SOMAWHE ESTATES MPONGWE

DRAFT

ENVIRONMENTAL IMPACT STATEMENT REPORT

[*ACQUISITION ENVIRONMENTAL IMPACT ASSESSMENT*]

PREAPARED FOR

Chobe Agrivision Company Limited | Villa 15, Millenium Village | Birdcage Walk | Longacres Walk | Lusaka | Zambia

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Executive Summary

General

Agriculture contributes significantly to social and economic development of the country. Statistics show that 80 percent of the population is dependent on agriculture with about 70 percent of the country's labour force being employed in the sector. However, agricultural production in Zambia is vulnerable to seasonal rainfall variability. Drought occurrences over the past decades have continued to affect agricultural productivity resulting into food insecurity thereby threatening 80 percent of the population.

Somawhe, a farm operation with an established irrigation scheme, is located in Nampamba area within the Mpongwe development zone of Mpongwe District in the Copperbelt Province of Zambia. Somawhe intends to expand its investment in irrigated agriculture. Exploiting this potential will enable Somawhe to contribute to increased overall national production levels of cash crops such as wheat, maize, and soya beans which are far short of meeting demand at national and regional level. Somawhe's geographical location in the northern part of Zambia gives it a competitive edge given that this part of the country is near to the equatorial region and less vulnerable to rain variability compared to the southern part.

In order to ensure that operations at Somawhe are done in a manner that is environmentally sustainable, an environmental impact assessment study was commissioned. The aim of the study was in broad terms to identify social economic and environmental impacts (positive and negative), extent and significance of these impacts and propose measures to either mitigate or enhance the impacts. In carrying out the study special focus was given to the current operations at Somawhe and identified future developments.

Limiting factors to the study included field surveys being done during the period following the rain season covering flora and fauna species encountered excluding the rain season.

Impacts and Mitigation/Enhancement Measures

None of the negative environmental or social impacts identified relating to operations at Somawhe can be considered critical, irreversible or unprecedented. In general, the overall environmental and social risks were to be manageable and of low significance. The following are the main impacts identified;

- economic boost at local level, national and international level,
- Significant economic multiplier effects at the national level,
- Positive impact on national food security from crop production,
- Enhanced national fiscal benefits,
- Employment creation, skills transfer and human resource capacity development,
- improved household incomes and food security impacts,
- Improved housing, water supplies and sanitation facilities for employees.

To enhance these positive impacts measures proposed included;

- increasing crop production levels by increasing the land under irrigation
- invest more in its farm equipment and support infrastructure such as irrigation
- develop a long term strategic plan for the expansion of its current irrigation scheme
- develop a human resources development plan and systems to ensure human resources development
- engaging in social enterprising by developing social economic programmes

Negative environmental impacts observed included;

- soil loss due to inappropriate land use by communities in surrounding areas,
- Inappropriate disposal of agricultural chemicals and containers
- Loss of habitat and disturbance to ecosystems due to land clearing

The proposed mitigation measures included;

- embarking on community programmes to educate and raise awareness of communities in surrounding areas to use appropriate methods of farming
- construct properly designed incineration facilities to avoid air pollution.
- Preserve vegetation by leaving strips of land within Somawhe that will offer habitat to fauna and act as a reserve to biodiversity in the area.

No significant impacts were observed relating to migration and temporary employment effects, unsociable behavior from increased disposable income, casualisation of labour, population density-related disease impacts and occupational health and safety.

Outcome

It is the opinion of the study team that social economic and environmental impacts resulting from operations at Somawhe can effectively be managed and reduced to acceptable levels as long as proposed mitigation measures are applied. Consequently, the benefits arising from operations of Somawhe as a developmental project outweigh the environmental costs.

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Abbreviations and Acronyms

CITES	Convention in International Trade in Endangered Species
DBH	Diameter at Breast Height
EIA	Environmental Impact Assessment
EPU	Environmental Protection Unit
FD	Forest Department
FNDP	Fifth National Development Plan
GPS	Geographical Position System
GRZ	Government Republic of Zambia
IBA	Important Bird Areas
IFC	International Finance Corporation
IUCN	International Union for the Conservation of Nature
IV	Importance Values
MAL	Ministry of Agriculture and Livestock
MSDS	Material Safety Data Sheets
PES	Present Ecological State
PSC	Possible Species of Concern
RAMSAR	Convention on Wetlands of International Importance
RD	Relative Density
RF	Relative Frequency
SSC	Species of Special Concern
WWF	World Wide Fund for Nature
ZAFFICO	Zambia Forestry and Forest Industries Corporation
ZEMA	Zambia Environmental Management Agency

1. Introduction

This report presents the outcome of an environmental impact study (EIA) that included ecological, social and cultural assessments of Somawhe Estates Limited (Somawhe) in Mpongwe one of the districts of Copperbelt province of Zambia. The study is commissioned by Chobe Agrivision Company Limited (Chobe), a Zambian agricultural development company, with prior investments in the Mkushi Farm Block, Zambia.

Chobe has recently acquired Somawhe. The study is required in order to comply with the Second Schedule, Section 6 of the Environmental Management Act of 2011. The schedule demands an environmental impact assessment (EIA) for land clearing for large agricultural developments and for irrigation developments exceeding 50ha in extent. The study is focused on the current operations and planned developments at Somawhe. The current operations at Somawhe, just like any other development, may be impacting upon the social and cultural elements, local ecology and biodiversity, including rare and threatened species, miombo forests and rivers/streams a number known to occur within the farm area.

The report also takes into account the International Finance Corporation (IFC), Equator Principles and Commonwealth Environmental Protection and Biodiversity Conservation Act 1999. The report further provides some recommendations on how the various social, cultural and ecological aspects within and around the area ought to be managed.

1.1 Agriculture and Irrigation Potential

Agriculture is one of the priority sectors recognized by the Government of the Republic of Zambia as it contributes significantly to social and economic development of the country. Statistics show that 80 percent of the population is dependent on agriculture with about 70 percent of the country's labour force being employed in the sector.

However, agricultural production in Zambia is vulnerable to seasonal rainfall variability as almost 70 percent of food crops are produced by traditional farmers who depend on rain for farming.

Drought occurrences over the past decades have continued to affect agricultural productivity resulting in food insecurity thereby threatening 80 percent of the population.

For this reason, the government has put in place policies and legislation aimed at creating an enabling environment for boosting irrigated agriculture. Farmers are being encouraged to partner up with financial institutions to invest in agricultural investments especially in creating water storage reservoirs that will minimize dependence on rain fed agriculture. This has created an investment opportunity in the agricultural sector.

Chobe intends to take advantage of this opportunity and expand Somawhe's irrigation scheme. Statistics show that there are very few private and public commercial irrigation schemes combined in Zambia compared to other countries in the region. Figure 1 below show how scattered these schemes in Zambia are despite the high potential for irrigation.

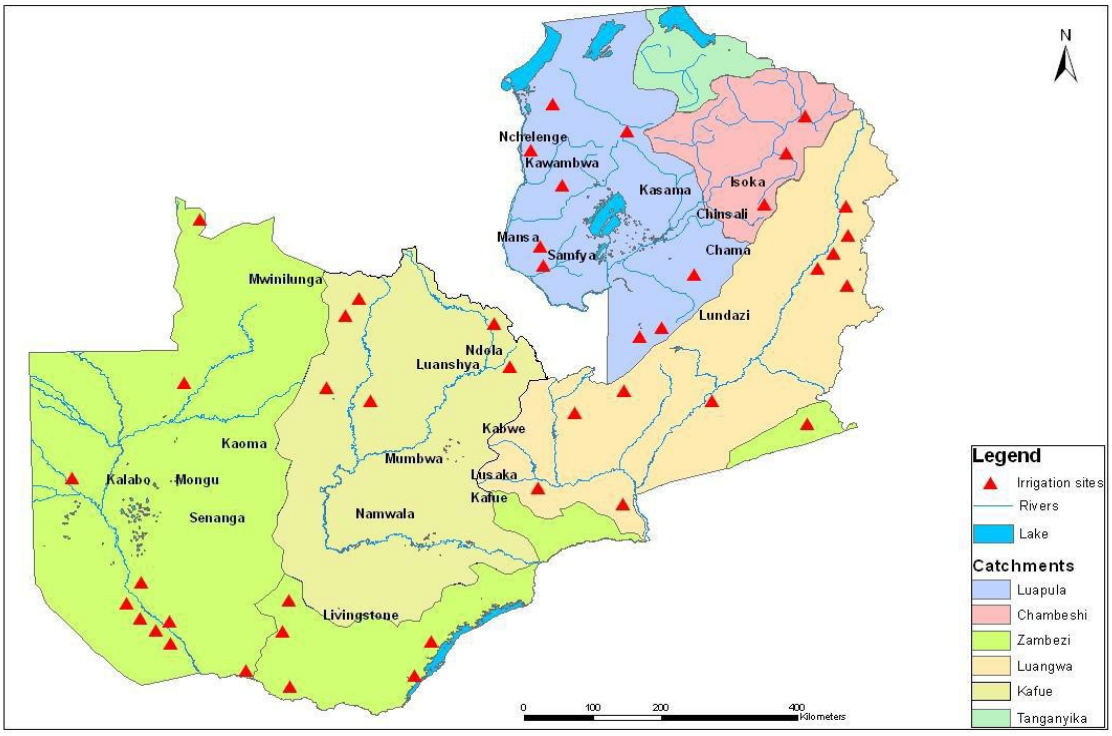


Figure 1: Map 1- Irrigation schemes in Zambia (*Source National Irrigation policy*)

Although these statistics may have improved slightly due to increased agricultural activities in recent years, this is still an opportune time for any investor such as Chobe to take advantage of the enabling environment and maximise the irrigation potential to expand on current agricultural production levels. Somawhe Estate's current geographical location in the northern part of Zambia gives it a competitive edge given that this part of the country is near to the equatorial regions and less vulnerable to rain variability compared to the southern part. Other than being located in Mpongwe District Copperbelt Province the economic heart of Zambia, Somawhe is within easy reach of Katanga Province in the Democratic Republic of Congo (DRC) and ideally situated to execute a strategy of supplying crops to these areas of high population and experiencing economic and urban growth.

1.2 Location and Layout

Somawhe is a diversified crop production farm in Nampamba area within the Mpongwe development zone of Mpongwe District in the Copperbelt province of Zambia. The estate lies on the Southern part of Copperbelt Province (Figure 2). Somawhe is situated in the south-west part of Mpongwe District approximately 120 kilometers south west of the city of Ndola along the Kafue River and about approximately 40 kilometers to the west of the nearest administrative centre Mpongwe. The farm with a total land size of 12,892Ha is about 350 kilometers north of Lusaka, the capital city of Zambia.

Somawhe is bordered by Mpongwe Road on its Northern side, traditional land with villages on the North-western and South-western side. Although Impumbu Dam reservoir falls within the perimeters of the farm, dam water front on the North-western side and South-western side is being shared by local communities settled in the area.

Figure 2: Location Map of SOMAWHE Estate

1.3 Study Objectives

The objectives of the study were to:

1. To review the project from an independent environmental and socio-economic viewpoint so as to identify and assess its potential positive and negative impacts and to recommend mechanisms to remove, or mitigate negative impacts.
2. To take environmental factors into consideration from the outset in order to optimise the functions of the project in the landscape.
3. To prevent polluting and nuisance impacts before they are realised.
4. Minimising these impacts where they are unavoidable.

5. Providing management tools for environmental risk and hazard assessments.
6. Contributing monitoring tools to optimise project operations that also minimise environmental, social, environmental extreme event and hazard impacts.
7. Provide an emergency preparedness and response decision pathway when accidents or extreme events occur.
8. Provide the baseline data and anticipate project outcomes in a manner that permits a full assessment of the acceptability of the project to ZEMA, other regulatory agencies and to the general public.
9. Characterise the social set up of communities from within and the surrounding the areas
10. Establish the cultural dynamism of the communities from within and the surrounding the areas
11. Establish the water resources potential, status and vulnerability of catchment areas

1.4 Methods and Process of Study

A systematic approach was employed to investigate and examine different aspects of the operations at Somawhe and planned developments in relation to the environment. Secondary data collection was done through literature review while collection of primary data was done through dedicated field investigations focusing on different field disciplines. The study team further assessed the need for design adjustments taking into account existing and planned infrastructure. Consultative meetings for consideration of opinions and concerns of interested parties formed an important element of the process. In particular, the EIA multi-disciplinary study team studied the site and surrounding environs using a process defined by a sequence of steps outlined below that included detailed specialised field investigations and targeted stakeholder consultations (See Annex….. for minutes).

Baseline Environmental Conditions: Baseline data on environmental, cultural and socio-economic conditions for the project area within Somawhe and surrounding areas was collected and compiled. Further an analysis of primary data collected during field investigations with reference to the available secondary data from past studies on biological, zoological, botanical and aquatic for Mpongwe area in particular was undertaken.

