesting sites are where grass and sedge marshes are bordered by drier, flat to sloping grassland meadows
Great Snipe	Gallinago media	Palaearctic Migrant, Near Threatened (IUCN), population decreasing	Marshlands and short grass or sedges but also on drier habitat such as sand dunes
African Skimmer	Rynchops flavirostris	Near Threatened (IUCN), population decreasing	Vast calm water for feeding. It breeds during the dry season along broad rivers on large, dry sandbars that are largely free from vegetation
<b>Reptiles &amp; amphibians</b>			
Barotse Burrowing Skink	Typhlacontias gracilis	Endemic to western Zambia	Lives under leaf litter of sandy area
Barotse Legless Skink	Typhlosaurus jappi (syn. Acontias kgaladi)	Endemic to Barotseland	Unknown

English name	Scientific name	Status	Habitats
Barotse Snout-burrowing Frog Also named Mongu shovelnose frog	Hemisus "barotseensis"	Supposedly Endemic to Barotseland	Typically inhabits floodplains, burrowing frog living most of his life underground
<b>Wetland dependent butterflies</b>			
No English name	Mylothris bernice overlaeti	Vulnerable	Marshes, food plant: Polygonum sp.
Dark Marsh Acraea	Acraea mirifica	Vulnerable	Riverine grassland
No English name	Acraea periphanes	Vulnerable	Wet grassland
Beautiful Zebra Blue	Leptotes pulcher	Rare	Marshes

#### PLANT WITH STATUS

Potential impacts on plants with special status is impossible to assess due to lack of detailed on-field surveys.

#### FISH WITH STATUS

The Banded Neolebias (*Neolebias lozii*), a critically endangered fish (according to IUCN red list) is present nearby the study area in two waterbodies: the Kataba River and its tributary the Siandra stream (right outside of Musiamo canal at its southern tip, 40 km south of Mongu, see sensitive area map).

With current knowledge, the Project will not have any direct impact on the species. However, any additional work on Musiamo in the fish habitat will have deleterious impact on the fish. It is therefore required to avoid all work in the delineated critical habitat including both Kataba River, Siandra stream and their web of wetlands toward the Zambezi as shown in the map. Currently, the foreseen activities of this Project do not encroach in this area. However in the medium term, it is planned to recalibrate Musiamo further South, this has to be avoided in the fish habitat.

The presence of this fish call for integrating his critical habitat in the proposed Wetland Management Plan (see impact on wetlands).

#### BIRDS WITH STATUS

Outside of temporary disturbance due to presence of excavator or dredger, there is no particular serious impact on waterbirds with special status, other than those presented in the previous bird section, for the following reasons:

- ▶ Slaty Egret: this species does not breed in the area. Impact is therefore no different from other non-protected waterbirds.
- ▶ Wattled Crane: no particular threat since the species can move in function to water availability, although this species breeds in the Study area, it was already recommended to avoid the rainy season (breeding season) in the previous section;
- ▶ Great Snipe: no particular threat since the species can occupy many type of habitats.
- ▶ African Skimmer: the species breed in the dry season on sand banks along broad rivers, there is a risk of impact is dredger or excavator encroach on sand banks along canals, however, such encroachment will not take place along the Malile or the Zambezi where sand banks are located, therefore there is no foreseen particular impact on this species.

## HERPETOFAUNA WITH STATUS

Skinks with special status are not likely to be impacted as their habitats, typically in dry area are not under particular threat by the Project activities.

The Mongu shovelnose frog, a rare endemic frog to the Barotse region, could be impacted by the Project since it inhabits wetlands, living most of his life in the mud. Earthwork could impact this species. Since no inventory of that species has ever been carried out, it is impossible to assess the probability that some specimen would be impacted. It is, with today information, also impossible to assess whether the floodplain is a Critical Natural Habitat from the species (as defined in the OP 4.04 Natural Habitats). However, it has to be considered potentially present along or near canals to be rehabilitated and the plain has to be considered an important habitat.

The following activities could impact the Mongu shovelnose frog:

- ▶ Reshaping of canals with excavation (dredger or excavator) along all canals

In case of specimen mortality due to the dredger or excavator, impact would be of Major significance as shown in the following table. Although very little is known about the species abundance, the only scientific article that studied the species mentions that it is most likely very rare and localised (Channing & Broadley, 2002), the precautionary principle will consider that the species is very rare, and only localized in the Barotse flood plain.

Impact significance	Major
Affected component's value	High
Duration	Impacts could be permanent in case of high mortality caused by the dredger or excavator, in that case, taken into account that the species is really rare, mortality of a few specimen could have deleterious long term effects on the species.
Extent	The impact will be local
Intensity	The impact is of high intensity since, from known data; the Mongu shovelnose frog has a very limited home range and is very rare.
Impact occurrence probability	This impact has low probability to take place (risk) since very little is known about this species repartition in the Barotse.

Measures

Since no specific inventory of the species has been carried out, nothing more than measures proposed in previous section for the protection of wetlands and herpetofauna can be proposed. As mentioned in these sections, work shall be carried out during the dry season.

The only possible specific mitigation measure would be to hire a biologist who can recognize the distinctive advertisement call of the Mongu shovelnose frog and its morphology (as shown in the following figures) and carry out listening and recording surveys along all canals to be rehabilitated. The total length of canal to be rehabilitated is more than 150 km, only a few foreign biologists have identified this species, involving such international experts along 150 km of canal, is not economically feasible.

Figure 16 Mongu shovelnose frog identification process

Species	Emphasized frequency (kHz)	Pulse structure	Pulses/s	Source
<i>H. guineensis</i>	3.0–3.1	Doublets	48	Inger (1968), Schiøtz (1964)
<i>H. marmoratus</i>	3.5–4.2	Singlets	76–80	Passmore and Carruthers (1995), A. Channing (unpubl.)
<i>H. guttatus</i>	2.2	Singlets	45	Passmore and Carruthers (1995), A. Channing (unpubl.)
<i>H. barotseensis</i>	4.2–4.3	Quadruplets	28	A. Channing (unpubl.)

- 1a. Not normally exceeding 30 mm SVL (males), 38 mm SVL (females) ..... *Hemismus marmoratus*
- 1b. Normally exceeding 30 mm SVL (males), 38 mm (females) ..... (2)
- 2a. A light vertebral line present, bordered on either side by a generally regular dark band ..... *Hemismus wittei*
- 2b. Light vertebral line, if present, not contained in a light vertebral band with continuous dark border ..... (3)
- 3a. Fifth toe relatively short, < 75% of the length of inner metatarsal tubercle ..... *Hemismus guineensis broadleyi*
- 3b. Fifth toe relatively long, usually > 75% of the length of inner metatarsal tubercle ..... (4)
- 4a. Fifth toe < 60% of the width of upper eyelid ..... *Hemismus guineensis microps*
- 4b. Fifth toe > 60% of the width of upper eyelid ..... *Hemismus barotseensis*

Source: Channing & Broadley, 2002

#### WETLAND DEPENDENT BUTTERFLIES WITH STATUS

The project activities are not likely to affect butterflies with status in a greater way than common butterflies, since none of their life cycle phase involves water, direct mortality of protected species is not likely to take place. Impact significance is Minor (see same assessment as previous section).

#### RESIDUAL IMPACT

The following table shows the residual impact significance.

Species with special status	Impact significance before mitigation	Impact significance after mitigation
Plants	Impossible to assess with current knowledge	
Birds	No particular impacts other than those presented in the bird section	
Skink	Not likely to be impacted since their habitat will not be disturbed by activities	
Mongu shovelnose frog	Potentially Major (risk)	Potentially Major (risk)
Wetland dependent butterflies	Minor	Minor

## 6.2 SUMMARY OF BIOPHYSICAL ENVIRONMENTAL IMPACT ASSESSMENT

The following tables summarize impact significance before and after mitigation. As explained in previous sections, the main impacting activities will be reshaping of canals with excavation (dredger or excavator). Reshaping of canals will improve drainage of wetlands, reducing their water retention capacity, thus reducing their ecological value for obligated wetlands plant species, amphibians and other water dependent wildlife. Reshaping of canals could however improve fish habitat continuity, which is a positive impact as long as adequate measures are implemented to stop the use of illegal fishing equipment.

**One element that is an absolute requirements is the avoidance of the delineated protection zone for the critical natural habitat of the Banded Neolebias (*Neolebias lozii*) south of the Study area. Any work on Musiamo in the delineated area (Kataba River, Siandra stream and their associated dambos and wetlands), will have major impact on the critically endangered species. Currently, the foreseen activities of this Project do not encroach in this area. However in the medium term, it is planned to recalibrate Musiamo further South, this has to be avoided in the fish habitat.**

Implementation of mitigation measures for negative impacts will not reduce them significantly. This is because, besides best management practices, there are limited actions and that can be implemented in order to reduce impacts during construction activities. This situation calls for compensation or offsets, three options are presented in the ESIA and were discussed during the third Workshop:

- ▶ Designate offsets areas instead of conservation areas. Offsets areas are sites outside the Project scope of impact set for restoration or protection. The principle would be to protect wetlands for the damage on other wetlands. The proposed designation of offsets areas would be rather difficult due to customary land tenure issues and the difficulties to find equivalent wetlands close to the Study area.
- ▶ Compensate the impact by designating a fish protection area along wetlands. One candidate for compensation could be the riverine grasslands area along the Zambezi. Fisheries in these wetlands suffer from illegal use of fishing gears, this issue could be the subject of aimed actions. One program actually exists to manage fishery activities in the floodplain: World Fish (a research center part of the CGIAR) in partnership with Namibia Nature Foundation is currently starting the creation of Fish Protection Area in the plain. Discussions between the Project proponents (Zambian Ministry of Transport, Works, Supply and Communications) and World Fish/Namibia Nature Foundation could to be established in order to study the possibility of including riverine grasslands of the Study area in the Fish Protection Area.
- ▶ Compensate the impact by implementing a Comprehensive Wetland Delineation, Zoning and Management Plan. Being a Ramsar site, such a plan could be useful. Although Management plan is not a requirement for Ramsar sites, it is a recommended management tool. This measure seems to be the most adequate and feasible one, and would bring many positive impacts to the plain. This option was presented during the third workshop and discussed in a group. Participants agreed that a management plan would be useful for the wetlands. The presence of IUCN species calls for such management tool.

Impact assessment does not study in-depth cumulative impacts since Project impacts are limited to the Study area. The only known source of direct impacts on wetlands other than traditional agricultural activities in the Plain is the under-construction Mongu-Kalabo road. This road creates serious impacts on wetlands on both their hydrology and their ecological continuity. The presence of a causeway across the plain and the numerous borrow pits along it has left a permanent impacts on wetlands and wetland dependent wildlife. Once in operation, this road will fragmentize wildlife habitat for amphibian, birds and fishes.

The following table presents identified impacts on environmental components and their significance after mitigation measures (- represents negative impact and + positive).

Muyowamo + Namitome										
Proposed activities from Assessment Report / Conceptual Design	Environmental components									
	Wetlands	Dry lands	Fish	Birds	Wetland mammals	Wetland herpetofauna	Terrestrial herpetofauna	Odonata	Wetland Butterflies	Species with special status
Reshaping of the canal with excavation (dredger or excavator)		Minor -	Minor- Minor+	Minor-		Moderate-	Minor-	Moderate-	Minor-	Risk Major- for the Mongu shovelnose frog*
Strengthening the flood dikes			Minor-							
Installation of ship locks with stop locks			Minor-							
Lowering of the bed slope			Minor- Minor+							
Building of one sand trap			Minor- Minor+							
Building of silt basin			Minor- Minor+							

\*Since no inventory of the Mongu shovelnose frog has ever been carried out, it is impossible to assess the probability that some specimen would be impacted. It is, with today information, also impossible to assess whether the floodplain is a Critical Natural Habitat from the species (as defined in the OP 4.04 Natural Habitats). However, it has to be considered potentially present along or near canals to be rehabilitated and the Barotse floodplain has to be considered an important habitat.

Musiamo										
Proposed activities from Assessment Report / Conceptual Design	Environmental components									
	Wetlands	Dry lands	Fish	Birds	Wetland mammals	Wetland herpetofauna	Terrestrial herpetofauna	Odonata	Wetland Butterflies	Species with special status
Reshaping of the canal and lowering of the bed with excavation	Moderate-	Minor	Minor- Minor+	Minor-		Moderate-	Minor-	Moderate-	Minor-	Risk of Major- for the Mongu shovelnose frog* Major- for the Banded Neolebias if Musiamo is recalibrated further south
Installation of water control structures with stop logs	Moderate-		Minor-							
Installation of canal crossings										

\*Since no inventory of the Mongu shovelnose frog has ever been carried out, it is impossible to assess the probability that some specimen would be impacted. It is, with today information, also impossible to assess whether the floodplain is a Critical Natural Habitat from the species (as defined in the OP 4.04 Natural Habitats). However, it has to be considered potentially present along or near canals to be rehabilitated and the Barotse floodplain has to be considered an important habitat.

Lubitamei										
Proposed activities from Assessment Report / Conceptual Design	Environmental components									
	Wetlands	Dry lands	Fish	Birds	Wetland mammals	Wetland herpetofauna	Terrestrial herpetofauna	Odonata	Wetland Butterflies	Species with special status
Reshaping of the canal and lowering of the bed with excavation	Moderate-	Minor	Minor- Minor+	Minor-		Moderate-	Minor-	Moderate-	Minor-	Risk of Major- for the Mongu shovelnose frog*
Installation of water control structures with stop logs	Moderate-		Minor-							
Rehabilitation of low water crossings										
Building of silt basin			Minor- Minor+							

\*Since no inventory of the Mongu shovelnose frog has ever been carried out, it is impossible to assess the probability that some specimen would be impacted. It is, with today information, also impossible to assess whether the floodplain is a Critical Natural Habitat from the species (as defined in the OP 4.04 Natural Habitats). However, it has to be considered potentially present along or near canals to be rehabilitated and the Barotse floodplain has to be considered an important habitat

Nebubela										
Proposed activities from Assessment Report / Conceptual Design	Environmental components									
	Wetlands	Dry lands	Fish	Birds	Wetland mammals	Wetland herpetofauna	Terrestrial herpetofauna	Odonata	Wetland Butterflies	Species with special status
Lowering of the bed with dredger		Minor	Minor-	Minor-	Minor-	Moderate-	Minor-	Moderate-	Minor-	Risk of Major for the Mongu shovelnose frog*
			Minor+							
Building of silt basin			Minor-							
			Minor+							

\*Since no inventory of the Mongu shovelnose frog has ever been carried out, it is impossible to assess the probability that some specimen would be impacted. It is, with today information, also impossible to assess whether the floodplain is a Critical Natural Habitat from the species (as defined in the OP 4.04 Natural Habitats). However, it has to be considered potentially present along or near canals to be rehabilitated and the Barotse floodplain has to be considered an important habitat

N'gombala										
Proposed activities from Assessment Report / Conceptual Design	Environmental components									
	Wetlands	Dry lands	Fish	Birds	Wetland mammals	Wetland herpetofauna	Terrestrial herpetofauna	Odonata	Wetland Butterflies	Species with special status
Lowering of the bed with dredging	Moderate-	Minor	Minor-	Minor-	Minor-	Moderate-	Minor-	Moderate-	Minor-	Risk of Major- for the Mongu shovelnose frog*
			Minor+							
Building of silt basins			Minor-							
			Minor+							

\*Since no inventory of the Mongu shovelnose frog has ever been carried out, it is impossible to assess the probability that some specimen would be impacted. It is, with today information, also impossible to assess whether the floodplain is a Critical Natural Habitat from the species (as defined in the OP 4.04 Natural Habitats). However, it has to be considered potentially present along or near canals to be rehabilitated and the Barotse floodplain has to be considered an important habitat

Fisheries										
Proposed activities from Assessment Report / Conceptual Design	Environmental components									
	Wetlands	Dry lands	Fish	Birds	Wetland mammals	Wetland herpetofauna	Terrestrial herpetofauna	Odonata	Wetland Butterflies	Species with special status
Lowering of the bed with dredging	Minor-	Minor-	Minor-	Minor-		Moderate-	Minor-	Moderate-	Minor-	Risk of Major- for the Mongu shovelnose frog*
			Minor+							
Building of silt basins			Minor-							
			Minor+							

\*Since no inventory of the Mongu shovelnose frog has ever been carried out, it is impossible to assess the probability that some specimen would be impacted. It is, with today information, also impossible to assess whether the floodplain is a Critical Natural Habitat from the species (as defined in the OP 4.04 Natural Habitats). However, it has to be considered potentially present along or near canals to be rehabilitated and the Barotse floodplain has to be considered an important habitat

### 6.3 SOCIO-ECONOMIC AND CULTURAL

The objective of this part of the Environmental Impact Assessment (EIA) is to identify potential social, cultural and economic impacts on the environment in the priority canals namely Lubitamei, Musiamo, N'gombala, Nebubela, Fisheries and Muoyowamo arising from their proposed rehabilitation.

The rehabilitation of the six canals has potential to generate positive and negative impacts on the inhabitants and workers involved in the rehabilitation works, which impacts should be understood by the promoters, in this case the Government of the Republic of Zambia (GRZ), the community leadership and contractors so that measures to avoid, mitigate or enhance them are put in place.

Impacts are referred to as positive if they are capable of enhancing the effect caused by the project and as negative when they reduce the effect.

The social survey in the six priority canals identified few negative impacts on the social, economic and cultural state as compared to positive ones and these are described below.

#### 6.3.1 Impact identification matrix

Impact	Type of Impact	Duration	Intensity	Spatial extent	Probability of occurrence	Sensitivity	Overall significance
<b>CONSTRUCTION PHASE</b>							
Settlements	No impact	-	-	-	-	-	Negligible
Population increase	Direct	Temporary	Minor	Site	Potential	Low	Minor
Land tenure	No impact	-	-	-	Low	-	Negligible
Cultural heritage	No impact	-	-	-	Low	-	-
Agriculture production (disrupted irrigation)	Direct	Temporary	Moderate	Localized	High	Moderate	Moderate
Increased fishing due to improved access to markets	Direct	Temporary	Minor	Localized	High	Low	Minor
Women and Youth	Direct	Temporary	Major	Localized	Potential	High	Major
Vulnerable groups	Indirect	Temporary	Major	Localized	Potential	High	Major
Housing	No impact	-	-	-	Low	-	Negligible
Disrupted Water supply to households dependent on target canals for water	Direct	Temporary	Major	Localized	High	High	Major
Reduced water quality	Direct	Temporary	Major	Localized	High	Moderate	Major
Sanitation	No impact	-	-	-	-	-	Negligible
Improved access to health facilities	No impact	-	-	-	-	-	Negligible
Improved access to Schools	No impact	-	-	-	-	-	-
Increased incidence of HIV/AIDS	Direct	Permanent	Moderate	Localized	High	High	Major
Increased incidence of Sexually Transmitted Infections	Direct	Temporary	Moderate	Localized	High	High	Major
Employment creation	Direct	Temporary	Moderate	Localized	High	High	Major
Increased transportation of goods and passengers	Direct	Temporary	Moderate	Site	Low	Low	Negligible
Improved Navigation	Direct	Temporary	Minor	Localized	Low	Low	Negligible
Increased trade	Direct	Temporary	Minor	Localized	Potential	Low	Minor

Risk of occupational accidents to workers	Direct	Temporary	Moderate	Site	Potential	Moderate	Major
<b>IMPACT ONCE CANALS RESTORED</b>							
Settlements	Direct	Permanent	Minor	Localized	Potential	Low	Minor
Population increase	Direct	Permanent	Minor	Localized	Potential	Moderate	Moderate
Land tenure system	No impact	-	-	-	Low	Moderate	Negligible
Cultural heritage	Indirect	Permanent	Minor	Site	Potential	High	Moderate
Increased agriculture production	Direct	Permanent	Moderate	Localized	Potential	Moderate	Moderate
Increased fishing due to improved access to markets	Direct	Permanent	Major	Localized	Potential	High	Moderate
Women and Youth	Direct	Permanent	Moderate	Localized	Potential	High	Major
Vulnerable groups	Indirect	Permanent	Moderate	Localized	Potential	High	Major
Housing	Indirect	Permanent	Moderate	Localized	Potential	Moderate	Moderate
Disrupted Water supply to households dependent on target canals for water	Indirect	Temporary	Minor	Localized	Low	Low	Minor
Reduced water quality	Direct	Permanent	Minor	Localized	Potential	Low	Moderate
Sanitation	Indirect	Permanent	Moderate	Localized	Low	Moderate	Negligible
Improved access to health facilities	Direct	Permanent	Major	Localized	High	High	Major
Improved access to Schools	Direct	Permanent	Moderate	Localized	High	Moderate	Major
Increased incidence of HIV/AIDS	Indirect	Permanent	Moderate	Localized	High	High	Major
Increased incidence of STIs	Indirect	Temporary	Moderate	Localized	High	Moderate	Moderate
Employment creation	Direct	Temporary	Moderate	Localized	Potential	Moderate	Moderate
Increased transportation of goods and passengers	Direct	Permanent	Major	Localized	Potential	High	Major
Increased trade	Direct	Permanent	Major	Localized	Probable	High	Major
Risk of occupational accidents to workers	No impact	-	-	-	Low	Low	Negligible
Construction of new Infrastructure	Indirect	Permanent	Minor	Localized	Potential	High	Moderate

### 6.3.2 Impact on land use

#### IMPACT ASSESSMENT

The rehabilitation of the six priority canals in the Barotse Flood Plain may follow existing alignment and include expansion in width resulting in the loss of portions of rice fields and vegetable gardens, especially those on the immediate banks of the canals. It was observed that many farmers cultivated rice, maize and vegetables on the immediate banks of some canals without consideration for a strip of separating land.

#### MEASURE TO MITIGATE IMPACT

The owners of the fields that have been established along the edges of the canals should be advised by the Project developer to be based at the provincial headquarters in Mongu to harvest and remove their produce long before commencement of rehabilitation works. As such, these affected persons will not be compensated because they will not lose any income.

### **6.3.3 Impact on resettlement**

#### **6.3.3.1 Loss of land (physical resettlement)**

The Project will not involve any physical resettlement of people.

#### **6.3.3.2 Loss of livelihood (economic displacement)**

The Project involves recalibration of existing canals that may require additional land on each side of canal (a few meters on each side).

In addition, the 7 Silting basin and 4 Sand traps of about 300 m<sup>2</sup> each will require land. This economic displacement will have to be addressed in a Resettlement Action Plan, which is a separate mandate from the ESIA.

### **6.3.4 Loss of access routes**

Improvement of canal will not cause any significant issue regarding access route, on the contrary, canal recalibration will improve mobility of local communities. As mentioned in the Project description section, the Project will design 3 crossing points for cattle in Fisheries canal.

### **6.3.5 Loss/restriction of access to common resources (water front, forest)**

During canal restoration, water will become turbid due to excavation. However, canal water is not drinkable, therefore there is no impact on drinking water sources. For other domestic uses, they will be temporarily disturbance, people may have to walk a few hundred meter for excavation site. The Project developer will have to provide in cases of more important disturbances domestic water to affected communities (truck tank).

Improvement of canal will not cause any significant issue regarding access to common resources, on the contrary, canal recalibration will improve access to fish resources in the Malile river.

### **6.3.6 Loss of customary rights**

The Project will not cause any significant issue regarding customary rights. Since no land will be alienated from customary right.

### **6.3.7 Damage to agriculture/fisheries**

The Project will increase agricultural and fishery production (see positive impact section).

### **6.3.8 Loss of amenity values**

The Project will not cause any loss of amenity value.

### 6.3.9 Loss of ethnicity (culture/traditions)

The Project has been built using participative approach, and the customary authorities (BRE), the Project does not lead to loss of ethnicity.

### 6.3.10 People's health and wellbeing

#### 6.3.10.1 *Increased incidence of Sexually Transmitted Infections (STIs) and HIV/AIDS*

##### IMPACT ASSESSMENT

During the rehabilitation of the six priority canals, the local workers and imported skilled workers like machine operators will bring more money into Mongu district and this is likely to result in such social vices as excessive beer drinking and prostitution causing an increase in incidences of STIs and new HIV/AIDS cases. This is a significant negative impact with long-term effects.

To mitigate the impact, measures will need to be put in place to ensure that awareness creation on STIs and HIV/AIDS is undertaken among the local communities living along the six priority canals and among workers. The measures will include outsourcing sensitization materials from relevant institutions and using existing channels such as Mongu Hospital, Rural Health Centres, District AIDS Taskforce or Non-Governmental Organizations (NGOs).

##### MEASURE TO MITIGATE IMPACT

Increased flow of fish traders and migrant fishermen into the Barotse Flood Plain, relatively high poverty levels due to lack of employment opportunities and lack of awareness are partly responsible for increased social immorality among the communities living along the six priority canals. The Project developer in close coordination with the BRE will need to create awareness and increase access to condoms among villagers and workers in order to reduce the spread of STIs and HIV/AIDS.

The Project developer will need to outsource specialized services from hospitals/clinics in the area in order to provide early diagnosis and hence treatment. The PPCR will also need to involve community leaders in the sensitization process.

#### 6.3.10.2 *Occupational accidents*

##### IMPACT ASSESSMENT

Improper usage of construction equipment during the construction phase can cause accidents which can lead to fatalities or injury among workers. This negative impact is localized and of low significance.

##### MEASURE TO MITIGATE IMPACT

During the rehabilitation, the Project developer should strive to enforce good working ethics and conditions in all the six canals and training of construction workers in safety in order to ensure worker's safety and minimize accidents. The contractor will also need to ensure that rehabilitation equipment/machinery is properly serviced.

### Health and Safety measures

Health and Safety measures apply to construction phase:

- ▶ When working in or near water (including canals), all machinery must have a life jacket or a buoyant work vest. Ring buoys shall be present on site.
- ▶ When working in or near water (including canals), the construction contractor must warn local authorities and village headmen about the risks to navigation.
- ▶ At all time, the construction contractor must restrict access of the construction site to outsiders (including fishermen, children, etc.) the work area must be delineated with construction fences.
- ▶ All workers on construction site must wear personal protective equipment:
  - Safety boots
  - Helmet (hard hats)
  - Gloves
  - Ear plugs and protective eyeglasses (goggles) must also be provided to workers in particular cases
  - When welding takes place, welding shields must be used.
- ▶ First aid kits must be available on site. At least one worker on site must be trained for first aid.

## **6.3.11 Positive impacts**

### **6.3.11.1 Employment creation**

#### IMPACT ASSESSMENT

During the rehabilitation phase of the canals, it is anticipated that some local people will be employed as unskilled workers. This in turn will empower the local people with additional household income.

In some cases, it will be the community organizations themselves through the Barotse Royal Establishment (BRE) who will take the lead in the employment of the workers at each canal level. The significance of the impact is medium because of high unemployment in the project area and will be for the entire canal rehabilitation duration. The impact will be experienced within and around the project site.

At this juncture, it is not easy to state the exact number of jobs that shall be created until the bills of quantities have been made by the engineering design group of the consultancy.

The involvement of women would also arise from the provision of services during the rehabilitation phase through direct employment of women for light manual works and indirect services to the labour force through sale of food stuffs and snacks (sweet potatoes, roasted and cooked green maize, groundnuts etc).

Through the process women, will be financially empowered enabling them to desist from the illicit sexual activities that may contribute to the incidence of HIV/AIDS and Sexually Transmitted Infections (STIs).

The other positive impact related to employment generation will be emergence of new traders taking advantage of the available opportunities to sell more produce to Leului, Sefula, Mongu and Limulunga markets. This positive and indirect impact will result in increased household incomes and it is therefore of medium significance. The social survey discovered that Lubitamei canal, once important for transportation of building poles and roofing grass from the uplands of the Simulumbé plains along the Lusaka/Mongu road via Ndiki plains is likely to regain its significance after rehabilitation.

Similarly, the rehabilitation will improve the movement of goods from the upland areas into the Barotse Flood Plain.

#### MEASURES TO ENHANCE POSITIVE IMPACT

During the rehabilitation of the six selected priority canals the Project developers should give preference to locals for unskilled jobs during the rehabilitation of the six selected priority canals. This has far reaching implications on the survival abilities of the affected persons in view of the depressed employment opportunities in the project area due to its remoteness.

