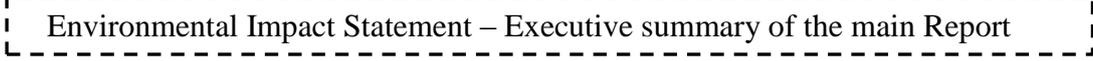


Environmental and Social Impact Assessment of the Zambezi Integrated Agro-Commercial Development Project Phase 1

Overall structure of the three volumes:

 = This report

Volume One: Environmental Impact Statement - Main Report

 Environmental Impact Statement – Executive summary of the main Report

Environmental Management Plan (EMP) for the Zambezi Integrated Agro-Commercial Development Component

Environmental Management Plan (EMP) for the Main Conveyance System and Pump Station

Volume Two: Socio-Economic Assessment

Socio-Economic Assessment Report

Volume Three: Specialist Reports

Appendix 1: Stakeholder Participation

Appendix 2: Environmental Health

Appendix 3: Land Use, Tourism and Settlement

Appendix 4: Irrigated Agriculture

Appendix 5: Aquaculture

Appendix 6: Poultry

Appendix 7: Hydrology

Appendix 8: Faunal Biodiversity, Wildlife and Ecology

Appendix 9: Botany

Appendix 10: Archaeology

Appendix 11: Resource Use and Environmental Economics

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1 EXECUTIVE SUMMARY

This Environmental Impact Statement addresses the proposed Zambezi Integrated Agro-Commercial Development (ZIACD) Project Phase 1 together with the water conveyance system from the Chobe River to the northern edge of the Pandamatenga farms.

The purpose of the environmental (and social) impact assessment (ESIA) and archaeological impact assessment (AIA) was to identify, assess and mitigate potential socio-economic, cultural, heritage and ecological impacts resulting from any of the activities associated with the establishment and subsequent operation of the agricultural development.

TAHAL is undertaking the engineering pre-feasibility study and business plan for the project in parallel with the EIA process. The project is evolving in time and changes have occurred and will continue to be made. The EIA study is based on the project situation as of January 2009. Significant project changes will require additional environmental assessment inputs.

1.1 Policies, Legal, Planning and Administrative Framework

The review covered the following relevant policies and legislation as outlined below. Several policies and Acts are currently under review or in preparation. Prior to project implementation, policy and legal requirements need to be up-dated with new policies and Acts.

Policy/ law	Main issues	Study implications
Review of 1991 BNWMP	Shift toward integrated water resource management and water demand management Re-use and recycling	Efficient water use in agro industry and settlement WWTW need to be linked with re-use and recycling Re-use and recycling opportunities of treated wastewater in settlement and agro-industry Water pricing based on opportunity costs Possible changes in institutional structure of water management authority in settlements
2003 MPSWW	Improved management of sewerage and wastewater treatment works Village of 20 000 required WWTW	Contribute towards policy target for re-use and recycling of 98% of outflow in 2030 Consider costs and benefits of different WWTW technologies On-site handling and treatment of WW for agro- industry Additional WWTW or expansion of existing one. Meeting effluent discharge and WWTW standards
1968 Water Act	Requires borehole registration with the Water Apportionment Board Otherwise, water from a water service provider to be used	Application for water abstraction rights from the WAB Possible delineation and declaration of waterworks area for settlement. There may be need for a TEA for agro industry
Water conservation policy (draft)	Water conservation and efficiency	The project must achieve high water use efficiency Water charges should be based on cost recovery and the user pays principle
Waterworks Act	Water works areas and settlement supplies	Declaration of water works areas and existing water supply systems for settlements; Possible compensation requirement for withdrawal of existing water rights in