Project Activities Description: Information on operational activities, materials and equipment used was collected thus leading to the description of project inputs, activities and outputs during the operational life stage of the development as well as planned developments

Social-Economic and Environmental Impacts Analysis: An assessment of environmental effects and benefits of the project regarding biophysical and socio-economic environment was examined including an analysis of the impacts including their extent, duration, intensity and significance.

Possible Mitigating Measures Formulation: Measures and plans for mitigating the identified possible adverse cultural, social and biophysical impacts resulting from current operations of Somawhe and planned development have been proposed including measures and plans for enhancing positive environmental impacts.

Environmental Management and Monitoring Plan Elaboration**:** A plan for managing and monitoring the implementation of cited mitigation measures during the operational life of the project are discussed. The plan further indicates management responsibilities and time frames.

Emergency Response Plan for Critical Infrastructure**:** A plan outlining measures and actions to be undertaken in an event of an emergency situation arising from natural or human induced situation such as possible dam failure due has been elaborated.

Stakeholder Consultations**:** In order to ensure that public views are taken into consideration, stakeholder involvement is promoted, and as part of the transparent consultative process, targeted meetings were conducted with identified key stakeholders that included the traditional leadership, local communities and Somawhe management team. The approach to the stakeholder consultative process involved meetings, open discussions and interviews. This interaction afforded the EIA team to establish how stakeholders understood the dynamics of the environment in which Somawhe is located and any possible underlying causes that could lead to changes over time as a result of operation of the project. The outcome of these stakeholder

meetings and interviews provided relevant background information and helped identify major environmental concerns of the stakeholders within the project area.

1.5 Limitations to the EIA Study

The scope of this EIA study covered social, cultural and ecological aspects. However, the study had its own limitations.

One of the limiting factors regarding ecological aspects was the fact that the field surveys only covered flora and fauna species encountered during the survey period following the rain season. Although flowering had finished for many plant species, there were few flowering plants observed. Therefore, there was high possibility that some plants and animal species were missed as the survey was done just in one season. The ideal situation is to sample in all the seasons of the year so as to cater for those species that are visible in a particular season. This is because no season specific survey can be expected to encounter all the fauna or flora occurring within a project area.

With regard to social and cultural aspects, the limiting factor was the lack of interaction between the previous management team at Somawhe and the general surrounding communities. As a result there was a sense of mistrust between the two parties and it's likely that some of the responses obtained during the interviews lacked objectivity. Chobe is aware of the strained relationship and intend to address as a matter of urgency. The other limiting factor was inadequate hydrological data for the project area. Very little secondary data was available and generating primary data requires field work for a number of hydrological years which was not possible under this project.

2. Project Rationale

2.1 Scope

The scope of this report is limited to assessment of social-economic, cultural, ecological and biodiversity aspects of Somawhe, its immediate environs and its surroundings. It highlights the biophysical, social and cultural aspects within Nampamba area of Mpongwe District, identifies possible impacts and proposes mitigation measures and above all outlines a plan of action on how to ensure the suggested measures are implemented.

2.2 Overall Objectives

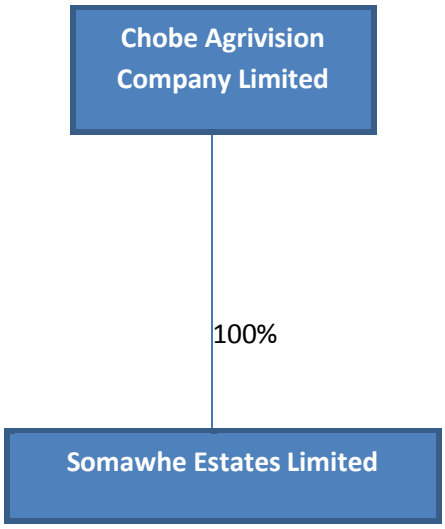
The overall objective of the EIA study was to determine, analyse and present the environmental impacts resulting from current operations and planned development at Somawhe and formulate an environmental monitoring and management plan outlining remedial measures to mitigate these negative impacts with a view of complying with national and international EIA legislative requirements in order to ensures that current and future developments are carried out in a sustainable manner.

2.3 Project Ownership, Components and Costs

2.3.1 Ownership

The farm now known as Somawhe Estates Limited has changed ownership since its establishment in the 1980s. The farm has recently been acquired by Chobe Agrivision Company Limited.

Figure3: Current Ownership for Somawhe Estates Limited



2.3.2 Project Components

Chobe plans to develop the farm in three phases. The first phase will be to expand the irrigation scheme by June 2013 to increase hectares under centre pivot irrigation to approximately 3,800 hectares and embarking on an immediate land clearing.

Figure 4: Existing irrigation scheme covering 2,611 hectare at Somawhe Estates Limited.

The second phase will be to undertake a major maintenance and replacement of the existing irrigation scheme. The third phase will be to have a further 200 hectares cleared land currently rain fed due to poor drainage. This will be improved by installing proper drainage systems and therefore bringing an additional 263 hectares into irrigable production supported by construction of a new dam. The figure above shows the land layout currently under centre pivot irrigation covering 2,611ha.

2.3.3 Object Costs

At the time of the study, the process of changing ownership of Somawhe Estates Limited was still underway. Arising out of this, preliminary indications of expected costs associated with this venture were obtained and are outlined in table 1 below. Note that these figures are merely indicative and are subject to change once Chobe has full operational control.

Table 1: Projected Project Costs

	Total spend($m)
Acquisition price	31.9
Replacement irrigation	2,8
Additional clearing	2,4
Additional irrigation	5,1
Additional plant and equipment	5,0
Total	**47,2**

3. Detailed Description of the Project

3.1 The Project

Somawhe is primarily in the business soya, maize and wheat crop cultivation mainly under irrigation. The irrigation fields are supported by 30 centre pivots. According to an earlier assessment, Somawhe has potential for expansion of land under irrigation to over 3,800 hectares. This would give the Somawhe the potential of producing over 30,000 tons of wheat, 15% of Zambia's current production. However, such an expansion needs to be supported with additional water storage infrastructure.

A recent analysis conducted by Imagen Consulting Limited on water resources potential show that with the 38,700,000m^3 existing dam, supplied by the Impumbu River, the dam capacity is sufficient to support an irrigation scheme with a maximum capacity of 3,800 hectares. When fully developed, Chobe plans to develop an additional storage dam within the farm boundaries.

3.2 Project Area

Somawhe is 12,822 hectares in extent. Approximately 2,874 hectares is cleared of which 2,611 hectares is currently under centre pivot irrigation. Due to inadequate drainage, 263 hectares of the cleared land is not irrigated and therefore rain-fed. Future plans include extension of land under irrigation by about 1800 hectares. This will involve clearing of additional land and construction of a new storage dam to meet increased water demand.

3.3 Principal Components of the Project

3.3.1 Existing Components

Somawhe has been operational for some years and its current principal components as an establishment include agricultural fields and grain storage facilities, water infrastructure and conveyance system, workshops and plant equipment, residential areas and social infrastructure. The operations at Somawhe are also supported by associated infrastructure such as boreholes

for domestic water, road network and electricity supplied by ZESCO Limited (ZESCO), Zambia's power utility provider. These are elaborated below;

- **Water Infrastructure**
  - A dam of 38,700,000 cubic meters dam on Impumbu River
  - A 20km long main canal and distribution canals
  - Water pumping stations
  - 30 centre pivot systems

- **Agricultural fields**
  - Irrigated agricultural fields 2611ha in extent
  - Rain fed agricultural fields

- **Workshops**
  - A mechanical workshop and offices
  - Chemical storage
  - Plant equipment
  - Store rooms

- **Administrative office block**
  - Offices for administration

- **Residential Areas**
  - Staff houses
  - Market place

- **Social Infrastructure**
  - A school
  - Health centre
  - Power substation and transmission lines
  - Recreation Club

- **Grain storage**
  - Silos
  - Storage Bags

- **Road network**
  - Gravel roads

3.3.2 Water impoundment and storage elements

The hydrological system for area where Somawhe is situated is such that the groundwater and surface water are very much linked. The main river in the area known as Impumbu River has its source originating from some form of a number of springs in a dambo area that is outside the boundaries of Somawhe in the eastern direction. Field surveys showed that the groundwater table in the area fluctuates and is shallow. The discharge from these springs is continuous throughout the year thus making Impumbu River a perennial river.

Taking advantage of this river and the good rain pattern in the area, Impumbu River was impounded and a dam with a capacity of 38.7 million cubic meters was constructed. In addition, there are two tributaries to Impumbu River that transect Somawhe Estates.

3.3.3 Electrical infrastructure

Somawhe requires adequate power supply to operate smoothly. Somawhe is connected to the national grid managed by ZESCO and has onsite transformers of varying ratings given in the table 2 below: -

Table 2: Onsite Transformers

Transformer	Capacity (KVA)	Quantity
1	630	1
2	500	2
3	400	2
4	315	6
5	200	1

Field surveys revealed that power is reticulated to all management and workers' houses and commercial buildings within the farm. Somawhe has one onsite 150 KVA diesel generator set available on site as a backup in case of power failure. Three substations that support power supply to Somawhe were observed. 11 KVA power transmission lines were observed within the farm covering approximately 40 kilometers. However, all other electrical installations with the farm belong to Somawhe Estates.

3.3.4 Agricultural storage and management areas

Somawhe has adequate storage facilities to meet current demand for grain storage. However, these facilities may not be adequate in the near future when production levels increase.

Grain Silo and Drier Complex: The silo complex comprises 4 x 1,000 metric tons and 3 x 2,000 metric tons. This brings the total to 10,000 metric tons of raised cylindrical silos built of curved galvanized corrugated steel sheets bolted onto a steel reinforcing frame. Each silo is equipped with an aeration fan and a 12m x 6" offloading auger. The silos are supported by 2 x 500 metric tons wet grain silos with 1 x 30 metric tons per hour batch drier unit using diesel fired burners and 10 cubic feet per meter compressor. The intake pit is constructed of corrugated iron sheets resting on concrete block walls. Grain is moved about within the system via a planned network of box conveyors and augers.

Weigh Bridge Office: The weighbridge office is located near the main entrance of the silo complex and is alongside the weighbridge comprising 80 tones x 24 meters long unit fitted with a single electronic load cell. The weighbridge office is situated alongside the weighbridge and is constructed of a mono pitched roof of corrugated asbestos sheets resting on timber members and devoid of ceilings.

Control Room: This is constructed of a mono pitched roof of corrugated asbestos sheets resting on timber members devoid of ceilings.

Open Sides Silo Shed: This is an open sided shed constructed of a ridged roof of corrugated iron sheets resting on timber trusses and devoid of ceilings and supported by tubular poles.

Fertilizer Storage Shed: This is a high head room steel framed structure used for storage of fertilizer. This is constructed of a ridged roof of IT4 iron sheets resting on steel members with roof additionally supported on stanchion bolted on to concrete pad foundations.

Chemical Stores: This is constructed of a mono pitched roof of corrugated iron sheets resting on timber members devoid of ceilings, concrete block infill walls plastered and painted internally

and rendered externally and solid concrete floor finishes with cement and sand screed.

Workshop: This is a steel portal framed high headroom open fronted building with high head room constructed of a ridged roof of IT4 sheets resting on steel members and supported by steel beams and steel columns bolted to the concrete floor. The offices and store rooms are lined underneath with hard board ceilings. It comprises workshop area, offices and store rooms occupying 580.55 m^2.

Welding/Tyre Mending Bay: This is an open sided structure constructed of ridged roof of corrugated iron sheets resting on timber members devoid of ceilings. It comprises welding section, tyre mending area and battery room occupying an area of 84square meters.

Open Sided Tractor Shed: This is constructed of a Mon pitched of IT4 sheets roof on steel members and upright supports. It's a gravel earth floor comprising six parking bays occupying an area of 488.6 square meters.

3.3.5 Housing and social infrastructure

Housing

Somawhe has provided accommodation to most of its permanent workers. Most of the permanent employees are accommodated within Somawhe boundaries while some permanent employees and all temporary workers reside in surrounding villages. The existing housing infrastructure is divided into categories depending on the position the employee has in the company. The four major residential areas observed were Munsoshi, Tap, Kayumba and Workshop compounds. In addition Somawhe has Kalimba and Kalasha residential areas reserved for middle and top managers respectively. Each housing category constitutes a specific residential area thus providing an appropriate environment for each category of employees and their families to freely interact with their fellow colleagues. This has resulted in strong social cohesion which might not have been the case had all employees been accommodated within the same residential area regardless of their positions in the company.

Kabasha Area houses the Directors' house comprising two en-suite bedrooms, one additional bedroom, lounge, dining room and guest toilet and passage ways and is constructed of thatch roof resting on tabular gum poles, burnt brick walls plastered and painted internally and with face brick finish externally, timber framed louver windows and timber framed timber doors. Internal fittings and fixtures include water closet and overhead showers to the bathrooms combined with toilets. In addition, the house has a guest cottage, garden cottage, stand alone kitchen and entertainment area

Kalimba residential area houses the finance manager, crop manager and farm manager. The finance manager's house, comprises of a self-contained master bedroom, two additional bedrooms, lounge and dining room, kitchen with a pantry, communal bathroom, separate toilet, passageway, front veranda and an enclosed rear veranda. The crop manager's house comprises a self-contained master bedroom, two additional bedrooms, lounge, dining room, kitchen with a pantry, communal bathroom, separate toilet, passageway, front and rear verandas. The farm manager's house comprises of a self-contained master bedroom, two additional bedrooms, lounge and dining room, kitchen with a pantry, communal bathroom, separate toilet, passageway and front and rear verandas. In addition there is a driver's house and guest houses.