In order to increase employment opportunities in the project area, the respective district councils of Nalolo, Mongu and Limulunga should enhance training in self-help programmes in order to improve the quality of life of the local communities. This training must be done in collaboration with the Barotse Royal Establishment (BRE) in order to sustain the process of clearing the canals after the payment for labour has been completed.

### **6.3.11.2 Increased agricultural production**

#### IMPACT ASSESSMENT

It was observed throughout the social survey that rice and maize were very important crops along the six selected priority canals and cassava has the third position of importance. With the drainage and free movement of water through the rehabilitated canals, more land will be drained and become available for rice and maize cultivation with a likelihood of increased productivity. These are positive impacts with short and long-term effects on society.

#### MEASURES TO ENHANCE POSITIVE IMPACT

The positive impact likely to be created by the rehabilitation of the six priority canals can be enhanced by providing technical and entrepreneurship skills to farmers in the areas and making it easier for them to access agricultural inputs and credit.

This can be achieved if the Ministry of Agriculture and Livestock puts in place a mechanism to train farmers in improved agricultural production practices and entrepreneurship skills.

### **6.3.11.3 Increased volumes of goods transported on canals**

#### IMPACT ASSESSMENT

The rehabilitation of the six priority canals will impact positively on the transportation of agricultural produce (rice), fish and forest products through increased volumes of cargo on canoes and reduced transportation costs incurred when using alternative transport means (Ox-carts). Currently the private sector involved in buying rice only reach accessible areas in the Barotse Flood Plain, but with the improved canal water transport system, they will be able to reach even the furthest places where crops in the past were not purchased. This will ultimately contribute to increased agricultural efficiency as inputs and outputs will get to production areas and markets. The rehabilitation of the canals will have a long-term positive impact.

#### MEASURES TO ENHANCE POSITIVE IMPACT

This positive impact which will generate immediate effects on the local economies can be enhanced further by empowering local youth with entrepreneurship skills and financial capacity to invest in large canoes and boats.

### **6.3.11.4 Improved fish production in the Barotse Flood Plain**

#### IMPACT ASSESSMENT

Presently the canal network in the Barotse Flood Plain is difficult to use as some portions are blocked since they have not been cleared for decades. Therefore in their current state, the canals cannot be used by Fisheries Department for effective monitoring of fishing methods and enforcement of the annual fish ban. As a result of illegal method, fish catches in the Barotse Flood Plain have fallen in the last decade. Illegal methods of fishing, using mosquito nets and Malelo, are used in the breeding grounds and this was reportedly rampant in the Lubitamei canal around Mombo Hill.

Therefore, the rehabilitation of the six canals could enable the Department of Fisheries to enforce the fish ban and implement the Fisheries Co-Management program designed to re-stock the Barotse Flood Plain fishery given they have sufficient human capacity to enforce the fish ban. The resulting improved fish production is a potential positive impact of high significance with medium term effect.

#### MEASURES TO ENHANCE POSITIVE IMPACT

This positive impact can be enhanced through sensitization of the fishing communities on matters of fish conservation, sustainable harvesting and resting breeding grounds as well as implementing the Fisheries Co-Management programme which seeks to check the downward trend in fish production of the entire Zambezi Flood Plain and its tributaries fisheries of the Luena Flats. This collaborative programme is achievable with strengthened cooperation between government, traditional authorities (the BRE) and fishermen.

### **6.3.11.5 Increased local tourism**

#### IMPACT ASSESSMENT

The Kuomboka ceremony and Kifuluhela ceremonies, that take place on the Muoyowamo canal, have become important tourist attractions that have put Zambia on the international tourism map. According to the Zambia National Tourist Board, the Kuomboka ceremony alone attracts over 100,000 tourists to the Western Province every year generating foreign exchange earnings for the country and significantly contributing to the economy of Mongu district. Its rehabilitation therefore, will also impact positively on the tourism potential held by such cultural and historical sites as Lwatile Church, Old Boma Site and Lealui Palace.

Similarly, the rehabilitation of Lubitamei canal is likely to impact positively on the tourist potential of the late King Lewanika's sugar cane farm, a cultural site associated with the construction of the same canal, and Kate, a beautiful site designated for establishment of the new Limulunga District Centre.

#### MEASURE TO ENHANCE POSITIVE IMPACT

This positive impact, with significant long-term effects on the economy of the newly established districts of Limulunga and that of Mongu in the short term can be enhanced by enabling investments in hospitality businesses within the Barotse Flood Plain.

### **6.3.11.6 Improved access to health facilities and enhanced human health**

#### IMPACT ASSESSMENT

Most of the people living in the Barotse Flood Plain have difficulties in accessing medical facilities that are only found on the uplands in Limulunga, Mongu, Sefula and Namushakende due to poor transport network. With a rehabilitated network of canals, their inhabitants in the Barotse Flood Plain will be able to access health services easily and at reduced cost by canoe or boat. Even the few rural health facilities located in the Flood Plain who use bicycles to obtain their monthly drug requirements will benefit from canal rehabilitation as it will become easier to bring in medical supplies easily. These are direct, positive and highly significant impacts given the limited number of health facilities in the Barotse Flood Plain and poor roads.

#### MEASURE TO ENHANCE POSITIVE IMPACT

These positive impacts with long-term social and economic benefits to the communities and country at large can be enhanced by introducing mobile health services to cater for settlements far from existing facilities using canal transport which is faster and cheaper as compared to road transport.

### **6.3.11.7 Increase in trade and incomes**

#### IMPACT ASSESSMENT

Rehabilitation of the six priority canals will impact positively on the trade between the upland areas and the Barotse Flood Plain settlements through increased volumes of goods transported using rehabilitated canals. Currently it is costly to transport goods on the limited available ox carts, whose capacity is also limited and which takes a longer time to reach the intended destinations.

**MEASURE TO ENHANCE POSITIVE IMPACT**

When operational, the rehabilitated canals network will increase trade between the Barotse Flood Plain and uplands areas. This will in turn contribute to increased incomes of the people. The impact of increased trade and incomes can be enhanced by empowering local people with entrepreneurship skills and financial capacity to expand their businesses.

## 7. CONCLUSION AND RECOMMENDATIONS

This ESIA has described both social, cultural and environmental baseline in the Study area. It has studied the potential changes to baseline brought from the Project implementation.

The Lozi people are also known as the “plains or water people”, and local livelihoods and cultural traditions are linked closely with seasonal flooding.

The use of floodplain resources was in the past managed according to traditional systems, under the customary authority of the Litunga. Today, although formal control over natural resources has been passed over to central and provincial government, the Barotse Royal Establishment (BRE) maintains a great influence on natural resource use and regulation.

During the dry season, the bulk of local production, economic activities and settlement are focused in the floodplain area. As the plain becomes inundated, most of the population moves to the uplands and plain fringes.

Most of the population in the Barotse Flood Plain depends on a mixed livelihood strategy, combining crop farming, livestock keeping, fishing and natural resource exploitation. This diversity of livelihood components, many of which depend on wetlands and canals, is an effective strategy for spreading risk, and income and subsistence sources vary at different times, especially according to season. The rural economy is for the most part subsistence-based, and is subject to high levels of uncertainty and variability.

The Barotse flood plain with its annual flood has allowed the creation of wetlands habitats that are valued for many wildlife species including fishes. Only few human settlements are present in the plain, which has help to preserve many habitats, population concentration along the plain fringes has however created environmental pressure of nearby wetlands. The study area is poorly occupied by herbivores mammals, probably due to high incidence of subsistence hunting by local population. In fact, large terrestrial mammals are believed to be totally absent of the Eastern side of the Barotse plain. Bird presence in the plain are adjusted to the annual flood pattern, with receding water many wetlands are created that allow for great flocks of birds to forage. When the dry season is at its peak, many seasonal wetlands disappear and bird population decrease or concentrate along perennial wetlands and the rivers.

Between the Zambezi-Malile area, and the wet grassland along the edge of the plateau lies a large strip of grassland savanna. This area is more occupied by human, with settlements and grazing cattle. It is the area with the lesser environmental value. In the plain trees are scares and there is no forest, the main reason being the annual floods. Along the edge of the plateau (plain fringes), riparian forests have been extensively replaced by mango tree culture leaving only few relicual riparian forests.

In terms of plant species with special status, the area is not rich neither in endemism nor in protected species.

A few waterbirds have a special status, as well as other wetland dependent insects and amphibians such as the Mongu shovelnose frog. Since no inventory of the Mongu shovelnose frog has never been carried out, it is impossible to assess the probability that some specimen would be impacted. It is with today information also impossible to assess whether the floodplain is a Critical Natural Habitat from the species (as defined in the OP 4.04 Natural Habitats). However, it has to be considered potentially present along or near canal to be rehabilitated and the plain has to be considered an important habitat.

Fishes are specialized in slow moving and turbid water as found in canals. Important spawning grounds are located in riverine wetlands along the Zambezi and perennial wetlands close to the Malile. Fishes spawn in their emergent-leaved grasses.

Many positive impacts will be brought by canal improvement since people's livelihood is closely related to the functions of the canal network in the plain, functions that have been deteriorated by poor maintenance and that need restoration.

The main impacting activities will be reshaping of canals with excavation (dredger or excavator). Reshaping of canals will improve drainage of wetlands, reducing their water retention capacity, thus reducing their ecological value for obligated wetlands plant species, amphibians and other water dependent wildlife. Reshaping of canals will however improve fish habitat continuity, which is a positive impact. Implementation of mitigation measures will not reduce significantly negative impacts. This is due to the fact that, besides best management practices, they are limited actions during construction that can be implemented in order to reduce impacts.

**One element that is an absolute requirements is the avoidance of the delineated protection zone for the critical natural habitat of the Banded Neolebias (*Neolebias lozii*) south of the Study area. Any work on Musiamo in the delineated area (Kataba River, Siandra stream and their associated dambos and wetlands), will have major impact on the critically endangered species. Currently, the foreseen activities of this Project do not encroach in this area. However in the medium term, it is planned to recalibrate Musiamo further South, this has to be avoided in the fish habitat**

A special measure, that would bring long-term positive impacts on the floodplain, is proposed in this ESIA: to develop a Comprehensive Wetland Delineation, Zoning and Management Plan. Being a Ramsar site, such a plan could be useful. Although Management plan is not a requirement for Ramsar sites, it is a recommended management tool. This option was presented during the third workshop and discussed in a group. Participants agreed that a management plan would be useful for the wetlands.

The main recommendation from this ESIA is therefore to engage as soon as possible in developing a comprehensive wetland management plan for the plain. This plan could fill the gaps in scientific knowledge on ecology of the plain and could ensure sustainability of natural resources uses such as fishery. It would also define areas of high ecological value and implement a zoning of the plain. Implementing such plan would need specific expertise but could also be a mean to involve local knowledge such as scientists from the Barotseland University. This plan would call for redefining delineation of the current Ramsar site by integrating wetlands around Lubitamei and the plateau lakes north of Mongu as well as the critical habitat of the Banded Neolebias fish (Kataba River, Siandra stream and their associated dambo and wetlands). Development of this plan would necessitate external source of funds since it is out of the scope of the Study

## 8. ENVIRONMENT AND SOCIAL MANAGEMENT PLAN

This environmental and social management plan has to be distributed to the contractor in charge of excavation.

The construction contractor and all subcontractors shall also appoint a full time Environmental and Social specialist with proven qualification in environmental monitoring (this specialist cannot be selected randomly among workers). They will be in charge of follow-up of the work areas, health and safety measures, and will be liable to ZEMA. His/her experience will allow him/her to take environmental friendly and socially responsible decisions throughout construction activities in order to minimize impacts and to communicate with affected communities.

The specialist will produce notes to the attention of affected communities regarding the advancement of work, the compliance of mitigation measures, health and safety issues, etc.

Regular meetings with affected communities will be organized by the specialist to communicate and take note and address community grievances.

Aspect	Impact	Mitigation/Enhancement measure	Frequency of Monitoring	Time frame	Performance indicator	Responsible person	Cost
Population & demography	Population increase	Awareness creation on family planning measures Distribution of family planning materials to community members	Quarterly	Throughout construction activities and on the long term	Monitor awareness creation activities Monitor population trends	MCDMCH, CSO	2000 (ZMW)

Aspect	Impact	Mitigation/Enhancement measure	Frequency of Monitoring	Time frame	Performance indicator	Responsible person	Cost
Cultural heritage	Increased local tourism	Enabling local investments in hospitality businesses within the Barotse Flood Plain and adjacent areas.	As needed		Monitor and regulate access to heritage sites	Project developer, CEEC, BRE	200 (ZMW)
Livelihoods	Disrupted agriculture production and loss of irrigated land	Advance notice to farmers with fields along the affected canals Allocation of alternative land	Once	Throughout construction activities	Monitor removal of crops from affected fields	BRE, Construction Contractor	500 (ZMW)
	Increased irrigated production of rice, winter maize and vegetables; Increased trading and fishing	Farmers should be given necessary production and entrepreneurship skills through training. Implementing the Fisheries co-management programme Enhancing the enforcement capacity of the Fisheries Department; Enhancing access to financing for investment in small business enterprises	Annually	Once canal restored	Monitor trends in irrigated area, crop production, trade volumes and fish catches	BRE, MAL, Fisheries Department, CEEC	1,500 (ZMW)

Aspect	Impact	Mitigation/Enhancement measure	Frequency of Monitoring	Time frame	Performance indicator	Responsible person	Cost
Gender Aspect	Enhancing opportunities for gender participation	Establish employment quotas for females	Quarterly	Throughout construction activities	Monitor number of people employed by gender	BRE, Project developer	500 (ZMW)
	Enhancing opportunities for gender participation	Providing entrepreneurship skills through training Improving access to affordable financing	Bi-annually	Once canal restored	Monitor training of local people	Project developer	500 (ZMW)
Vulnerable people	Enhancing opportunities for economic participation	Providing entrepreneurship skills through training Improving access to affordable financing	Once	Throughout construction activities and once canal restored	Facilitate and monitor training activities and access to credit or empowerment funds	Project developer	20,000 (ZMW)
Housing	Increase in number of improved houses	Enhancing employment opportunities and economic participation of local people	As needed	Throughout construction activities	Monitor number of new improved houses	Project developer	500 (ZMW)
Water sources	Disrupted Water supply to households dependent on target canals for water	Supply alternative domestic water sources by truck tank	Once	Throughout construction activities	Monitor construction of alternative water sources	Project developer	500 (ZMW)

Aspect	Impact	Mitigation/Enhancement measure	Frequency of Monitoring	Time frame	Performance indicator	Responsible person	Cost
Water sources	Improved water supply to households, for livestock and irrigation	Ensuring continuous canal maintenance programme	Annually	Once canals restored	Monitor implementation of canal maintenance programme	BRE, Department of Maritime	500 (ZMW)
Diseases	Increased incidence of HIV/AIDS and STIs	Awareness creation; Increased access to condoms among villagers and workers.	Quarterly	Throughout construction activities	Monitor sensitization meetings and trends in disease incidence	MCDMCH, DATF	500 (ZMW)
Health facilities	No impact	None	-	Throughout construction activities	-	-	-
Health	Occupational accidents	Enforce good work ethics and conducive work environment Training of construction workers in safety Ensuring rehabilitation equipment/machinery is properly serviced. Contractors to provide orientation on safety to workers and safety wear.	Regularly	Throughout construction activities	Monitor conditions at construct sites	Construction Contractor, Project developer	500 (ZMW)

Aspect	Impact	Mitigation/Enhancement measure	Frequency of Monitoring	Time frame	Performance indicator	Responsible person	Cost
		Provide First Aid Kits on construction sites and implement Health and Safety measures (see below)					
Education	Improved access to schools	Construction of additional schools	Quarterly	Once canal restored	Monitor enrolment and attendance levels	MoE, MoFNP	500 (ZMW)
Infrastructure	New canal-associated infrastructure like crossing points	Put in place a sustainable maintenance system	Annually	Once canal restored	Monitor maintenance works	Department of Maritime, BRE	1000 (ZMW)
Health and Safety measures	Risk of accident	<p>Health and Safety measures must be implemented by the Construction Contractor:</p> <ul style="list-style-type: none"> <li>▶ When working in or near water (including canals), all machinery must have a life jacket or a buoyant work vest. Ring buoys shall be present on site.</li> </ul>	ZEMA shall carry out regular monitoring of compliance with this measure	Throughout construction activities	The construction contractor is required to keep record of all accidents and disclose them to ZEMA upon request	Environmental and Social specialist of the contractor	To be included in the construction contractor contract

Aspect	Impact	Mitigation/Enhancement measure	Frequency of Monitoring	Time frame	Performance indicator	Responsible person	Cost
		<ul style="list-style-type: none"> <li>▶ When working in or near water (including canals), the construction contractor must warn local authorities and village headmen about the risks to navigation.</li> <li>▶ At all time, the construction contractor must restrict access of the construction site to outsiders (including fishermen, children, etc.) the work area must be delineated with construction fences.</li> <li>▶ All workers on construction site must wear personal protective equipment: <ul style="list-style-type: none"> <li>• Safety boots</li> <li>• Helmet (hard hats)</li> <li>• Gloves</li> </ul> </li> </ul>					

Aspect	Impact	Mitigation/Enhancement measure	Frequency of Monitoring	Time frame	Performance indicator	Responsible person	Cost
		<ul style="list-style-type: none"> <li>• Ear plugs and protective eyeglasses (goggles) must also be provided to workers in particular cases</li> <li>• When welding takes place, welding shields must be used.</li> </ul> <p>▶ First aid kits must be available on site. At least one worker on site must be trained for first aid.</p>					

Aspect	Impact	Mitigation/Enhancement measure	Frequency of Monitoring	Time frame	Performance indicator	Responsible person	Cost
Soil and spoils	Pollution	<p>► For all work, it strongly suggested to avoid importing soil for embankment construction, but rather use excavated soil from canal bed for embankment. In addition, excavated soil shall be directly reused without creating large soil deposits. This is particularly important with peat soils where direct reuse will allow plant revegetation and ecological function recovery</p>	ZEMA shall carry out regular monitoring of compliance with this measure	Throughout construction activities	None	Environmental and Social specialist of the contractor	To be included in the construction contractor contract

		<p>► For wet grassland along Musiamo (peat bog): the canal is mainly located at the western end of the wetlands, therefore it is suggested to excavate the canal's bed from the western bank to limit encroachment and to avoid soil deposit in the eastern bank. Also all tracks for machinery shall be located on the western bank of the canal, outside of the wetland. As mentioned above, if embankment are required, it is suggested to directly use the excavated peat soils for embankment rather than importing soils. This will allow for providing habitats for wetland plant and herpetofauna and quick ecological recovery. If embankment is not necessary, all peat</p>					
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Aspect	Impact	Mitigation/Enhancement measure	Frequency of Monitoring	Time frame	Performance indicator	Responsible person	Cost
		<p>soils shall be spread on a uniform layer on the western side of the canal.</p> <ul style="list-style-type: none"> <li>▶ For wet grassland along Libutamei: excavated soil shall also be reused as embankment. If not possible, it shall be given to local farmers to be reused locally. The canal runs in the middle of the wetland, avoiding encroachment by machinery will not be possible.</li> <li>▶ For perennial marshes along N'gombala: the canal bed is sandy, the excavated material will not serve any ecological purposes. It will be forbidden to spread the sandy material close to perennial wetlands</li> </ul>					

Aspect	Impact	Mitigation/Enhancement measure	Frequency of Monitoring	Time frame	Performance indicator	Responsible person	Cost
Fish protection	Impact on fishes	<ul style="list-style-type: none"> <li>All work in canals involving excavators must be avoided during the rainy season between December and April. It is also suggested to avoid starting works once the rainy season starts</li> </ul>	ZEMA shall carry out regular monitoring of compliance with this measure	Throughout construction activities	None	Environmental and Social specialist of the contractor	To be included in the construction contractor contract
	Impact on the Banded Neolebias fish	<ul style="list-style-type: none"> <li>All work around its habitat shall be avoided. This include both Kataba River, Siandra stream and their web of wetlands toward the Zambezi</li> </ul>	ZEMA shall carry out regular monitoring of compliance with this measure. On the long term, ZEMA shall not approve any work in the fish habitat	Throughout construction activities	None	Environmental and Social specialist of the contractor	To be included in the construction contractor contract
Bird protection	Impact on birds	<ul style="list-style-type: none"> <li>All work in canals involving excavators must be avoided during the rainy season as it the breeding season of most waterbirds</li> </ul>	ZEMA shall carry out regular monitoring of compliance with this measure	Throughout construction activities	None	Environmental and Social specialist of the contractor	To be included in the construction contractor contract

Aspect	Impact	Mitigation/Enhancement measure	Frequency of Monitoring	Time frame	Performance indicator	Responsible person	Cost
Mammals	Impacts on mammals	<ul style="list-style-type: none"> <li>▶ Extreme care has to be made not to deposit any spoils in perennial wetlands along the Zambezi or the Malile. These wetlands are confirmed habitats of Spotted-necked Otters</li> <li>▶ Special precaution will have made not to harm hippos during construction</li> </ul>	ZEMA shall carry out regular monitoring of compliance with this measure	Throughout construction activities	None	Environmental and Social specialist of the contractor	To be included in the construction contractor contract
Amphibian	Impact on amphibians	<ul style="list-style-type: none"> <li>▶ All work in canals involving excavators must be avoided during the rainy season to avoid disturbing reproduction.</li> <li>▶ Dredger operator and excavator must be trained and sensitized to avoid oil spill while refueling</li> </ul>	ZEMA shall carry out regular monitoring of compliance with this measure	Throughout construction activities	None	Environmental and Social specialist of the contractor	To be included in the construction contractor contract

Aspect	Impact	Mitigation/Enhancement measure	Frequency of Monitoring	Time frame	Performance indicator	Responsible person	Cost
Best management practices for work in canal near wetland		<p>► Prior to all work, the work contractor must be aware and sensitized about the following topics:</p> <ul style="list-style-type: none"> <li>• He must be in possession of the map showing areas with high concentration of wetlands.</li> <li>• The ecological and economic value of the wetlands to limit encroachment.</li> <li>• The interdiction to pick bird eggs or chicks, fish or any wildlife.</li> <li>• The interdiction to refuel in or near wetlands.</li> <li>• The use of booms in case of spills and the procedure for decontamination</li> </ul>	ZEMA shall carry out regular monitoring of compliance with this measure	Throughout construction activities	None	Environmental and Social specialist of the contractor	To be included in the construction contractor contract

Aspect	Impact	Mitigation/Enhancement measure	Frequency of Monitoring	Time frame	Performance indicator	Responsible person	Cost
		<ul style="list-style-type: none"> <li>▶ Machinery must be in good operating condition and free of leaks.</li> <li>▶ If soil is needed to backfill, only clean soil shall be used</li> <li>▶ After machinery has finished its work, land shall be left with the same grade and elevation as it was in its original state</li> <li>▶ Refueling and maintenance of machinery, including washing machinery and storing fuel is strictly prohibited in wetlands (except for dredgers).</li> <li>▶ Machinery operating in or near wetland must be equipped with oil spill containment equipment such as floating boom.</li> </ul>					

Aspect	Impact	Mitigation/Enhancement measure	Frequency of Monitoring	Time frame	Performance indicator	Responsible person	Cost
		<ul style="list-style-type: none"> <li>▶ In case of oil spill, the area of the spill must be confined with booms and the water inside the boom must be pumped or the contaminated soil excavated. Contaminated water or soil must be removed from the project area.</li> </ul>					
Best management practices for work near rivers		<ul style="list-style-type: none"> <li>▶ If needed, backfill material shall be certified free of pollutants.</li> <li>▶ If soil or riprap is needed to stabilize channels, only clean material shall be used. Riprap shall be free of silt and other debris.</li> <li>▶ Machinery shall operate from watercourse bank without disturbing bank stability.</li> </ul>	ZEMA shall carry out regular monitoring of compliance with this measure	Throughout construction activities	None	Environmental and Social specialist of the contractor	To be included in the construction contractor contract

Aspect	Impact	Mitigation/Enhancement measure	Frequency of Monitoring	Time frame	Performance indicator	Responsible person	Cost
		<ul style="list-style-type: none"> <li>▶ Refueling and maintenance of machinery, including washing machinery and storing fuel is strictly prohibited in a 100m radius from rivers.</li> <li>▶ Machinery operating in or near rivers must be equipped with oil spill containment equipment such as floating boom design for fuel and oil containment.</li> <li>▶ Before entering the site, all machinery shall be free of mud to avoid colonization of invasive species.</li> <li>▶ Machinery must be in good operating condition and free of leaks.</li> </ul>					

Aspect	Impact	Mitigation/Enhancement measure	Frequency of Monitoring	Time frame	Performance indicator	Responsible person	Cost
		<ul style="list-style-type: none"> <li>▶ In case of oil spill, the area of the spill must be confined with oil booms and the water inside the boom must be pumped or the contaminated soil excavated.</li> <li>▶ Raw concrete and concrete washwater shall never be release in any waterbody, including canals but shall be stored in washout containers and evacuated by road tanker to be treated outside the plain. Concrete washwater from cleaning concrete trucks drums could also be reused as batch water to make fresh concrete. The washout container cannot be installed less than 100 m from any waterbody</li> </ul>					

Aspect	Impact	Mitigation/Enhancement measure	Frequency of Monitoring	Time frame	Performance indicator	Responsible person	Cost
Wetland Management Plan	Impact on wetlands	<ul style="list-style-type: none"> <li>▶ The plan must follow the “Guidelines on Management Planning for Ramsar Sites and Other Wetlands”</li> <li>▶ The plan must develop a zoning of the floodplain based on ecological important areas, development of the plan must involve experts to delineate valuable ecosystems and wetlands, wildlife habitat, important spawning grounds, etc. This zoning would determine acceptable activities.</li> <li>▶ The plan and its zoning must be in line with the valued cultural elements identified in the “Application for inclusion of the Barotse cultural landscape on the World Heritage List”.</li> </ul>	NA	NA	NA	<p>Implementation: the management plan would need to be carried out by a consultant with experience in biodiversity management plan</p> <p>Responsible authority: the management plan and its objectives could be under the responsibility of a joint-partnership between ZAWA, Fisheries Department, Department of Water Affairs and the BRE (Barotse Royal Establishment)</p>	150 000 \$US

Aspect	Impact	Mitigation/Enhancement measure	Frequency of Monitoring	Time frame	Performance indicator	Responsible person	Cost
		<ul style="list-style-type: none"> <li>▶ The plan must develop objectives and associated measures to ensure conservation and sustainable use of resources</li> <li>▶ Capacity building: the plan will require capacity building and training for the Zambia Wildlife Authority and other stakeholders in order to implement recommended measures.</li> <li>▶ Consultation with stakeholders: consultation with the BRE and local communities would be required in order to establish the management plan and to reach agreements on the planned actions, objectives and zoning.</li> </ul>					

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## 9. DECOMMISSIONING AND REHABILITATION PLAN

This section does not apply to the Project.

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## 11. DECLARATION OF AUTHENTICITY OF REPORT CONTENTS

BRLI and NIRAS hereby declare this report to be authentic. Each member of the Consortium guarantees the contribution of its own experts. The report is based on field work by BRLi/NIRAS experts as well as secondary sources. When secondary sources such as Web sites, scientific articles and books were used, the source was duly cited in the text as well as in the bibliography section.

Eric Deneut, (BRLi)



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30<sup>th</sup> October 2014

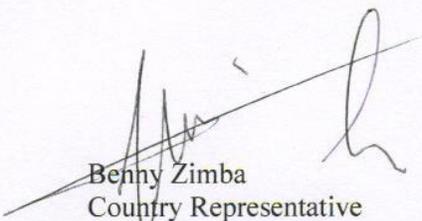
The Director General,  
Zambia Environmental Management Agency,  
Corner of Suez/Church Roads,  
P.o. Box 35131  
**Lusaka**

Dear Sir

**“DECLARATION OF AUTHENTICITY OF REPORT CONTENTS”**

*BRLI and NIRAS* hereby declare this report to be authentic. Each member of the Consortium guarantees the contribution of its own experts. The report is based on field work by BRLi/NIRAS experts as well as secondary sources. When secondary sources such as Web sites, scientific articles and books were used, the source was duly cited in the text as well as in the bibliography section

Sincerely,

  
Benny Zimba  
Country Representative  
NIRAS Zambia Limited.  
Cell No. 097 666 45 79

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## 12. APPENDICES

## 12.1 ANNEX 1: MINUTES OF COMMUNITY CONSULTATIONS

### METHOD

During consultative meetings with the local communities, the Socio-Economic Team gave presentations on the project and also received the questions/concerns from the community on issues that should be considered during the canal rehabilitation project when it commences.