		a water works areas;
Borehole Act	Abstraction and water quality	Permits are required for water abstractions (groundwater and surface water); The water quality of any water discharged from the project should not pose a risk to human health and animals and plants. The developer has the duty to minimize water pollution. Permission is required for the drilling of boreholes
Waste management strategy	Waste handling hierarchy	Minimise waste generation Adequate handling and disposal of waste and payment. Need for new land fills Encourage re-use and recycling in settlement and agro industry.
Waste Management Act	Waste management	No littering by workers and contractor All waste to be disposed at registered landfill
APCP Act	Controls air pollution Does not regulate noise	Possibly Air Pollution Certificate required for agro industry Need for proper maintenance and monitoring of emissions
1998 NSP	Settlement hierarchy and principles of compensation	Level of services related to settlement size and hierarchy
State Land Act	State land management	Contractor may have to pay fees for services provided on State land
Tribal Land Act	Land management and administration	The developers must obtained surface rights from the Land Board and compensate existing rights where these have to be terminated or relocated in favour of national interest development. The developer will be required to pay an annual fee for each year of the lease period.
Forest Act	Forest Reserve Declaration Declaration of Protected Trees	Request for permission and license for any non-forest activities from the Minister Ensure that license is obtained for any protected tree that will be felt
Wildlife Policy		The policy seeks to protect wildlife resources particularly in buffer zones and in migration routes. Moreover, it seeks to minimize wildlife-human conflicts The project needs to be 'wildlife sensitive' in selecting settlement site(s) and minimize wildlife-human conflicts (e.g. noise and habitat fragmentation). (draft) management plans for elephants and predators are important for the study
Wildlife Conservation & National Parks Act 1992	CHA WMA	Assess CHA and WMA status of the areas of the agro-industry and settlements
Tourism policy	Tourism concessions	Inventory of tourism concessions in the area Ensure that concession rights are not infringed upon or offer compensation.
Tourism Act		Competitive awarding of tourism concessions
Fisheries Act		Control of exotics; is outdated and needs replacement
2008 Fisheries regulations		Export and import regulations Import and trading permit for gillnets Permit for fish capture for educational and research purposes Regulations for movement of fish between water bodies and for capture of fish for breeding and farming.

Forest policy 2007		Identification of areas with potential for ecotourism and CBNRM (in PAs and communal areas)
1999 Agrochemical Act and subsequent regulations		Only registered chemicals can be legally used; License is required for import, commercial use and disposal of agro-chemicals (fertilisers, pesticides & herbicides);
Forest Act		Adjustment of boundaries possible Commercial use of FR requires a license Application for licenses for clearing & construction.
Mines and Mineral Act	Control and regulates the use of minerals, including gravel, sand, rock Part XI, Section 65 (2) - pit material excavation	Use of material from registered pits If own abstraction would occur, rehabilitation measures need to be put in place.
Settlement policy	Three tier settlement structure	Kasane-Kazungula is a planning area Choice of settlement determine the level of settlement and infrastructure-service entitlements Project needs to fit into District Settlement Plan No new settlements for special purposes such as mining and security
Town and Country Planning Act	Mostly for settlement	Settlement: preservation of designated trees and special architectural or historical sites
2005 EIA	PEIA, scoping and full EIA DEA decides whether full EIA is necessary	Identify main impacts, such as interference with wildlife and vegetation removal/destruction Mitigation measures EMP Monitoring and evaluation
Public health Act	Sections (43-54), (62-63) and Section (87)	Notification duty of communicable diseases Proper sanitary facilities for workers Ensuring that water supplies do not get pollution
Malaria Strategic Plan		Provides strategic direction for malaria control in Botswana for the period 2006-2011. The project needs to comply with the MSP.
Road traffic Act (69:01)	General Relevance – most Sections	Driving code of conducts for truck drivers Obeying road traffic regulations
Herbage preservation Act (38:02)	Sections (4,6 and 9) and Section (14)	Minimise risk of veld fires Draft fire management plan Under review and merged with Forest Act
SADC Protocols		Water: notification duty of project to abstract water from shared water course; EIA and identification of adverse impacts on other countries (with mitigation and compensation). Wildlife: minimise possible adverse impacts on transfrontier conservation projects and CBNRM

		Tourism; explore tourism opportunities associated with the project
UN Conventions	Convention on Biodiversity	Compliance with BDSAP
KAZA MoU	Transfrontier conservation effort	Ecosystems protection and tourism development Avoidance of adverse transboundary impacts No official treaty as yet
AIA Monuments and Relics Act	Section (12) and (19) and Section (23)	Compliance with EIA and Monument and Relics Act
Stockholm convention on POPs		Phasing out of the use of 12 POPs with certain exceptions. An important exception for the project is the use of DDT for malaria control.

1.2 Project Description

The objective of the project¹ is to develop 21,400 ha of new agricultural areas as a raw production site for agro industries zone development and the construction of a water transfer infrastructure to deliver water to the project area and the Pandamatenga farms. The agro-industrial site is located in the Northern Plains of Chobe District.

Project Purpose and Rationale

The idea is to provide the momentum for developing major commercial food production enterprises in the Northern Region, encouraging exports and reducing the present imports of agricultural products.

Description of Proposed Development

Agro-Commercial Development

The project components covered by this study are the development of the new agricultural area and the location of settlement. The physical scale of the project is the development of 21,400 ha of new agro-commercial land as raw production floor for agro industries enterprises which are planned to process fish, poultry, edible oil, fruits and vegetable, dry seeds and more. The production scale is about 300,000 tons per annum of agricultural products.