Housing is divided into three categories:

- Type A: comprising of three bedrooms lounge/dining room, kitchen, bathroom combined with toilet, passage way and two side verandas
- Type B: comprising a self-contained master bedroom, two additional bedrooms, lounge and dining room, kitchen with a pantry, communal bathroom, separate toilet, passage way, front and rear verandas.
- Type C: comprising of en suite bedroom, two bedrooms, lounge/dining room, kitchen, pantry, toilet, shower room, passage way and an enclosed veranda and a servant's Quarter.
- Supervisor: comprising of a master bedroom, one additional bedroom, lounge, dining room, kitchen, communal bathroom, separate toilet, passage way, front and rear verandas

- Worker: comprising two bedrooms, kitchen, toilet and bathroom

There are two compounds containing:

Tap Compound:

Type A: 5

Type B: 3

Type C: 1

Workshop Compound:

Supervisor: 5

Worker: 11

Note: there are two new staff houses still under construction

Kanyuma Compound

Worker: 65

Social Infrastructure

The residential areas are supported by a number social infrastructure that include a recreation club and tuck shop, football pitch, health centre, market, a school and churches of different denominations among them were;

- Seventh Day Adventist Church:
- United Church of Zambia:
- Kingdom Hall of Jehovah's Witness:
- Living Waters Church:
- St. Clements Catholic Church:
- New Apostolic Church:
- Kanyuma Baptist Church:
- Church of God:

In addition, portable piped water from 14 boreholes is available servicing all residential areas. Sanitary conditions are equally good and a septic soak way system is used. A good road network

makes accessibility to any of the residential areas easier. Access within the farm is by a comprehensive network of motor able single-track dirt roads, which are adequate to service the requirements of the farm. There is approximately 100 kilometers of all-weather of motor able gravel estate roads within the farm. The main farm gravel road to access Somawhe covers a distance of about 50 kilometers through ETC Bio Energy Limited from Mpongwe's main boma. The area is also serviced by mobile cellular providers (Airtel and MTN) and coverage for e-mail and facsimile facilities are also available.

3.3.6 Water delivery and irrigation infrastructure

Water from Impumbu Dam, the main reservoir, has to be transported over a distance of 20km. To facilitate the delivery of water to agricultural fields, a 20km main canal was constructed with a network of distribution canals. Water from the main canal and distribution canals are pumped to the respective agricultural fields from pumping stations located at appropriate points.

Centre pivot pump houses are generally constructed of a Mono pitched roof of IT4 corrugated iron sheets resting on timber members devoid of ceilings. They have honeycombed concrete block walls painted internally and externally, solid concrete floors finished with cement and sand screed. There are two types of pump houses namely A (4Nos) and B (4Nos) with gross external floor area of 8.00m^2 and 16.00 m^2 respectively.

Each agricultural field has a centre pivot system that irrigates the crop at given times and duration according to farm irrigation schedule. Below are photos showing the water extraction point from the dam and the main canal.

Figure 6: Photos showing spillway and main canal

Furthermore, each irrigation field is supported by a pump of a given capacity and an associated electric motor depending on the size of the field. The irrigation pumps and associated motors currently in use are provided in table 3.

3.3.7 Planned Project Components

Additional agricultural fields

In order to increase the production capacity, Chobe will in the near future expand the land under irrigation. Up to 2,000ha of land will be cleared to create new field for irrigation using centre pivot system. However, this exercise will be carried out in phases over the next 12-18 months. Table 3 below shows existing agricultural fields under irrigation (indicated by white circles) while the additional planned agricultural fields are indicated by yellow circles.

Impoundment of water for additional water storage

To support the planned expansion of irrigated land, Chobe plans to construct a new dam to supplement the existing Impumbu dam. A potential dam site (S-13.62096, E-027.73166) has already been identified on one of tributaries of Impumbu River. The tributary with a potential site is known as Munsoshi stream (See figure 7 below). The dam will serve as storage dam and will capture any run off from the canal irrigation scheme. The precise capacity of the dam will only be established when dam surveys are done for purposes of dam design.

Table 3: IRRIGATION MOTOR & PUMP DESCRIPTION

FIELD	MOTOR SIZE	MOTOR CURRENT	PUMP TYPE	PUMP SIZE	PUMP CAPACITY	PUMP HEAD	IMPELLER DIAMETR	PIPE SIZE	AREA
1A	55 KW	101 AMPS	KSB TA-100-200	N/A	N/A	N/A	F/S (209)	200MM	75 ha
1B / C	200 KW	405 AMPS	APE – VIT	4 STAGE 16 HC	350M / HR	90M	304MM	250MM	150 ha
2A & B	200 KW	88 AMPS	APE – VIT	4 STAGE 16 HC	350M / HR	90M	304MM	250MM	212.9 ha
3A	55 KW	143 AMPS	KSB LA 150-400	N/A	N/A	N/A	360MM	200MM	83.5 ha
3B	75 KW	143 AMPS	APE – VIT	5 STAGE 12 HC	250MM / HR	60M	229MM	150MM	98.8 ha
4A	75 KW	143 AMPS	APE – VIT	5 STAGE 12 HC	259M / HR	60M	229MM	150MM	100 ha
4B	75 KW	143 AMPS	APE – VIT	6 STAGE 12 HC	259M / HR	60M	229MM	150MM	98.8 ha
5A	75 KW	143 AMPS	APE – VIT	5 STAGE 12 HC	259M / HR	60M	229MM	150MM	100 ha
5B	75 KW	143 AMPS	APE – VIT	5 STAGE 12 HC	259M / HR	60M	229MM	150MM	99 ha
5C	75 KW	143 AMPS	APE – VIT	6 STAGE 12 HC	260M / HR	73M	229MM	150MM	88.9 ha
6A	90 KW	172 AMPS	APE – VIT	7 STAGE 12 HC	260M / HR	87M	229MM	150MM	100.5
6B	90 KW	172 AMPS	APE – VIT	7 STAGE 12 HC	260M / HR	87M	229MM	150MM	100 ha
6C	45 KW	83 AMPS	KSB FTA 80-250	N/A	N/A	N/A	N/A	200MM	58 ha
6D	45 KW	83 AMPS	KSB FTA 80-250	N/A	N/A	N/A	N/A	200MM	55.3 ha
7A	75 KW	143 AMPS	APE – VIT	6 STAGE 12 HC	260M / HR	73M	229MM	150MM	100.2 ha
7B	75 KW	143 AMPS	APE – VIT	5 STAGE 12 HC	260M / HR	63M	229MM	150MM	88.3 ha
8A	75 KW	143 AMPS	APE – VIT	6 STAGE 12 HC	260M / HR	63M	229MM	150MM	100.9 ha
8B	75 KW	143 AMPS	APE – VIT	6 STAGE 12 HC	259M / HR	73M	229MM	150MM	99.8 ha
9A	75 KW	143 AMPS	KSB FTA 150-50	N/A	N/A	N/A	N/A	200MM	121.8 ha
9B	75 KW	143 AMPS	APE – VIT	7 STAGE 12 HC	260M / HR	87M	229MM	150MM	122.5 ha
9C	75 KW	143 AMPS	APE – VIT	6 STAGE 12 HC	260M / HR	73M	229MM	150MM	119.6 ha
10	75 KW	143 AMPS	APE – VIT	6 STAGE 12 HC	260M / HR	90M	229MM	150MM	99.9 ha
11A/B	200 KW	405 AMPS	APE – VIT	4 STAGE 12 HC	350M / HR	90M	304MM	250MM	113.5 ha
12	90 KW	172 AMPS	APE – VIT	5 STAGE 12 HC	259M / HR	60M	229MM	150MM	115.7

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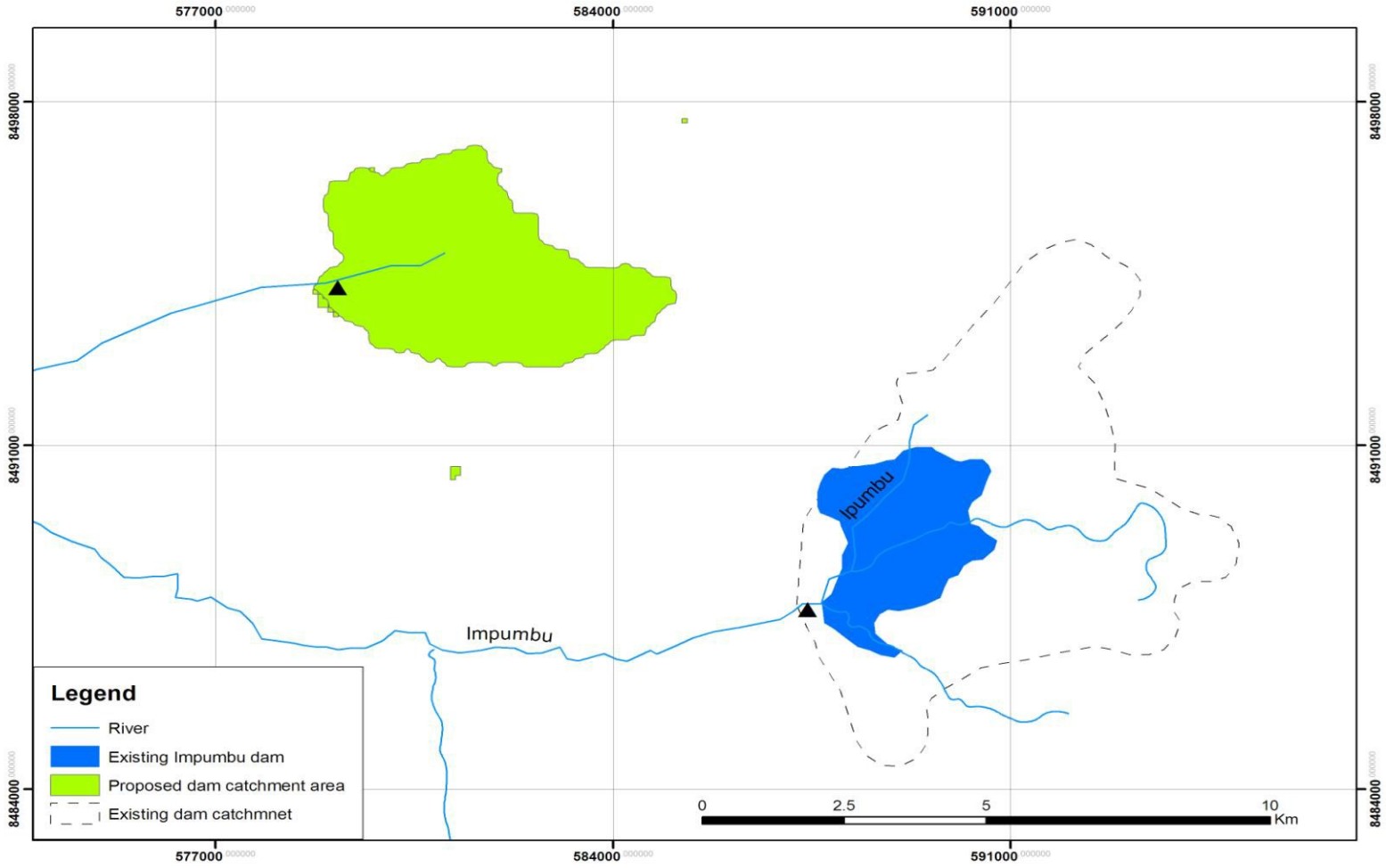


Figure 7: Sketch layout of showing Impumbu Dam (Blue) and potential site for another dam (Green)

Additional centre pivot systems and associated infrastructure

Additional centre pivots will be acquired to service new fields. Associated infrastructure as pump stations and a further network of distribution feeder canals will be constructed. Figure 6 shows a layout of existing and planned agricultural fields. The land earmarked for additional fields is 1,332ha but this could potentially increase to a maximum of circa 2,000ha.

3.3.8 Natural habitats

Important habitats for sensitive mammal species at Somawhe include gallery forest and forest streams. The clearing of miombo woodland and gallery forest may impact on dormouse, tree-roosting bats, squirrels, anomalies (scaly-tailed flying squirrels), monkeys and tree pangolin. The major habitats present within the farm area are shown in Table 4.