One village per canal was interviewed.

These discussions were centered on the following:

- ▶ To find out if the village inhabitants have heard about the canal project of the world Bank and the Government of the Republic of Zambia (GRZ).
- ▶ What do they know about the history of the canal in their area?
- ▶ Have they been involved in maintaining the canal?
- ▶ How they are using the canals?
- ▶ Before restoring the canals, what do they think should be understood in terms of canals passing through important villages housing royal burial sites.
- ▶ What are the sources of livelihoods?
- ▶ How many people depend on the canals in the village?
- ▶ How important are the canals to the households and the community?
- ▶ What do they expect from the proposed canal rehabilitation project?
- ▶ What do they propose as a method of managing and maintaining the canals once they are rehabilitated?
- ▶ What they would not accept in terms of canals rehabilitation (mandatory labour work, community free work on the canals?)
- ▶ What do the women do in terms of their daily calendars including the problems the women face in the flood plain and assess if the women's work load is heavy? Basically also the women involvement in the canal clearing tasks? What benefits do women get from the canals? The role of the youth in canal project and cross if the youth are moving out of the villages and also look and understand if the population was increasing or decreasing in the villages?
- ▶ Lastly but not the least to understand the types infrastructure available such as schools, clinics and the accessibility in terms of distances.
- ▶ Learn in details about the sensitive areas (protected areas, graveyards, historical sites, etc.)
- ▶ Employment opportunities

### MUSIYAMO CANAL

- ▶ Scoping meeting at **Sikuyu Village**
- ▶ Present from NIRAS: Mr. Charles Chileya (NIRAS) and Mr. Mubiana Muliokela (Interpreter and Research Assistant)
- ▶ Community Members present: confidential.

In his introductory remarks, Mr. Charles Chiley informed the community that the Government of the Republic of Zambia has engaged BRL of and NIRAS of Zambia to undertake this Environmental and Social Impact Study (ESIA) to try to change the picture and get to the grass root beneficiaries before the project starts. Mr Chiley went on to encourage the people present to be as open as possible as the meeting has no structured questionnaire which will quote them. He encouraged members to be free and comfortable to discuss matters regarding canal rehabilitation.

The Chairman of the meeting from the village thanked the group for the initiative and hoped that the discussions were going to be fruitful as the meeting affected the rehabilitation of the Musiyamo canal which was one of the important assets the local villages depended for most of their basic needs.

During the discussions, the following were noted. All the twenty-four village members present had heard of the proposed rehabilitation of the six selected canals. It was also reported that they heard that the canals were dug by one of the Litungas though they could not specifically say which one and the year the canal was dug. All the villages along the Musiyamo canal are involved in the clearing of their part of the canal. The people reported using the canal for bathing, washing clothes, irrigation, watering cattle and fishing with baskets.

The community would willingly participate in the clearing of the Musiyamo canal if the government provided incentives. Some of them hoped dredgers will be used so that a good depth is attained and ensure the dredged sand and silt were not left on the canal edges but spread a distance away. Most villagers reported that they have heard that in some parts of Zambia, they have such dredgers that are able to dredge sand some fifty or more meters away from the canals.

The community noted that they expect to have good harvests on rice because their fields will have no more floods once they are cleared properly. In terms of maintaining the canal they noted that it is important that the BRE is closely involved as they can supervise the clearing after the government deepens the canals. The BRE can lead the people in cleaning the canals.

It was reported that the most important usage of the Musiyamo canal are interception of water from the uplands, drainage, watering livestock, transportation and irrigation.

Women in the village reported that woke up at around 05.00 hours every day and they go to bed between 20.00 hours and 22.00 hours depending on the household chores they want to complete on that particular day. The women complained that lack of clean water and poor sanitation were big constraints along all the villages on the Musiyamo canal. During the rainy season, people resort to using the bush. They have persistent diarrhea with young children being adversely affected. Few homesteads and villages have protected wells. Most of the houses along the Musiyamo canal are made out of pole and mud while toilets are made of reeds. Clinics and schools are all located on the uplands in Limulunga and children walk 5-10 Kilometre distances to access these.

The youth reported that they have no intentions of leaving the villages as these are their ancestral homes and would love to live along the Musiyamo canal like their parents have done. However, they need good facilities to make their stay easy. They also noted that population along the canal is increasing a bit.

Women complained that their workloads were too heavy. There were no women clubs through which they can access empowerment schemes or indeed promotetheir development agenda. On the contrary, women around Limulunga have women clubs and are able to access inputs for farming.

The communities along the Musiyamo see the challenge in the area as being poor toilets and housing.

- ▶ Scoping meeting at **Sikuyu Village** along the Musyamo Canal, 27<sup>th</sup> November 2013

- ▶ Present from NIRAS: Mr. Charles Chileya (NIRAS) and Mr. Mubiana Muliokela (Interpreter and Research Assistant)
- ▶ Community Members present: confidential

In his introductory remarks, Mr. Charles Chileya informed the community that time and again projects in most parts of the country failed to materialize due to Government's poor logistics and sensitization. There is a general feeling that Government has always developed cold feet on projects implemented in most parts of the country. It is for this reason, that the Government of the Republic of Zambia has engaged BRL of and NIRAs of Zambia to undertake this Environmental and Social Impact Study (ESIA) to try to change the picture and get to the grass root beneficiaries before the project starts. Mr Chileya went on to encourage the people present to be as open as possible as the meeting had no structured questionnaire.

The Chairman of the meeting from the village thanked the group for the initiative and hoped that the discussions were going to be fruitful as the meeting affected the rehabilitation of the Musyamo canal which was one of the important assets the local villages depended on for most of their basic needs.

Discussions yielded the following information: most people had heard about the proposed canal rehabilitation project, people knew something about the history of canals in the floodplain, that successive Lozi kings constructed the canals using compulsory labour mobilized within the kingdom, and that people living along the canal are involved in canal maintenance. They revealed that the main uses of the Musyamo canal were bathing, washing clothes, irrigating gardens, watering cattle and fishing with baskets.

The community would willingly participate in the clearing of the Musyamo canal if the government provided incentives. Some of them hoped dredgers will be used so that a good depth is obtained and ensure the dredged sand and silt were not left on the canal edges but spread a distance away. Most villagers reported that they have heard that in some parts of Zambia, they have such dredgers that are able to dredge sand some fifty or more meters away from the canals.

The community mentioned that they expected to realize good rice harvests after the canal's rehabilitation as it will be easier to control floods. As for canal maintenance, most people were of the view that they needed to participate as it was for their own benefit. They were also of the view that the traditional leadership together with the BRE be responsible for canal maintenance after rehabilitation. They revealed that the Musyamo canal is mainly used to intercept surface water from the uplands, drainage of the plain edge, watering livestock, transportation and irrigation.

Women in the village reported that they woke up around 05.00 hours every day and they go to bed between 20.00 hours and 22.00 hours depending on the amount of household chores to be completed on a particular day. People complained that lack of clean water and poor sanitation were big constraints in all the villages along the Musyamo canal. During the rainy season, people resort to using the bush as toilets. They have persistent diarrhea with young children the worst affected. Few homesteads and villages have protected wells. Most of the houses along the Musyamo canal are made out of pole and mud while toilets are made of reeds. Clinics and schools are all located on the uplands in Limulunga and children walk 5-10 Kilometre distances to access these.

Most of the youth in the area do not intend to leave as they consider it their ancestral home and would love to continue living along the Musyamo canal like their parents. However, they were quick to point out that there was need for good social facilities to make life in the floodplain more bearable. They also noted that population along the canal is increasing a bit.

Women complained that their workloads were too heavy. There were no women clubs in floodplain villages, which could help them to access much needed empowerment resources to raise their economic status. On the contrary, women around Limulunga have women clubs and are able to access inputs for farming. Poor housing is another challenge observed among the majority of households along the Musyamo canal

- ▶ Scoping meeting held at **Namboata Village** (central place) and included Nasisholo, Kembu and Nakalenge villages, along the Musyamo Canal around the Namushakende Farmer Training Centre, 1<sup>st</sup> February 2014
- ▶ Mr. Christoph Navitel (BRLi) and Charles Kapekele Chileya (NIRAS Zambia), Mr. Mubiana Muliokela (Research Assistant for NIRAS) and Mr. G. Sitali, Camp Extension Officer
- ▶ Community Members present: confidential

The meeting opened with a prayer from one of the participants. Thereafter, Mr. Charles Kapekele Chileya went on to explain the purpose of their visit and thanked the people for having assembled to meet and discuss the proposed canal rehabilitation. He urged people to feel free and raise pertinent issues that can help the rehabilitation of the six priority major canals in the Barotse Flood Plain under the PPCR project implemented by the Ministry of Finance and National Planning.

The meeting noted that they heard about the rehabilitation of the canals through the radio during the time the Minister of Finance came to Mongu early in 2013 to sign a loan with the World Bank representative for the rehabilitation of the canals. They went further to argue that they recently saw surveyors measuring the width and length of the canals in the area. They also knew from their history that King Lewanika was the first Litunga to initiate construction of canals for draining the land in order for people to cultivate crops in the flood plain. It did work well during the reign of Litunga Lewanika as productivity increased and cultivated area expanded. People present also remembered that the Musyamo canal was last rehabilitated in 1970 by government. The people who participated in the rehabilitation exercise were paid cash or given food. This spirit has made everyone expect to be paid something for any work done.

The people use the canal as a source of water for irrigating vegetables, soaking cassava, drinking water, bathing, watering livestock and transportation. The meeting also revealed that there was no burial site along the canal that might affect rehabilitation works. It was further observed that 100% of the total inhabitants obtain their livelihoods from the canal in the four villages we interviewed during the scoping meeting. The communities only cleared the portions of the canal where they bath and soak their cassava. There is no coordinated clearing of the canal now. Each village does what they feel is important to their benefit.

During canal rehabilitation, people are expecting to be employed as a way of deriving tangible benefits from the project. Some sections of Musyamo canal have mud and may require the use of dredging machines. These sections are at Nasisholo, Kembu, Namakomena and Namakeka Villages. These villages have muddy soils that are difficult to work using hand tools.

However, local people at a fee should clear some parts of the canal by hand, as they are not willing to provide free labour. They would like to work for cash and thereafter continue to maintain the canals without being paid.

The people proposed that necessary tools be provided to the Disaster Management Committee at local level, which coordinates development projects on the ground. The DMMU satellite committee in the four villages was reportedly very hard working and tends to have the capacity to mobilize the people in conjunction with the BRE without problems.

Women in the villages interviewed like in most parts of the Barotse Flood Plain have heavy work loads. They wake up around 05.00 hours and set off for the upland fields (Matema) fields until about 13.00 hours when they return to prepare lunch and rest a while. About 15:00 hours they again set off for the flood plain gardens (Sitapa) where they work until 18.00 hours when they return home to prepare supper for the family. They continue with other household chores until they retire to bed around 21.00 hours every day.

Women reported that apart from their heavy workload, they also face other challenges, which affect their lives. People reported that Open Defecation was a normal practice in many households. During the rainy season, all the human and animal wastes in the area are washed into the Musyamo canal contaminating the water and resulting in high incidences of diarrhea. The incidence of malaria is high due to stagnant water in the Musyamo canal. The high rates of morbidity experienced in the area impact the girl child she is required to stay at home to take care of the sick and perform household tasks.

Women were also worried at the high rates of illicit beer drinking among males. This not only poses a danger to the health but also to labour availability and productivity. There are no permanent bridges across the Musyamo and women reported that they find it difficult to cross the makeshift bridges as they go to the fields in the plain. It is the wish of the people that when the rehabilitation of the canals is being done, consideration should be made to construct bridges across the canal.

The issue of orphans came up as one of the new challenge affecting women-headed households as they have additional responsibility to look after children left behind by sons and daughters who die from HIV/AIDS-related illnesses.

Populations seem to be increasing in the villages visited during the scoping meetings. Young men and women are not migrating due to lack of employment opportunities in the urban areas. Some young men confessed during the meeting that they had attempted to go to look for jobs in the towns and returned without success.

On the land tenure system, community members mentioned that land for settlement is available although there are a few incidences of people renting some small pieces of fertile land on mounds (Mazulus) and Sitapas at relatively high fees. On average, one can rent an acre of land on a Lizulu for at ZMW 300 per year. The practice of renting is not common on the upland due to its infertile status. In general, the Litunga owns the land on behalf of the people and everyone has access to it.

The walking distance to the nearest school is one hour thirty minutes (90 minutes) which translates into 3-4 Kilometers. The nearest school is Liunga Basic School located between the villages interviewed and Namushakende Farmers Training Centre. The nearest clinics are Namushakende Rural Health Center, about 5 Kilometers to the south and Sefula Rural Health Center, 7 Kilometers to the North.

► Scoping meeting at **Situlu Village** along the Musyamo canal, 29<sup>th</sup> November 2013

**In attendance were Mr. Charles Kapekele Chileya and Mr. Mubiana Muliokela from NIRAS Zambia who were facilitating the scoping meeting in Situlu village.**

Mr. Charles Kapekele Chileya started by introducing his team which included Mr. Mubiana Muliokela and Maimbolwa Mukelebai who were acting as Guide and Interpreter respectively to the Socio-Economic Team of the BRL of France and NIRAS Zambia Limited.

The people reported that they were not aware of the project on the rehabilitation of the canal. As to the history of canals in the Barotse Flood Plain, they acknowledged the fact that King Lewanika initiated the construction of canals for the purposes of reclaiming land for farming in the 1890s. Since the Litunga built the canals, most Lozi people have been involved in maintaining them. The King is known to have used compulsory labour. Village headmen were required to mobilize subjects to clear their portions of the canals and if this was not done the whole village was punished.

In addition, any husband who fought his wife or anyone who formented trouble in the community was punished by working on the canal under the supervision of a Kapaso (Chief's retainer).

After independence, the government of the United National Independence Party (UNIP) abolished the system of compulsory labour. The new government established a Ministry responsible for Water Affairs, which took over the functions of maintaining the canals through wage labour. This continued for sometime until the government started to fail in financing canal clearing and in recent times the responsibility was transferred to the Office of the Vice President's Disaster Management and Mitigation Unit (DMMU). Through Food For Work Programme the DMMU has been able to maintain important canals occasionally.

Other institutions such as Non Governmental Organisations (NGOs) have come into the clearing and cleaning of the canals through food for work programmes. Notable among these has been Concern Worldwide International.

The people mentioned that there was another canal called Nonge that flows into the Musyamo canal. They considered Nonge as an important canal that should be considered for rehabilitation, too. Nonge flows into the Luena River and there it becomes Mapuwa. They also mentioned that Lubitamei originates from Nonge and flows into the Zambezi River at Mbanikelako. Mbanikelako is home to a village called "Ilalamupa", believed to have been established by King Lewanika as a winter capital.

People reported that they used Musyamo canal as a source of drinking water, washing, irrigating winter maize and vegetable gardens as well rice fields. There are no sites of cultural importance along that can hinder rehabilitation works. They all reported that 100% of the people living in the village depend on the Musyamo for their livelihoods.

When the rehabilitation starts, the local people expect to get some employment from the project. They also foresee that the Musyamo will have fast flowing water and will also contribute to more land for farming being drained and there by increasing agricultural productivity in the village. Fishing will be more in the village as the water will be flowing from very far. Bridges should be rebuilt for animals and human beings to cross to the flood plain for grazing and farming respectively.

They propose that the Musyamo be worked on by the local people using appropriate tools. However, the project should describe the depths and width for the local people to follow when rehabilitating the Musyamo. There are some portions of the Musyamo that need to be rehabilitated with machinery. There are places which has mud and sand and this needs machinery to open them up. The local people would not do the rehabilitation for free but they should be paid by the project and in future, the modalities for voluntary cleaning and clearing will be agreed upon by the BRE and the local people. For this reason, the BRE ought to be part and parcel of the planning process for the rehabilitation of the Musyamo canal., The NGOs working on the canals in Barotse Flood Plain is engaging people through food for work.

On the women's work load, the women present noted that their work loads were too heavy in the village. Their daily work start as early as 05.00 hours when they set off for the field. Come back around 13.00 hours and prepare lunch for the homestead. Rest a bit and then go back for round 2 around 15.00 hours and return back to the village around 18.00 hours to start to make arrangements for supper. They retire to bed between 20.00 to 22 hours depending on the work they have to do in the evening. Women thought that there is need to introduce some technologies such as hammer mills to lessen the burden of pounding cassava for example.

The problem was more so for the female headed households who are not in a position to cultivate big portion of land but small portions which give them very little harvests.

There are no women associations in the area except for the women Christian fellowship which meets to discuss Bible study as opposed to development issues in the area.

They also complained of the challenges they face. There are no safe water points where to draw water for their homesteads. They get water from the blocked Musyamo canal or the scoop wells that they dug along the canal. The animals, cattle, pigs and dogs use these water sources.

Due to the poor water they drink, there is a lot of malaria and diarrheal in the village. Pitlatrines are not in existence. All they have are small pits built with grass and not permanently thatched. With the onset of rains, these toilets are easily sub merged in water and causes problems to the health status of the people in the village.

The other problem was the long distances to the nearest schools and clinic. The nearest school of the Catholic school, Mupatu in St. Lawrence Mission which is 5 kilometers away from Situlu village. The clinic is about 6 kilometers. Maternity problems frequently occur due to the long distances to the nearest clinic.

The problem of the lack of rice market was reported by both men and women in the meeting. There are no oxcarts for transportation of the produce to the nearest town markets like Mongu.

The population is increasing and a few young men are migrating to the near by towns of Mongu, Senanga and Kaoma to look for employment opportunity. These are few in numbers as most young men are still in the village. It was also reported that most people at the age of 20 are married and have started producing children.

The housing is in bad state. The houses are built of grass-thatched houses. A few well to do households have iron sheets on the roofs but these are few and countable.

On the land tenure they are of the view, that land is owned by the Mulena on behalf of the local people. The people can ask for land to be allocated to them through the local Silalo Induna and this is not a big problem. Once land is allocated to someone, nobody can grab it from that person. The children will come to inherit their parent's land upon the demise of the head of household and it is the first borne child who takes over and distributes the land to the other siblings in the same family.

"The land issue in the Barotse Flood Plain is straight forward we all have own lands left by our fore fathers and know the boundarie, we only lack the equipment to till the land in the plain as our soils are very hard and sandy"... said one woman in the audience

- ▶ Scoping Meeting at Mikuyu Village along the Musyamo Canal on the 30<sup>th</sup> November 2013
- ▶ Mr. Charles Kapekele Chileya, Mr. Mubiana Muliokela from NIRAS Zambia as consultants.

The meeting opened with a prayer from one of the participants. After the prayer, Mr. Charles Kapekele Chileya explained the purpose of the gathering to enable participants feel comfortable when presenting issues and putting up points. He reminded the participants that there are no correct or wrong answers and no name will be mentioned in the paper as to who said what during the discussions. He ended his introduction by giving the synopsis of the objectives of the canal rehabilitation project in the area being implemented by the Zambian government through the PPCR Secretariat in the Ministry of Finance and National Planning.

The meeting acknowledged knowing about the project. However, they were not aware of the history of canals in the Barotse Flood Plain as they are all young people who have just inherited the land from their dead parents.

They reported having been involved in the clearing of the Musyamo canal in the recent past through the food for work programme. They were engaged to work on the canal in exchange for maize, beans and cooking oil by the Vice President's Office Disaster Management and Mitigation Unit (DMMU). They were using shovels and hoes to clear the Musyamo canal.

They are using the Musyamo canal for draining purposes, fishing, bathing, soaking cassava, watering crops for the vegetable gardens, water for animals and transportation. However, the major livelihood is farming among almost all households and this represents 100% of the people using the Musyamo for their livelihood.

The meeting noted that during the rehabilitation of the Musyamo canal, it is imperative that bridges are provided for to make ease crossing for the people and the livestock. Most important is the fact that there is need to stop people blocking the Musyamo through fish traps in order to catch fish. The *malelo* type of fishing is blocking the flow of water in the Musyamo canal.

People in the village would not clear the canals for free. They expect to be paid for clearing the canals. They also expect employment from the rehabilitation exercise. They also expect that the government will have the plan to support the clearing of the Musyamo canal on a more permanent basis as compared to now when only the Musyamo has received great attention may be due its political plays it has in the country's tourism calendar. They proposed that the Musyamo canal should be rehabilitated by the local people using the tools they have used before and not big machines. There may be portions that are blocked where a caterpillar can be used but on the whole the local people should clear the canal. Except that they need to be told of the width and the depth they should dig by the Engineers from Maritime Department at the Mongu Harbour. It was reported that there no cultural nor burial sites on the Musyamo Canal that can hinder the clearing of the canal.

It was emphasized that there is need for the project to involve the BRE from the beginning so that the future clearing of the canals is planned in each village with the local Silao Indunas. The project should understand that in Western Province, the BRE plays a fundamental role in sustaining development.

On the gender aspects, it was reported that women in Mikuyu village start their day around 05.00 hours every day. At 06.00 hours they set off for the field. This is after having done some household chores like cleaning the surrounding, fetching water for drinking and cooking when they return back from the field in the afternoon. They return around 13.00 hours to organize the lunch and rest a bit and then go back to the fields around 15.00 hours. They return from the field around 18.00 hours to start making supper. They go to bed between 21.00 and 22.00 hours.

Women mainly obtain their revenue from sale of vegetables as the sale of rice and cattle are dominated by the men in the area. The women also pointed that there is no transport to the field and during the floods they drink contaminated water due to the lack of protected water wells in the village. It becomes practically impossible for the people to do agricultural work as the fields are normally flooded.

On the population trend, it was noted that population is increasing. Many youths are doing nothing and they see children production as one of the tasks they perform in the village. The youth have no intentions of going to towns to look for jobs as they have already failed to get the jobs in the neighbouring Mongu township.

Their houses are constructed of mud, wooden poles and grass-thatched. There are no toilets but temporary pitlatrines. When it rains, these pitlatrines collapse and their faecal contents washed away into the Musyamo canal. This means that people drink contaminated water contributing to the high incidences of diarrhea. To attain a semblance of normality, people in the area need improved housing and sanitation facilities.

The nearest school is the Community School at Isambai 2 kilometers away. The people mentioned that Isambai School is just a Community School built by the Villages and has just received four teachers recently. The people then have to send their children for upper primary school to Ushaa which is 9 Kilometers away. The children in the final analysis drop off after grade 4 as they are not willing to move 18 Kilometers every day from grade 5 to 9 until they are selected to go to Senior Secondary School. Ushaa is a Basic school up to grade 9. The people wished that the government will consider building a Basic School at Isambai and a Rural Health facility.

On land tenure, they are understand the present condition that is generally accepted that land belongs to the Litunga and it is the Litunga who has assigned his Indunas to distribut the land to the subjects through the Silalo Indunas. According to them, it is within the realms, traditions that no Lozi can be land less, and hence the reason why the Litunga would not issue a 99 year lease to any person. Land is owned by the Litunga in behalf of the people and families arelocated land that they can use permanently during their lives and after their death their children would inherit the land.

## MUYOWAMO CANAL

- ▶ Scoping meeting held at **Ikakuyu Village** along the Muoyowamo Canal
- ▶ Present from NIRAS: Mr. Charles Chiley, Mr. Mubiana Muliokela
- ▶ Community Members present: confidential

After personal introductions led by Mr. Charles Chiley, the group went straight into discussions and noted that every member of the village present was aware of the proposed canal rehabilitation project. The local Councilor had been mentioning it to the people in his Ward. The community also knew something about the Muoyowamo canal as it is the canal used every year by the Litunga during the Kuomboka ceremony and it is one of the most important canals as it attracts tourists to the Western Province. None of the community members remembered the year when it was dug but only reported that from the oral tales by the old people, that it was constructed by one Litunga who had a vision of draining the Barotse Floodplain for promoting agriculture and controlling the floods and that it was dug using compulsory labour.

The government does the dredging of the canal with cash contribution sometimes with the participation of the local people especially just before the Kuomboka ceremony. All the villages living along this canal are mobilized by the local Indunas to help out in the clearing and the BRE plays a very significant role in the mobilization of the village headmen. The BRE punishes villages with monetary fines if absent. The community living along the Muoyowamo thought that the BRE has a lot of influence if well involved in mobilizing local people. It was felt that given its political connections, Muoyowamo is one of the few canals that is well maintained by both the government and the BRE.

During the meeting it was noted that every household living around the canal depended on it and, therefore, has a special position to the lives of the people. Muoyowamo canal connects Limulunga and Lealui, the two most important villages in Barotseland. The people were also of the view that the government needed to hire someone with proper equipment to dredge the canal as the current professionals, Maritime Department is using very basic Excavators from Finland called Water Master which throws the dredged soil and silt just a few meters from the edge of which materials are washed back when it rains. “we would like the government to stop using old equipment they are using to clear our canal during Kuomboka....” One woman from Likomokelo Village contributed. The meeting agreed that thereafter, the community will have it easy to clear the canal as all the sand will never come back to the canal. The government should engage the local people when selecting the machines to dredge the canals. “We in Barotseland, we are very educated and we know that equipment from Continental Europe is stronger than the Scandinavian countries when it comes to dredging. When I worked under KK, he would never allow to import excavators as dredgers. It is new Governments of MMD and PF that can allow the excavators. I worked at Mulambwa Harbour for twenty years.” said the Village Headman, who happened to be a retired civil servant during the first republic of Kenneth Kaunda in the Ministry of Transport and Communication.

The meeting gave the chance to the women present to answer questions related to the women. One woman stood up and said “Women are forced to wake up as early 4 or 5 am every day in order to start sweeping their household surroundings. They leave their spouses sleeping as their job during this time is to just plough tracks of land for us with their oxen and leave us with our babies at the back to break the clods. We sometimes go back to the fields in order to finish preparing the land quickly before the onset of rains.”

Others verified this statement that showed a heavier workload for women in the villages around the Muoyowamo canal. The women noted that there are some women clubs and women associations in the area but they are concentrated in Limulunga and Lealui only. Women also reported that they are also involved in canal clearing. They use cycles to cut the grass while their men use shovels and picks to remove the sand. Women and children use the canal for fishing with baskets.

The meeting noted that the population was increasing in the area and attributed this to people not practicing family planning. On migration, they noted that there are very few young men leaving the Floodplain except those going to colleges and universities. Muoyowamo has three basic schools; one in Lealui and three in Limulunga and the distances to schools and clinics in both Lealui and Limulunga is about 5 kilometers.

The major problems they have are the poor state of toilets and poor housing made out of mud and pole.

There being no other business to discuss, the meeting ended at 15.30 hours and Mr. Charles Chileya thanked the community for their contribution and wished them good luck as the project starts to uplift their life styles in the Barotse Flood Plain.

- ▶ **Nalutimbo and Nateo villages** scoping meeting, 30th January 2014, along Ikwichi/Namitome/Muoyowamo canal
- ▶ The scoping meeting was held at Nalutimbo for the two villages along the plain edge of the Muoyowamo. Ikwichi area is located along the Namitome canal that passes behind the Moombo Hill and flows into the Muoyowamo canal near Limulunga. Besides the visiting consulting team, there were 22 people in attendance

Mr Chileya began the meeting by introducing himself and members of his team members before explaining the purpose of their visit to the area. He urged the people to feel at liberty as they deliberate and informed them that all responses from the deliberations were going to be taken note of, but that no one was going to be quoted by name. Mr. Konoso Konoso, who chaired the meeting, also welcomed Mr. Chileya and his team on behalf of the Silalo Induna.

The majority of people in attendance were aware of the proposed canal rehabilitation project. The Village Headman had even been present at the project signing ceremony held in Mongu.

According to community members, the history of canals in the Barotse Floodplain is traced back to the reign of the famous Lozi King, Lewanika, in the late 19th century when he first constructed Namitome canal that led to his Mushati Farm where he grew sugar cane. Mushati is the Lozi name for sugarcane. In order to ensure the Nalikwanda barge was not stuck during the Kuomboka, he diverted floodwaters from upstreams into the Muoyowamo canal using the Namitome canal. The Nalikwanda was a big boat used by the King during Kuomboka. The construction of the Namitome canal resulted in the draining of large tracks of fertile land that became available for agriculture purposes.