Water for agricultural development will be supplied via a pipeline that will run adjacent to the main Nata/Kazungula road. Zambezi River water will be pumped from a location on the Chobe channel.

Field crops produced by the project will include grains and seeds for consumption as feed for the fish and poultry farms as well as for the local market. The agro-industrial products will mostly be exported.

The following crops are proposed for the project:

- Rainfed crops, including grains and sunflowers, canola and soybeans.
- Irrigated crops, namely, grains, oil crops, legumes, paprika and other items.
- Vegetables such as cabbages, onions, potatoes, butternuts and carrots.
- Tree crops such as mangoes, avocados, papayas, citrus and bananas.

¹ This information is based on the January description of the project as contained in the Mid term Report 2009 (revised business plan) and vol 1 and 2 of the engineering reports. In other words, the project is frozen as per January 2009. It must be realised that the project details have changed in time and are likely to change in future in response to changes in global markets and preferences of government and TAHAL.

Post-harvest facilities are to be constructed for the preparation of fruits and vegetables earmarked for the local and export markets.

A number of agro-industrial plants are proposed as described below:

- The fish farm, based on the dual use of the Zambezi water for irrigation and the fish farm.
- The poultry farm will be an integrated farm obtaining its feed from the project feed mill and producing a variety of products, mainly for export. Rendered by-products from the poultry farm will be used in the preparation of feed.
- The feed mill will process the various feed sources produced on the farm.
- The oil mill will process seeds and grains for edible oil and oil cake as raw material for the feed mill.
- The essential oils plant will produce distilled odorous liquids with a high added value.

The main conveyance system will deliver water from the Chobe River to the New Commercial Farm Enterprises and a reservation is made for the supply of 100 Mm³ for linking up with the NSC in eastern Botswana. The secondary distribution system will be connected to the main conveyance system and will deliver water by means of a series of pumping stations and reservoirs to the on-farm distribution system for irrigation of crops as well as to the agro-industrial plants. The on-farm infrastructure will comprise irrigation systems, drainage and roads.

The Main Conveyance System

The water conveyance system starts at the intake on the Zambezi River, and includes buried pipelines, operating reservoir, pumping stations, a regulating system and a distribution system to the agricultural lands. The conveyance system is designed for a maximum capacity of 37,000 m³/h. Another important function of the conveyance line is to bring drinking water to an extension of the Botswana National Water System, the North-South Carrier (NSC). The conveyance line will be electrically powered in order to lift the water. The electrical power demand of the conveyance system will be supplied by BPC. The design of the water supply system as a whole will be carried out in stages.

A number of alternative water abstraction sites were examined by the engineers and one was found to be suitable for a pumping station. The selected site, on the Chobe River near the confluence with the Zambezi, is the subject of the assessment

Water and Power Requirements

The total amount of water required by the ZIACD-project and associated enterprises is 182.9 M m³ per annum. Field crops, vegetables and orchards are the largest consumer of water (153.1 M m³ per annum). The total net water consumption is 182.9 M m³ per annum as 73.9 M m³ of water discharged from fish ponds will be re-used to irrigate crops. Re-use of water from the fish ponds to irrigate crops will lead to water savings of up to 28.8% of total gross water consumption

The energy consumption is estimated at 319,400.77 MWh/year in stage 1. Some 39% of this electric power is needed for stage 1 conveyance system; over a quarter for the fish farms (27%) and almost 15.6% for poultry. In stage 2 of the project, annual electricity consumption is estimated to be 576,358 MWh. The annual electricity consumption of the conveyance system in Stage 2 will be 323,528 MWh/year at the cost of US\$14.6 million.

Waste Streams

Solid waste

Agro-industry: The project re-uses most 'waste' in poultry feed (e.g. fish) and as fertiliser (e.g. chicken manure). The project refers to options of deep burial and incineration for poultry waste. Furthermore, reference is made to the need for adequate disposal of excavated soil

Wastewater

Agro industry: The water from fish farms is to be re-used for irrigation. Therefore it is assumed that no wastewater will be discharged from the agro-industry site. This implies that wastewater from the mills and other agro industries will be treated on-site and re-used.

1.3 Description of the Study Area

Physical Environment (Vol. 1, Section 5.1)

Climate: There is an average annual rainfall of 570mm and the prevailing winds are from the east-southeast. Temperatures range from an average monthly maximum of 34°C (October – November) to an average low of 8°C in July.

Global warming is expected to reduce the reliability of rainfall falling within the Zambezi basin. Therefore, the frequency and magnitude of low flow events and arid periods when irrigated crops require irrigation is likely to increase.