Table 4: List of habitats within the farm area

	Habitat	**Description**
1	Miombo Woodland	This habitat included predominately Julbernardia and Brachystegia tree species. Canopy layer was relatively closed. The ground flora cover was generally sparse, with dominance of a few, shade-tolerant species. Bare earth, leaf litter and a proliferation of fallen/felled trees and deadwood. This habitat supports most small mammals present within the farm area such as duickers, rabbits, bats to mention but few. Reptile diversity was greatest in miombo woodland and chipya woodland.
2	Riparian forest	The habitats are along the banks of Impumbu and Munsoshi rivers within the project area. The main dominant species include: *Erythrina abyssinica, Syzygium cordatum, Costus spectabilis* and *Harungana madagascariensis.* This habitat type supports monkeys, birds and many other animals associated with riparian forests. This type of habitat is classified as sensitive.
3	Dambo	In this type of habitat, avian diversity was greatest. Birds were also many within the miombo and the riparian forests.
4	Termitaria	The termite mounds within the project area mostly support termite ants that inhabit these habitats.
5	Rivers/Streams	These habitats support a number of aquatic lives such as fishes and other organisms. Amphibian diversity was greatest in streams

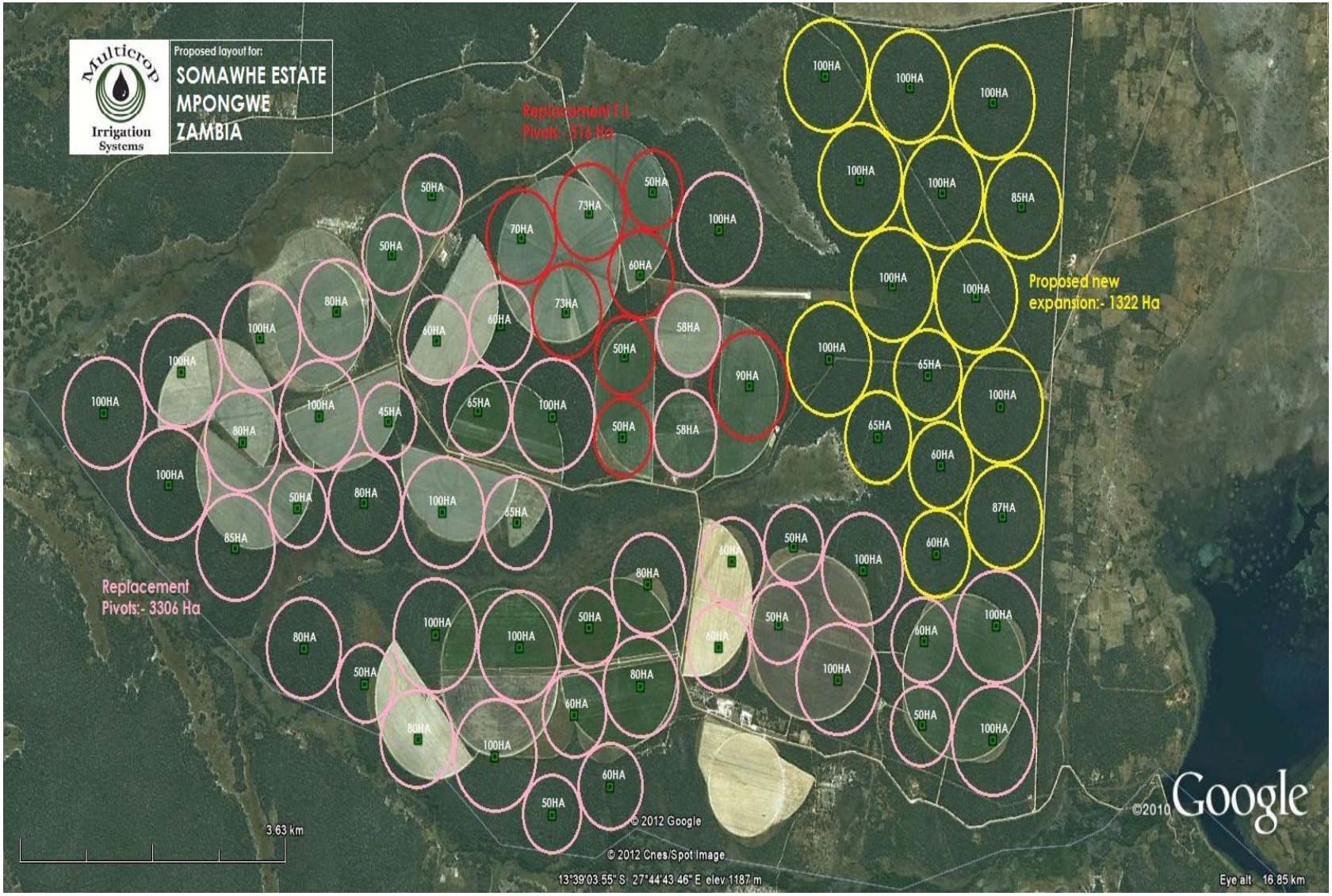


Figure 8: layout of Somawhe irrigation infrastructure

3.4 Main Project Activities – Operational Phase

3.4.1 Dams, night storage and rising main infrastructure

Somawhe operations depend on Impumbu Dam on Impumbu River. This is the sole water reservoir that is sustaining the irrigation scheme. Currently, there are no night storage reservoirs or any other dams. Abstraction of water from the dam and subsequent conveyance to agricultural fields is through a concrete lined canal being the rising main infrastructure supported by a network of distribution canals. At selected points along the main canal as well as distribution network, there are pump stations. From the pump stations water is pumped through PVC pipes acting as rising mains to agricultural fields.

3.4.2 Irrigated lands and irrigation systems

Somawhe is more than 12,000ha, with 2,611 under irrigation. A portion of the land is not suitable for irrigation due to factors such as steep slopes, reserve for faunal and human habitat and poor drainage. There are a number of irrigation systems are available on the market, the choice of irrigation system depends largely on a number of factors that include cost, topography, and availability of water, equipment and expertise. The topography at Somawhe is favorable for centre pivot system and has been adopted as the only irrigation system currently being practiced.

3.4.3 Agricultural storage facility areas

Smooth operation of an irrigation scheme depends not only on availability of expertise and equipment but also support infrastructure such as housing, offices and other associated infrastructure. Observation made during field surveys revealed that Somawhe has well organized agricultural storage facilities to meet the demand at current production levels.

3.5 Equipment and Raw Materials Use – Operational Phase

3.5.1 Dams and rising main infrastructure

For water storage Somawhe uses Impumbu dam the only major hydraulic infrastructure (S-13.67998, E-027.80837) and a 20km open canal with feeder canals for conveyance of water to agricultural fields. At the time of the field surveys the water level in the dam was found to be at about 2.7m according to the gauge plate reading at the dam wall bridge.

Figure 9: Photos showing the dam, platform for gauging, spill-way and open canal

3.5.2 Agricultural lands and centre pivots

The topography of the area is generally flat land and gentle slopes towards the Impumbu River and its tributary. However, the Impumbu Dam is on the high altitude with the land gently sloping towards the western end of the farm. Surrounding the Impumbu dam are some isolated highland areas not appropriate for centre pivot system. The fields are mainly located westward away from the dam. This provides the much needed slope for the water in the canal to flow under gravity across the farm from point A to B as shown in figure 10. The fields are located along both sides of the main canal. Each field is served by a centre pivot system. There are 30 centre pivot systems currently in operation. The figure below shows the agricultural fields under irrigation. Individual existing agricultural fields are indicated by pick circles while the yellow circles are potential fields earmarked for future development.

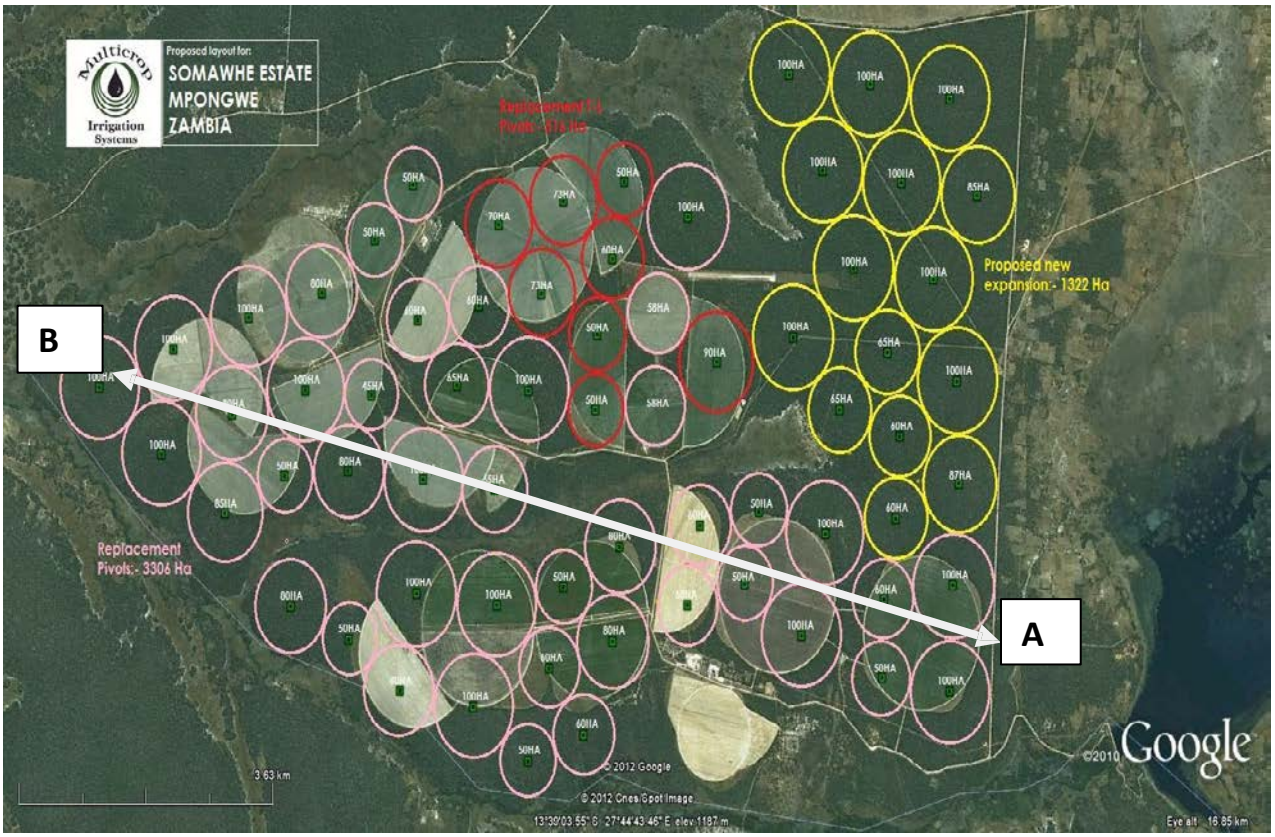


Figure 10: Showing existing and planned agricultural fields

3.5.3 Chemical Use

Currently, there several chemical substances used in its crop management and intended to protect and store the farm produce (See Appendix … for the list of chemicals). From the fields, fertilizers are used to grow the crop followed by chemical weeding and control of pests. At final harvest, chemicals continue to be used in or to add port-life to the produce and further protection from pests. In the silos, fumigation or drenching is used according to the state of technology preferences. See annexure 2 for the list of chemicals stocked at Somawhe.

3.6 Products and By-products

3.6.1 Operational Phase

Once the crop is harvested, it is stored in silos located on the farm for transportation to buyers. No processing of the grain crop is carried out at Somawhe. Consequently there are no by-products.

4. Baseline Information on the Project

4.1 Physical Environmental Setting

4.1.1 Topography and Landscape

The topography of the area is generally flat land and the land gently slopes towards the Impumbu River and its tributary. The Project area lies at an elevation of about 1,200m above mean sea level (amsl). Apart from the cleared land currently under irrigation, there remains virgin land with mostly open woodland that could be developed into irrigated land.

4.1.2 Geology and Geomorphology

Geology

The geology of Zambia comprises of various rocks and layers dating from over 1,000 million years ago. These rock formations consist of igneous, sedimentary and metamorphic rocks.

The age of the Katanga ranges from late Precambrian to cambriam (100 to 500 million years old). The Katenga Super Group comprises shales, sandstone, dolomites, quarzites, limestone and comglomarates. The project site is within the Katanga Super Group widely distributed in the northern and central parts of Zambia. It is characterized by deformed sedimentary rocks of the Katanga super group. And most prominent feature of the system is that most of the formations are calcareous or dolomite in nature.

Geomorphology

The geomorphology of Somawhe Estates area can be classified as a central African plateau (CAP). The elevation of this plateau ranges 1,850m to 600m. The highest parts of the plateau are located in the North and North West of Zambia. The elevation gradually reduces towards the south west/south to the Zambezi River. In general the plateau is gently undulating in all places.

4.1.3 Soils, Soil Management and Nutrient Cycling

Farm Soil Characteristics

The project area is characterised by three soil types (Figure 11): Acrisols, Ferrolsals and Associations. Effective management of the soil chemistry is all about monitoring and managing trends and to establish these trends requires soil analysis over many years. For reliable information to be collected all steps need to be closely managed from the collection and handling of the samples to the laboratory work. There is no methodical buildup of this information at present, soil sampling and analysis is usually done by one of the fertilizer suppliers, a practice that can lead to conflicts of interest. Services of an independent company should be engaged to carry out soil sampling and the necessary recommendations.