Regarding the methods to be employed in the proposed rehabilitation, the community suggested that heavy machinery be used because there is too much sand that has been deposited over the years and that this method would be more effective and efficient.

With respect to canal maintenance, the people reported that past kings organized people in villages to clear the portion of the canal that fell within their village boundary and that it was mandatory and anyone failing to do the needful would be punished if reported. Most people were obliged to do the king's bidding because punishment was usually a fine of one cow. The community revealed that the system worked well as the King's Induna responsible for canals would physically supervise the clearing and take a written report to the King. After independence, the new government took over the responsibility of canal maintenance using paid labour and this approach destroyed the old system of using free labour that King Lewanika had established.

People recalled that Namitome canal was last cleared in 1968. After 1991, the new Movement for Multi Party Democracy-led government introduced the food-for-work approach to rehabilitate canals. This did not promote community responsibility as well, because people were still being paid for clearing their own canals.

The discussion further revealed that construction of canals led to draining of inundated lands and this contributed to increased agricultural output in the floodplain at the time.

People in the area grow rice, maize, vegetables, sweet potatoes, mangoes, sugar cane, quavas, bananas, pineapples, oranges, tangerines, bambaranuts and cowpeas. Cattle, goats and pig rearing is another source of livelihood. Cassava in the area is prone to Cassava Mosaic Virus (Nyamomboto). Maize yields were reportedly low and this could be because of lack of fertilizers and improved seed. The major sources of household income are beer brewing, charcoal burning, selling construction poles, rice trading and selling vegetables. TCharcoal and poles are transported by ox-cart to Limulunga and Mongu for sale.

People in the area use the canal as a source of domestic water, for bathing, washing clothes and watering livestock. The canal has no sites of cultural importance along its course. The discussion revealed that all the inhabitants in the area depend on the canal for their livelihood.

There are no protected water wells in the area and many households do not have improved toilets. The poor sanitation is made even worse by the collapse of pit latrines during the rainy season because of the sandy nature of soils.

The people in the area expect that the rehabilitation of canals will provide employment to the locals, increase farmland, make it possible to make fishponds and improve their standard of living. They also expect a proper bridge to be constructed at Ikwichi.

The meeting recommended that the canal be rehabilitated using machines as some portions of the canal are hard and cannot be deepened using hand tools. They also proposed that after major rehabilitation, local headmen (Silalo Indunas) should be in the forefront of mobilizing people in maintaining the canal for free, and that the government empower communities with necessary tools like shovels, sickles, slashers and wheel barrows.

Women in the area wake up around 05:00 hours and begin the day by sweeping their homesteads before leaving for the upland fields by 06:00 hours. They usually return home about 13:00 hours to prepare for lunch. After 15:00 hours, they leave for the saana fields where they work until about 17:00 hours. Upon returning home, they start preparing for supper which is normally eaten around 19:00 hours. Most of them reported retiring to bed between 20:00 and 21:00 hours.

There are no women groups or associations in the area.

On the other hand, men reported waking up between 05:00 and 06:00 hours and beginning their day by going to the Saana fields where they work up to about 10:00 hours returning home to rest and wait for lunch. They go back to the field or go to milk cows around 15:00 hours knocking off about 18:00 hours. Men usually went to bed around 21:00 hours.

A few young people are moving out of the area to urban centers in search of jobs particularly those that successfully complete Grade 12, otherwise most young men remained in the villages and continue to eke out what they could to survive.

There is a health facility in the area and furthest village from the clinic is about 5 kilometers. The nearest school is at Mombo, about 7 Kilometers away.

The major challenges identified during the meeting were flooding of rice and maize fields (which results in low yields and food insecurity) and lack of access to safe water supplies.

With respect to land tenure, the area's inhabitants were faced with a big dilemma; the land they are occupying belongs to a surviving princess (Mukwae) of one of the late kings. The people living here have access to regulated portions of the land but have no control over it. It would appear that people are not happy with this status quo, as they feel that they are caretakers only.

- ▶ **Scoping meeting for Katoya and Nandopu Villages** on 29<sup>th</sup> November 2013 along the Muoyowamo Canal
- ▶ The two villages came together at a central location for the scoping meeting. In attendance were Charles Chewe and Mubiana Muliokela from NIRAs Zambia

Mr. Chewe explained the purpose of the team's visit, encouraged the people to contribute freely and that the meeting was important as it afforded the people an opportunity to bring out any issues about the proposed canal rehabilitation as it affected them.

People reported that the major crops grown along the Muoyowamo canal in the area were rice (Supa variety), maize, pumpkins, sugarcane, cassava and sweet potatoes.

Many of the elderly people said that they knew about the history of canals in Barotseland Flood Plain, that King Lewanika was behind their construction with the purpose of increasing food production through reclamation of arable land by draining the floodplain.

People revealed that the Barote Royal Establishment currently supervises the annual maintenance of the Muoyowamo canal before the Kuomboka Ceremony by people living along the canal and those villages that fail to participate are charged. It would appear that this is the only canal where people provide free labour during its maintenance. The government was reportedly carrying out annual maintenance works on the canal before the Kuomboka Ceremony, too. Consultants also heard that there is another canal called Nonge that comes out of the Muoyowamo that needs rehabilitation as well. This canal links the Barotse Floodplain with the Luena flats, where it is known as Mupuwa canal. The local people in the area contended that the Lubitamei canal originates from Nonge and exits into the Zambezi River at Mbanikelako. Nonge canal is reputed to have 25 villages along its course.

The meeting revealed that there is an important village for the Litunga called "Ilalamupa", which village was like a winter capital during the reign of King Lewanika.

Inhabitants listed the main uses of the Muoyowamo canal as being farming, transportation of goods, the Kuomboka Ceremony (tourism use), watering cattle, source of drinking water, bathing and laundry, washing utensils, fishing and soaking cassava. The people also reported that rice fields adjacent to the Muoyowamo canal normally have good yields in normal rain years.

The water and sanitation situation in settlements along the Muoyowamo canal is relatively bad for the majority households. The homes in these settlements are made of mud and reeds with grass-thatched roofs. Pitlatrines predominate and are prone to submergence during floods. This poses a great challenge in terms of hygiene and safe water supply. A few well-to-do households have good permanent houses with improved toilets. People said that it was common for those living in temporary housing structures to be visited by crocodiles and snakes during floods.

There was one protected well constructed by OXFAM in the area and it was said to be about 1 kilometer from the furthest village.

The daily calendar for women in the area begins at about 05.00 hours when they wake up, make a fire, and prepare breakfast if any, sweep the house and surroundings, then go to the Sitapa or Saana fields. They return home between 13.00 and 14.00 hours to prepare lunch and a brief rest before going back to the field around 15.00 hours to knock off about 17.00 hours. When they get home they go to bath and draw water then begin to prepare supper for the family retiring by 21:00 hours. The nearest school and clinic are in Limulunga, about 5 kilometers away. The distance poses a great challenge to young school-going children who have to make the return journey for five consecutive days each week. There is also another school at Mupatu another 5 Kilometers away.

During the flooding period, scoop holes where most villagers draw water for drinking and cooking become contaminated forcing girl children to walk the long distance to the nearby school to fetch. Many girls in the area drop out of school or fail to make it to secondary level. The consultants also discovered during the meeting that household chores contributed to the poor performance at school among girls second only to illness that was a major reason for absenteeism.

Though the men could not agree to the allegations that most of them prefer to send the boy child to school because education for the girl child is perceived as preparation for marriage. This was a debatable issue and women and men would not accept to be the proponents of the stigma. We ended up to the accusations only. There might be some truth looking at the number of young women married in the group.

There is a women's club in the area although few women were members. Women are involved in clearing the canal, mainly removing siltation materials and grass dug by the men.

Women complained that the 6 Km distance to the nearby health facility was a challenge in times of sickness and maternity cases and looked forward to a health facility being established within easy reach or mobile health services introduced in the area.

The people in attendance expect to be employment during the canal's rehabilitation. They suggested that the canal be dredged with proper machinery that can throw the silt and sand far from the canal to prevent their being washed back into the canal during flooding. Some of the people also voiced concern over the practice of fishing using Malelo (Fish traps made by blocking water flow) and called for their discouragement.

The people revealed that the population in the area was increasing as attested by the large number of children. Consultants noted that youths who successfully graduated from local schools, usually left the village to pursue further education in nearby Limulunga, Mongu, Lusaka and the Copperbelt Provinces. It was also reported that there are plenty of early marriages that contributed to the population increase

- ▶ Scoping meeting held at **Muchumbu Village** involving Nanjeko, Kandiyana, Kazauli, Kasibi, Kabula, Mabuto, Litongo, Katongo and Libula Villages along the junction of the Namitome and Muoyowamo canals, 30<sup>th</sup> January 2014

**The village headmen agreed to the scoping meeting being held at Muchumbu village. In attendance were Christoph Navitel from BRL France, Charles Kapekele Chileya and Mubian Muliokela from NIRAs Zambia**, Mr. Mumbuna Mumbuna, the headman, opened the meeting with an apology to the consultants for having brought all the participants together as the villages were too small to be visited singly. He hoped the measure would prove convenient to everybody. Mr. Chileya thanked the Village Headman for having made the consultant's job easier by bringing all participants to one place. He told the gathering that they had come to discuss the proposed canal rehabilitation project in the Barotse Floodplain especially their expectations and potential roles.

Many of the participants acknowledged hearing about the proposed canal rehabilitation project on the local radio station and that they knew something about the history on the canals in their area. According to the local people, the first canal to be constructed in the area was Sefula followed by Namitome and thereafter Nangula, which is also known as Lubitamei. Some elders at the meeting pointed out that the Lubitamei canal is called by different names along its course.

Long after the death of King Lewanika, maintenance of canals in the Barotse Floodplain continued to be undertaken by local people under the supervision of the BRE. History has it that after Independence in 1964, the rehabilitation of canals became the responsibility of the Department of Water Affairs who employed paid labour force for the exercise. Elders in attendance recalled that the last time the canal was rehabilitated using voluntary labour was in 1968.

People use canals for irrigating winter crops, as a source of domestic water, bathing, washing clothes, fishing and soaking cassava.

The meeting noted that the majority of the inhabitants depended on the canal for their subsistence with livelihoods closely associated with the canals. The main sources of livelihood in the area include charcoal burning, cattle rearing and beer brewing.

The inhabitants of Ikwichi area were of the view that their involvement in canal rehabilitation should be at a cost as has always been the case after the abolition of compulsory labour.

The communities expect that the project will create employment opportunities for the youth and other able-bodied persons from the area, increase cultivatable land through draining, result in clean water flow and increased water supply during the dry season. With water flowing in the canals, the people expect the breeding of mosquitoes to reduce with an associated reduction in the incidence of malaria, bilharzia, trachoma, ringworms, intestinal worms and skin rashes.

Some people have proposed that Ikwichi Bridge be rebuilt and expanded during the rehabilitation of the Lubitamei canal. They contend that this will allow maximum flow of water from the uplands.

The majority of people in the area live in houses made of reeds, mud, poles with thatch grass. Some households in the area have pitlatrines made of grass while others have none.

Like other womenfolk in the floodplain, the women in this area have similar daily routines that begin around 05:00 hours and end at about 20:00-21:00 hours.

Some of the constraints the gathering cited include long distances to schools and health facilities, lack of safe water sources, burden of keeping orphans, malaria and water borne diseases. According to women, there are no women clubs or associations in the area. The nearest primary school is at Mombo, 7 Km away. Accessibility to the school and health facility is usually poor during the rainy season because the roads get flooded. Parents reported that children most often absent themselves from school during this period. This situation may be one of the main contributing factors to the observed high rate of school drop out.

Discussions also revealed that the land tenure system prevailing in the area does not favour the people because a princess owns most of the arable land. People have access to portions of it but have no control over it. There were sentiments that they were not happy with the arrangement because other people in the Barotse Floodplain have access to land for guaranteed long period.

- ▶ Scoping Meeting at **Natwale Village** along the Muoyowamo Canal, 29<sup>th</sup> November 2013
- ▶ Present were Mr. Charles Chewe and Mubiana Muliokela from NIRAS Zambia The meeting started with a prayer after which Mr. Chewe introduced himself and his colleague. He explained the purpose of their visit and urged people to answer the questions that he would be posed as earnestly as possible so that their views and expectation were captured. He also urged them to bring out any concerns and questions about the proposed canal rehabilitation project.

The community knew about the project and the historical background of the Muoyowamo canal. Besides the Kuomboka ceremony, they cited transportation of goods and building materials from Limulunga to Lealui, fishing, bathing, washing clothes, watering cattle, and irrigating such crops as vegetables, rice and winter maize as uses of the canal.

Many people admitted having participated on the clearing of the Muoyowamo canal for cash or food-for-work programme every year before the Kuomboka Ceremony. They also confirmed working on the canal for free sometimes as demanded by Induans and that those that avoid it are collectively punished as a village. Incidences of a Village Headman being fined a cow are common and because of the fine most people prefer to work than be fined.

The main crops grown in the area are maize (with MMV 441, MM 603, local as varieties), rice (with Supa, Xiang Zhou, kajaketi as varieties) and Angola. Rice is specifically grown as a cash crop in the village and it was reported to be the major income source for most households. "No one can eat rice and claim he has eaten a meal, maize and cassava are our Lozi staples" ...said one woman in the crowd.. A cattle rearing was reported to be the most important livelihood activity for the village as it brings in very high incomes in case of a sale or slaughter. It was noted the 100% of the population all use the Muyowamo for their livelihood in Natwale Village. In trying to rank the livelihoods they obtain from the Muyowamo canal, the people provided the following list:

1. Source of water for drinking in the homes
2. Fishing
3. Water for cattle
4. Kuomboka/transportation
5. Improved flow of water

Other livelihood sources mentioned in the meeting was ox cart hire, which at the moment cost K50 per trip for 60 Kg bag of paddy rice.

During the rehabilitation of the Muyowamo canal people are expecting to get employment. The Muyowamo will be cleaned and will have its water flowing into the Zambezi and thereby reducing the stagnance that is usually experienced around Limulunga and on the Junction of Nonge canal. The Muyowamo has only one cultural site at Leauli to allow the Lealui harbor to have the Nalikwanda pass through the canal during the Kuomboka. It is therefore important during the designing of the rehabilitation of the Muyowamo canal, this aspect is taken into consideration as the Nalikwanda starts off its journey from Leauli during Kuomboka and a provision of a good harbor at Leauli has to be considered by the designers.

It was reported that the nearest social facilities were 3 to 4 Kilometers in Limulunga for both schools and clinic.

Women in the village rise up at 05.00 hours and set off for their fields around 05.30 hours. They return back for lunch mid day at 12.00 hours. Do some domestic chores like fetching water and collecting of firewood to prepare lunch. It was noted that firewood is a big challenge in the plain. They sometimes depend on old mango trees that have been cut by their male counterparts. These mangoes are those that unproductive and have stopped bearing mangoes that are usually chopped as firewood in the village. Otherwise, it has to be collected from the uplands by the women themselves.

They go back to the fields after lunch after resting around 15.00 hours and return to the homestead around 17.00 hours in readiness for supper. They eat around 19.00 hours and go to bed between 21.00 and 22.00 hours. Apart from the heavy load of work, the women have challenges in the village as they have no clubs for women talking about development or indeed spearheading income generation projects for women. The women do not have pitlatrines and are forced to use the Open Defecation (OD). During the flooding, all the faecal materials are washed into the Muyowamo and people drink contaminated water thereby increasing the incidences of diarrhea diseases in the village.

Most of the houses in the area are typically constructed of reeds, mud and grass thatched. Nearly all the households in the area have pitlatrines that frequently collapse during the floods. Well-to-do households have improved permanent houses with corrugated iron sheet for the roof.

With respect to land tenure, participants felt the Lozi traditional land tenure system is good enough for every one has access to the floodplain. Asked if they see any constraints by not having a title deed to the land, the people responded by saying the issue of title deeds was not important to them. What was important to them was the provision of agricultural inputs at the right time and in correct amounts for the development of agriculture in the area.

They acknowledged that the population in the area was increasing and that young people seasonally migrate to the Zambia Sugar Company's Nakambala plantation in Mazabuka for cane cutting. The apparent lack of job opportunities in urban areas has provided incentives for many young people to remain in the villages.

#### LUBITAMEI CANAL

- ▶ Scoping meeting held at **Nalwela Village** on 30th November 2013
- ▶ In attendance: Charles Chewe from NIRAS Zambia, Maimbolwa Sitali NIRAS Zambia
- ▶ Community Members present :confidential

Mr. Charles Chewe started by introducing the purpose of the visit of the team from NIRAS Zambia in the village. Mr. Chewe encouraged participants to feel comfortable and discuss matters about the canal in question with free minds so that the team from NIRAS Zambia can learn and write the sentiments of the local people from Lubatamei canal.

The Induna Sisii who chaired the meeting was thankful to the team for having selected the Nalwela village for the study. The discussions started by agreeing that they had heard about the canals being rehabilitated from the radio when Honourable Alexander Chikwanda and the World Bank Resident representative in Zambia came to Mongu to sign and launch the project sometime this year. The community could not recall the exact month and date when this was. Through discussions, some recalled that the canal was rehabilitated sometime in 1968 from Nangula to Mombo. They also know that Lubatamei starts from Kate (the would be new district headquarters for the new Limulunga District) up to Mbanikelako close to the Zambezi river.

The community understood the history and that in the past it was being maintained by the local people themselves under the guidance of the Litunga and his council of elders the Indunas under the BRE. However, after independence in 1964, the new government started to manage and rehabilitated the canals and this gave the community the relieve to start working on the canals with cash bonuses from the government. Some people in the meeting noted that this was the beginning of the problem as people became lazy to work on the canals without being paid. This trend has continued and destroyed the local participation in canal clearing.

In answering the question as to what they were using the Lubatamei canal for, the answers were that the local people use the canal for fishing, drinking, poultry (local chickens and ducks) cattle rearing, bathing and washing clothes, transport and agriculture. The villages were reported to be heavily involved in gardening of vegetables along the Lubatamei. The community mentioned that the most important crops grown along the Lubatamei are rice (*supa variety*), sorghum (*Kuyuma*), Maize (*MM608*), Cassava (*Nalumino and Kapumba*).

The community is also aware of the fact that Lubatamei is an important feature for draining their land.

The community reported that there were no royal grave yards along the Lubatamei canal from Kate to Mbanikelako in the Barotse Flood Plain.

The community reckons and expects that during the rehabilitation, some form of temporal employment will be provided to the local people and people felt that there is no point of importing labour from outside Lubatamei canal during the rehabilitation. The community also noted that they will be willing to start the clearing the canals as long as the government helps us to deepen the canal as it has become very shallow with too much sand. The villages know the boundaries where they should be responsible for clearing, but this needs to be supported by the local Indunas and the entire BRE. The government also needs to do serious sensitization in order to get rid of the dependence syndrome that has been created by the government after independence.

The community expected to have the crop production, have more fish in the canal. The community expects that with the rehabilitation of the Lubatamei canal the community will have more incomes in their pockets with the increased agricultural production. The government should empower traditional authorities through headmen to oversee management and maintenance after the proper dredging by the project. The canal is too wide to be maintained by hand with the deep sands inundated in it.

On the issues of women, the entire women folk present noted that they are compelled to wake up between 04.00 and 05.00 am to start cleaning the surroundings to their homesteads after which they have to prepare for the journeys to the field around 06.00 hours for clearing the fields. Other duties they are engaged in are fetching water for the homestead before they set out to the fields. Their work load in a day goes for more than 12 hours at most. Women sleep around 20.00 and 21.00 hours in the Nalwela village and they thought similar situations are prevailing in the Barotse Flood Plain. One of the women highlighted in her contribution the major problems women faced in Nalwela Village as follows:

Female headed households are not able to afford the high fertilizer prices and do not belong to the Farmer Input Support Programme (FISP) as the collateral asked to join a club is K50 and thereafter one is expected to invest at least 50% for the cost of the input. The only prominent women group available is the Programme Against Malnutrition (PAM) group in the area.

Lubatamei has crafts such baskets and clothing materials for chairs in houses but has no market for the same.

Women do not have access to oxen as oxen under the Lozi culture and tradition are owned by the men. The lack of oxen reduces their productivity in terms of hectares they can work on every year.

The well for water is very dirty and usually encounter diarrhea diseases and this is more dangerous to the young ones.

There are no schools or clinics in vicinity. The nearest basic school is Limulunga (18 Kilometers), Clinic (Ikwichi, some 10 Kilometers away, which takes 4 hours walk one way), Nangili Rural Health centre, 20 Kilometers, Ushaa Rural Health Centre, 10 Kilometers, Mwanawina Rura Health Centre, 15 Kilometers, Basic School (Machu, 8 Kilometers which takes 3 and half hours walk). The nearest school is the new community school that has just been built at Isambai (4 Kilometers away, takes about 1 hour walk one way). The women complained explained that this was the reason why many kids between the ages of 6 to 9 were present during the interviews in the village as they can not manage to go to school. In the village the community reported that they have tended to go to Ushaa for the clinic facilities.

Women are involved in clearing the Lubatamei only for the portions of their field if they are cultivating rice. Some women reported that their hectarages for rice along the Lubatamei is maximum two Limas. On average, women have only 1 Lima of rice.

On the youth, they noted that they love to stay in the Barotse Flood Plain as they have to do something for their survival but are constantly discouraged by the hardships they face such as poor toilet facilities due to the sand which makes the toilet collapse during the rainy season and end up using the bush and when it rains, the faeces get into the same Lubatamei and we tend to drink contaminated water.

The meeting felt that housing was another challenge the inhabitants of Lubatamei face. Most of the houses are made out of mud and pole. The other challenges were lack of employment opportunities in Barotse Flood Plain. Education opportunities for the young children is limited to grade 4 at Isambai Community School which is nearest to the village for our children.

It was observed that population in the village was increasing in the village and reasons brought forward were that there are no other employment opportunities to attract the young people to go to in the neighboring municipality of Mongu. Hence, people have no choice but to stay in the village and deal with the situation as they work on the soil and find food on the table for their families. Migration to cities was not noted as people are sure they will never get jobs even in the urban areas. They prefer to stay locally and continue dwelling with the production of crops for survival.

- ▶ Scoping meeting at **Ndiki Basic School** with representatives from Namusa, Iyoo, Sitendo, Nakalembe, Kakulo, Kashiko, Kaole Ole, Nalufumo Villages along the Lubitamei Canal, 28<sup>th</sup> January 2014.
- ▶ The local Silalo Induna, who had attended the previous PPCR meeting, held in Mongu in January 2013, mobilized eight villages for a scoping meeting at Ndiki Primary School. Forty-six (46) people attended the meeting. Also in attendance were Mr. Charles Kapekele Chileya, Mr. Mubiana Muliokela, and Mr. Shatontoka from NIRAs. After the opening prayer from one of the participants, Mr. Charles Kapekele Chileya went on to explain the purpose of their visit. He encouraged the participants to contribute freely as no one's opinions were less important.

Many community members acknowledged hearing about the proposed canal rehabilitation project through local area Chief Lubinda Tanga, who had attended a meeting about the subject in Mongu. People reported that teachers had also been informing the local people about it through school pupils. Community member knew how to clear the canal using shovels, picks, hoes, axes and sickles. The meeting revealed that local people took part in the periodic maintenance of the canal through the food-for-work programme and that it would be difficult for them to work without pay.

This attitude and apathy towards communal projects among the local people was confirmed by Mr. Mushele (Headteacher) and the Senior Teacher. The consultants observed that a community project to increase classroom space at the local primary school of Ndiki had stalled. The community stated that there were no burial or ritual sites along the canal, which could affect the proposed rehabilitation works. The Lubitamei canal is known by several names; Ndiki canal around Ndiki area; Nangula canal around Nangula area; and Lubitamei between Ushaa and the Zambezi River.

Many people in attendance were aware that King Lewanika initiated the construction of canals in the Barotse Floodplain in order to drain the floodplain to reclaim land for agricultural purposes. People confessed that the king used compulsory labour to construct the canals and later kings employing the same approach to maintain them. However, since independence in 1964, people have been maintaining the canal as paid labour force. Most people in the area are involved in clearing the canal since time immemorial. They proposed that the government should employ them during the rehabilitation works and that they were not willing to maintain the canal without being paid. They described the working on the canals during the Lewanika's reign as having been slavery. Women also would also like to participate in the canal's rehabilitation to generate additional income.

Alcoholism appears to be affecting agricultural production in Ndiki area as most men are heavily engaged in the consumption of locally brewed wine. The method used in the preparation of the wine was described as unhygienic for the women brewers use dirty sisal sacks to filter the ingredients (mangoes and sugar). The wine's alcohol percentage is not known, but believed to be higher than that found in industrially brewed wine.

In addition to the hygienic condition of the beer brewing, the area also has problems with water for drinking. There is poor access to clean and safe drinking water except for the villages around Ndiki School. Consultants observed that the area lacks sources of safe water, lacks good housing and there are very few households with pitlatrines. It was revealed that dogs and pigs contributed to the contamination of the slow flowing water in the canal. Community members pointed out the fact that poor water supply in the area is the cause of the annual outbreaks of waterborne diseases experienced during the rainy season, which not only puts a heavy economic burden on the already economically constrained communities. It was concluded that interventions that can address these factors be highlighted by the consultants.

According to the Deputy Headmaster at Ndiki Basic School, the boy/child ratio stands at 7:4. This is a clear indication that there are more boys going to school compared to girls. The meeting noted that this calls for interventions by creating awareness among parents of the need to give girls an equal opportunity to be educated.

Local people are expecting that canal rehabilitation will create employment opportunities and enable expansion of their gardens. They also anticipate that trade in poles for construction purposes will increase between the Barotse Floodplain and Ndiki and with surrounding forested upland areas.

The main source of livelihood in Ndiki area is agriculture with rice, maize, cassava and vegetables as major crops. Rice is the major cash crop. Cassava is mainly cultivated for home consumption. A few households also rear cattle and local pigs. The majority of local inhabitants said they depended on the Lubitamei canal for their livelihood. Besides being the main source of domestic water supplies for many of the households in the area, people use the canal for bathing, watering cattle, soaking cassava and irrigating vegetable gardens. According to the people, the canal was in the past used for transportation of construction poles to Lealui and Limulunga from the upland areas of Mweke and Simulumba. Presently, because some portions of the canal are silted, navigation by boats and canoes is not possible.

The consultants observed that there was a local Disaster Management Committee in the area, which if strengthened and monitored properly, would ably spearhead canal maintenance in future. People revealed that after independence the government provided incentives for local people to get involved in the canal's maintenance. This not being sustainable, the meeting agreed that as the local people were the ones who benefited most from the canal, they should be responsible for its maintenance at their own cost. The meeting agreed that this was possible as long as the government works closely with the BRE and the local Disaster Management Unit in the area. The people of Ndiki area advocated for usage of machinery and equipment in the proposed rehabilitation of the Lubitamei canal and then manual tools during maintenance works thereafter. Some people also proposed that the canal should be deepened in order to allow big canoes ferrying poles and other products from the upland areas to navigate with ease.

Consultants were informed that the canal was last cleared in 2009 with the assistance of Concern Worldwide International who provided the necessary tools to the local Disaster Management Committee.

Women in the area are mainly engaged in farming and beer brewing. There are no women associations to enhance their welfare. Some women revealed that some womenfolk belonged to grassroot structures of a political party, which structures only became active during election times.

On the land tenure issue, the local people thought that it was not a constraint as any Lozi person had equal access to land and the Silalo Induna allocates land on behalf of the Litunga. Children are able to inherit their parents land once they become of age and their parents die. There is always a rule in the Lozi culture that the first-born child inherits the parent's estate regardless of sex.

However, the meeting noted that there are instances of land squabbles especially on the Mazulu in the plain, but Silalo Indunas at the Kuta easily sort out these squabbles.

Fewer young men and women were leaving the area in search of employment in towns. Most of the youth present at the meeting talked of having gone to towns and had to come back after failing to find respectable employment. Given the foregoing, most youngmen found solace in staying and tilling the land and starting families in the village. The population was increasing in the area as evidenced by the number of children under five years.