Topography, Geomorphology, Geology and Soils: The proposed development area is located on relatively flat land with elevation varying from 1040m in the west to a high of 1075m in the east

The project area has been divided into: (1) the western land unit is part of a much larger clay basin, spreading west and south, characterized by flat land with heavy clay soils, low slopes and poor natural drainage. (2) The eastern part consists of alternating ridges in the form of stabilized sand dunes running east-west, with flat clay surfaces between them.

The plains are drained westwards by the Ngwezumba channel which flows to the Mababe Depression.

Geology: Basalt underlies the soils at a depth of between 4-22 metres going from shallow to deep from west to east and from south east to north.

Hydrology: The hydrological assessment focused on the Ngwezumba to the immediate south east of the project area. The remnants of a lake system drains west down the Ngwezumba towards the Mababe. Substantial flows occur in the Ngwezumba River during periods of heavy rains.

Biological Environment (Vol. 1, Section 5.2; Vol.3 Appendix 8 and 9)

Flora: The plains contain a mixture of Kalahari sands forest species and Mopane woodland associations. This study is the first systematic survey of the Northern Plains (CH/5). Teak is internationally classified as threatened although it is not classified as such within Botswana. Several Red Data Listed plant species have been recorded within Chobe District, including *Huernia levui* and *Nesaea minima*; the orchid *Ansellia africana* occurs in the area and Botswana's only *Protea* (*P. gagedi*) occurs in a narrow belt in the project area. The project area has a high diversity of plant species due to the unique mix of aeolian sand deposited on black cotton soils. The area contains commercially important tree species and a large number of baobab trees, which are important nesting sites for raptors.

Fauna: Of the 601 recorded *bird* species from the region, 524 are known to breed in the area. There are 76 palaeartic migrants and an additional 52 intra-African migrant bird species. A diversity of 60 species of raptors is listed, of which 36 have been recorded in the immediate vicinity of Kasane. The project area is adjacent to the Important Bird Areas of the Linyanti Swamp/Chobe River and the Chobe National Park to its west. The species of most concern are birds which are restricted (or virtually so) to the forests around Kasane. These species include Crowned and Trumpeter Hornbills, Racket-tailed Roller, Miombo Rock Thrush, Broad-tailed Paradise Whydah, Golden-backed Pytilia and Black-eared Canary. Many palaeartic migrants such as Lesser Spotted Eagle, Thrush Nightingale and Grasshopper Warbler favour forest areas.

The abundance of *large herbivores* in and around the project site varies with season due to availability of surface water. Water dependent species, especially zebra, wildebeest, buffalo and elephants, are more abundant in the wet season while no-water dependent species occur all year round. The CH/5 area is an important ecological link between the Hwange / Kazuma ecosystem in the east and the Nogatsaa / Ngwezumba and Chobe River ecosystems in the west. One of the richest mammalian assemblages in southern Africa is encapsulated in the four countries surrounding the proposed project, as a result of the high proportion of formally protected areas. This greater area supports approximately 30% of Africa's estimated elephant population. Out of the 197 mammal species listed as occurring in the four countries, none are endemic but ten are considered as threatened. These include the Spotted-necked otter (*Lutra maculicollis*), Painted hunting dog (*Lycaon pictus*), lion (*Panthera leo*), cheetah (*Acinonyx jubatus*), black rhino (*Diceros bicornis*) and the African savanna elephant (*Loxodonta africana*).

The interface between the sands and black cotton soils form important wildlife movement corridors. There are several corridors directly affected by the proposed project:

- Chobe River – Zambezi / Victoria Falls NP corridor;
- Chobe River to Kazuma Pan NP (northern edge of the proposed agro-commercial development);
- Southern edge of CH/5 linking CNP to Kazuma Pan NP

The area is a meeting place of the reptilian and amphibian fauna from the Kalahari, the Upper Zambezi, and from the broad-leaved woodlands of Central Africa. There are 128 species of reptile and fifty species of amphibian recorded. Out of the 178 species recorded there are five endemic or near-endemic reptiles (Spiny agama *Agama makarikarica*, Tsodilo gecko *Pachydactylus tsodiloensis*, Long-tailed worm-lizard *Dalophia longicauda*, Barotse water snake *Crotaphopeltis barotseensis*, Okavango hinged terrapin *Pelusios bechuanicus*) and three endemic frogs (the Reed frogs *Hyperolius aposematicus*, *Hyperolius rhodesianus* and the Grass-frog *Ptychadena mapacha*).