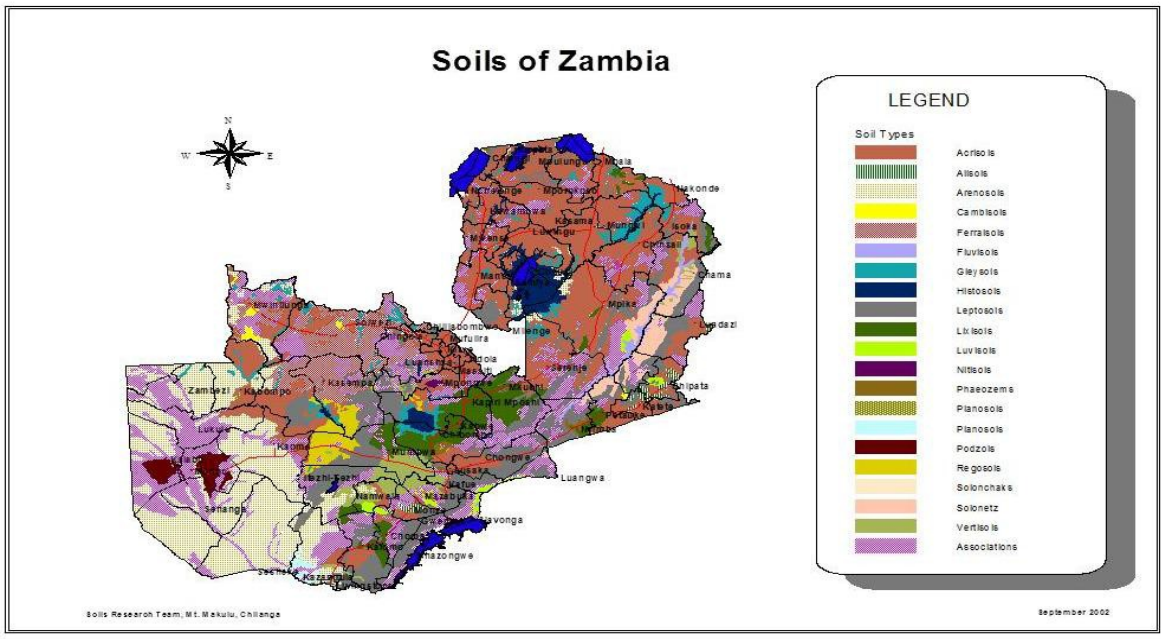


Figure 11: Map of showing soil types in Mpongwe where the farm is situated

Soil analysis

Soil samples to a depth of 20cm were collected at four selected sites at the project site for soil physical-chemical characterization. Details of soil tests and results are shown in Appendix 1.

The analysis of the soil samples was conducted at Forest Research Division in Kitwe Zambia. The results of the physical-chemical analysis are shown in Tables 5 and 6. The physical-chemical results relate to surface horizons, and not the entire profiles. Soil color was determined using Munsell Color Charts (United State Department of Agronomy). Particle size analysis was done using Hydrometer. Exchangeable basic cations were determined using flame photometer while calcium and magnesium were determined by ethylene di-amine tetra acetate method. Organic carbon was determined using the WALKLEY- BLACK method.

Table 5: Physical properties of the soils at the project site

Lab No	Field code N/E	Depth Cm	Clay %	Silt %	Coarse Sand%	Fine Sand %	Total Sand	Texture (USDA)	Color (Munsell)
9	8487855, 578486	0 -20	2.2	6.76	40	53.24	93.24	Sand	Brown
10	8491993, 584370	0-20	3.6	10.70	24	65.30	89.30	Loamy Sand	Dry Brown
11	8491354, 582211	0-20	1.8	10.76	52	37.24	89.30	Loamy Sand	Very Dark Brown
12	8493207, 576326	0-20	0.5	4.82	40	55.18	95.18	Sand	Very Dark Brown

Table 6: Chemical properties of the soil at project site

Lab No.	Field code	Depth Cm	pH	Kppm	Na ppm	Ca me/ 100g	Mg me/100 g	Organic carbon %	Organic Matter %	Total carbon %
9	848785	0-20	4.6	14.3	7	0.20	0.30	0.411	0.882	0.547
10	849199	0-20	5.1	13.3	5	0.30	0.10	0.695	1.390	0.924
11	849135	0-20	3.4	13.0	10	0.30	-	0.394	0.788	0.524
12	849320	0-20	4.5	10.0	8	0.35	0.10	0.697	1.390	0.927

Soils at project site

The soils in the study area can be classified as acrisols and ferrasols. Acrisols have moderate soil pH and a moderate cation exchange capacity. They are moderately leached and as such their production potential may be increased by addition of inorganic fertilisers and other soil management activities that build soil fertility such as incorporation of organic materials. Ferralsols on the other hand are highly weathered. This means they have low soil pH which means the soils are acidic. These soils may experience aluminium toxicity to plants because under low soil pH aluminium solubility increases. It is therefore important that the physical- chemical properties of the soils are known for effective management of the soils.

Physical-chemical properties

-Physical properties

The physical analysis of the soils for all samples collected indicated that soils are sandy. Sandy soils have undesirable physical properties for plant growth. This can be attributed to the fact that the soil particles are 2 to 0.02 in diameter implying that the soil has large pores. In soils with such properties water easily drains to deeper levels.

-Chemical properties

Sandy soils have low cation exchange capacity implying that the ability of these soils to retain nutrients for plant uptake is low. Timing of fertilizer application in such soils is important to ensure nutrients are supplied at the right time when plants most need them.

These soils are derived from biotite quartzite parent rock with some schist bands. Soils derived from this type of parent material are sandy with quartz as a primary mineral. These soils are inherently deficient in nutrient elements because they have low cation exchange capacity for adsorption of nutrients. They have poor physical properties in that they have low water holding capacity and as such they are drought prone soils. Soils developed from dolomitic limestone were also observed on the Eastern part of the project site. These soils are known to be rich in plant nutrients, due to their high nutrient retention ability coupled with good water holding

capacity (Salama 1992).

These soils are moderately acidic and as such some of the exchange sites on the soil complex may be occupied by hydrogen and aluminium ions (high solubility of Aluminium in acid conditions that is toxic to plants). The low soil pH may explain the low amounts of calcium and magnesium in these soils.

Nutrient elements

Elements required by plants fall into two categories; those required in relatively large amounts such as nitrogen, magnesium, potassium, calcium, etc., and those required in small amounts such as copper, manganese, zinc, etc. (Hinrich et al.,1979).

Nitrogen is required by plants in large amounts. Soil nitrogen is usually bound to organic matter and concentrated in the top soil (Thornely et al., 1992). Nitrogen requirements by plants can also be obtained by using nitrogen fertilizers such as nitrate, urea and ammonium. The transformation of organic nitrogen compounds to inorganic forms is known as mineralization and is mediated by enzyme activities from microorganism. The activities of microorganisms may be affected by soil pH. The microorganisms require optimum soil pH in order to decompose the organic matter.

Most soil nitrogen is concentrated in the top soil (0-15 cm) of soil depth with about 90-95% occurring in organic form. The amount varies from <0.01% to 0.5% in most mineral soils and >2.5% in some organic soils (Maliondo 1990). The analytical results indicated that the soils at the project site are low in organic matter and as such the amount of nitrogen is low.

Calcium deficiency causes malformation and disintegration of the terminal plant parts. Magnesium is a constituent of chlorophyll molecule and is involved in protein synthesis and cellular pH regulation. Deficiency of magnesium reduces chlorophyll content, and cause starch accumulation in the leaves. Calcium and magnesium are susceptible to leaching in acid soils and deficiency occurs mostly in soil with soil pH of < 5. Analytical results indicated that soils at the project site are deficient in calcium and magnesium.

Phosphorus was found to be low in all sites that were sampled. Phosphorous is a constituent of nucleic acids and phospholipids. It is involved in cell division and development of meristematic tissues. Deficiency of phosphorous in plants results in retarded cell division and plants are often stunted due to poor root and shoot growth. Phosphorous deficiency may lead to delayed maturity of crop plants and reduced seed formation.

Potassium is the third most important primary nutrient in plants after nitrogen and phosphorous. Potassium is important in enzyme activation and water regulation in plants. It is essential for photosynthesis, starch formation and for development of chlorophyll. Symptoms of deficiency include: leaves which are dry and scorched at the edges and irregularly chlorotic with impaired photosynthesis and starch synthesis (Maliondo 1990). Analytical results showed that Potassium was not limiting with reference to threshold amounts.

4.1.4 Meteorology and Climate

Climate

The climate of the area is controlled largely by the north-south migration of the Inter Tropical Convergence Zone (ITCZ) with seasons. The ITCZ migrates between the equator and the Tropic of Capricorn (23º S) between November and February. The area lies within the high rainfall region of receiving in excess of 1,000mm per annum. Somawhe has its own small meteorological station equipped with basic weather instruments. The nearest meteorological service station is located at Simon Mwansa Kapwepwe International Airport.

Temperature

The region experiences an annual average temperature of approximately 20°C, with warm to hot summers, reaching 33°C and higher in September and October (Figure 12). Warm winter days are accompanied by cold nights. Minimum temperatures at times drop below 12°C especially over June and July.

Rainfall, Meteorology and Evaporation

Summer rains commence in late October. The bulk of the rainfall occurs between November and March when more than 90% of the annual rainfall is measured. The mean temperature between 1998 and 2011 has shown an increasing trend (Figure 13). The average evaporation recorded in the area is 4.7mm per year between 1997 and 2011 (Figure 14) (SOMAWHE INVESTOR REPORT, 2012).

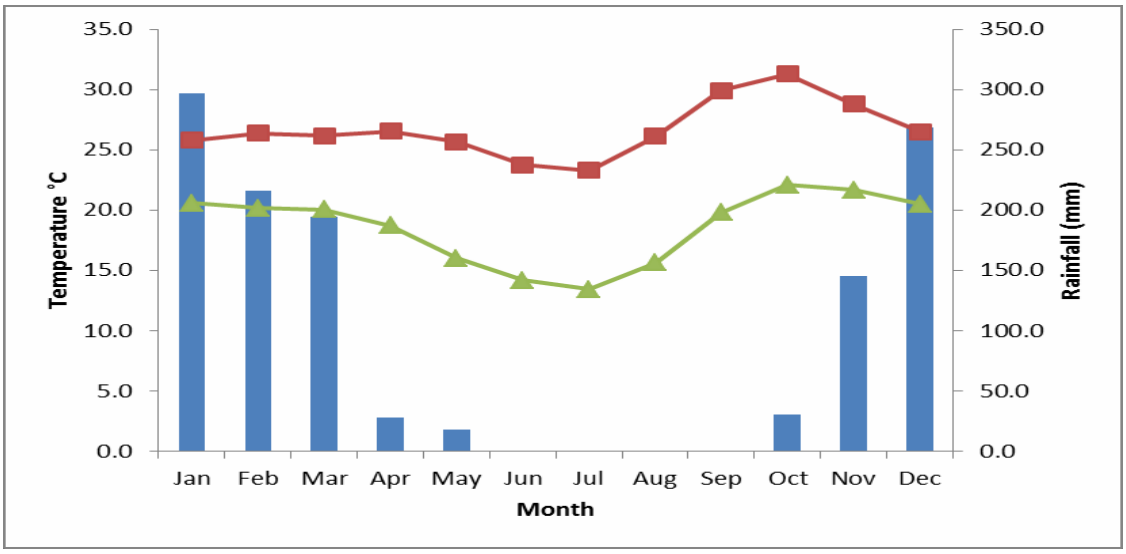


Figure 12: Mean monthly maximum and minimum temperatures at SOMAWHE farm including average rainfall