- ▶ Scoping meeting at Nangula Village at Chief Lubindatanga's Palace along the Lubitamei Canal on 28<sup>th</sup> January 2014

**In attendance were Charles Kapekele Chileya (Consultant from NIRAs Zambia, Mr. Mubiana Muliokela, Research Assistant from NIRAs Zambia)** Mr. Charles Kapekele Chileya introduced the purpose of the meeting and urged the participants to be open minded when discussing the issues as the canal rehabilitation was an important project that was bound to affect the community of Nangula. Through an interpreter, the area chief informed the meeting that Nangula was the area first settled by the Lozi after carriving from Kola in present day Democratic Republic of Congo (DRC). It is reputed that Nangula School was built in 1914.

People reported hearing about the canal rehabilitation project on radio and from the area Induna who attended a workshop organized by the PPCR Secretariat from the Ministry of Finance in Mongu, at which workshop preliminary findings of the feasibility study were presented. According to residents, surveyors visited Nangula and erected beacons near the canal in full view of residents. They also revealed that the canal was dug during the reign of King Lewanika.

The people cited fishing, irrigation, transportation, washing, drinking water for both animals and human beings as the main uses of the canal.

There are no sites of cultural importance along the canal which can affect rehabilitation works. Local burial sites are located far from the canal. However, people revealed the presence of a small lake called Lito lya ndiki in which it is believed a small animal known as Kapuwe lives. Local people believe that the water in the lake heals sick people if they drink it. The lake, is however not attached to the main canal.

Local people expect that the rehabilitation of the canal to create employment opportunities, open up land for rice production, improve navigation and thereby increasing the volume of trade in rice and other agricultural produce, improve the quality of water thereby reducing the incidence of waterborne diseases through continuous flow. They also expect that this is the opportunity for footbridges to be constructed across the canals. They contend that the canal offers a shorter route to the Mongu and Limulunga markets than the Lusaka-Mongu road.

The meeting deliberated on the best way of rehabilitating the canal. Most people would like the canal to be rehabilitated using machinery. Participants were of the view that villages along the canal should be empowered with tools necessary for maintaining the canal after rehabilitation. During King Lewanika's reign people worked on the canals by force and after independence in 1964, the new government under Dr. Kenneth David Kaunda stopped the usage of compulsory labour and introduced the employment of local people. As time went on the new government could not afford it and the canals remained unattended to. Some NGOs came into the picture with following the food-for-work concept and people in the area have become used to the idea and would find it difficult to work for nothing.

With respect to gender, the meeting established that women in the Nangula area wake up around 05:00 hours to start the day by going to the upland fields. They work in the fields until about 12:00 hours when they return home to fetch water, collect firewood and prepare lunch. They go back to the fields around 15:00 hours to knock off around 18:00 hours. Once home they prepare for supper and attend to other family needs. They reportedly go to sleep around 21:00 hours. According to the women, they have a heavy workload with little time to rest.

On the other hand, as cultivated fields are small men also help women to till the land and it is common for men and women to share the ploughing tasks.

There are no development-oriented women clubs in the area except for church oriented ones. Women cited lack of capital, lack of agricultural implements, lack of hammer mills in the area, lack of markets for their fine grass, and long distance to the nearest Secondary School (Lukalanya, 50 Km away).

Many women and youth are involved in growing vegetables from which they generate an estimated ZMW 300 per month. Onions, chinese cabbage, rape, tomatoes and ordinary cabbage are the major vegetable types grown. On the other hand, some men in the area are engaged in drinking local wine, which makes them unproductive.

The canal is the major source of livelihood for many people in the area and its rehabilitation is likely to impact positively on the community. For this reason, they are willing to participate in the canal's maintenance.

The houses and toilets in Nangula area are not different from those in the rest of the Barotse Floodplain; houses are made of reeds, mud and poles with grass-thatched roofs while the few pitlatrines are made of grass or reeds.

Except for households around the school and health center, the rest of the population get their water from scoop holes dug near the banks of the Nangula canal. The water is not safe for drinking as the sources are prone to contamination. During the rainy season, the area floods and all domestic and animal wastes are washed down into the canal increasing the risk of waterborne diseases. The water table in the area is reported to get low during the dry season and scoop holes dry forcing the affected households to make the long journey to the school or health center to access water.

The population in the area was increasing. A few young men have tried to move out of the area to the nearby towns of Mongu and Kaoma in search of employment and most of them have returned to the village after failing. Those that succeeded in getting jobs have stayed on. Population was on the increase in the area and key informants confirmed this.

On land tenure, the participants pointed out the fact that they were aware the Litunga holds the land on behalf of the people and that they cannot obtain title deeds but can have access to it and pass it over to their children. They do not perceive land tenure as a constraint to development but lack of investment capital.

During deliberations people pointed out that land in the Barotse Floodplain belongs to the people. They revealed that if anyone wanted land, one needed to go to the local chief through the local induna. "When one is given, it is all yours until you die. The eldest child will inherit the land but share it with other siblings. Local Indunas chair land allocation committees that consider requests for land within their boundary. The initial approval is then passed on to the Kuta, which makes the final decision. Land becomes yours when you are given.

#### ► Scoping Meeting at Isambai Village along the Lubitamei Canal, 30<sup>th</sup> November 2013

The meeting opened with Mr. Charles Kapekele Chileya informing the people the purpose of the consultants' visit as being to engage with them on the proposed Canal Rehabilitation project in the Barotse Floodplain including the Lubitamei canal that passed through the area. He also informed the audience that the Ministry of Finance and National Planning would implement the project.

The attendees reported that they had heard about the project on local radio during the signing ceremony between the World Bank and the Government of the Republic of Zambia (GRZ). The people also recited the little they knew about the the history of the first canal (that it was constructed by the famous King Lewanika during his reign and that he used compulsory labour.

Local people used the Lubitamei canal for irrigating gardens, watering cattle, fishing, washing, transportation using canoes, bathing, soaking cassava and as a source of drinking water. It was revealed that there were no burial sites or places of cultural importance along the canal that may impede rehabilitation works. It turned out that every household in Isambai village is associated with the canal and that the people depended on it for their livelihood. The consultants were told that the residents of Isambai Village and the surrounding considered the canal as an economically viable natural asset, which needed to be properly maintained. Despite this understanding, no one in the area was willing to get involved in the canal's maintenance without being paid.

The canal has not been rehabilitated for close to 20 years and people expect that since some portions are blocked and would require machines to dredge these points as picks and shovels cannot do a good job. By so doing, the local people will find employment when the project starts on a daily and monthly basis. There is also the feeling that once the canal is rehabilitated flooding will stop or reduce and therefore more land will be available for cultivation. They also expect that the water will be relatively clean as water flow will be continuous. Generally, the local people believe that the standards of living will improve with improvement in navigation and irrigation opportunities.

The people proposed that the usage of machines be considered during the rehabilitation of the Lubitamei canal as it needs some good depth and good width to sustain the transportation of poles and timber from the upland to the flood plain for construction as it was in the past. Two canoes loaded with poles should be able to cross at any point of the canal. Human labour should be involved in the removal of dredged sand and other materials in the process. The people are of the opinion that the labour has to be paid for as no person in the village was willing to do any work on the canal free. People who have worked on the canals are paid in cash or in kind (food for work).

The people were of the view that people needed sensitization on their responsibility of maintaining their portions of the canal and that the government should procure tools for maintenance works and left in the communities for easy access. It was also suggested that satellite Disaster Management and Mitigation Committees in collaboration with traditional leadership be given the responsibility of overseeing canal maintenance.

With respect to gender, women in Isambai area talked of waking up around 05:00 hours and starting their day by cleaning the homestead surroundings before setting off for their fields around 06:00 hours. They return homes around 13:00 hours to prepare lunch. After eating lunch and a brief rest they go back to the fields to return around 18:00 hours. Once home they fetch water, take a bath, wash children and prepare dinner. They go to bed between 21:00 and 22:00 hours. Women's workload was said to be heavy and demanding as there were no hammer mills to reduce on the labour spent on maize or cassava meal processing,

Women complained of the high incidence of malaria in the area, which reportedly affected productivity and agricultural production, lack of agricultural inputs, flooding of fields, poor sanitation and lack of safe drinking water. The people of in Isambai village largely depend on rain fed agriculture and fluctuations in the rainfall pattern leads to crop failure and subsequently food shortages. According to most people, canal rehabilitation will afford them the opportunity diversify to irrigated crop production and will contribute to poverty reduction.

Houses are made of reeds and mud with grass-thatched roofs which do not last for a long periods. There are no pitlatrines in the area and people use the forest. This contributes to contamination of water during the rainy season when faecal material is washed into the Lubatamei canal by surface runoff.

Population is increasing in the area and people would like the government to build them a school up to the Grade 9. The nearest school and health facility are at Ushaa, 9 kilometers away. There is a community school that provides education up to Grade 4 at Isambai.

With respect to land tenure, the people living around Isambai pointed out that land in the Barotse Floodplain belongs to the Litunga who has entrusted the Silalo Indunas to allocate it to his subjects within their village boundaries. Any one allocated land is assured of living on that particular land with his siblings until death. The eldest child inherits the land, be they female or male.

#### N'GOMBALA CANAL

- ▶ Scoping meeting held at **Mwandi Village** on 30th November 2013, Sefula Area along the Zambezi River Bank.
- ▶ In attendance were: Charles Chewe, NIRAS, Mr. Muliokela Mubiana (Research Assistant)
- ▶ Community Members present : confidential.

Mr. Charles Chewe started to explain to the community the purpose and gist of the visit to N'gombala canal on the beautiful banks of the Zambezi River to the community around 09.00 hours. The group was guided by the village headman Akabondo Muchwala who in return welcomed the team. On the history of N'gombala, Mr. Akabondo explained that the canal was dug by a Japanese construction company called Taisei to facilitate transportation of building materials to Lukona in Kalabo district in the late 1980s. The Construction Company wanted to create a shorter route for their building materials and it so happened that N'gombala was the shortest route to Kama. They even put a big barge at N'gombala village to transport the materials. After the Japanese left, the canal has never been used.

The community was aware of the new project coming to clear the canal and promote development for the Lozi living in Barotse Flood Plain. They had heard this from various people who have been coming to N'gombala especially the Fisheries Department people and the agricultural camp officer at Sefula working under the Ministry of Agriculture and Livestock.

The community has never been involved in the clearing of the N'gombala canal except in 2010 when Fisheries Department came to deepen the confluence of the canal then did some young men and women get employed by the Fisheries Department.

The community reported that the major sources of livelihood are cattle rearing, farming (rice especially and maize), fishing for both breams some kilometers away from the Zambezi during the flooding period), and basket fishing by women in the shallow waters of the canal), beer brewing. The most important crops grown along the N'gombala canal were reported to be rice (with supa, blue bonnet, xiang Zhou as varieties), local maize, pumpkins and gourds. It was also reported that all the villages along the canal use it for bathing, washing clothes and watering cattle.

Everybody present noted that the canal was an important commodity to them. During the rehabilitation, they expect the canal to be widened and enlarged to allow large boats and canoes. They expect this to shorten the distances the fish traders travel to buy fish.

The community expects that village headmen and women will be heavily involved during the rehabilitation of the canals and especially after the canal has been deepened and enlarged and all the sand deposit dredged away from the banks of the canal, it will be easier for the people from the villages to do the minor clearing. In addition, during the rehabilitation, the community expects that local labour will be locally sourced as opposed to importing it from outlying areas of Mongu and Namushakende.

The community will be able to work for free once the canals have been rehabilitated by the project and with the guidance of the local authorities. They were of the view that headmen should be in the forefront of canal maintenance.

The women took the lead in answering their questions posed by Mr. Chewe. They reported that women along the N'gombala canal like in most parts of the Western province wake up every day around 05.00 and 06.00 hours. They commence their day by sweeping their homesteads and then set off for their rice or maizefields to work until about 12.00 hours when they return home to prepare lunch. Some women go back to the fields in the afternoon to continue with the morning work knocking off by 17:00 hours. After taking a bath and preparing dinner they reportedly go to bed around 20:00 hours.

Overall, the women reported that the major constraints they face are lack of ox-ploughs, poor sources of clean water for drinking, poor sanitation (many households have no toilets).

There are no women associations or clubs in the area. Women were involved during the canal clearing through the provision of labour for slashing around the canal during the time of the Japanese construction company. According to the women, the N'gombala canal was used for transportation, bathing, washing clothes, farming and gardening, fishing with baskets at the shallow end of the canal.

There is temporal migration of people into the Floodplain to buy and trade in fish. These people stay up to the time of the fish ban on the 1<sup>st</sup> of December every year. Otherwise, the meeting noted that there are no people leaving the floodplain in search of jobs in urban areas or new people coming to settle there.

The youth reported that there is no way they would move out of the plain as there are no prospects for jobs in the urban centers as their friends who migrated some time ago have not found jobs. It was discussed also that population in the plain was increasing as people in the area do not practice family planning and children are forced to marry early as the distances to schools from N'gombala is about 13 kilometers. Girls in the area tend to get married at very tender ages of as low as 15 years. The type of housing and toilets are not encouraging and the people use more of the bush than the grass thatched toilets and the situation is even worse during the rainy season.

The community ended up by discussing the distances to the nearest social facilities such as clinics and schools. Mr. Akabondo ended up by thanking the survey team once more and the meeting ended at 16.30 hours.

- ▶ Scoping meeting at Sipolota and Taisei Fishing camps on the bank of the Zambezi River along the Ngombala Canal, 30<sup>th</sup> November 2013.
- ▶ The meeting was held at Sipolota Village and was attended by Charles Chewe and Mubiana Muliokela from NIRAS Zambia

Mr. Chewe opened the meeting by explaining the purpose of their visit and urging everyone to contribute and ask questions.

Taisei village turned out to be a former building site and transit point for building materials the Japanese construction firm Taisei used during the construction of Lukona Secondary School and Rural Health Center. It is now a permanent village for migrant fishermen and women fish traders. The community members in attendance were said to have migrated from different parts of the Western Province including Kalabo, Lukulu, Sesheke, Mongu, Sefula and Senanga Districts. Some of these people have even built permanent structures like groceries that provide services to the inhabitants and visiting traders. Parafin, cooking oil, sweets, pens, bathing soap, detergents and sugar are the common items stocked in the groceries.

Some of the community members informed the visiting consultants that they were aware that the Ngombala canal would be rehabilitated through a government project. However, the group was not aware about the canal's history besides the fact that a Japanese Contractor constructed it. The canal was mainly used for transportation of fish, agricultural produce and commodities. Other uses mentioned included irrigating vegetable and maize gardens, watering livestock (cattle and pigs), bathing and washing clothes and fishing during floods. The people in the area do not use the canal as a source of drinking water but rely on the Zambezi River.

The people also revealed that the Ngombala canal was last maintained by hired labour that was paid for with cash or fish contributed by fishermen and fish traders living in Taisei and Sipolota fishing camps. The canal is blocked in some parts and is therefore not navigable throughout its length.

The people recommended that the canal be widened so that it could accommodate big canoes and large boats. Mr. Ngombala, a farmer with local knowledge about the canal was reputed to have been involved in the mobilization of people during the canal's occasional maintenance. There were suggestions that future maintenance activities involve village headmen under the supervision of the traditional leadership.

The women living here wake up around 06.00 hours and set off for their rice fields. Women fish traders also wake up also this time and go to the river to wait for fishermen returning from nighttime fishing expeditions. The women who are involved in rice cultivation reported returning from the fields about 12.00 hours to start preparations for mid-day meal. They usually have lunch around 14.00 hours. About 15.00 hours the women farmers go back to the fields to knock off around 18.00 hours to complete household chores and cook supper. Most of the women reported going to sleep around 21.00 hours.

The women mentioned that the workload on women is heavy but that they are able to cope. The Zambezi River, less than a kilometer from the settlements, is the major source of domestic water.

The area has no women associations or clubs that can promote the interests of women. The consultants observed that firewood was a major challenge for households along the Ngombala canal as they depend on old mango trees that have reached pick production or purchased small cords of firewood imported from the uplands.

People identified the following as challenges they faced: long distances to health facilities and schools (Namushakende and Sefula at 15 and 13 Kilometers, respectively); poor sources of drinking water (Zambezi River and scoop holes); high incidence of malaria, bilharzia, trachoma and diarrhea; and long distance to markets (fish traders). Women also reported that scoop holes accumulate worms after three-four months forcing them to dig new ones. Health personnel at Sefula Rural Health Center confirmed the disease prevalence mentioned by the community.

A few youth and men have migrated into the urban areas in search of gainful employment but the common trend is temporary migration during the period between December and April every year, coinciding with the annual fish ban. The youth revealed that fishing was a very profitable enterprise that generated daily income and relish for the family and not easy to abandon.

Participants posed a question as to when the actual rehabilitation works would start. Mr. Chewe confessed that the question was a difficult one to give a straight answer to explaining that the project was in its feasibility study phase involving technical field measurements and assessment of impacts on the environment and communities but as was required for development projects of this nature. He assured the people that actual implementation would start after appraisal of the feasibility study phase and identification of a contractor. He reiterated that the government and World Bank were committed through the signing ceremony and engagement of BRL and NIRAS Zambia to undertake the feasibility studies.

- ▶ Scoping meeting for farmers along the Ngombala Canal namely **Litondo, Sipai, Nakalenge, Kundiana, Mungongo and Namakomena Village**, 31<sup>st</sup> January 2013
- ▶ The meeting was held at Sefula Farmer's Training Centre located on the edge of the floodplain. Most of the participants were former beneficiaries of the JICA project that promoted irrigated rice production. The purpose of this scoping meeting was to try to find out why the project failed.
- ▶ In attendance were Charles Kapekele Chileya, Christoph Navitel and Mubiana Muliokela from NIRAS and BRL.

The ten farmers were from villages that were involved in the defunct rice irrigation project. The farmers continue to grow rice without external assistance.

Asked about the proposed canal rehabilitation project in the area, they answered that they were fully aware and looked forward to its successful implementation. After explaining about the proposed canal rehabilitation project, Mr. Chileya asked the participants what went wrong with the rice project at Sefula. The answers were vast.. One of the answers was that the Japanese did not understand the social fabric dynamics of the Lozi people and assumed that you would maintain the irrigation project without the full involvement of the BRE in the area. The BRE plays a very significant role in the development of the Western province. One has to understand how the BRE functions and one ought to involve them from the scratch. From his view point the BRE should have been asked to take the lead in the mobilization of the locals for example in the management of the sand bank that was built upstream.

The second point mentioned was that the main Sefula canal was being blocked near its source in Malile. The movement of sand also affected the Sefula Irrigation project in the sense that there is water logging in the Sefula area. The outlet built from the main canal was silted and much of the area is poorly drained. There were no provisions to clear parts of the canal in Nomai area, source of the Sefula canal. Nomai is an important place that the Paris Missionary Society (PMS) established to get the water source protected and built a small Mission settlement to ensure that there were people living around the source of the canal to monitor the flooding levels and movement of the water in the canal.

The meeting also heard that the infrastructure was not as solid as it should have been resulting in the collapse of the secondary canal. The canal's collapse was also a result of lack of maintenance. In addition, the lateral canals were supposed to be dredged from time to time, but this was never done after the project team left.

On top of the factors alluded to above the farmers noted that they did not have access to tillage equipment after the project wound up.

It was reported that land disputes emerged and scheme members started to default on paying water user fees. This was because the people did not consider the scheme as theirs. They perceived the project as a JICA project. Currently, the scheme register has 300 farmers but less than 10% pay water user fees to the Association for canal maintenance.

The other problem observed with the scheme is that there was too much emphasis on rice farmers with little consideration for other stakeholders like livestock farmers, maize farmers and fishermen. These canal users should have been taken on board during the design and implementation stages. They do have an impact on the irrigation scheme as well indirectly and directly. Fishermen and livestock farmers were known to damage the canals as they fished and watered their animals. There are by laws that guide the operations of the scheme but they exclude fishermen and livestock farmers. It was assumed that only rice farmers were stakeholder and others not relevant to the goals.

Siltation along the canal from Nomai area of up to the Scheme area must be sorted out and of course the sand bank located in the villages behind Sefula shopping area should be cleared and opened up to allow the ease flow of water into the scheme. The state in which the sand trap needs to be dredged. After dredging the sand bank, the local people and the farmer association with the new impetus it would acquire by having an extended membership list of various stakeholders can then be charged and be made responsible for the clearing of the same. Of course with the full involvement of the BRE. Upstream cleaning and clearing of the Sefula Canal is crucial and most important.

Rice requires fine tillage and good soils. The soils in the scheme are acidic and liming should become an integral part of production practices if better yields are to be realised. There is no tillage equipment in the irrigation scheme. Lime is not easy to source locally and this compounds the problem for scheme farmers as it not part of the usual package under the Farmer Input Support Programme (FISP).

## FISHERIES CANAL

- ▶ Scoping meeting held at **Situnda Village** on the plain edge of the Fisheries canal.
- ▶ In attendance were Charles Chileya (NIRAS of Zambia, Muliokela Mubiana, Research Assistant and Interpreter).
- ▶ Village members of Situnda Village present were: confidential.

Mr. Chileya commenced by introducing the subject matter at hand to the local people who were very keen to hear of the message and the purpose of the visit. In his opening remarks, Mr. Chileya encouraged all the present members of the village to speak their minds out and represent the views of the people who were not present during the meeting for one reason or the other. He also encouraged them to go back and take the message to same group of people.

Mr. Friday Walubita thanked Mr. Chileya and his group for paying them an impromptu visit which they never expected but will be willing to contribute to the meeting as the canal issues in Namushakende has been a key issue people want sorted out by the new government.

From the discussions, the members reported that they have heard about the project from the Fisheries Extension Assistant located at Namushakende and other people from the political ward.

They also recall that the canal was first constructed by the Fisheries Department in 1972 but only completed the canal around 1973. The objective for dredging the fisheries canal was to ensure that there was safe fish breeding in the Zambezi area during floods and also ensure that drainage for the farming enterprise was going to be a complimentary issue to agriculture.

The community also noted that during the dredging of the fisheries canal, many local people were employed and this acted as an incentive to them. The Fisheries Department dredged the canal but it was too wide.

The community was aware of the uses of the canal which they summarized as follows: 1. Transportation of people, 2. Farming, 3. Draining of the Barotse Floodplain 4. Fishing, 5. Washing and bathing and 6. Transportation of charcoal and fire wood. They also acknowledged the importance of the fisheries canal to the entire populace living along the canal.

The people in the village expect that during the dredging, local people will be provided with employment and business will improve given the fact that the community will have a harbor also completed and this will provide a readily available permanent market structure for the villages living along the start of the canal in the Namushakende plain edge of the Barotse Flood Plain. They also expect that they will be involved in clearing the canal using the village headmen as coordinators in the mobilizing the communities with the support of the BRE Indunas of the areas along the fisheries canal. Indunas can form committees to clear portions of the canal for each village. Currently, the Indunas are levying fishermen and fish traders side by side with the Mongu district council at the markets and the system is working pretty well. The community encouraged us to work closely with the BRE on the canal matters.

The issue of women came up and women took the floor and answered questions. The women noted that they woke up every morning around 5.00 hours. After waking up, they clean their surroundings and homes before going out into the fields for cultivation. They return back to the villages around 13.00 hours pm to prepare lunches for their homes and then rest a bit and set off for the afternoon sessions around 15.00 hours. The women noted that the Indian Mark 2 pump is within the vicinity of the village within a radius of 500 meters for all households.

There is a Women Savings and Credit Association in Namushakende and most of the village women are members. The Savings and Credit Association is supported by the government through the Ministry of Community Development Mother and Child. There is a bore hole in the village sunk sometime by Village Water in 2006. The major problem women face in this village was the poor toilet and poor housing otherwise the school and the clinic were just a stone throw away. "One would wish to have a programme which can provide us with cement and we build permanent toilets for ourselves on self-help basis" one woman lamented. Others joined and said this was one of the major challenges the area is facing as we have more diarrhea cases during the rains as most of the households use the bush for the toilet. The distance to the school and the clinic is just 1 kilometer away. The area they noted and appreciated was too close to main Senanga-Mongu Road and transport was not a problem for them to take their produce to the urban markets of either Senanga or Mongu. There is a fully fledged Secondary School at Namushakende and it is now expected that King Lewanika University will soon be built by the government to compliment the newly established University of Barotseland, a private institution. In the village, there are no major constraints for women except they would like to have access to loans for ox ploughs and implements.

- ▶ Scoping meeting held at **Nakatoya Village** (Central place) and included seven other villages of Namuku, Loyana, Nasinandi, Nyambe, Lilami, Kashumba and Nashikundu on the plain edge of the Fisheries canal, 1<sup>st</sup> February 2014
- ▶ The local agricultural camp officer resident at Namushakende Agricultural Camp mobilized the people and arranged the meeting for the morning of Saturday, 1st February 2014. People from eight villages assembled Nakatoya village located near the Fisheries canal. The village is host to the planned mini-harbour and Fish Market.
- ▶ In attendance were Charles Kapekele Chileya and Mubiana Muliokela from Niras, Christoph Navitel from BRL and Mr. Sitali from Ministry of Agriculture and Livestock (MAL).

The Village Headman opened the meeting by welcoming the visitors from NIRAs and BRL of France and asking for an opening prayer from a volunteer within the group. After the prayer, the Headman asked the team leader to introduce the subject matter. Mr. Chileya took the floor and explained that the purpose of their visit to the area was to engage the people on the proposed canal rehabilitation project in the Barotse Floodplain under the PPCR of the Ministry of Finance and National Planning. He stressed the importance of everyone present to contribute freely on any issues deemed relevant to the rehabilitation and local people's expectations.

Mr. Christoph Navitel added that BRL and NIRAS had now been working in the project area collecting technical information for some time but that it was also necessary to collect their views and other socio-economic information for inputting into the final report.

Community members acknowledged that they had heard about the proposed project and seen Surveyors putting beacons at intervals along the Musyamo and Fisheries canals. The consultants were informed that the local radio station had spread news of this development during and after the signing ceremony between the Minister of Finance and the World Bank's Country Representative in Zambia.

The community was aware of the history of the two canals, Musyamo and Fisheries. They pointed out that Fisheries Department constructed the latter with the objectives of enhancing transportation of fish catches to the markets and providing breeding ground for fish during floods. They further revealed that the Musyamo canal was constructed during the reign of King Lewanika in the 1800s. The community reported that there are other canals that were built in the Namushakende area and these are, Mbumbi, Muku, Nasikundu and Sefula canals. Maintenance of canals was a responsibility of the local people before independence but that after independence, the government took over the maintenance and employed paid labour, destroying the self-help spirit that existed in the past.

According to the community, the government in 1992 and 2006, respectively last maintained the Musyamo and Fisheries canals

Local people use the Fisheries canal for transportation, fishing, as a source of drinking water, for bathing and washing clothes, soaking cassava, watering cattle and small livestock (pigs and goats). The Fisheries canal has no sites of cultural importance or burial sites along its course that could affect rehabilitation works. They proposed that Musyamo canal be rehabilitated using manual labour except for the portions that needed machinery. The local people knew the portions of the canal that are bad.

The main sources of livelihood in the area are fish trading, chicken trading. Beer brewing, charcoal burning and harvesting poles.

Some participants in the meeting were of the view that the Fisheries canal should be dredged with machinery that can throw the silt and sand far from the banks as the current practice of heaping gruded material on the banks is ineffective as the the material is washed back by floods. They also contended that because the canal is deep it cannot be effectively cleared using manual labour. On the other hand, some people living in Nakatoya Village along the Musyamo canal are of the opinion that it be cleared by manual labour provided appropriate tools are provided by the project. The community is of the opinion that local inhabitants should be responsible for future maintenance of canals under the supervision of the BRE. The people expressed willingness to take responsibility after the government has carried out major rehabilitation works.

Nearly all the residents of Nakatoya Village depended on the Fisheries canal for survival. They are expecting the rehabilitation of the canal will create job opportunities for many of the unemployed youth. People also anticipate that smooth flow of water in the rehabilitated canal will result in more drained land for cultivation. People pointed out that the BRE and the Disaster Management Committees in the area should be involved from the start of the works.

Women in the 8 villages reported that they woke up between 04.00 and 05.00 hours and went to their upland fields returning home between 13:00 and 14:00 hours for lunch preparation and brief rest. They again leave home for Saana fields around 15:00 hours returning around 18:00 hours only to start preparing for supper which is eaten around 19.00 hours. The majority of them go to sleep around 21:00 hours.