Biodiversity (Vol.1, Section 5.3; Vol.3, Appendix 8 & 9)

According to the BSAP, CH 5 has a high Biodiversity Conservation Priority Index and a high Fauna Species Priority Index. The area also supports Botswana's highest number of Red Data listed wildlife species. The area of agro-commercial development was found to carry a unique and highly diverse assemblage of habitats.

Archaeological and Cultural Heritage (see Vol.1, Sections 5.4 and 7.8 and Vol. 3, Appendix 10)

Most artefacts were found on the black cotton soil albeit thinly distributed. Only rarely however do these archaeological finds concentrate in large enough numbers to warrant being

called sites. Both the sandveld and the intermediate compacted sand/clay were relatively sterile. No obvious prehistoric finds were made on the northern sandveld. The two large pans in the central eastern sandveld area investigated, though, contained artefacts. The survey unexpectedly located broadly Middle Stone Age period sites on the black cotton soil. It is thought that these are derived from below by soil activity.

Overall, this study has indicated that the area was important possibly at different times during the Pleistocene. Late Stone Age material indicates some occupation during the Holocene. The presence of a small fragment of pottery does point to some use sometime during the past 2000 years.

Land Use (Vol.1. 5.5-6; Vol.3, Appendix 3)

The land tenure systems found in Chobe District are state and tribal land. The total land area for Chobe District is 211,704 km² (Department of Surveys and Mapping). Tribal land in Chobe is found in both Chobe west and east. Chobe District is divided into thirteen (13) Controlled Hunting Areas (CHAs) which classified as protected areas as follows:

- Chobe National Park (CH/3),
- Forest Reserves (CH/2, CH/4, CH/6, CH/7 & CH/13) and
- Wildlife Management Area (Nunga which encompasses CH/1 and CH/12).

Chobe National Park (CPN) is strictly managed with restricted access to the public and hunting is not allowed. WMAs are set aside for sustainable wildlife utilization i.e. they provide public access for hunting and various other uses. In Forest Reserves communities are allowed access through a permit system to collect firewood, harvest fruits and graze their livestock

The CNP and all forest reserves (Kasane Forest Reserve, Kasane Extension Forest Reserve, Kazuma Forest Reserve Maikaelelo Forest Reserve & Sibuyo Forest Reserve) except Chobe Forest Reserve are state land. Chobe Forest Reserve which is tribal land is used by Chobe Enclave Community Trust for CBNRM purposes. Nunga Wildlife Management Area also falls under tribal land. This area encompasses both CH 11 and 12 and has been leased out to private companies to be used for commercial hunting and photographic safari.

The proposed project area is within CH/5 in an area currently known as KM 256, which is mainly used for subsistence agriculture by the communities of Chobe east. The boundaries of the project area coincide with those of KM 256.

Socio-Economic Environment (Vol.1. 5.7-8; Vol.2)

Population size and settlements: the population is clustered in four settlements: the district capital Kasane, Kazungula, Lesoma and Pandamatenga. The population of Kasane and Kazungula has grown rapidly to 7,933 and 1,860 in 2001. There are 2,171 and 394 households in Kasane and Kazungula respectively; the majority is male headed (54.4% for Kasane and 58% for Kazungula). Pandamatenga has experienced the fastest population growth: between 1981 and 2001, the population increased seven-fold from 304 to 2,167. Lesoma's population is the smallest settlement in the area (454 people in 2001). CSO has projected that the population of Chobe District will grow to 28,648 by 2031.

Education: the district has nine primary schools and two junior secondary schools. There is no senior secondary school in the district and the nearest ones are in Francistown and Maun. Illiteracy, particularly of adults, undermines people's participation in productive work and in the business arena. The Chobe Brigades Development Trust located in Kasane offers vocational education in carpentry, welding and fabrication, computer studies, building and mechanics. About 90% of students enrolled in this institution are from outside Chobe area.

Health: major local diseases include malaria, HIV, AIDS (Chobe is among the most affected areas in the country) and Sexually Transmitted Infections (STIs). The Chobe district is serviced by one primary hospital, five clinics and eight health posts. Pandamatenga has a clinic with a maternity ward which also provides monthly mobile health services to the Pandamatenga commercial farms, camping sites and remote area dwellers. There is no referral hospital in Chobe.

Sanitation, Waste and Water: the most common sanitation facility is the pit latrine; universal sanitation is only achieved in Kasane. Only just over a third of the households in Pandamatenga have sanitary facility. The most common method of waste disposal is collection by the District Council, particularly in Kasdane. Most households in Pandamatenga use road side dumping (43%) while in Kazungula rubbish pits are common (62.4% of the households). Kasane and Pandamatenga have achieved a 99% rate of households with access to clean piped water while in Kazungula the rate is 90%. However in Pandamatenga, most of the households (62%). use communal tap water for drinking.