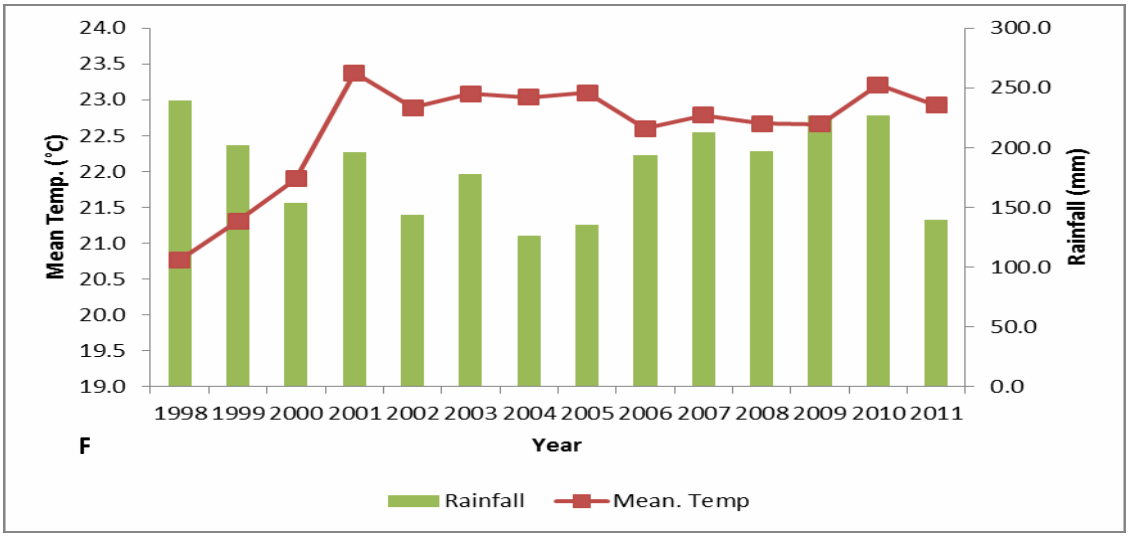


Figure 13: Mean Temperature and Rainfall trend between 1998 and 2011

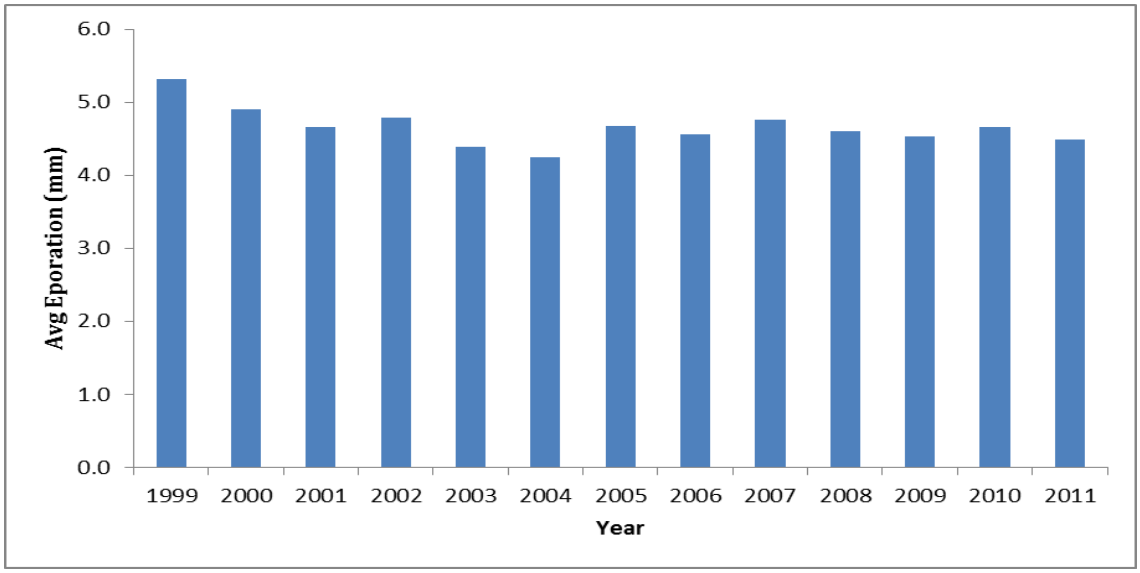


Figure 14: Average Evaporation within the farm area

The suitability of the climate for the production of maize and soya in the summer and wheat and barley in the winter is well proven in this area. The summer rainfall pattern fits well with the double cropping requirement for a dry April and September allowing for harvesting.

Agro-ecological considerations

The map below gives the agro-ecological zones of Zambia. The project area is situated in the agro-ecological zone III which has average annual rains of above 1,000mm.

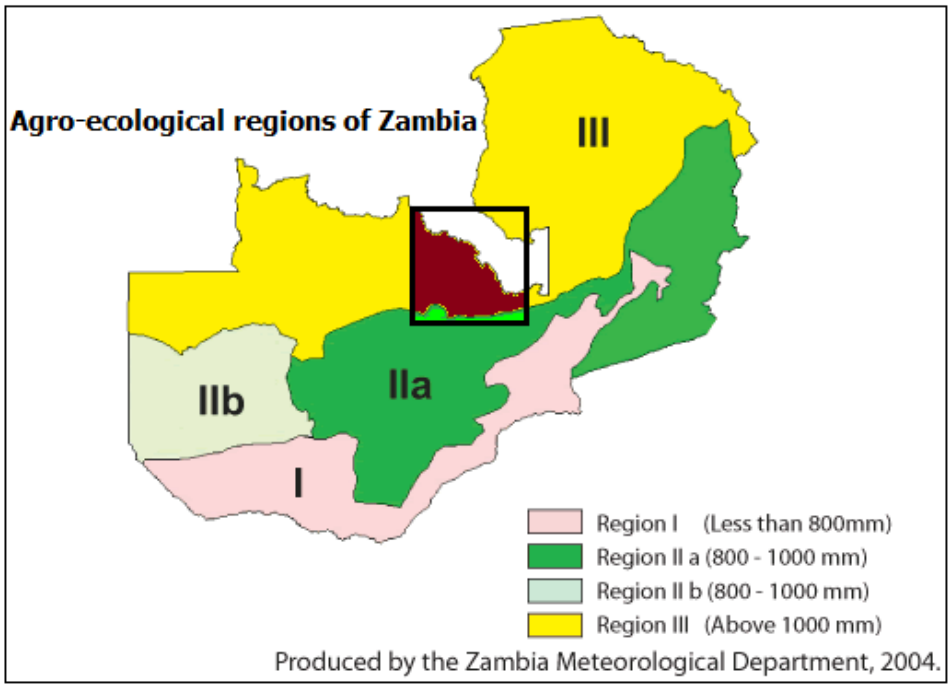


Figure 15: Agro-ecological regions of Zambia

Wind and Air quality

The maximum mean average temperatures for October is 19.4 degrees celsius while the coldest month has an average of between 12 to 27 degrees celsius. Wind direction is predominantly from north-east to south-east in the project area while average wind speeds range from 1.4m/s in summer months to 0.8m/s in winter periods.

Mpongwe and in particular the project area is a rural community setting with no major industries except for the intermittent emissions from farm operations, charcoal making operations and firewood burning. Motor vehicle traffic is low and therefore there are no significant vehicle emissions.

4.1.5 Hydrology, Hydrogeology and Water Quality

Surface hydrology

The Kafue River is the biggest water body traversing almost all the districts of the Copperbelt Province and it is flanked by valleys, streams 'dambos' and wetlands with a very vital hydrological potential to support the climate and weather of the region. These wetlands also act as natural water filters of pathogens, organic and inorganic pollutants. In addition, they also restrict river current to minimize soil erosion with improved river sedimentation.

Dambos also act as water storage facilities, which release the trapped water which in turn slowly support all aquatic ecosystems during dry spells. Wetlands are a rich habitat for complex ecosystems and diverse species in terms flora and fauna. This natural resource base is what has supported agriculture and defines both the ancient and modern socio-economic potential of the region at commercial and subsistence levels.

As such, the Kafue River Basin with its associated ecology is relevant to the socio-economic stability of the region. Great care has to be taken during land use and planning in order to conserve the resource with its ecosystem. This will ensure ecological biodiversity and socio- economic stability. This is as a result of the *miombo* being associated with a wide range of important benefits especially relevant to the local poor.

Mpumbu River

The Impumbu River originates at the Eastern end of the Impumbu dam and flows in a South Easterly direction to a point it enters the main Kafue River and approximately 4 ½ km east of the Machiya Pontoon. At the time of the field surveys, measured flows for Impumbu River near the dam site were found to be 4.093m^3/s. The flow measurement for Impumbu River at Machinya Hydro station was reported to be 5.079m^3/s.

Mulilanama Stream

Mulilanama Stream originates within the Somawhe flowing from the Eastern Part of the Dambo and flows in the South – westerly direction into Impumbu River. The flow measurement for Mulinama Stream was found to be 0.439m3/s before it joins Impumbu River.

Munsoshi Stream

The Munsonshi Stream originates within Somawhe on the Eastern side of the dambo and flows in a south – westerly direction into Impumbu River. The flow measurement for Munsonshi Stream was found to be 5.079m^3/s before joining Impumpu River.

Catchment characteristics

Impumbu Sub-Catchment is defined by Impumbu River and its tributaries. Within Somawhe the two tributaries include Mulilanama and Munsoshi streams. These streams drain an area of about 17.6km^2. Within Somawhe, the sub-catchment lies on the eastern side of Kafue River. Generally the catchment is well drained and still enjoys relatively undisturbed patches of woodland especially within boundaries of land under private title such as Somawhe. In areas under customary title, woodland has been depleted over the years due to cutting of trees for charcoal and for agricultural fields. Refer figure 16.

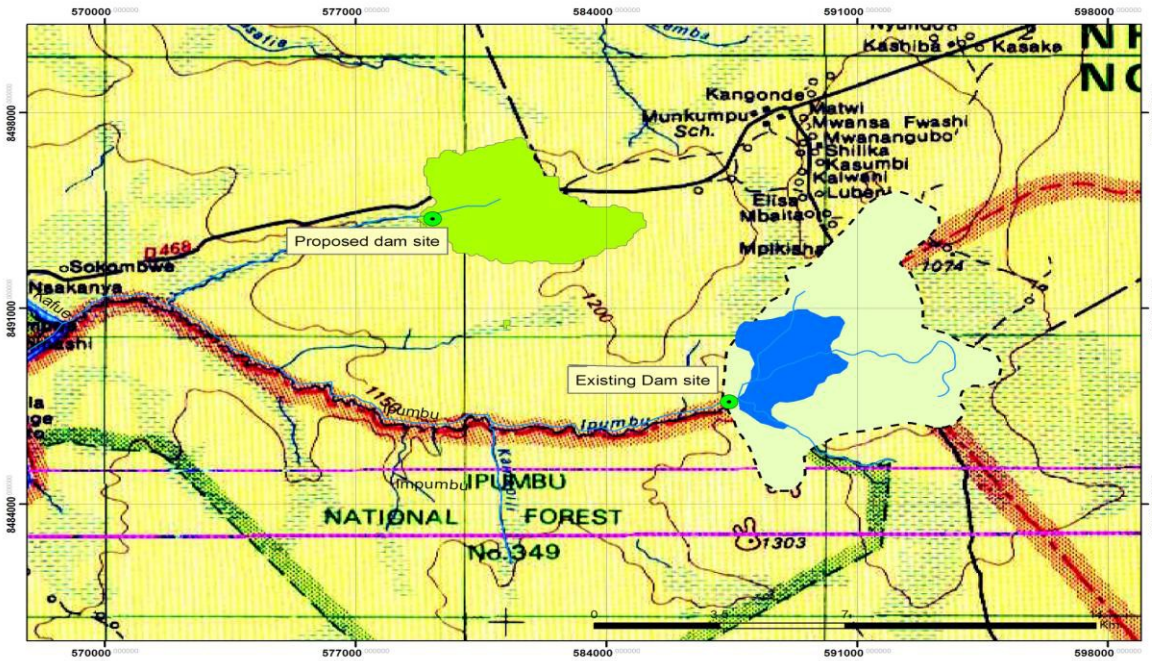


Figure 16: Showing Impumbu sub-catchment

The sub-catchment within Somawhe has a potential site on Munsoshi stream for construction of a dam. The figure below shows the potential site and the extent of its catchment.

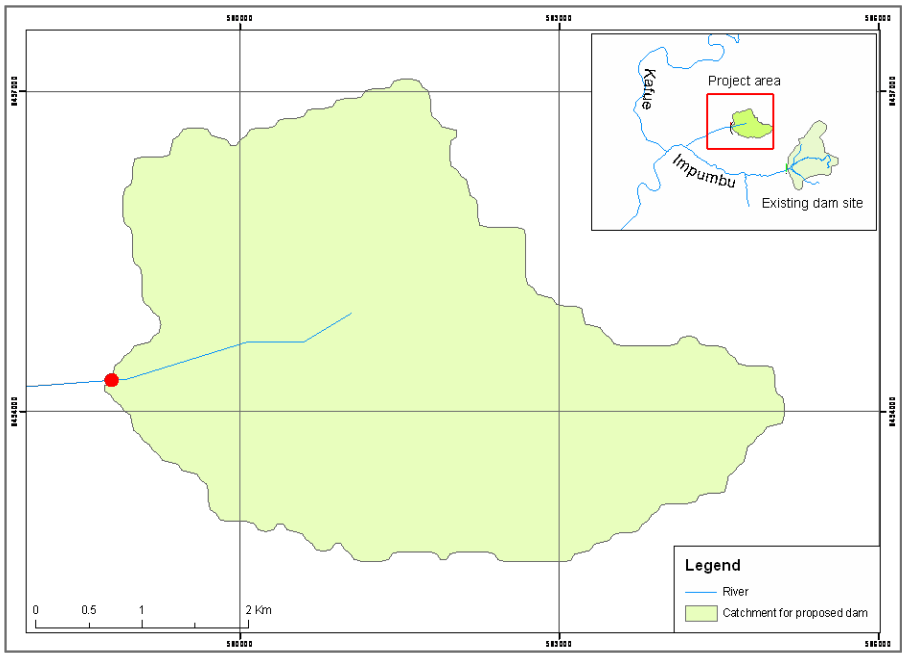


Figure 17: Location of the potential dam site

Catchment Yield

The yield of the catchment (water potential) is based on the amount of annual rainfall, groundwater recharge as wells as evapotranspiration. Other catchment characteristics, such as slope and shape also contribute to the overall catchment yield. From the figure above, the estimated catchment yield, based on annual rainfall and extent, is 4.0 mm^3 (Table 7). Estimated monthly flows for the catchment range from 1.4m^3/s to 22m^3/s.