Women also reported that besides a heavy workload and long working hours, they also faced a variety of challenges. The most important of which are lack of implements for tilling the land, black beetle attacks in their rice fields, excessive flooding in some years, long distance to safe water source (fetch water (2 Kilometers from the water sources), No fertilizer available (up to 2 Km), poor sanitation, poor state of the road linking Namushakende and the Fisheries canal.

The consultants observed that the majority of households had no toilets or pitlatrines and were using matema fields for defacating. Because of this, the water in the Musyamo and Fisheries canals is not safe for drinking.

The people claimed that they do not dig pitlatrines because they easily collapse due to the sandy nature of the soil. Although they were aware that they could prolong the lifespan of pitlatrines by reinforcing the hole with burnt bricks and cement, they claimed it was costly to source cement.

Due to poor access to clean water, proper sanitation facilities and inadequate hygiene, the communities of the 8 villages constantly experience outbreaks of waterborne diseases especially among children under the age of five. Typically, this is yet another woman's burden as it is generally the responsibility of women to attend to medical needs of sick children.

People also reported that there is a high incidence of diseases in the area and this adversely iaffected agricultura productivity.

On land tenure, the people described the land tenure system as being customary and to make matters worse for the 8 villages much of the land in the 8 villages belonged to an absentee princess (Mukwae). The land was allocated to her by the father before his death, and according to custom will continue to own it until death. Although a property owner, she does not get any land rentals but controls its allocation by local Indunas.

On population trends, elders reported that there was a general increase in the population of the area as evidenced by the higher proportion of young children. Most of the youth were not moving out to urban areas because others had tried only to come back after failing to find jobs.

- ▶ Scoping meeting held at Namutondo Village on 28<sup>th</sup> November, 2013 around Namushakende but now in Nalolo District
- ▶ In attendance were Charles Chewe and Mubiana Muliokela from NIRAS Zambia.

Mr. Chewe introduced the subject and invited the participants to the meeting to be as open as they could be when discussing the matter of canal rehabilitation as it concerned them and their livelihoods. He asked them to be objective in their contributions and accept other people's opinions. He further explained the purpose of their visit as being to generate information on the views and expectations of the local people on the proposed rehabilitation project covering the Fisheries, Ngombala, Musyamo, Muoyowamo and Lubitamei canals under the PPCR project to be implemented by the Ministry of Finance and National Planning with financial assistance from the World Bank.

From the onset of the discussions, the local people reported to have heard about the project on radio and from the local Agricultural Extension worker at Namushakende as well as Fisheries Officers from Mongu.

All the participants knew the historical background of the Fisheries canal; that construction works began in 1973 with the the purposes of connecting the plain edge and the Zambezi River and to provide breeding ground for fish. The canal is used for irrigation of vegetable gardens and rice fields, too. The Fisheries Department maintains the canal through locally employed people.

The maor sources of livelihood of people living along the Fisheries canal are agriculture with rice, maize, sweetpotatoes, pumpkins and cowpeas as main crops; and trading.

The Fisheries canal's harbour near Nakatoya Village is now a busy market for fresh and dry fish with people from Namushakende and surrounding areas coming to buy the commodities during the fishing season. The Mongu Manucipal Council generates revenue through fish and marlet levies. The people of Namutondo village attach great importance to the Fisheries and Musyamo canals as they contribute significantly to household and local economies.

With the proposed rehabilitation of the Fisheries canal, local people are expecting employment opportunities, increased business activities, establishment of a full-fledged harbour and market, increment in yields of crops grown in sitapa fields and reclamation of presently water logged adjacent lands.

The local people pointed out that the Fisheries canal is too deep and requires machines to rehabilitate it properly and that they are not willing to provide labour at no cost for future maintenance activities.

The meeting analysed the long list of constraints faced by the local people and identified the major ones as being excess flooding of rice due to poor water control, drought in the recent past has affected crop production, rice pests which include mice and fish, and of course low incomes. They proposed assistance to access agricultural implements especially for women, entrepreneurship skills training and construction of an all-weather road from Senanga/Mongu road to the Fisheries canal harbour.

There is a Savings and Credit Scheme group in the area to which a few women were members.

On population trends, the participants reported an increase, which they attributed to low levels of family planning among the youth and early marriages among girls. A few of the youth were moving to urban centers in search of jobs but the majority has stayed behind. There has been no significant migration of people from the area as some are able to get employment locally in government departments and as domestic workers for people working in government institutions such as agriculture, health, community development, police and schools.

People in the village sourced water from a protected well with the furthest household from the well being just 100 meters. The nearest school and health centre are at Namushakende about 1 Km away. Although the health center was within easy reach, it had inadequate trained maternity personnel and maternity facilities. There were claims that untrained members of staff often attended to patients.

The daily calendar for women showed that they woke up at about 05:00 hours to go to the fields returning home around 13:00 hours to prepare lunch for the family. They go back to the field at about 15:00 hours for the second round of agricultural work finally knocking off about 18:00 hours. On reaching home they have to fetch water, clean the homestead, take a bath and prepare supper which is normally eaten between 19:00 and 20:00 hours. The women reported that they usually retired to bed between 21:00 and 22:00 hours.

The meeting ended at 17:00 hours after a prayer from one of the women participants and a statement thanking the people from the consultants.

## 12.2 ANNEX 2: FISH SPECIES OF THE UPPER ZAMBEZI FLOODPLAINS

Scientific Name	English Name / Local Name
<b>MORMYRIDAE</b>	
<i>Cyphomyrus discorhynchus</i>	Parrot-Fish
<i>Marcusenius ansorgi</i>	Ansorges Stone-Basher
<i>Marcusenius macrolepidotus</i>	Nembele
<i>Mormyrus ellenbergeri</i>	Ellenbergeri's Bottlenose
<i>Mormyrus lacerda</i>	Bottlenose / Ndikusi
<i>Petrocephalus catostoma</i>	Churchill
<b>KNERIIDAE</b>	
<i>Kneria polli</i>	Angola Kneria
<b>CHARACIDAE</b>	
<i>Brycinus lateralis</i>	Stripe tailed Robber
<i>Hepsetus odoe</i>	Pike
<i>Hydrocynus vittatus</i>	Tiger Fish
<i>Petersius rhodesiensis</i>	Silverfish
<i>Microalestes acutidens</i>	Silver-robber
<i>Rhabdalestes maunensis</i>	Slander robber
<b>CITHARINIDAE</b>	
<i>Nannocharax macropterus</i>	
<i>Nannocharax multifasciatus</i>	Many Banded Citharinid
<i>Nannocharax sp.</i>	Banded Citharinid
<b>CYPRINIDAE</b>	
<i>Barbus (Beirabarus) aurantiacus</i>	Red Eyed Barb
<i>Barbus unitaeniatus</i>	Longbeard Barb
<i>Barbus bifrenatus</i>	Hyphen barb
<i>Barbus barnardi</i>	Blackback barb
<i>Barbus radiates</i>	Beira barb
<i>Barbus miolepis</i>	Zigzag barb
<i>Barbus afrovernayi</i>	Spot-Tail Barb
<i>Barbus barotseensis</i>	Many-Spotted Barb
<i>Barbus bellcrossi</i>	
<i>Barbus codringtoni</i>	Yellow-Fish
<i>Barbus eutaenia</i>	Stapper's Yellowfish
<i>Barbus fasciolatus</i>	Red banded Barb
<i>Barbus gangandensis</i>	
<i>Barbus Labialis</i>	Plain Barb
<i>Barbus lineomaculatus</i>	Spotted Barb
<i>Barbus multilineatus</i>	Multi-Striped Barb
<i>Barbus neefi</i>	Golden Barb
<i>Barbus paludinosus</i>	Ubiquitous Barb
<i>Barbus poechii</i>	Smooth spine Spot Barb
<i>Barbus puellus</i>	Dot-Tailed Barb
<i>Barbus Sp.</i>	Pied Barb
<i>Barbus thamalakanensis</i>	Thamalaka Barb
<i>Clypeobarbus Sp.</i>	Black-Scaled Barb
<i>Coptostomabarbus wittei</i>	
<i>Engraulicypris brevinialis</i>	Whitebait
<i>Labeo annectens</i>	Striped mudscucker
<i>Labeo lunatus</i>	Mudsucker Linyonga
<i>Labeo cylindricus</i>	Redeye labeo

Scientific Name	English Name / Local Name
Laeboe lunatus	
<b>SCHILBEIDAE</b>	
Eutropius yangambianus.	
Schilbe intermedius	Silver Barbel Lubango
<b>CLARIIDAE</b>	
Clarias gariepinus	Sharp-Toothed Barbel: Ndombe
Clarias ngamensis	Blunt-Toothed Barbel Ndombe
Clarias submarginatus	Muscelehead Barbel
Clarias stappersii	Bloched catfish
Clarias theodora	Snake Barbel Minga
<b>MOCHOKIDAE</b>	
Chiloglanis neumanni	Sucker-Mouth Catlet
Synodontis macrostigma	Sigonge
Synodontis nigromaculatus	Spotted Squeaker
Synodontis unicolor	Plain Squeaker
Synodontis woosnami	Vermiculated Squeaker Sigonge
Chiloglanis faciatus	Okavongo suckermouth
Synodontis macrostoma	Largemouth squeaker
Synodontis thamalakanensis	Bubblebarb squeaker
Synodontis vanderwaali	Finetooth squeaker
<b>BAGRIDAE</b>	
Auchenoglanis ngamensis	
Leptoglanis rotundiceps	Spotted catlet
Aplocheilichthys hutereaui	
Aplocheilichthys katangae	
Hypsopanchax jubbi	
Hypsopanchax Sp.	Dark Top Minnow
Nothobranchius taeniopygus	
Leptoglanis dora	Chobe sand catlet
Amphilius uraoscopus	Mountain catfish
<b>CICHLIDAE</b>	
Haplochromis carlottae	Charlottes Bream
Haplochromis darlingi	Darlings Dwaf Bream
Haplochromis fasciatus	
Haplochromis frederici	Frederics Bream
Haplochromis giardi	
Haplochromis philander	Dwarf Bream
Pseudocrenilabrus philander	Southern mouthbrooder
Hemichromis fasciatus	Banded-Jewel Fish
Oreochromis andersonii	Three-Spot Bream Njinji
Oreochromis macrochir	Green headed Bream / Mu
Pelmatochromis robustus	Pink Bream Nembwe
Pelmatochromis ruweti	
Sargochromis codringtoni	Green Bream/ Seo
Serranochromis angusticeps	Thin-faced bream Mushuna
Serranochromis macrocephalus	Purple-faced Bream Njenga
Pharyngochromis acuticeps	Zambezi happy
Sar gochromis carlottae	Rainbow Happy
Serranochromis altus	humpback largemouth
Tilapia ruweti	Okavango Tilapia
Serranochromis robustus	Yellow-belly Bream
Serranochromis thumbergi	Brown-spot Bream

Scientific Name	English Name / Local Name
<i>Serranochromis. longimanus</i>	
<i>Tilapia rendalli</i>	Red-Breasted Bream/ Mbufu
<i>Tilapia Sparrmanii</i>	Banded Bream Situbu
<i>Ctenopoma ctenotis</i>	Spot-Tail Climbing Fish
<i>Ctenopoma multispinis</i>	Climbing Fish
<i>Sargochromis giardi</i>	Pink happy
<i>Sargochromis greenwoodi</i>	Greenwood happy
<i>Aethiomastercembelus vanderwaali</i>	Ocelated spiny eel
<b>MASTACEMBELIDAE</b>	
<i>Mastacembalus mellandi</i>	Spiny Eel
<b>MALAPTERURIDAE</b>	
<i>Amphilius platyichir</i>	Mountain Catlet
<i>Amphilius platyichir</i>	Mountain catlet

Source: Weiss (1970) and SAIAB (2002, 2003) and Skelton (2001)

## 12.3 ANNEX 3: FISH CATCHES IN THE UPPER ZAMBEZI

Table 48 Fish catches of the Upper Zambezi and National fish catches

Year	Upper Zambezi (metric tons)	% of national	National (metric tons)
1966			43862
1967			41146
1968	1000	2.35	43050
1969	2500	5.62	44451
1970	3500	6.84	51139
1971	3500	7.47	46841
1972	3500	7.01	49894
1973	3500	6.95	50352
1974	3500	7.46	46929
1975	5827	10.14	57464
1976	5995	11.05	54267
1977	3490	6.49	53734
1978	4475	9.41	47569
1979	5559	11.23	49511
1980	6572	12.89	50988
1981	6694	16.95	39553
1982	5200	9.32	55809
1983	3301	6.09	54175
1984	4309	6.57	65555
1985	3864	5.68	68000
1986	5235	9.31	56229
1987	4491	7.03	63893
1988	9200	15.12	60830
1989	8358	12.49	66926
1990	4213	6.49	64868
1991	8403	12.56	66926
1992	9605	14.15	67864
1993	9243	14.05	65768
1994	5763	8.23	70057
1995	6064	8.61	70546
1996	6785	10.23	66332
1997	6992	10.61	65923
1998	6614	9.46	69938
1999	6578	9.77	67327
2000	6728	10.09	66671

## 12.4 ANNEX 4: PLANTS IN THE BAROTSE FLOOD PLAIN

sa: submerged aquatic

ea: emergent-leaved aquatic

T/S: tree/shrub

Sf: suffrutex

r: limited distribution range to the Zambezi catchment

a: found across much of the Afrotropics (including East & West Africa), or pantropical

s: found over a large part of southern Africa (South Africa to Southern Tanzania)

Table 49 Plant inventory in the Barotse flood plain

Scientific name	Life form	Distribution
<b>Pteridophyta</b>		
Azolla pinnata	sa	a
Equisetum ramosissimum		a
Osmunda regalis		a
Salvinia molesta	sa	a
Lygodium microphyllum		a
Ampelopteris prolifera		a
Cyclosorus interruptus	ea	a
Thelypteris confluens	ea	a
<b>Monocotyledons</b>		
Burnatia enneandra	ea	a
Limnophyton angolense	ea	a
Ranalisma humile	ea	?
Crinum macowanii		?
Commelina diffusa	ea	?
Commelina fluviatilis	ea	a
Commelina nigriflora		?
Floscopa glomerata	ea	a
<b>Cyperaceae</b>		
Ascolepis capensis		?
Ascolepis elata		?
Ascolepis protea		?
Ascolepis pusilla		?
Bulbostylis abortiva		
Bulbostylis laniceps		
Courtoisina cyperoides		?
Cyperus amabilis		?

Scientific name	Life form	Distribution
Cyperus articulatus	ea	a
Cyperus bulbosus		?
Cyperus compressus		a
Cyperus digitatus	ea	a
Cyperus esculentus		?
Cyperus maculatus		a
Cyperus papyrus	ea	a
Cyperus pectinatus	ea	a
Cyperus tenuispica		a
Eleocharis acutangula	ea	a
Eleocharis dulcis	ea	a
Fimbristylis complanata		?
Fimbristylis dichotoma		a
Fimbristylis squarrosa		a
Fuirena leptostachya		?
Fuirena stricta		a
Fuirena umbellata	ea	a
Fuirena welwitschii		?
Kyllinga intricata		a
Lipocarpha atra	ea	?
Lipocarpha chinensis	ea	?
Lipocarpha nana		?
Mariscus deciduus		a
Mariscus dubius		?
Pycreus aethiops	ea	a
Pycreus flavescens		a
Pycreus macrostachyos		a
Pycreus mundii	ea	a
Pycreus nigricans		?
Pycreus nitidus	ea	a
Pycreus pelophilus		a
Rhynchospora candida	ea	?
Rhynchospora corymbosa	ea	a
Rhynchospora holoschoenoides	ea	a
Schoenoplectus corymbosus	ea	?
Schoenoplectus senegalensis	ea	?
Scleria erythrorrhiza		?
Scleria griegiifolia		a
Scleria hirtella		?
Scleria lagoënsis		a

Scientific name	Life form	Distribution
<i>Scleria melanomphala</i>	ea	?
<i>Scleria woodii</i>		?
<b>Poacea</b>		
<i>Acroceras macrum</i>	ea	a
<i>Alloteropsis cimicina</i>		a
<i>Andropogon brazzae</i>	ea	s
<i>Andropogon eucomus</i>		a
<i>Andropogon huillensis</i>		s
<i>Andropogon laxatus</i>		a
<i>Andropogon perligulatus</i>		a
<i>Aristida cumingiana</i>		a
<i>Aristida denudata</i>		s
<i>Aristida junciformis</i> ssp. <i>welwitschii</i>		s
<i>Aristida pilgeri</i>		s
<i>Aristida stipitata</i>		s
<i>Bothriochloa bladhii</i>		a
<i>Brachiaria arrecta</i>		a
<i>Brachiaria bovonei</i>		a
<i>Brachiaria humicola</i>		a
<i>Brachiaria oligobrachiata</i>		s
<i>Brachiaria rugulosa</i>		a
<i>Chasmopodium purpurascens</i>		?
<i>Chloris gayana</i>		a
<i>Chloris virgata</i>		a
<i>Cynodon dactylon</i>		a
<i>Dactyloctenium giganteum</i>		a
<i>Dichanthium annulatum</i>		a
<i>Digitaria acuminatissima</i>		a
<i>Digitaria brazzae</i>		a
<i>Digitaria comifera</i>		a
<i>Digitaria debilis</i>		a
<i>Digitaria diagonalis</i>		a
<i>Digitaria eriantha</i>		s
<i>Digitaria maniculata</i>		s
<i>Digitaria monodactyla</i>		s
<i>Digitaria perrottetii</i>		a
<i>Digitaria remotigluma</i>		s
<i>Digitaria scalarum</i>		a
<i>Diheteropogon grandiflorus</i>		a

Scientific name	Life form	Distribution
<i>Echinochloa colona</i>		a
<i>Echinochloa haploclada</i>		a
<i>Echinochloa jubata</i>		s
<i>Echinochloa pyramidalis</i>	ea	a
<i>Echinochloa stagnina</i>		a
<i>Entolasia imbricata</i>		a
<i>Eragrostis aethiopica</i>		a
<i>Eragrostis arenicola</i>		a
<i>Eragrostis atrovirens</i>		a
<i>Eragrostis botryodes</i>		a
<i>Eragrostis ciliaris</i>		a
<i>Eragrostis curvula</i>		a
<i>Eragrostis cylindrifolia</i>		a
<i>Eragrostis gangetica</i>		a
<i>Eragrostis heteromera</i>		a
<i>Eragrostis hierniana</i>		a
<i>Eragrostis hispida</i>		a
<i>Eragrostis inamoena</i>	ea	a
<i>Eragrostis japonica</i>		a
<i>Eragrostis lappula</i>		a
<i>Eragrostis mildbraedii</i>		a
<i>Eragrostis pallens</i>		s
<i>Eragrostis rotifer</i>		s
<i>Eragrostis tremula</i>		s
<i>Eragrostis turgida</i>		a
<i>Eriochrysis pallida</i>	ea	s
<i>Eulalia aurea</i>		a
<i>Harpochloa pseudoharpechloa</i>		r
<i>Hemarthria altissima</i>		a
<i>Heteranthoecia guineensis</i>		a
<i>Hyparrhenia bracteata</i>		a
<i>Hyparrhenia filipendula</i>		a
<i>Hyparrhenia rufa</i>		a
<i>Hyperthelia dissoluta</i>		a
<i>Ischaemum afrum</i>		a
<i>Leersia denudata</i>	ea	a
<i>Leersia friesii</i>	ea	s
<i>Leersia hexandra</i>	ea	a

Scientific name	Life form	Distribution
Leptochloa fusca	ea	a
Loudetia angolensis		r
Loudetia densispica		s
Loudetia simplex		a
Megastachya mucronata		a
Microchloa altera		s
Microchloa annua		r
Miscanthus junceus		a
Odyssea paucinervis		a
Oryza barthii	ea	a
Oryza longistaminata	ea	a
Panicum brazzavillense		a
Panicum coloratum		a
Panicum fluviicola		a
Panicum graniflorum		s
Panicum madipirensense		a
Panicum maximum		a
Panicum parvifolium	ea	a
Panicum repens	ea	a
Panicum subalbidum	ea	a
Panicum trichonode		s
Paratheria prostrata		a
Paspalidium geminatum		a
Paspalidium obtusifolium		a
Paspalum scrobiculatum		a
Pennisetum macrourum	ea	a
Pennisetum polystachion		a
Phragmites australis	ea	a
Phragmites mauritianus	ea	a
Phyllorhachis sagittata		s
Pogonarthria squarrosa		a
Rhytachne rottboellioides		a
Sacciolepis africana	ea	a
Sacciolepis chevalieri	ea	a
Sacciolepis indica	ea	a

Scientific name	Life form	Distribution
Sacciolepis typhura	ea	a
Schizachyrium sanguineum		a
Setaria incrassata		a
Setaria longisetata		a
Setaria pumila		a
Setaria sphacelata		a
Setaria verticillata		a
Sorghastrum nudipes		s
Sorghum bicolor		a
Sporobolus acinifolius		s
Sporobolus ioclados		a
Sporobolus macranthelus		s
Sporobolus nitens		s
Sporobolus pyramidalis		a
Sporobolus spicatus		a
Sporobolus subtilis		a
Triraphis schinzii		a
Tristachya leucothrix		s
Tristachya lualabaensis		s
Tristachya rehmannii		s
Urochloa trichopus		a
Vetiveria nigritana		a
Vossia cuspidata		a
<b>Other monocotyledon families</b>		
Eriocaulon cinereum		a
Eriocaulon teusczii		a
Ottelia kunenensis	sa	?
Ottelia muricata	sa	s
Gladiolus dalenii		a
Hesperantha longicollis		s
Lapeirousia littoralis		s
Lapeirousia zambeziaca		r
Thalia geniculata		?
Eulophia alta		?
Eulophia angolensis	ea	?
Eulophia walleri		?
Habenaria schimperiana	ea	a
Satyrion trinerve		a
Eichhornia natans	sa	a

Scientific name	Life form	Distribution
Potamogeton octandrus	sa	a
Potamogeton thunbergii	sa	a
Xyris capensis	ea	a
Xyris congoensis	ea	a
Xyris straminea	ea	a
<b>Dicotyledons</b>		
Asystasia gangetica		?
Hygrophila abyssinica	sa	?
Hygrophila pilosa		?
Justicia anselliana		?
Nelsonia gracilis		?
Achyranthes aspera		?
Alternanthera sessilis	ea	a
Gomphrena celosioides		a
Pandiaka carsonii		r
Rhus quartiniana	Sea	a
Centella asiatica		a
Hydrocotyle verticillata	ea	a
Adenostemma mauritianum		?
Ambrosia maritima		?
Blumea axillaris		?
Conyza welwitschii		?
Crassocephalum picridifolium	ea	a
Denekia capensis		a
Eclipta prostrata	ea	a
Emilia protracta		?
Emiliella drummondii Torre var. drummondii		r
Ethulia conyzoides	ea	a
Ethulia rhizomata		s
Grangea anthemoides		a
Grangea maderaspatana		a
Nicolasia nitens		?
Nidorella resedifolia		?
Nolletia zambesica		?
Pseudognaphalium luteo-album		?
Senecio chlorocephalus		?s
Senecio madagascariensis		?
Sonchus asper		a
Vernonia glabra		a

Scientific name	Life form	Distribution
Vernonia rosenii	sf	s
Kigelia africana	t	a
Heliotropium baclei		a
Heliotropium ovalifolium		a
Brasenia schreberi	ea	a
Gunillaea rhodesica		s
Wahlenbergia banksiana		s
Wahlenbergia undulata		a
Polycarpon prostratum		a
Ceratophyllum demersum L. var. demersum	sa	a
Chenopodium ambrosioides		a
Garcinia livingstonei	t	a
Combretum imberbe	t	s
Combretum mossambicense	t	s
Ipomoea aquatica	sa	a
Ipomoea rubens	ea	a
Cucumis metuliferus		a
Mukia maderaspatana		a
Drosera burkeana	ea	a
Drosera madagascariensis	ea	a
Bergia ammannioides		a
Bergia glutinosa		s
Bergia pentheriana		s
Acalypha ornata	s	a
Antidesma rufescens	s	a
Antidesma venosum	s	a
Caperonia fistulosa	ea	a
Croton leuconeurus	t	a
Croton megalobotrys	t	s
Phyllanthus reticulatus	s	a
Chamaecrista mimosoides		a
Senna obtusifolia		a
Senna occidentalis		a
Acacia hebeclada ssp. chobiensis	s	r
Acacia montigena	s	a
Acacia pilispina	s	a

Scientific name	Life form	Distribution
Faidherbia albida	t	a
Mimosa pigra		a
Neptunia oleracea	sa	a
Neptunia oleracea	ea	a
Aeschynomene fluitans	sa	s
Aeschynomene indica		a
Aeschynomene nilotica	ea	a
Aeschynomene uniflora	ea	a
Crotalaria ochroleuca		a
Lonchocarpus capassa	t	s
Sesbania coerulescens	ea	s
Sesbania microphylla	ea	a
Sesbania sesban	ea	a
Vigna luteola	ea	a
Vigna vexillata		a
Exacum oldenlandioides		a
Pychnosphaera buchananii	ea	a
Laurembergia repens	ea	a
Myriophyllum spicatum	sa	a
Hyptis spicigera		?
Neohyptis paniculata		
Ocimum americanum		?
Plectranthus mirabilis		?
Cassytha pondoensis		s
Utricularia benjaminiana	sa	a
Utricularia foliosa	sa	a
Utricularia gibba	sa	a
Utricularia reflexa	sa	a
Utricularia scandens		a
Utricularia stellaris	sa	a
Utricularia subulata		a
Utricularia tortilis	sa	a
Lobelia angolensis		a
Lobelia erinus		a
Anthocleista liebrechtsiana	t	a

Scientific name	Life form	Distribution
Ammannia priuriana		a
Ammannia senegalensis		s
Nesaea cordata		a
Nesaea crassicaulis	sa	a
Nesaea radicans		a
Nesaea rautanenii		r
Nesaea rigidula		s
Nesaea schinzii var. schinzii		a
Rotala filiformis	ea	a
Rotala fluitans		s
Rotala longistyla	sa	r
Rotala tenella		s
Hibiscus diversifolius	ea	a
Kosteletzkyia buettneri	ea	a
Wissadula rostrata		a
Antherotoma naudinii		a
Dissotis falcipila		r
Dissotis gracilis		r
Dissotis princeps		a
Melastomastrum segregatum	ea	a
Trichilia emetica	t	a
Turraea zambesica	t	s
Nymphoides brevipedicellata	sa	a
Nymphoides forbesiana	sa	a
Nymphoides indica ssp. occidentalis	sa	a
Glinus oppositifolius		a
Ficus capreifolia	eat	a
Ficus pygmaea	easf	r
Ficus verruculosa	easf	a
Morella serrata	eas	?s
Syzygium cordatum	eat	a
Syzygium guineense	eat	r
Nymphaea maculata	sa	a
Nymphaea nouchali	sa	a
Nymphaea nouchali	sa	?s
Jasminum fluminense	s	a
Ludwigia abyssinica	ea	a
Ludwigia leptocarpa	ea	a
Ludwigia palustris	sa	a
Ludwigia senegalensis	sa	a

Scientific name	Life form	Distribution
Ludwigia stolonifera	sa	a
Sesamum calycinum		r
Persicaria attenuata	ea	a
Persicaria senegalensis	ea	a
Kohautia caespitosa		s
Kohautia cuspidata		s
Oldenlandia angolensis		a
Oldenlandia capensis		a
Oldenlandia goreensis		a
Oldenlandia lancifolia	ea	a
Pentodon pentandrus	ea	a
Psychotria djumaensis var. zambesiaca	s	s
Psychotria peduncularis var. rufonyassana	s	s
Sabicea sp		?
Spermacoce quadrisulcata	ea	a
Salix mucronata	eat	a
Buchnera randii		s
Crepidiorhopalon spicatus		a
Cycnium tubulosum	ea	a
Jamesbrittenia elegantissima		r
Limnophila barteri	sa	a
Limnophila indica	sa	a
Lindernia parviflora		a
Mimulus gracilis		a
Rhamphicarpa brevipedicellata		s
Sopubia mannii var. tenuifolia		a
Sopubia simplex		a
Torenia thouarsii	ea	a
Walafrida angolensis		s
Melochia corchorifolia		a
Gnidia chrysantha		?
Corchorus fascicularis		a
Corchorus trilocularis		a