Energy Sources: the main energy sources for cooking are LPG gas and wood while for lighting it is electricity and paraffin.

District economic structure: the area has a narrow economic base characterised by tourism and agriculture. The majority of the people are subsistence farmers. Crop farming is very limited due to wildlife damage and land constraints.

Employment: Employment is provided in sectors such as government, hotels and restaurants, tourism, construction, farms, manufacturing as well as wholesale and retail businesses. A total of around 6,000 formal jobs exist in the district. The unemployment rate for the entire Chobe east was 17.1% in 2001 (the national average was 19.6%). In 2001, 846 people in Chobe east were actively seeking jobs.

1.4 Public Consultations and the Stakeholder Engagement Process (Vol.1, Chapter 6)

The public consultative meetings were held in the villages of Pandamatenga, Lesoma, Kazungula and Kasane Township (27th and 28th August 2008). In addition consultations were held with key persons based in Chobe District, and with the central government departments.

The EIA team also benefited from the August 2008 Chobe District stakeholder workshop organized by TAHAL and MoA. In addition to the initial public meetings held in August 2008 as part of the scoping phase, a two-week field visit was undertaken in November 2008 with extensive community consultations and stakeholder interviews. A third field trip dedicated to the pipeline and inlet point was undertaken in February 2009 and involved additional community level discussions and interviews with key informants. The community consultations were in the form of focus group discussions (FGD) among the (groups within) the communities of Pandamatenga, Kasane, Lesoma and Kazungula. Key informant interviews with public officers, private sector representatives and civil society organisations have also informed this assessment of the project.

1.5 Identification and Assessment of Environmental, Socio-economic and Archaeological Impacts (Vol.1, Chapter 7)

Impacts, for the key concern areas identified during scoping and incorporated into the terms of reference for the ESIA, have been assessed by sector specialists. The impacts are identified and assessed in Chapter 7, Vol. 1. In addition, this chapter proposes and assesses mitigation measures. As the impacts are too many to be included in the executive summary, the reader is referred to Chapter 7. Below, some of the findings are highlighted.

The environmental sensitivity analysis was carried out to identify areas of environmental concern within the primary and secondary impact zones. The analysis incorporated the existing regional data and appropriate outputs from the specialist studies.

The results of the analysis are:

- Kazungula: The area between the river and the escarpment is a high density wildlife corridor linking the Victoria Falls National Park (VFNP) and Chobe (Riverfront) National Park (CNP). There is planning and development into this area which is compressing the wildlife corridor between Kazungula and Lesoma.
- Lesoma: The expansion of the settlement splits the wildlife movements to the north (CNP – VFNP) and the south (CNP riverfront) from Kazuma Pan National Park (KPNP).
- Lesoma to the project area: High plant and habitat biodiversity to the immediate north of the project area. Important for roan sable and tsessebe. Key corridor area linking CNP (riverfront) to KPNP.
- Project area: Highest habitat diversity to the north and east, overall important habitat for roan, sable and tsessebe. Part of the CNP (Riverfront) to KPNP wildlife movement corridor.
- Project area to Kazuma Forest Reserve: Moderate to high plant diversity, immediately adjacent to KPNP and wildlife populations using areas adjacent to the national park
- Kazuma Forest Reserve: High habitat and plant diversity particularly in the north east. Adjacent to KPNP high density wildlife populations. Wildlife corridor to central CNP.

The pipeline will pass through areas of high environmental sensitivity between the Chobe River and Lesoma, in the area immediately north of the project area and throughout the ZIACD project area and the southern side of CH/5 /northern Kazuma Forest Reserve.

Impacts Identified

Impacts were identified during the specialist studies carried out under the environmental and socio-economic impact assessment (ESIA). Environmental impacts are identified and assessed in terms of their likely occurrence and significance. It is important to note that the impacts are assessed prior to any mitigation, management or compensation being applied and then reassessed after impact mitigation.

The following major impact groups are distinguished:

1. Environmental:
 - Physical environment (changes in surface water, soil conditions, etc.)
 - Biotic environment (changes to ecosystem processes, biodiversity)
2. Pollution and Waste:
 - Agro-chemicals pesticide and herbicide usage
 - Solid waste
 - Liquid waste
3. Land use:
 - Land use changes

- Impacts on current land uses
 - Risk of illegal land uses
4. Socio-Economic:
 - Economic, livelihoods and poverty
 - Socio-cultural
 - Community and environmental health
 - Migration and labour
 - Institutional and planning
 5. Archaeology
 6. Cumulative Impacts
 - Traffic
 - Other land use developments and projects

1.6 Review of the settlement options

Location of the proposed settlement needs careful consideration given that already the forest resources in the area are under threat. Establishment of a settlement within or in close proximity to the project site will bring with it a concentration of activities to an area already under pressure from activities of the project. Development of a settlement in a wildlife and tourism area is not advisable also given the impact it will have on the villages of Chobe East.