Table 7 : Catchment yield of potential dam site

Catchment Area	Size (km^2)	Annual Rainfall		Evapotranspiration	GWR(9% of rainfall)		Yield	
		mm/a	Mm^3/a	mm/a	mm/a	Mm^3/a	mm/a	Mm^3/a
Proposed dam site	18	1200	21.1	866.0	108.0	1.9	226.0	4.0

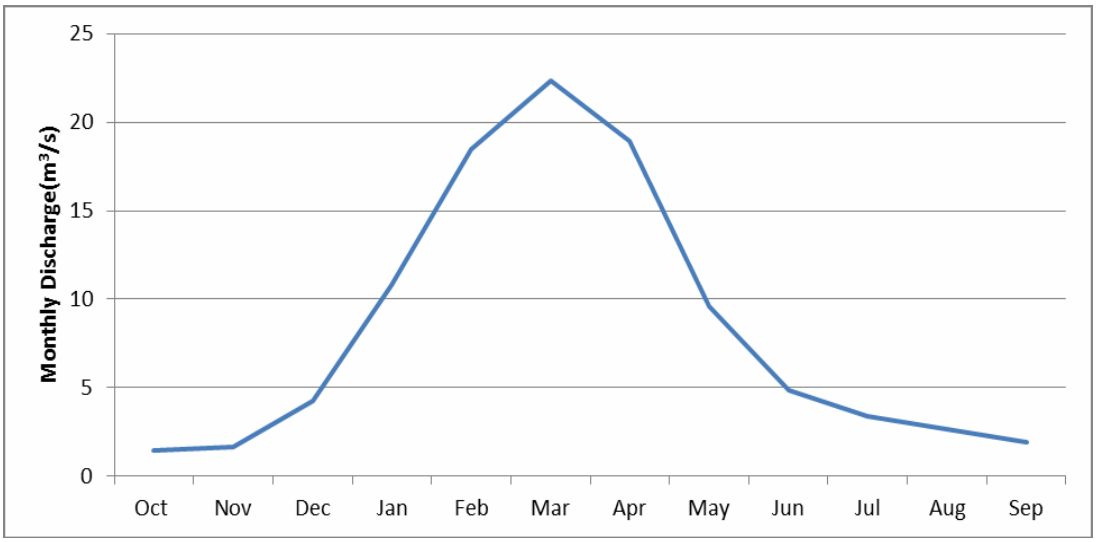


Figure 18 : Estimated monthly flows for the catchment areas

Baseline Water Quality

Field surveys indicated that no significant pollutant sources are known in the area except from agricultural activities. For baseline surface water quality, water samples were collected by the technicians during site visits to establish the water quality. Sampling was carried out in accordance with WHO accepted procedures for the collection of surface water quality samples. Full suite chemical and physical analyses were performed on samples and analysed by Department of Water Affairs Laboratory in Lusaka. Pesticides were analysed at the Zambia Bureau of Standards Laboratory.

Preliminary results for physio-chemical results shows that all parameters analysed were found to be within acceptable allowable limits according to WHO standards. Equally for all pesticides analysed although traces of pesticides were found in some samples, no sample had shown any parameter to be above allowable limits.

4.2 Habitats and flora

4.2.1 General description of the vegetation

Vegetation in Mpongwe district, the project area, is typical of the Copperbelt province vegetation covered mainly by single storied deciduous *Miombo* Woodland with limited areas of dry evergreens, swamps and riparian forests known as *Mushitu*, *Chipya* woodlands and savannah scrubs. This unique woodland often grows to form a closed-canopy. Degraded forest areas were however observed to have secondary grassland and juvenile re-growths of woody species across the land.

Though the Ecoregion on the Copperbelt has changed during the past century, the predominant vegetation type still remains the *miombo* woodland with its characteristic fire hard species composing mainly of *Brachystegia*, *Julbernardia* and *Isoberlinia species* which are generally depleted due to uncontrolled human activities. The project area is characterized by private commercial farms and traditional land. These areas have either been cleared of vegetation for agricultural activities or settlements. Such areas are devoid of dense indigenous primary species.

Forest depletion can be attributed to charcoal burning; planned and unplanned settlements; industrial and agricultural expansion activities. As a result of forest depletion, most big mammals have either been depleted or have fled the area hence only small animals may be spotted in less protected areas. However, to-date, some large tracts of land however exist, housing a sizeable number of large animals.

Exotic Forests

The Department of Forestry was established in 1948 and so far, exotic forests on the Copper cover about 6,000 hectare of land (Zimba, 2007). Protected forest areas were established after specialized studies were conducted in the 1930s. About 4,000ha of exotic forests belong to the Zambia Forestry and Forest Industries Corporation ZAFFICO and the rest is under the Department of Forestry for industrial timber production and research.

Approximately 50,000 hectares of the area on the Copperbelt Province is used for exotic plantations by the Zambia Forestry and Forest Industries Corporation. The main exotic tree

species grown for commercial purposes are *Eucalyptus* and *Pine*. *Gmelina aborea* is also grown along peripherals of the ZAFFICO plantations as fire buffer zones. Exotic forests are widespread on the Copperbelt Province although in Mpongwe and the project area in particular, they are not as significant as in Ndola and Kitwe towns. Plant species such as the Gmelina, Pine and Eucalyptus are the most favoured due to their fast growth, short rotational periods, strength (*Eucalyptus*), suitability and ability to meet demand for various purposes. Their well suitability and adaptability to the region has primarily reduced pressure on the indigenous forests resources. On the other hand, species like Flamboyant, *Jacarandas, Acacias*, *Percia,* mangoes, avocados and guavas mostly dominate human dwellings in which some scattered indigenous *miombo* trees may also be found.

Indigenous Forests

There are currently two categories of forests in Zambia and these are the National Forests, which are under the control of the Forestry Department and the Local Forest, which is managed by the department together with the local community.

National forests are either designated as "Protected" or "Unprotected". Protected forests are meant for the purposes of research or for the protection of water catchment areas. In this type of a forest, harvesting of timber is not allowed although almost every such forest has been disturbed today. The unprotected forests are usually harvested by the community under a license obtained from the Department of Forestry.

There are at least 51 protected forests in Zambia which cover about 515,482 Ha of land accounting for about 17% of land on the Copperbelt. There are also forty-three forest reserves in urban districts and the remaining eight are in rural districts of the province. The eight account for about 58% (276,681Ha) of the total protected forests. Twelve of the protected forests contain portions of both indigenous and exotic trees but the majority is composed of indigenous trees. The pine plantations are more than the eucalyptus and these exotic plantations account for about 42,500ha or 15% of the protected forest estates. As a deliberate policy, tracts of woodlands have been reserved within Somawhe as habitat for fauna.

The Pre-Mining and Farming Fauna Diversity of the Region

Not very long ago on the Copperbelt Province and the project area in particular, the *Miombo* woodland was thriving with abundant wildlife resource securely spanning across the forest cover as evidenced in Kafue and Lukusuzi National Parks. The carrying capacity of this woodland is about 2,000 kg/km^2 and is actually lower than that of the Serengeti and Mara Plains of East Africa, which have much richer substrate soils with higher nutrient value as a result of the characteristic volcanic soil sediments. In these rich forests, the carrying capacity is about three or four times as high. Even the Kafue Flats or flood plains are superior to the Miombo ecosystems.

However, the *miombo* woodland has the potential to support a wide range of large herbivores (grazers and browsers) and other animals of pray and has the capacity to carry at least 16 large herbivores such as the Elephant, Zebra, Black Rhinoceros, Eland, Sable, Roan Antelope, Hartebeest, Impala, Puku, Reedbuck, Warthog and Bush Pig etc. not to mention other medium sized animals. It is further reported that 115 mammals of all sizes exist in the Copperbelt province (Chidumayo, 1987).

Other documented accounts indicate that between 1913 and 1914, lions and elephants would be seen on a daily basis by travelers between Katanga and Ndola on the Copperbelt. Fairweather's (1993) and other reports also reveal that bird life was very active in the region. However, this is no longer the case. The project area no longer has such habitat due to agricultural activities and settlements.

4.2.2 Survey methodology

The ecological survey was conducted using a systematic approach. The ecological survey involved the following steps.

Step 1: Desk Study and Reconnaissance Survey

An initial desk study was undertaken on the behest of Chobe prior to the surveys. The desk work involved review of necessary literature and documents provided on the farm. It also assisted in the collection of secondary data relevant to the objectives of the ecological assessment. We

were able to make initial assessments of the project by driving through project during this period. The information that was obtained from both the desk study and reconnaissance survey guided the determination of the sampling methods and the identification of the types of data collection tools to be used. The findings of the desk study were also used to identify initial risk areas for Chobe during the due diligence phase.

Step 2: Flora Assessment

The flora surveys were undertaken between April and May 2012. Flora was surveyed using stratified random sampling. The area was stratified according to the various land use that were identified during the desk study and the reconnaissance survey. For example, identified land use included riparian forests, miombo woodlands, cultivated areas, chipya woodlands, termitaria, dambos and built up areas. After identifying the different habitats, a sample plot of 20m x 20m was established in each of these habitats to collect data on trees. During the data collection, however, these square sample plots were converted to circular sample plots. This is because the 14 to 20 m radius has been reported to capture adequate data (e.g. Zimba, 1991; Geldenhuys, 2004) in the inventory of the Zambezian phytoregion. Another advantage was that the circular plots were easier to establish in the field than square plots. In total 18 circular sample plots (each 400m^2) were made throughout the area. The GPS coordinates were taken at the centre of each plot. For the exact GPS coordinates for each plot see annex 5.

Table 1 shows the parameters that were from the 20m x 20m plot (main plot). The diameter was taken at breast height on all the trees with Diameter at Breast Height (DBH) greater than 5cm and more than 50cm height. All the measurements conducted on the main plot were recorded on the main plot data collection form (see annex 6).

Table 9: Parameters measured from the main plot

Parameter	Comment
Diameter at Breast Height (DBH)	Taken on each tree in cm
Bole height	Taken in m
Total Height	Measured in m
Tree condition	Crooked, moribund, etc
Tree species	Identified by use of check lists and KYT
Crown size	In m
Evidence of fire	
Health of canopy	In %
Vegetation type	Marquesia, Parinari forest etc

In each main plot 2-3 (3mx3m) sub-plots were established. On these sub plots all seedlings below 50cm height were measured. Regeneration measurement involved counting and identifying the species in the 3m x 3m plots within the main plot. Fire occurrence within the plot was observed and its impact on the plants growing in that area was also recorded. Regeneration data was recorded on the regeneration data collection form (see appendix 3). Weeds were also identified.

Step 3: Fauna Assessment

The number of fauna survey sites closely reflected the number of vegetation communities present within the study area. Location of fauna survey sites was determined from vegetation community identified during the reconnaissance and from available maps and prior to the commencement of detailed surveys. The minimum level of required fauna survey work varied where appropriate taking into consideration the characteristics of the vegetation communities or habitats present. Sampling transects and point stations were used to collect data on fauna. The boundaries of each vegetation community and the location survey sites were determined from the map of the study area.

The mammal survey involved direct observation (during daylight hours) of signs of mammal activity which could include prints, tracks, hairs, droppings, odour, digging and evidence of feeding.

Data about fauna was also collected through interviews. Employees at the farm and community members were interviewed for the purpose of collecting data on the type of animals; location, distribution and frequency of occurrence in altered and disturbed environment within Somawhe. The following key questions were used to collect data on wildlife resources in the area:

- What types of animals (mammals, birds, reptiles amphibians and insects) were once present in the area?
- What animals are found in the area today? and
- What has caused the changes in animal population structures?

All the data collected was recorded on the fauna assessment form (see appendix 4)

For bird species, a checklist of questions included:

- What type of migratory birds you usually see in the area?
- Do you notice any strange or extraordinary birds during certain seasons?
- Do you know their names?
- When do they appear and leave each season?

In order to detect the occurrence of threatened fauna species, specific methods for targeting these species were employed in addition to the standard fauna survey methods mentioned above.

Step 4: Habitat Assessment

Habitat assessments were undertaken and the various habitat types were identified within the project area. General habitat information, as well as other features of ecological value were also recorded for the purpose of providing recommendations as to how such habitats could be managed for the minimisation and enhancement of negative and positive impacts respectively.

To determine the potential presence of rare and threatened species within the study area, habitats encountered during the field survey were compared with those preferred by, or typical of, rare and threatened species listed under the various local and international legal

frameworks. Those species with habitat requirements that overlapped with the habitat characteristics encountered during the field assessment were considered to be potentially present. Those species, which have habitat requirements not encountered during the field assessment, were considered unlikely to be present.