Scientific name	Life form	Distribution
Grewia flavescens var. olukondae	s	s
Grewia schinzii	s	r
Triumfetta pentandra		a
Trapa natans var. bispinosa	sa	a
Vahlia capensis ssp. vulgaris Bridson		s

Source: adapted from Timberlake (1998)

## 12.5 ANNEX 5: LIST OF BAT SPECIES

Table 50 Potential bat presence in the floodplain

English name	Scientific name	IUCN status	Population trend IUCN	Remark*
Dobson's Fruit Bat	<i>Epomophorus dobsonii</i>	Least concern	Stable	
Gambian Epauletted Fruit Bat	<i>Epomophorus gambianus</i>	Least concern	Unknown	
Midas free-tailed bat	<i>Mops midas</i>	Least concern	Decreasing	Locally common
Angola free-tailed bat	<i>Mops condylura</i>	Least concern	Unknown	Common
White-bellied free-tailed bat	<i>Mops niveiventer</i>	Least concern	Unknown	Locally common
Chapin's Free-tailed Bat	<i>Chaerephon chapini</i>	Least concern	Unknown	Rare
Little free-tailed bat	<i>Chaerephon pumila</i>	Least concern	Unknown	Common
Nigerian free-tailed bat	<i>Chaerephon nigeriae</i>	Least concern	Unknown	Locally common
Lesser house bat	<i>Scotophilus borbonicus</i>	Data deficient	Unknown	Common
Yellow house bat	<i>Scotophilus dinganii</i>	Least concern	Unknown	Common
	<i>Scotophilus sp.</i>			Undescribed species
Dark-winged Lesser House Bat	<i>Scotoecus albigula</i>	Least concern	Unknown	Rare
Botswana long-eared bat	<i>Laephotis botswanae</i>	Least concern	Unknown	Rare
Cape pipistrelle	<i>Pipistrellus capensis</i>	Least concern	Stable	Common
Melck's pipistrelle	<i>Pipistrellus melckorum</i>	Data deficient	Unknown	Rare
Somali pipistrelle	<i>Pipistrellus somalicus</i>	Least concern	Stable	Common
Anchieta's pipistrelle	<i>Pipistrellus anchietae</i>	Least concern	Unknown	Locally common
Rusty bat	<i>Pipistrellus rusticus</i>	Least concern	Unknown	Common
Kuhl's pipistrelle	<i>Pipistrellus kuhli</i>	Least concern	Stable	Rare
Banana bat	<i>Pipistrellus nanus</i>	Least concern	Unknown	Common
	<i>Pipistrellus sp.</i>			
Butterfly bat	<i>Glauconycteris variegata</i>	Least concern	Unknown	

\* Source: adapted from Timberlake, 1998 and IUCN, 2013

## 12.6 ANNEX 6: POTENTIAL WATERBIRDS IN THE STUDY AREA (BAROTSE FLOODPLAIN)

English name	Scientific name	Species of special concern (Timberlake, 1998)
Dabchick (Little Grebe)	Tachybaptus ruficollis	
White Pelican	Pelecanus onocrotalus	
Pink-backed (Grey) Pelican	Pelecanus rufescens	
Reed (Long-tailed) Cormorant	Phalacrocorax africanus	
White-breasted Cormorant	Phalacrocorax carbo	
African Darter	Anhinga melanogaster	
Grey Heron	Ardea cinerea	
Goliath Heron	Ardea goliath	
Purple Heron	Ardea purpurea	
Great White Heron (Egret)	Egretta alba	
Little Egret	Egretta garzetta	
Yellow-billed Egret	Egretta intermedia	
Black Egret	Egretta ardesiaca	
Slaty Egret	Egretta vinaceigula	Visitor, Vulnerable (IUCN), population decreasing
Squacco Heron	Ardeola ralloides	
Rufous-bellied Heron	Butorides rufiventris	
Green-backed Heron	Butorides striatus	
Black-crowned Night Heron	Nycticorax nycticorax	
White-backed Night Heron	Gorsachius leuconotus	
Little Bittern	Ixobrychus minutus	
Dwarf Bittern (Rail Heron)	Ixobrychus sturmii	
Bittern	Botaurus stellaris	
Hamerkop	Scopus umbretta	
Woolly-necked Stork	Ciconia episcopus	
Open-billed Stork	Anastomus lamelligerus	
Saddle-billed Stork	Ephippiorhynchus senegalensis	
Marabou Stork	Leptoptilos crumeniferus	
Yellow-billed Stork (Wood Ibis)	Mycteria ibis	
Sacred Ibis	Threskiornis aethiopicus	
Glossy Ibis	Plegadis falcinellus	
Hadedda Ibis	Bostrychia hagedash	
African Spoonbill	Platalea alba	
Greater Flamingo	Phoenicopterus ruber	
Lesser Flamingo	Phoenicopterus minor	
White-faced Duck	Dendrocygna viduata	
Fulvous Duck	Dendrocygna bicolor	
Egyptian Goose	Alopochen aegyptiacus	
Yellow-billed Duck	Anas undulata	
Cape Teal	Anas capensis	
Hottentot Teal	Anas hottentota	
Red-billed Teal	Anas erythrorhyncha	
Southern Pochard	Netta erythrophthalma	
Pygmy Goose	Nettapus auritus	
Knob-billed Duck	Sarkidiornis melanotos	
Spur-winged Goose	Plectropterus gambensis	
African Fish Eagle	Haliaeetus vocifer	

English name	Scientific name	Species of special concern (Timberlake, 1998)
African Marsh Harrier	Circus ranivorus	
Osprey	Pandion haliaetus (PM)	
Harlequin Quail	Coturnix delegorguei	
Wattled Crane	Bugeranus carunculatus	Vulnerable (IUCN), population decreasing
Grey Crowned Crane	Balearica regulorum	
African Water Rail	Rallus caerulescens	
African Crake	Crex egregia	
Black Crake	Amaurornis flavirostris	
Red-chested Flufftail	Sarothrura rufa	
Purple Gallinule (Swamp Hen)	Porphyrio porphyrio	
Lesser Gallinule	Porphyrola alleni	
Moorhen	Gallinula chloropus	
Lesser Moorhen	Gallinula angulata	
Red-knobbed	Coot Fulica cristata	
African Jacana (Lily-trotter)	Actophilornis africanus	
Lesser Jacana	Microparra capensis	
Painted Snipe	Rostratula benghalensis	
Ringed Plover	Charadrius hiaticula (PM)	
White-fronted Plover	Charadrius marginatus	
Kittlitz's Sandplover	Charadrius pecuarius	
Three-banded Plover	Charadrius tricollaris	
Caspian Plover	Charadrius asiaticus (PM)	
Grey Plover	Pluvialis squatarola (PM)	
Blacksmith Plover	Vanellus armatus	
White-crowned Plover	Vanellus albiceps	
Senegal Wattled Plover	Vanellus senegallus	
Long-toed (White-winged) Plover	Vanellus crassirostris	
Ruddy Turnstone	Arenaria interpres (PM)	
Terek Sandpiper	Xenus cinereus (PM)	
Common Sandpiper	Tringa hypoleucos (PM)	
Green Sandpiper	Tringa ochropus (PM)	
Wood Sandpiper	Tringa glareola (PM)	
Marsh Sandpiper	Tringa stagnatilis (PM)	
Greenshank	Tringa nebularia (PM)	
Curlew Sandpiper	Calidris ferruginea (PM)	
Little Stint	Calidris minuta (PM)	
Sanderling	Calidris alba (PM)	
Ruff/Reeve	Philomachus pugnax (PM)	
Great Snipe	Gallinago media (PM)	Near Threatened (IUCN), population decreasing
Ethiopian Snipe	Gallinago nigripennis (PM)	
Curlew	Numenius arquata (PM)	
Avocet	Recurvirostra avosetta (PM)	
Black-winged Stilt	Himantopus himantopus	
Water Dikkop	Burhinus vermiculatus	
Red-winged Pratincole	Glareola pratincola	
Lesser Black-backed Gull	Larus fuscus (PM)	
Grey-headed Gull	Larus cirrocephalus	
Caspian Tern	Hydroprogne caspia	
Whiskered Tern	Chlidonias hybridus	

English name	Scientific name	Species of special concern (Timberlake, 1998)
White-winged Tern	Chlidonias leucopterus (PM)	
African Skimmer	Rynchops flavirostris	Near Threatened (IUCN), population decreasing
Black Coucal	Centropus bengalensis/grillii	
Coppery-tailed Coucal	Centropus cupreicaudus	
White-browed Coucal	Centropus superciliosus	
Marsh Owl	Asio capensis	
Natal (Swamp)	Nightjar Caprimulgus natalensis	
Pied Kingfisher	Ceryle rudis	
Giant Kingfisher	Ceryle maxima	
Malachite Kingfisher	Alcedo cristata	
Blue-cheeked Bee-eater	Merops persicus (PM)	
Southern Carmine Bee-eater	Merops nubicoides	
White-fronted Bee-eater	Merops bullockoides	
White-cheeked Bee-eater	Merops variegatus	
Wire-tailed Swallow	Hirundo smithii	
European Sand Martin	Riparia riparia (PM)	
African (Brown-throated) Sand Martin	Riparia paludicola	
Banded Martin	Riparia cincta	
European Reed Warbler	Acrocephalus scirpaceus (PM)	
Sedge Warbler	Acrocephalus schoenobaenus (PM)	
Cape Reed (Lesser Swamp) Warbler	Acrocephalus gracilirostris	
Greater Swamp Warbler	Acrocephalus rufescens	
African Sedge (Little Rush) Warbler	Bradypterus baboecala	
Pale-crowned Cisticola	Cisticola brunnescens	
Red-faced Cisticola	Cisticola erythrops	
Black-backed Cisticola	Cisticola galactotes	
Chirping Cisticola	Cisticola pipiens	
Levaillant's Cisticola	Cisticola tinniens	
African Pied Wagtail	Motacilla aguimp	
Long-tailed Wagtail	Motacilla clara	
Pink-throated Longclaw	Macronyx ameliae	
Swamp Boubou	Laniarius bicolor	
Brown-throated Weaver	Ploceus xanthopterus	
Red Bishop	Euplectes orix	
Golden Bishop	Euplectes afer	
Red-shouldered Widow	Euplectes axillaris	
Common Waxbill	Estrilda astrild	
Orange-breasted Waxbill	Sporaeginthus subflavus	

PM: Palearctic Migrants

Source: Timberlake, 1998

## 12.7 ANNEX 7: POTENTIAL HERPETOFAUNA IN THE STUDY AREA (BAROTSE FLOODPLAIN)

English name	Scientific name	Habitat	Remark
<b>Reptiles</b>			
Helmeted Terrapin	Pelomedusa subrufa	inhabits seasonal marshes (pans)	
Okavango Hinged Terrapin	Pelusios bechuanicus	need clear waters	
Zambian Hinged Terrapin	Pelusios rhodesianus	prefers weed-choked backwater	
Common Flap-neck Chameleon	Chamaeleo dilepis		
Cape Dwarf Gecko	Lygodactylus capensis		
Chobe Dwarf Gecko	Lygodactylus chobiensis		endemic to the Zambezi Basin
Tropical House Gecko	Hemidactylus mabouia		
Barotse Burrowing Skink	Typhlacontias gracilis		endemic to western Zambia
Kalahari Burrowing Skink	Typhlacontias rohani		
Speckled Skink	Mabuya punctulata	burrowing in sand	
Variable Skink	Mabuya varia	savanna	
Wahlberg's Skink	Mabuya wahlbergii	arboreal species	
Bocage's Dambo Skink	Eumecia anchietae	swampy areas	
Sundevall's Writhing Skink	Lygosoma sundevallii		fossorial skink
Spotted-neck Snake-eyed Skink	Panaspis "maculicolis"		northwestern range extension for this small species
Barotse Legless Skink	Typhlosaurus jappi		endemic to Barotseland west of the Zambezi
Kalahari Plated Lizard	Gerrhosaurus auritus		kalahari endemic, very common in Barotseland
Ellenburger's Plated Snake-lizard	Tetradactylus ellenbergeri		
Nile Monitor/Water Leguaan	Varanus niloticus		common
Black Round-snouted Amphisbaenian	Zygaspis nigra		
Kalahari Round-snouted Amphisbaenian	Zygaspis quadrifrons		widespread
Barotse Pestle-tailed Amphisbaenian	Dalophia ellenbergeri		
Zambezi Pestle-tailed Amphisbaenian	Dalophia pistillum		
Zambezi Blind Snake	Rhinotyphlops mucruso		

English name	Scientific name	Habitat	Remark
Southern African Python	Python natalensis		
Rhombic Night Adder	Causus rhombeatus	savanna	widespread
Rhombic Night Adder	Causus bilineatus		
Puff Adder	Bitis arietans arietans	savanna	widespread
Common Purple-glossed Snake	Amblyodipsas polylepis		widespread fossorial species
Kalahari Purple-glossed Snake	Amblyodipsas ventrimaculatus		kalahari endemic
Angolan Quill-snouted Snake	Xenocalamus mechowii		fossorial species
Cape Centipede-eater	Aparallactus capensis		widespread
Angolan Garter Snake	Elapsoidea semiannulata		
Zambezi Garter Snake	Elapsoidea boulengeri		widespread in the Zambezi Basin but in Barotseland it has only been recorded from Lealui
Anchieta's Cobra	Naja anchietae		
Black-necked Spitting Cobra	Naja nigricollis		widespread in west and central Africa
Blotched Wolf Snake	Lycophidion multimaculatum		
Herald Snake	Crotaphopeltis hotamboeia		widespread
Barotse Water Snake	Crotaphopeltis barotseensis	papyrus swamps	endemic to the greater Okavango system
Olive Marsh Snake	Natriciteres olivacea	aquatic	widespread
Bangweulu Striped Swamp Snake	Limnophis bangweolicus		endemic to the greater Okavango system
Grey-bellied Grass Snake	Psammophylax variabilis	grassland	
Barotse Striped Beaked Snake	Rhamphiophis acutus jappi		
Lined Olympic Snake	Dromophis lineatus	swamp-dwelling species	
Olive Grass Snake	Psammophis mossambicus		
Angola Green Snake	Philothamnus angolensis	semi-aquatic	
Southeastern Green Snake	Philothamnus hoplogaster	dambos	
Ornate Green Snake	Philothamnus ornatus	semi-aquatic	
Slender Green Snake	Philothamnus heterolepidotus	semi-aquatic	
Variiegated Bush Snake	Philothamnus semivariiegatus	less dependent on water than most members of the genus	
Boomslang	Dispholidus typus	savanna	widespread
Oates' Vine Snake	Thelotornis oatesii	savanna tree snake	
Common Egg-eater	Dasypeltis scabra	typically inhabiting floodplains	

English name	Scientific name	Habitat	Remark
Nile Crocodile	Crocodylus niloticus	fully aquatic	
<b>Amphibians</b>			
Tropical Clawed Frog/	Xenopus muelleri	fully aquatic	
Peter's Platanna	Xenopus petersii	Common in water bodies with muddy substrates such as cattle drinking ponds	
Guttural Toad	Bufo gutturalis	Locally abundant, found on grassy floodplain and near water	
Power's Toad	Bufo poweri		
Flat-backed Toad	Bufo maculatus	Found along the edges of waterways	very common
Lemaire's Toad	Bufo lemairii	Typically inhabiting floodplains	
Beira Dwarf Toad	Bufo beiranus	Typically inhabiting floodplains	
Red-banded Rubber Frog	Phrynomantis bifasciatus	Found in vegetaton along rivers	
Spotted Rubber-Frog	Phrynomantis affinis		
Barotse Snout-burrowing Frog Also named Mongu shovelnose frog	Hemisus "barotseensis"	Typically inhabiting floodplains	Supposedly endemic
Guinea Snout-burrower	Hemisus guineensis microps	Inhabits raised "islands" where palms are present	common
Marbled Snout-burrower	Hemisus marmoratus	Found in damp soil near water in localised patches of thick vegetation	
Tropical Bullfrog	Pyxicephalus edulis		
African Bullfrog	Pyxicephalus adpersus	Found on grassy flood plain	uncommon
Tandy's Sand Frog	Tomopterna tandyi	Occur in patches on the grassy floodplain	
Golden-backed Frog	Hylarana darling		
Ornate Burrowing Frog	Hildebrandtia ornata	Savanna and breeds in ephemeral pans	
Spotted Ridged Frog	Ptychadena subpunctata	Found around waterbodies with thick vegetation	locally very common
Mascarene Ridged Frog	Ptychadena mascareniensis	flooded grassland.	locally abundant
Striped Ridged-Frog	Ptychadena porosissima		
Grandison's Ridged-Frog	Ptychadena grandisonae		
Small Ridged Frog	Ptychadena taenioscelis	Present in localized patches in thick vegetation near water	
Upemba Grass Frog	Ptychadena upembae		

English name	Scientific name	Habitat	Remark
Udzungwe Grass Frog	<i>Ptychadena uzungwensis</i>		
Dwarf Grass Frog	<i>Ptychadena pumilio</i>		
Guibé's Grass Frog	<i>Ptychadena guibei</i>		
Natal Puddle Frog	<i>Phrynobatrachus natalensis</i>	Found near water in thick vegetation	abundant
Mababe Dwarf Puddle Frog	<i>Phrynobatrachus mababiensis</i>		
Bocage's Tree Frog	<i>Leptopelis bocagii</i>	grassy flood plain in rangelands	widespread
Cubango Running Frog	<i>Kassina kuvangensis</i>	semi-aquatic	
Senegal Running Frog	<i>Kassina senegalensis</i>		
Witte's Leaf-folding Frog	<i>Afrivalus wittei</i>		
Günther's Sharp-snouted Reed Frog	<i>Hyperolius nasutus</i>		
Bocage's Long Reed Frog	<i>Hyperolius benguellensis</i>		
Angolan Reed Frog	<i>Hyperolius angolensis</i>	Found above ground level in tall papyrus adjacent to water	
Power's Rain Frog	<i>Breviceps poweri</i>	Found on grassy floodplain. Abundant but difficult to find	

Source: adapted from Timberlake, 1998, Channing, 1998 and IUCN, 2013.

## 12.8 ANNEX 8: WETLAND DEPENDENT BUTTERFLIES AND ODONATA

The following table lists wetland dependent butterflies present in the study area.

English name	Scientific name	Habitat	Threats
African Wood White	Leptosia inalcesta	Riparian forests and thickets	None
Papyrus Dotted Border	Mylothris rubricosta	Marshes made of papyrus and polygonum	None
	Mylothris overlaeti	Marshes	Vulnerable
White Tipped Blue	Eicochrysops hippocrates	Permanent wetland (perennial marshes) and along river banks	None
Bush Bronze	Cacyreus lingeus	Along stream banks	None
Common Meadow Blue	Cupidopsis cissus	Wet grasslands, meadows and dambos	None
Lesser Ringlet	Ypthimomorpha itonia	Marshes, riverine grassland	None
Marsh Acraea	Acraea rahira rahira	Marshes	None
Banded Orange Acraea	Acraea ventura ventura	Wet grassland	None
Dark Marsh Acraea	Acraea mirifica	Riverine grassland	Vulnerable
The Falls Acraea	Acraea acerata	Marshes	None
	Acraea periphanes	Wet grassland	Vulnerable
Pirate	Catacroptera cloanthe	Marshes	None
Marsh Commodore	Junonia ceryne ceryne	Marshes	None
Jordan's Sailer	Neptis jordani	Riverine grassland, marshes	None
Water Watchman	Parnara monasi	Areas along rivers	None
Beautiful Zebra Blue	Leptotes pulcher	Marshes	No threats but rare
Fontain's Gem	Zeretis fontainei	Dambos	Vulnerable
Scarce Gem	Zeretis sorhagenii	Dambos	Vulnerable
False Fritillary	Pseudargynnis hegemone	Marshes, forest edge	None
Marsh Swift	Borbo micans	Marshes, wet grasslands	None

Source: adapted from Timberlake & Childes (2004)

The following table lists Odonata present in the Barotse flood plain, Timberlake (1998). All Odonata have their life cycles closely linked with river system.

Scientific name	Known distribution / status
Agriocnemis exilis	wide distribution
Agriocnemis sp.nr. exilis	
Agriocnemis sp.nr. falcifera	
Agriocnemis Victoria	

Scientific name	Known distribution / status
Ceriagrion cf. glabrum	wide distribution / common
Ceriagrion whellani	
Enallagma glaucum	
Pseudagrion coelestis	wide distribution / uncommon
Pseudagrion sp.	
Crenigomphus sp	
Ictinogomphus ferox	
Macromia bifasciata	
Macromia picta	
Macromia sp	
Acisoma panorpoides	
Acisoma sp.	
Aethriamanta rezia	
Brachythemis leucostricta	
Crocothemis erythraea	wide distribution / common
Crocothemis sp	
Diplacodes deminuta	
Diplacodes lefebvreii	wide distribution / common
Hemistigma albipuncta	wide distribution / common
Olpogastra lububris	
Orthetrum brachiale	
Orthetrum cf. brachiale	
Orthetrum chrysostigma	
Orthetrum icteromelas cinctifrons	
Orthetrum trinacrium	
Palpopleura lucia	wide distribution / common
Rhyothemis semihyalina	
Tholymis tillarga	
Tamea burmeisteri	
Trithemis annulata	wide distribution / common
Trithemis Hecate	
Trithemis kirbyi	
Trithemis sp.	
Urothemis edwardsi	wide distribution / common

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## 12.9 ANNEX 9: PROOF OF SUBMISSION TO ZEMA

24th December, 2013

The Director General,  
Zambia Environmental Management Agency,  
Corner of Suez/Church Roads,  
P. O. Box 35131,  
**Lusaka.**

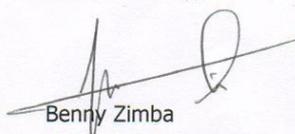


Dear Sir,

**Re: SCOPING REPORT FOR THE DETAILED ASSESSMENT, CONCEPTUAL DESIGN AND ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA) STUDY FOR THE IMPROVED USE OF PRIORITY TRADITIONAL CANALS IN BAROTSE SUB BASIN OF THE ZAMBEZI**

Kindly find enclosed one (1) copy of the Scoping ESIA Study for the Detailed Assessment Conceptual Design and Social Impact Assessment Study for the improved use of priority traditional canals in the Barotse Sub basin of the Zambezi for your review and records.

Yours sincerely,

  
Benny Zimba

Country Representative, NIRAS Zambia Ltd

CC **The National Director**- Maritime Affairs and Inland Waterways (MTWSC)  
**The National Coordinator** – The Pilot Programme on Climate Resilience in Zambia  
**The Participatory Adaptation Advisor** – The Pilot Programme on Climate Resilience in Zambia



Project followed by: Eric Verlinden

Tel.: +33 4 66 87 50 20 Fax: +33 4 66 87 51 03

Object: ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

Ref: Contract No.MTWSC /C/ID/01/12

*Detailed Assessment, Conceptual Design and Environmental and Social Impact Assessment (ESIA) Study for the improved use of priority Traditional canals in the Barotse Sub-basin of the Zambezi*

**TO : M. THE DIRECTOR GENERAL OF ZAMBIA ENVIRONMENTAL MANAGEMENT AGENCY AT: ZAMBIA ENVIRONMENTAL MANAGEMENT AGENCY, LUSAKA**



28TH MAY 2014

Dear Sir,

Please find a printed draft final version of the Environmental and Social Impact Assessment for the improved use of priority canals in the Barotse Sub-Basin of the Zambezi for review cycle and comments. Please include page number and section number to comments to ease follow-up.

This version does not include the Environmental and Social Management Plan and the Non Technical Summary as they will be done once all comments have been addressed in the Final ESIA report.

Can you acknowledge receipt of this document?

Yours faithfully,

Eric Deneut  
ESIA Specialist

Eric Verlinden  
Team Leader

Study of the Traditional Canals in the  
Barotse Sub-basin of the Zambezi  
BRLi



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## SECOND WORKSHOP

**PPCR BAROTSE CANALS REHABILITATION PROJECT**  
**2<sup>ND</sup> STAKEHOLDERS WORKSHOPS**  
**COMMUNITY BASED**  
**13<sup>TH</sup> JANUARY 2014**

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**PPCR BAROTSE CANALS REHABILITATION PROJECT**  
**2<sup>ND</sup> STAKEHOLDERS WORKSHOPS**  
**PROVINCIAL/DISTRICT INSTITUTIONAL BASED**  
**14<sup>TH</sup> JANUARY 2014**

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## THIRD WORKSHOP

## ATTENDANCE LIST FOR THE PILOT PROGRAMME ON CLIMATE RESILIENCE (PPCR) PHASE II BAROTSE CANALS REHABILITATION PROJECT

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## 12.11 ANNEX 11 : TERMS OF REFERENCE FOR THIS STUDY

# **Annex 1: Terms of references for the ESIA**

Insert TORs

**TERMS OF REFERENCE FOR  
DETAILED ASSESSMENT STUDY, CONCEPTUAL DESIGN AND ENVIRONMENTAL AND  
SOCIAL ANALYSIS FOR THE  
IMPROVEMENT, TO CLIMATE RESILIENT STANDARDS, OF SELECTED  
STRATEGIC CANALS WITHIN THE BAROTSE SUB-BASIN**

## **1. BACKGROUND**

### **A. The Barotse Floodplain**

The Barotse sub-basin (population 1.1 million in 2010) is one of Zambia's most vulnerable areas. It comprises the Barotse Floodplain, Zambia's second largest wetland<sup>1</sup>, a designated Ramsar site, and proposed as a World Heritage Site. The Barotse floodplain in the Zambezi is at the center of the livelihoods and culture of the Lozi people, who depend on the floodwaters for irrigation, fisheries, wildlife, and cultural events. It is the site of the world-renowned Kuomboko ceremony, marking the migration of the Lozi king (the Litunga) and his people to higher lands at the end of the rainy season. The annual floods start around December and reach their peak 3-5 months later, flooding an area of over 1 million ha. The width of the floodplain averages 30 km, but reaches 50 km north of Mongu. It extends from the Zambezi's confluence with the Kabombo and Lungwebungu Rivers (in the north) to south of Senanga, above the Ngonye falls (circa 230 km south).

The canals in the Barotse sub-basin have over the years been maintained through community-based approaches, and/or through force account, where the Provincial Maritime Department contracts out community-based works through cash-for-works or (with lesser success) food-for-works schemes. For works requiring dredging or excavation, the Maritime Department has relied on machinery based in Mongu, and implemented its own works, funded through an annual budget for canal maintenance. In all cases, the works are defined by the Government, with BRE and community participation, and community members are paid on the basis of unit prices for different work items, i.e. a contract based on "input" to the works. While the arrangements are socially acceptable, the results to date have been less than optimal. The problem is that the workers (or contractors) tend to have the wrong incentive, i.e. to carry out the maximum amount of works to maximize their profits, while at the same time they do not feel accountable for maintenance of service levels.

**(a) Figure 1 Satellite Map of the Barotse Floodplain**

<sup>1</sup> The main flood plain is 5,500 km<sup>2</sup> but it extends to 10,750 km<sup>2</sup> if the floodplains of tributaries (such as the Luena Flats) are considered. The landscape is generally flat, from 914 to 1,218 m. Sources: UNESCO, and Wikipedia,



Source: NASA

(b) The soil is mostly nutrient-poor Kalahari Aeolian sands, waterlogged during the flood period and dry most of the year. At the same time, the Barotse floodplain supports a rich and diverse ecological and human landscape, characterized by a network of canals, mounds, traditional houses, cultural shrines, swamp and evergreen forests, and a variety of natural landmarks.

(c) The Lozi people have learned to live with floods for centuries, relying on a complex system of canals for navigation, drainage, cultural ceremonies, fisheries, and irrigation. The canals and mounds are vital to their socio-economic livelihood. Through centuries of adaptation, they developed an intricate system of land and natural resource management under the overall patronage of their King (the Litunga) and the Barotse Royal Establishment.

This sub-basin accounts for a considerable and predominantly rural agrarian population exposed to harsh impacts of extreme climate change. This results in high pressure on arable land, and widespread degradation to the natural environment and natural resources which in turn aggravates exposure to climate extremes. It however remains an area of very significant biodiversity, while remaining a vital source of drinking water, power, irrigation, and natural resources for its people. Almost all of Barotse falls within the immediate catchment of the Zambezi River.