Development of a settlement is discouraged for the following reasons:

- No land available – development of a settlement on site will result in encroachment into either the areas zoned for wildlife, tourism or into the forest reserves. Hence intensifying the land use conflict already created by the project.
- Viability of the settlement – economic viability of the proposed settlement will be directly tied to the agro-commercial business. Should the agro-commercial industry become economically non-viable due to costs and market related factors, the sustainability of the settlement will be compromised. Loss of settlement vitality may result in migration and government having to identify and finance alternative economic drivers to sustain the town. The economic stimulation of mono industry towns (e.g., mining towns, such as Selebi Phikwe and Jwaneng) is already a major challenge to government.
- Settlement on site will be costly as it will require infrastructural developments and social services befitting its stature as per the National Settlement Policy. However integrating the proposed settlement into Pandamatenga, as recommended below will ensure that the provided infrastructure and social services are optimally enjoyed by both the project employees and the community.
- New settlement will kill the neighbouring villages through its pull factors thereby reducing the chances of Pandamatenga ever achieving the goals of its development plan

The study's recommendation regarding the proposed settlement is **Integration into Pandamatenga**. Given that 800ha of land is required for accommodating the anticipated 20 000 people, Pandamatenga is the best alternative as it has **833** Ha (outside the current Planning boundary) and 129 Ha (zoned as phase 5, which is reserved for future expansion) of land to accommodate land requirements for the entire phases of the project.

1.7 Environmental Management Plans

Separate EMPs have been prepared for the agro-commercial development and the pipeline. They are contained in separate reports, volume 1. The pipeline EMP is based on the approved pipeline EMP prepared by Water Resources Consultants and has been expanded and updated to incorporate the project specifications and specific concerns identified during the impact assessment.

The EMP includes:

- Outline on institutional requirements
- Generic impact management
- Specific construction phase impact management plan
- Specific operational phase impact management plan
- Monitoring and auditing requirements
- Procedures and timing for updating the EMP

1.8 Synopsis of the assessment (Vol. 1, Chapter 11).

This summary section summarises the major findings and recommendations. Given the magnitude and complexity of the project it cannot include all findings and conclusions. The reader is therefore further referred to the relevant chapters and the EMPs.

It is important to bear in mind the scale of the proposed project when considering the following comments and recommendations. It is equally important to bear in mind the spatial context of the project, i.e. Chobe District in northern Botswana.

The project is the largest commercial agricultural development in Botswana and will more than double current national agricultural output. At full production it will be the largest commercial fishery in the world – an intense and high tech industry. The project is forecasted to use more than the entire present national water requirements (inclusive of the mining sector) and phase two will roughly double water usage. The cost of supporting infrastructure such as the 86 km pipeline, housing and settlement for up to 20,000 people and power supply will be borne by the country. The project must therefore be able to contribute significantly to national and district development.

The spatial context of Chobe is defined by protected areas, rich and migratory wildlife resources, low density human population, a thriving tourism industry that creates employment and alleviates rural poverty. Compared to other parts of Botswana, Chobe District has relatively high biodiversity values.

The major concerns, impacts and mitigations/recommendations are discussed below in three sections:

- Prior to project development (1.7.1)
- During construction (1.7.2)
- During operation (1.7.3).

1.8.1 Requirements Prior to Development

- *Collapse of the Wildlife System and Change in Regional Land Use*
- *Allocation of National Resources to the Agricultural Sector*

- *Realistic Pricing of Resources and Cost Benefit Analysis*
- *Maximising District and National Benefit*
- *Integrate habitat heterogeneity into project design*
- *Waste flows and management of waste products*
- *Traffic flows and mode of transport*
- *Compliance with latest policies and legislation*

1.8.2 Construction Phase (conveyance system and agro-commercial development)

If the above (1.7.1) concerns are addressed prior to construction, many of the environmental and social impacts will have been mitigated. The construction phase will require the following:

- *Implementation of the Environmental Management Plan*

1.8.3 Operational Phase – Socio-economic and Land Use

Concerns and actions relating to the operation phase will include:

- *Loss of communal land*
- *Loss of residential and commercial land*
- *Adverse impact on tourism opportunities in CH5*
- *Phasing development and integration into district development*
- *Job creation, income generation, livelihoods and poverty reduction*
- *National benefits*
- *Socio, cultural and health impacts*
- *Labour and migration*
- *Living conditions and public services*
- *Institutional capacity*
- *Increased Traffic*

1.8.4 Operational Phase - Environmental

- *The need for Integrated Waste Management*
- *Integrated and Efficient Water Management*
- *Impact on the Zambezi Flows*
- *Agro Chemicals – Integrated pest management*
- *Ground and Surface Water Protection*
- *Ecosystems Maintenance (corridors and wetlands)*

1.9 Environmental Impact Statement

Three factors are likely to lead to significant cumulative and long term local, national and (some) regional impacts of the project. Firstly, the project is of a very large scale (over 20,000 ha), and will involve conversion of the present mixed agriculture and wildlife system into an

intensive arable and industrial system. Secondly the present absence of district linkages leads to a project that will have significant impacts even though much of the project area is already under threat from poorly planned land allocation and agricultural development. Thirdly, there is no district wide land use planning and additional projects may be initiated, including agricultural ones, without coordination and with significant cumulative impacts.

The project (the EIA is based on the project situation as documented per January 2009) is based on large scale water abstraction from the Chobe (in phase 2 up to 500 Mm³ per annum). The project's integrated nature ensures re-use of water (from aquaculture to irrigation) and many types of waste (e.g. for fodder, fish feed and fertilisers). The project will also contribute to agricultural diversification and commercialisation, increased exports, employment creation and poverty reduction.

The EIA has shown that most environmental impacts can be mitigated in a satisfactory way. However, given the above the conclusion of the EIA is that the project may proceed subject to a number of conditions that need to be met prior to project implementation and strict adherence to the EMPs.

The following must be realised *before* project implementation:

- An integrated district land use plan be prepared, which must accommodate all future projects and minimise conflicts and adverse cumulative environmental impacts;
- Wildlife corridors and linkages with Zimbabwe need to be formally protected;
- The project area is adjusted as per the recommendations made in this report;
- The project is fully integrated in the district plans and linkages with district developments are fully incorporated. Moreover, the project needs to be fully integrated into KAZA planning;
- Government has carefully considered the short and long term the public funding and benefit implications of the project (capital and recurrent), including subsidies (e.g. water and electricity) and opportunity costs. This should lead to an informed policy decision on the part of government.

Given the proposed time schedule, work on meeting these conditions has to start as soon as possible. In the mean time, increasing agricultural outputs from the existing commercial farms need to be pursued and Pandamatenga can be further developed as an agricultural hub.

The project has the potential to generate significant socio-economic benefits to the district and the nation. These include employment, development and diversification opportunities, poverty reduction and to a lesser extent increased food security. However, there is the risk of benefit leakages (e.g. through migrant labour and imports) and adverse impacts on tourism and subsistence agriculture (if not adequately mitigated). Adverse socio-cultural and health impacts are likely to occur if no mitigation measures are taken. Due to its integrated nature, the project takes advantage of 'waste and by-products' as inputs into other productive activities (e.g. aquaculture water for irrigation, organic fertiliser and chicken and fish feed). One of the largest challenges is achieving adequate and coordinated institutional management of a project of this scale and nature. This requires expanded government capacity and project offices to deal with the detailed design and implementation of this project (settlement, inlet point, pipeline and agro-industry).

The project will lead to a significant increase in population and requires more and higher level public facilities in line with the National Settlement Policy. The recommended settlement option is to expand Pandamatenga village as there is sufficient development space available, and it does not interfere with wildlife corridors.

The pipeline to Pandamatenga, which will ultimately be extended and connected to the water carrier in eastern Botswana, will have impacts. The international impacts on downstream riparian states are outside the scope of this ESIA and were meant to have been addressed in a separate study carried out for the Department of Water Affairs by Water Resources Consultants. Suffice to say here that the impacts of abstraction on the Zambezi wetland system should be fully addressed through international and multinational studies such as the SADC managed Zambezi River Basin Action Plan (ZacPlan) and that riparian nations should be bound by the results of such a study. Within Botswana the pipeline impacts can be managed if mitigations are followed, if the design is such that maintenance and failure are minimised and that if settlement is controlled through adherence to land use planning.

While the project is still at the design phase, changes in the detailed design are still likely to occur in response to changes in global market conditions, technological opportunities request of the major stakeholders (government and the agro-commercial consortium that will be put together by TAHAL). Some design changes have already been made in response to draft findings and proposed mitigations of this EIA. The environmental and socioeconomic impacts of significant future project design changes need to be assessed separately to ensure that no major adverse project impacts will occur without effective mitigation.