People living on the floodplain have developed intricate systems of adaptation, particularly through the development of the canals (many built during the 19<sup>th</sup> century) and mounds, used for settlements, farming, and burial sites. Soil is brought from the plains and piled on the mounds. Settlements are typically small and semi-permanent. Some of the mounds are used for temporary shelter or fishing camps, and some have been abandoned and are used for burials or animal shelters.

Traditionally, people living in the floodplain moved between two houses (one on the plain, one on higher land), but this tradition has been progressively weakened due to increasing urban-rural migration and changes in livelihood patterns. Economic opportunities are particularly limiting for the youth, who are typically allocated land further from irrigation canals, as well as for vulnerable elderly taking care of children and orphans. Traditional systems of canal and natural resources management are also under threat due to increased monetization, external pressures (particularly on forestry and fishing resources), increasing concentration of cattle ownership, and incongruencies between forms of traditional management and central government authority. Vegetation clearing in eastern Angola highlands as well as in the watersheds surrounding the Barotse basin is further changing hydrology and flood patterns.

The above trends have made it progressively more difficult for BRE authorities to organize communities to voluntarily clear the canals, and has led to expanded private water use behaviour, over communal or group agreements on water uses. The Harbor Master, who

responds to the Ministry of Communications, Transport and Public Works, has developed systems of food-for-works and cash-for-works (at about ZMK 5,000,000 per km) for the cleaning of the canals, but routine maintenance is affected by the lack of a steady and reliable operation and maintenance (O&M) budget. Water user associations are virtually unknown, although traditional systems of management (under BRE) remain strong.

Climate change is adding increasing pressure to these already complex anthropogenic trends. Once heavily reliant on traditional early warning signs, Lozi farmers are now increasingly exposed to unpredictable floods, and periods of drought and intense rainfall. The traditional canals built in the late 1880s have become silted and un-navigable, affecting agriculture and fisheries production and water logging is increasingly affecting shallow wells and food crop production.

Addressing these challenges effectively will require in-depth studies and participatory development planning endorsed by both traditional (BRE) and Government authorities, as well as local communities. In particular, attention has to be paid to water uses that promote livelihood diversification for the most vulnerable – women, elderly, and the youth – in ways that respect and sustain the delicate environment of Barotse and the Lozi's socio-cultural traditions, and is fully compatible with the submission of the Barotse floodplain as a World Heritage Site. Rehabilitation and management of the canals should aim to restore the canals as much as possible to their original state and socio-economic uses, and maximize the use of local labor (particularly targeting the most vulnerable households) while at the same time enhancing the canals' use in controlling the effects of climate change – particularly in managing floods, droughts and the effects of increased temperatures. It is also critically important that any rehabilitation and improved management of the canals not affect in any significant way the flood patterns for downstream riparians located along the Zambezi (particularly Namibia and Mozambique). To this end, the study should assess carefully not only the likely future socio-economic and physical impacts of the rehabilitated canals, but also the potential impacts of resulting changes in landuse (e.g. increased farming) on the hydrology and geomorphology of the floodplain.

As many of the target canals are deeply silted, solid community organization and agreement amongst water users – particularly on responsibilities and arrangements for O&M - will be essential prior to the start of the works. Hence, the design of the component should take into account an initial solid period of institution-building, with clear criteria for proceeding to investment.

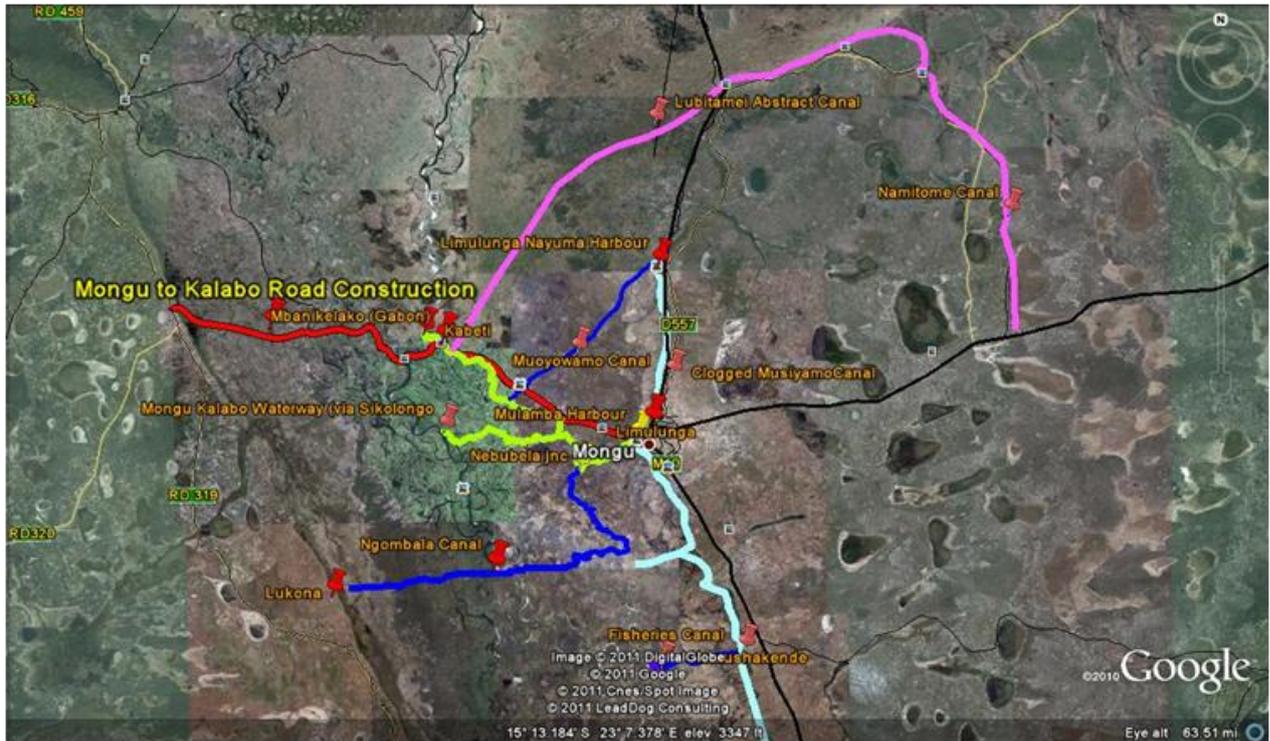
Fortunately, the PPCR counts with the support of BRE and the local authorities, as well as several complementary partners such as the National Heritage Conservation Commission, the Red Cross, Concern Worldwide, the Provincial and District DMMU committees and provincial Harbor Master, Water and Agriculture agencies. They know the sub-basin well, and their support and active involvement in the consultations led by the study would be of high importance.

The rehabilitation and strengthened management of canals will be accompanied closely by a separate, Participatory Adaptation component, which will fund a range of adaptation activities proposed by Local Area Development Committees and the 8 pilot districts of the

sub-basin (Kalabo, Kaoma, Lukulu, Mongu, Senanga, Sesheke, Shangambo, and Kazungula). Even though the design of this Participatory Adaptation component is not part of this study, the consultant should keep it closely in mind for complementarity.

### B. Target Canals

There are 5 target canals that have been prioritized by BRE and regional authorities and should be assessed by the study. Their approximate location is shown on the map below, and their approximate characteristics are as follows:



1. Muoyowamo Canal (28 km) – This canal was built between 1887 and 1889. Used in the annual Kuomboka ceremony, it is a culturally critical canal for the Lozi people. It is also used for agriculture, transport, drainage. This is a relatively large canal that would likely require mechanized dredging.
2. Lubitamei Canal (87 km) – important for agriculture, fisheries, transport, and drainage. This is a relatively narrow canal, which is normally handled through community-based O&M, although it may require some mechanization in particularly clogged areas.
3. Ng'ombala Canal (43.7 km) – an important canal for transportation linking the east and west banks to Kama. Likely to also require mechanized dredging.
4. Musiamo Canal (131 km) runs along the banks of the flood plain and is the longest – a critically important canal for agriculture, fisheries and drainage. Like Lubitamei, it is mostly maintained through community-based labor.
5. Fisheries Canal (9 km) – as per canals 1 and 3, likely to require mechanized dredging.

The initial design had also included the Mongu-Kalabo canal. Nonetheless, this canal is likely to be affected by the ongoing construction of the Mongu-Kalabo road, a large-scale

initiative which is outside the scope of the present project, and should therefore not be part of the PPCR design or included in the study.

It should be noted that due to their relatively small size (about 3 meters in diameter), earthlining, and degree of erosion, the precise location of the canals is not always clear from a quick side inspection or using Google Maps, particularly during the dry season. It will be important for the study to map out both their existing path, as well as any adjustments proposed to improve their role in climate resilience.

### C. The Pilot Program for Climate Resilience

The Pilot Program of Climate Resilience (PPCR) aims to incorporate adaptation to climate change into the most vulnerable sectors of the economy. In June 2011, Zambia submitted its proposal to a donors committee in Cape Town, and was pledged up to US\$40-50 million in grant resources, and up to US\$38 million in highly concessionary credit. The PPCR is an inherent part of Zambia's emerging National Climate Change Program. It aims to support three projects:

1. **Strengthening Climate Resilience in Zambia and the Barotse sub-basin** (*administered through the World Bank*). This project (ca. US\$34 million) will include three components:
    - *Strategic program support to Zambia's emerging Climate Change Programme* (at the national level), including institutional strengthening, policy mainstreaming, improved climate information, and management of external resources.
    - *Climate-Resilient Infrastructure - Improved management of priority canals in Western Province – the subject of the current study.*
    - Participatory Adaptation in 8 districts of the Barotse sub-basin (7 in Western Province, 1 in Southern Province). This will help supplement the Constituency Funds to help districts and Local Area Committees develop local plans that incorporate climate resilience.
  2. **Strengthening Climate Resilience in the Kafue Sub-Basin** (*administered through the African Development Bank*). This project (ca. US\$37 million) will include two components:
    - *Climate-Resilient Infrastructure - Rehabilitation of access roads linking Victoria Falls to Kafue National Park to flood-resistant standards*
    - *Participatory Adaptation* in 16 districts of the Kafue sub-basin.
  3. **Private Sector Support to Climate Resilience** (*administered through the International Finance Corporation*), approximately US\$15 million.
- These three projects are starting preparation now, and are expected to become active in 2013, for a period of 6 years (2013-2019). Their preparation is being funded through a Project Preparation Grant, which is also funding the present study.

**This study covers the detailed design and socio-environmental safeguards of the Climate-Resilient Infrastructure Component for Project #1, above.**

At present, the Ministry of Finance is also executing a Technical Assistance Grant (Phase I of PPCR) for US\$1.5 million, primarily to promote institutional coordination and economic mainstreaming. However, the PPCR is an inter-sectoral program, and counts with the support of several platforms managed by an eminent expert on their sector. As the

Climate Resilient Infrastructure platform is headed by an expert from the Roads Development Agency (RDA), the Ministry of Finance has asked RDA to assist them with the procurement of the studies and Environmental and Social Impact Assessments for, respectively, the canals in Barotse, and the access roads in Kafue. These two studies – and their associated ESIA – are being procured separately.

In addition, the Project Preparation Grant is funding the following preparatory studies:

1. A Strategic Environmental and Social Assessment (SESA), Environment and Social Management Framework (ESMF), and Resettlement Policy Framework for the entire program.
2. A baseline study for the two pilot sub-basins
3. The design of the Participatory Adaptation Component
4. Preparation of the final project documents, including Operational Manuals.

Whilst the SESA and ESMF will cover the entire project, the Climate-Resilient Infrastructure component is sufficiently sensitive to be rated Environmental Category A under World Bank safeguard policies. Hence, a full fledged and careful Environmental and Social Impact Assessment (ESIA) is needed as part of this study.

Preparation of the PPCR projects will be coordinated by the Ministry of Finance and National Economic Planning (MoFNP), Economic Management Department, in close collaboration with the inter-sectoral platforms mentioned above. Key stakeholders for this study will include, in addition to MoFNP:

- The Roads Development Agency (RDA) which is managing the study's procurement
- The Maritime Department at the national and provincial (Harbor Master) levels – the Government agency in charge of canals
- The National Heritage Conservation Commission – responsible for the submission of Barotse as a World Heritage Site
- The Zambian Wildlife Authority (ZAWA) – responsible for the Ramsar management
- The Provincial Government of Western Province, through the Provincial Development Planning Committee and the Disaster Management and Mitigation Committee
- The Barotse Royal Establishment – responsible for all traditional management in Barotse
- The Zambian Civil Society Network – responsible for community sensitization
- The Zambian Red Cross – a partner with ZCSN on community sensitization

Further details on the PPCR can be found on Zambia's submission to the PPCR Sub-Committee in June 2011 at the link below:

<http://www.climateinvestmentfunds.org/cif/sites/climateinvestmentfunds.org/files/PPCR%208%20SPCR%20Zambia.pdf>

**The selection of the consultant will be processed based on Quality and Cost-Based Selection (with heavy reliance on Quality) and the type of the contract will be a Lump Sum contract.**

## **2. OBJECTIVES AND TASKS EXPECTED FROM THE ASSIGNMENT**

### **A. Objective**

The objective of the assignment is **to assess how use of the targeted canals in the Barotse sub-basin can be strengthened to optimize their role in supporting the local population to become more climate resilient, taking into account the prevailing socio-cultural and environmental context.**

The ultimate goal of the investment is to strengthen canal management and rehabilitation in order to facilitate a transformative process in the Barotse, where communities would become better adapted to climate extremes (higher temperatures, and increasing floods and droughts). Building upon the strength of traditional systems, the study should also propose ways whereby traditional management could be optimized to take into account present-day realities and socio-economic pressures.

It is envisaged that the Consultant will design the Canal component (estimated total cost US\$11 million) with two major sub-components:

- (d) *Strengthened Management of Traditional Canals (estimated cost US\$2.5 million)*, providing the necessary policy, technical and institutional support to canal management, including: (i) piloting innovative ways to ensure sustainability – such as introduction of performance based contracts and dedicated operation and maintenance (O&M) funds; (ii) facilitating agreement between traditional water users; and (iii) better organization of communities in O&M.
- (e) *Canal Rehabilitation (estimated cost US\$8.5 million)*, including embankment stabilization (with earthworks and vegetative approaches), selected dredging, and erosion-control measures, with a view to restore the canals as much as possible to their traditional design, while optimizing their use in climate resilience. With the exception of specialized interventions (such as dredging), the works are expected to maximize the use of local labor, and benefit the most vulnerable. Rehabilitation of the canals should only proceed once pre-defined community organization criteria under sub-component (a) were achieved, thus ensuring sustainable O&M.

The estimated costs could be refined and if necessary adjusted during the study.

### **B. Principles to be followed**

The Consultant should design the interventions with the following principles in mind:

1. Strict observance and collaboration with traditional management structures,

2. Respect and conformity with the floodplain's status as a Ramsar site and proposed World Heritage Site
3. Optimizing the canals' role in climate resilience
4. Minimizing environmental and social impacts (including on riparians downstream)
5. Achieving sustainable future operation and maintenance
6. Maximizing the use of local labor, particularly benefitting the most vulnerable households
7. Be economically justifiable
8. Be within the available budget.

*The study should be undertaken in close consultation at all times with the BRE, the national PPCR team, the provincial and district authorities, and the National Heritage Conservation Commission, to ensure that the design is optimized to local conditions.*

### C. Sequencing

The study would involve the following estimated sequencing (the consultant should be free to propose its own approach):

- (a) A preliminary desk review of relevant information
- (b) A participatory socio-economic and an environmental assessment of the sub-basin, as relevant to the management of the targeted canals
- (c) Carry out a detailed technical and engineering assessment to determine the role of the targeted canals in (i) strengthening climate resilience for the local population, and(ii) flood management downstream.
- (d) With the strict participation of local authorities, and using the above assessments, evaluate options to rehabilitate and improve the management of the canals in climate resilience (flood and droughts). This should include an assessment of the best options for rehabilitation and sustainable operation and maintenance, based on both local as well as international experience.
- (e) Based on the above evaluations, propose the optimal design for PPCR Phase II interventions, from a physical as well as institutional point of view. This should include an economic and sensitivity analysis according to World Bank standards.
- (f) Based on the above assessments, carry out an Environmental and Social Impact Assessment of the proposed option(s), and prepare an Environmental and Social Management Plan, in accordance with the guidelines of the Zambia Environmental Management Agency and the applicable Safeguard Policies of the World Bank.
- (g) Design the detailed operational procedures for the proposed interventions, including schedule, costing, fund flow and proposed procurement packages.
- (h) Prepare the bidding documents (if applicable) and assist the client during the procurement process.

The assessment would therefore be into three major parts, below:

- I. Technical Assessment** - including (a), (c) and (d) above.
- II. Environmental and Social Impact Assessment** – including (b) and (f) above
- III. Conceptual Design** – including (e), (g) and (h) above.

### 3. Proposed Scope of Work

The scope of work to be carried out by the consultant shall include but may not be limited to the following:

## Part II: Environmental and Social Impact Assessment

### Background

The scope of the Environmental and Social Impact Assessment (ESIA) will cover all potential environmental and social, impacts, (positive and negative) that are likely to result from the implementation of activities related to the proposed rehabilitation of canals in the Barotse basin, taking into account the prevailing socio-cultural and environmental context. Rehabilitation interventions will be designed with strict observance of traditional management structures, the sub-basin's role in flood management, and its status as a Ramsar site and potential World Heritage Site.

The legislation, regulations, policies and guidelines that will govern the conduct of the impact assessment include the following:

- National laws, guidelines, and/or regulations on environmental assessments relevant for sustainable use/management of natural resources in Zambia;
- Regional, provincial or communal environmental assessment regulations; and
- The 10 World Bank Safeguard Operational Policies.

The Table below shows the World Bank safeguard policies that are likely to be triggered by this project. "TBD" implies "To be determined" through the on-going preparation studies. The Consultants should become familiar with the policies that are triggered and marked as "TBD" in the table below, as well as with previously successful ESIA's carried out in the context of World Bank projects

Safeguard Policies Triggered by the Project	Yes	No	TBD
Environmental Assessment OP/BP 4.01	X		
Natural Habitats OP/BP 4.04	X		
Forests OP/BP 4.36			X
Pest Management OP 4.09			X
Physical Cultural Resources OP/BP 4.11	X		
Indigenous Peoples OP/BP 4.10		X	
Involuntary Resettlement OP/BP 4.12	X		
Safety of Dams OP/BP 4.37			X
Projects on International Waterways OP/BP 7.50	X		
Projects in Disputed Areas OP/BP 7.60		X	

The project has in principal been rated as Environmental Category B due to the sensitive environmental and social aspects in the Barotse Sub-basin. This may preclude some re-design options which could have a significant environmental impacts if the consultant judges that such requirement if needed which may merit a reclassification of the project, they should promptly inform the Government and the World Bank.

The scope of work under the Environmental and Social Assessment will include the following:

- **A Scoping Study** determining the scope of social and environmental issues to be addressed in the ESIA and to help identify the range of alternatives to be considered, potentially significant environmental and social impacts and potential mitigation measures to be analyzed in the ESIA. This could take place at the same time as some of the initial tasks carried out by the Technical Assessment. Identified issues from the scoping exercise would be used for updating the detailed terms of reference for the ESIA, as outlined below. The Scoping Study and updated TORs would need to be cleared by the Client and the Zambian Environmental Management Agency, and should therefore be completed by the time of the Inception Report.
- **The ESIA** proper should follow the outline on Annex A, and involve three sections:
  - (i) An Environmental Assessment (EA), entailing an assessment of the potential environment impacts (positive and negative) anticipated from the activities involved in strengthening climate resilience of the canals in the Barotse basin.
  - (ii) A Social Assessment (SA), articulated around social impacts (negative and positive) anticipated from activities involved in the rehabilitation of canals in the Barotse basin.
  - (iii) An Environmental and Social Management Plan (ESMP), outlining specific, feasible and cost-effective measures to prevent or reduce to acceptable levels any significant potential negative impacts.

Completion of the ESIA is highly time sensitive, since it needs to be approved by both the Government of Zambia and the World Bank, and disclosed to involved stakeholders, 120 days prior to project presentation to the World Bank. For this reason, it is recommended that the Consultants start working on sections of the ESIA even before the final technical design is concluded. **A final draft ESIA for review should therefore be completed by no later than September 15, 2012.**

The ESIA would involve the following specific tasks/information:

**Task II.A. Description of the Proposed Project:** A summary description of the proposed investments, taken from Tasks I and III of this assignment, and including:

- (i) Description of the engineering and hydraulic aspects of the design, including such relevant aspects as topography, nature of flow, maximum and minimum discharge and canal depth at critical points; sediment load;
- (ii) Summary of the canal corridor survey, outlining major stakeholders, settlements, existing systems of canal uses (including merits and drawbacks), future water demand projections, critical issues and obstructions affecting the flow of the canals
- (iii) Summary of the proposed interventions, including scope (km, and location), estimated costs, implementation arrangements, and expected benefits.

**Task II.2. Description of the Socio-Economic and Environment Setting.** Assemble and evaluate a baseline data on the social and environmental characteristics of the study area. Include information on any changes anticipated before the project commences.

- (i) *Physical environment:* geology (general description for overall study area); topography; soils; monthly average temperatures, rainfall and runoff characteristics; ambient air quality; surface and ground water hydrology; identity of streams, rivers, or lakes. Include limits of Ramsar site and the proposed World Heritage Site on a map.
- (ii) *Biological environment:* flora and fauna; rare or endangered species within or in areas adjacent to project-related development sites and any adjustments to the present alignment; sensitive habitats, including wetlands, terrestrial communities in areas affected by canals, land application or disposal; aquatic communities in affected waters; significant natural habitats; species of commercial importance in land application sites and receiving waters.
- (iii) *Social environment:* present and projected population benefiting and/or affected by the canal interventions; present land use/ownership; planned development activities; community structure;
- (iv) *Cultural environment:* traditions, customs and aspirations; significant cultural, natural or historic sites. Importance of the project for the preservation and enhancement of cultural traditions. **This should include a mapping of relevant cultural sites, which will be critically important to the siting of the canals (to prevent possible negative impacts).**
- (v) *Stakeholder identification:* Identify the stakeholders, their needs, interests and aspirations, including the final recipients of the project who can positively or negatively be affected by project, and those which can affect the results or influence it
- (vi) *Social-economic profiles:* information on population per group of age, gender, social structures, vulnerable households (e.g. widows, elderly), employment trend and sources of income including the production and marketing activities in which the people are engaged, existing land tenure, access to services and public utilities, use of community and natural resources, and public health (including presence of HIV/AIDS and other sexually transmitted diseases). If at all available, emphasize any socio-economic information that is relevant to vulnerability to climate change. These profiles should be complemented by information from participative observations and informal interviews.
- (vii) *Institutional aspects:* identify the main institutions and organizations (formal and informal) in relation to the project; evaluate the structure, competence, and capacity of these institutions and organizations to target the most vulnerable and address social aspects; set up the role of each relevant institution, both formal and informal, on the design, implementation and monitoring of the project interventions; include recommendations to reinforce their capacities.

**Task II.3. Policy, Legal and Administrative Framework.** Describe the relevant laws, regulations and standards that may apply to the canal area, governing water quality and

use, pollutant discharges to surface waters and land, health and safety, protection of sensitive areas and endangered species, siting, land use control, etc., at international, national, regional and local levels. This section should also include a detailed description of World Bank safeguard policies and their relevance to the project to be implemented.

**Task II.4 Determination of the Potential Impacts of the Proposed Project.** . Identify all significant changes that the project is likely to generate, including potential social, economic, cultural and environmental changes. Address expected impact on the most vulnerable, on gender and people with HIV/AIDS. Distinguish between significant positive and negative impacts, direct, indirect and cumulative impacts, and immediate and long-term impacts. Include indirect impacts (e.g., increased erosion on canal banks, and other sensitive issues). Identify impacts that may occur due to unplanned or accidental events (e.g., spillage of toxic materials during rehabilitation works), and their potential risks. Identify impacts that are unavoidable or irreversible. Wherever possible, describe impacts quantitatively, in terms of environmental and social costs and benefits. Assign economic values when feasible. Characterize the extent and quality of available data, explaining significant information deficiencies and any uncertainties associated with predictions of impact. If necessary, provide TORs for studies to obtain the missing information.

**Task II.5 Analysis of Alternatives to the Proposed Project.** Describe alternatives that were examined in the course of developing the proposed project and identify other alternatives that would achieve the same objectives. The concept of alternatives extends to siting and design of new alignments, rehabilitation techniques and phasing, and operating and maintenance procedures. Compare alternatives in terms of potential environmental impacts, capital and operating costs (including mitigation measures and their monitoring), and institutional, training, and monitoring requirements. To the extent possible, quantify the costs and benefits of each alternative, incorporating the estimated costs of any associated mitigating measures.

**Task II.6 Development of an Environmental and Social Management Plan (ESMP).** Prepare a detailed mitigation plan, outlining feasible and cost-effective measures to prevent or reduce to acceptable levels any significant negative impacts. Estimate the impacts and costs of the mitigation measures and of the institutional and training requirements to implement them. If appropriate, assess compensation to affected parties for impacts that cannot be mitigated. This should include reviewing the Resettlement Policy Framework prepared for the entire PPCR project and making any adjustments or refinements that may be needed to take into consideration potential effects from canal rehabilitation.

The ESMP should identify a proposed work program, budget estimates, schedule, staffing and training requirements, and other necessary support to implement the mitigating measures. Include measures for emergency response to accidental events (e.g. entry of raw sewage or toxic wastes into rivers, streams, etc).

**Task II.7 Development of a Monitoring Plan** Prepare a detailed plan to monitor the implementation of mitigating measures and the impacts of the project during rehabilitation and operation and maintenance (e.g. emission and ambient levels of pollutants where these may be detrimental to human health, soil erosion, changes in the floodplain). Include in the plan an estimate of capital and operating costs and a description of other inputs (such as

training and institutional strengthening) needed to implement the plan. Include a schedule of monitoring the quality and flow of surface and ground waters to ensure that mitigation measures are effective. Provide guidance for effective enforcement and the conduct of environmental audits. This should include any environmental or social protection clauses that should be included in contracts or specifications.

Review the capacity of project institutions to implement the ESMP, and propose steps to strengthen them so that the ESMP may be effectively implemented. The recommendations may extend to new inter-sectoral arrangements, training, staffing, and financial support.

***Task II.8. Assist in Inter-Agency Coordination and Public/NGO Participation.***

The Consultant will assist the government in coordinating the EA consultations with relevant agencies, BRE representatives, NGOs and with community groups likely to be affected or to benefit from the proposed project. These groups should be consulted during preparation of the ESIA as well as when a draft ESIA is available (a summary of relevant materials and/or the ESIA should be made available prior to the meetings). The draft ESIA should also be available in a public place accessible to affected groups and local NGOs being consulted, in a form and language that they understand.

The Consultant should maintain a record of all public consultations undertaken, including (i) the date and location of the consultation meetings; (ii) a list of the attendees, with their affiliation and contact addresses; (iii) summary minutes; and (iv) whether means other than verbal consultation were used (e.g. surveys) to elicit the views of potentially affected stakeholders.

***Task II.9 Reporting.*** The consultant will prepare, for discussion with the Government and the World Bank, an ESIA report that is concise and limited to significant environmental and social issues. The main text should focus on findings, conclusions and recommended actions, supported by summaries of the data collected and citations for any references used in interpreting those data. Detailed or uninterrupted data are not appropriate in the main text and should be presented in appendices or a separate volume. Unpublished documents used in the assessment may also be assembled in an appendix. Please see Annex A for the proposed outline of the ESIA.

In addition, the social and environmental team should provide the following outputs, to be incorporated into Part III of the assignment and the Project's Implementation Manual.

- Implementation modalities that ensure a fully participatory and socially inclusive process
- Criteria for targeting the most vulnerable (e.g. in cash-for-works schemes)
- Criteria for water user organizations considered to be sufficient to proceed to rehabilitation and sustainable O&M
- A monitoring framework with clear baseline data and measurable results – to the maximum extent possible, it should include participatory score cards to enable a learning-by-doing approach amongst beneficiary communities.