Excel was used to analyze the data on flora. The species data was used to determine species importance values (IV) and species richness. Importance values were calculated as adopted from DWAF (2005). Species important values are very important in determining the performance of the species in a given area. Below are the formulae used in the analysis.

For plants with dbh ≥ 5 cm

Importance value (IV) = [Relative frequency (RF) + Relative density (RD) +Relative basal areas (RBA)]/3

where:

Relative frequency = Number of plots in which species is present * 100
Total number of plots recorded

Relative density = Number of stems recorded for species * 100
Number of stems recorded for all species

Abundance = Total Number of stems recorded for species
Total number of quadrants in which the species occurred

Relative basal area =Basal area of a species in a community * 100
Total basal area of all species in the community

Calculation of dominance Indices

Dominance indices are weighted towards the abundance of the commonest species. Dominance indices were calculated for the commonest species. The dominance indices that were used included the following:

Information-statistic indices

a. <u>Species Richness</u>

$$SR = \frac{S}{\sqrt{N}}$$

Where: S = Number of species observed in the

N = Total number of individuals trees Observed

b. <u>Shannon Index (Hs)</u>

$H_s = -\sum p_i ln p_i$

Where:

Pi = Proportion of individuals found in the *i*th species and

ln= Natural logarithm

Materials

In order to implement the ecological assessment, various materials were used. The equipment/materials used are shown in Table 10.

4.2.3 Relative Frequency, Relative Density, Relative Basal Area and Important Values (Flora)

Analysis of field data using the formulae given previously resulted into determination of Important Values (IV) and associated parameters shown in table below. Note that these indices relative frequency, densities and IV) are mostly useful for monitoring the impacts and identifying the most common species with a given ecosystem. From the table 11 it can be observed that *Julbernardia paniculata* has the highest IV (51%) as far as the entire farm area is concerned. This means that it is the most dominant species occurring within the farm.

Table 10: Materials/Equipment used in the assessment

ITEM	USE/PURPOSE
GPS Unit and extra batteries	Collection of geographic coordinates and altitude readings
Callipers	Measurement of diameter for small trees, shrubs and sub shrubs
Camera	Capturing photographic records of interesting observations
Identification Manuals	Identification of Plant and faunal species
Canvas tape measure (50m)	Demarcating quadrant /sampling site size and setting x and y axis; for measuring diameter and canopy size for trees, shrubs and sub-shrubs
Site/Top/Vegetation Maps	Predetermine the biophysical characteristics of the area to guide sampling model designs
Diameter Tapes	Measurement of diameter for very big trees
Metal tape measure (10m)	Measurement of canopy sizes for shrubs and sub shrubs and height measurements for sub shrubs
Height measurement rod	Shrub and small trees height measurements
Clinometers	Tree height measurements
Plant press	Keeping of plant specimen collections for further identification
Slope measuring equipment	Measuring of the slope of the land
Metal plates / nails / hammer	Marking quadrat / sampling site and reference point
Ropes (multiple colours)	Marking sampled plant species – especially in high density plant communities such as thicket
Beacons	Marking quadrat / sampling site corners and photo-point stations
Maps and reports / papers	Provision of base-line data
Water proof bags	For carrying data forms
Stationery + data forms	Recording field data

Important Values (IV)

Note that Important values (IV) measure the relative dominance of species in a forest community (Curtis, 1959). IV rank species within a site based upon three criteria:

a) How commonly a species occurs across the entire forest area,

b) The total number of individuals of the species and

c) The total amount of forest occupied by the species

Table 11: Relative Frequency, Relative Density, Relative Basal Area and Important Values

SPECIES	RF (%)	RD (%)	RBA (%)	IV (%)	SPH
Albizia antunesiana	18.8	1.0	0.2	6.6	100
Anisophyllea boehmii	37.5	3.2	1.4	14.0	325
Baphia bequaertii	18.8	1.0	0.4	6.7	100
Brachystegia boehmii	50.0	12.7	22.0	28.2	1300
Brachystegia longifolia	25.0	3.7	5.8	11.5	375
Brachystegia speciformis	18.8	4.6	5.2	9.5	475
Diospyros batocana	37.5	5.1	2.2	14.9	535
Diplorhynchus condylocarpon	25.0	5.4	2.5	11.0	550
Erythrophleum africanum	25.0	2.2	2.1	9.8	225
Isoberlinia angolensis	56.3	6.8	10.1	24.4	700
Julbernardia paniculata	100.0	22.7	32.1	51.6	2325
Monotes africanus	25.0	1.2	0.4	8.9	125
Parinari curatellifolia	31.3	2.2	3.4	12.3	225
Pericopsis angolensis	18.8	1.5	1.4	7.2	100
Pseudolachnostylis maprouneifolia	62.5	5.1	3.2	23.6	525
Pterocarpus angolensis	25.0	1.0	0.3	8.8	100
Uapaca kirkiana	25.0	4.6	0.9	10.2	475

Note: See appendix 5 for indicators for all the species identified within the SOMAWHE Farm area

Abundance

It is the study of the number of individuals of different species in the community per unit area. By quadrants method, samplings were made at random, at several places and the number of individuals of each species was summed up for all the quadrants divided by the total number of quadrants in which the species occurred. The outcome of this analysis is given in the table 12. From the table it can be observed that the species that showed most abundance were *Brachystergia speciformis, Diplorhynchus candylocarpon* and *Julbernardia paniculata*.

Table 12: Species abundance within the SOMAWHE Estates

SPECIES	STEMS	PLOTS	ABUNDANCE
Albizia antunesiana	4	3	1
Albizia Versicolor	5	3	2
Anisophyllea boehmii	13	6	2
Baphia bequaertii	4	3	1
Brachystegia boehmii	52	8	7
Brachystegia longifolia	15	4	4
Brachystegia speciformis	19	3	6
Diospyros batocana	21	6	4
Diplorhynchus condylocarpon	22	4	6
Erythrophleum africanum	9	4	2
Isoberlinia angolensis	28	9	3
Julbernardia paniculata	93	16	6
Monotes africanus	5	4	1
Parinari curatellifolia	9	5	2
Pericopsis angolensis	6	3	2
Pseudolachnostylis maprouneifolia	21	10	2
Pterocarpus angolensis	4	4	1
Uapaca kirkiana	19	4	5

Species Diversity

The Shannon index was used to calculate the current status of species diversity within Somawhe. The overall Shannon index shown in Table 13 provides important information about rarity and commonness of species in a community. It indicates the number of species present and how these individuals in the community are more equitably distributed among these species. It measures overall biodiversity and in the case of Somawhe, the overall Shannon index indicates that the number of individuals is unevenly distributed among the given species since the H is low. This index can also be used as an indicator for monitoring the impact of farm

activities on overall biodiversity. For example, if after a certain number of years, when another similar study is conducted, the comparison will be made between the two calculated indices to check whether there has been some decline or remains the same.

Table 13: Shannon Index for the species observed within Somawhe

Species	Pi	lnPi	PilnPi
Acacia albida	0.0024	-6.0162	-0.0147
Acacia polyacantha	0.0122	-4.4067	-0.0537
Albizia Amara	0.0024	-6.0162	-0.0147
Albezia Andianthifollia	0.0024	-6.0162	-0.0147
Albizia antunesiana	0.0098	-4.6299	-0.0452
Albizia Versicolor	0.0122	-4.4067	-0.0537
Anisophyllea boehmii	0.0317	-3.4512	-0.1094
Baphia bequaertii	0.0098	-4.6299	-0.0452
Brachystegia boehmii	0.1268	-2.0649	-0.2619
Brachystegia longifolia	0.0366	-3.3081	-0.1210
Brachystegia speciformis	0.0463	-3.0717	-0.1423
Combretum molle	0.0024	-6.0162	-0.0147
Dalbergia nitidula	0.0024	-6.0162	-0.0147
Diospyros batocana	0.0512	-2.9716	-0.1522
Diplorhynchus condylocarpon	0.0537	-2.9251	-0.1570
Erythrophleum africanum	0.0220	-3.8189	-0.0838
Hymenocardia acida	0.0049	-5.3230	-0.0260
Isoberlinia angolensis	0.0683	-2.6840	-0.1833
Julbernardia paniculata	0.2268	-1.4836	-0.3365
Lannea discolor	0.0293	-3.5313	-0.1034
Marquesia macroura	0.0024	-6.0162	-0.0147
Monotes africanus	0.0122	-4.4067	-0.0537
Olax obtusifolia	0.0024	-6.0162	-0.0147

Orchna pulchra	0.0073	-4.9175	-0.0360
Parinari curatellifolia	0.0220	-3.8189	-0.0838
Pericopsis angolensis	0.0146	-4.2244	-0.0618
Protea angolensis	0.0171	-4.0702	-0.0695
Pseudolachnostylis maprouneifolia	0.0512	-2.9716	-0.1522
Pterocarpus angolensis	0.0098	-4.6299	-0.0452
Rothmannia englerana	0.0024	-6.0162	-0.0147
Swartzia madagascariensis	0.0366	-3.3081	-0.1210
Syzygium guineense	0.0024	-6.0162	-0.0147
Syzyguim cordatum	0.0049	-5.3230	-0.0260
Uapaca kirkiana	0.0463	-3.0717	-0.1423
Uapaca nitida	0.0024	-6.0162	-0.0147
Uapaca sansibarica	0.0024	-6.0162	-0.0147
Vitex doniana	0.0073	-4.9175	-0.0360
Zanha Africana	0.0024	-6.0162	-0.0147
			-2.8783

Vegetation Types

The predominant vegetation is a mosaic of miombo woodland and termitaria. This vegetation type is common throughout Zambia and in the Copperbelt Province. There are also some dambos that occur within the farm area. Riparian forests occur along the river banks. Much of the vegetation has been cleared especially in areas where the fields have been active. The presence of large patches of undisturbed miombo left between the fields within the farm area provide an ecological corridor running in between fields and links the rest to the riparian forests that occur along the banks of the river in the South West and North West area. These corridors are important for ecosystem functioning. In the north east area of the farm exists a large area of less disturbed miombo woodland that supports a number of fauna species.

Miombo woodland

Despite its large extent over much of central Southern Africa, it is nonetheless listed as a vulnerable vegetation type by the World Wide Fund for nature (WWF). The miombo at Somawhe is very distinctive, although the dominants in some areas may change. Within the farm area, there are two distinct miombo subtypes, *Julbernardia* and *Marquesia*. The J*ulbernardia* dominated miombo consist of *Julbernardia/Brachystegia/Isoberlinia* tree species while the *Marquesia* dominated miombo comprises of *Marquesia* and *Pseudolachnostylis* tree species. In some areas of the farm, the canopy of this type of woodland is fairly closed especially when viewed from the bottom.

In total, 16 miombo releves were studied in order to determine the characteristics of this vegetation type within the entire farm area. From a total of 16 releves of this community type, 37 species were recorded. The most common and important of these are given in Table 14.

Table 14: Dominant species in the Miombo Woodland

Species	**% of releves in which it occurs**
Julbernardia paniculata	100
Pseudolachnostylis maprouneifolia	63
Isoberlinia angolensis	56
Brachystegia boehmii	50
Anisophyllea boehmii	38
Diospyros batocana	38
Parinari curatellifolia	31
Protea angolensis	31

NB: A full list of plant species observed within Somawhe is given in the annexes.

According to Chidumayo and Kwibisa (2003), tree stem density ranged from 10.6 (± 2.9) to 118 (± 11.8) across four 200m^2 miombo woodland plots with mean value for these four plots of 48.9 (± 48.8) trees per 200m^2. This equates to an average of 2,445 trees per hectare within miombo woodlands. The average tree stems per hectare at Somawhe was 700 stems. This is indicative of a disturbed miombo.

Figure 19: View of the canopy of the miombo woodland occurring in some areas of the farm

Miombo Regeneration

According to Chidumayo (1997), natural regeneration of miombo woodlands is through seed, stumps (coppices) and roots. There are five factors that affect natural regeneration and these include: Canopy shading in selective felling systems; Inter-shoot competition-whereby only the dominant shoots contribute to the next generation; Capacity to regenerate (coppice) decreases with age and stem size; Late forest fires which kill seedlings and coppices; Cutting of seed bearers for wood fuel and saw logs and clearing for agriculture. Seed bearers are usually cut because of their bigger diameters and hence are preferred for timber as saw logs. This contributes to poor regeneration from seed.

Chitondo (1999) states that 100 years is regarded as the period needed for a tree in Miombo woodland, under natural conditions, to attain Diameter Breast Height (DBH) of 30cm. In terms of establishment period, the average is 8 years for both seedlings and coppices while in areas where cutting is selective and clear felled is 20 years and 60 years respectively. Normal establishment period for new crop is best regarded at 10 years when stool mortality and different sources of regeneration are taken into account.

Within Somawhe, about 28 tree species were observed to be regenerating. The average number of stems regenerating per hectare is 812 with *Julbernardia paniculata* having the highest (8075) stems regenerating per hectare (Table 9).

Miombo Transition within Somawhe

Most areas of miombo have been cleared for agriculture. These fields have been cultivated for many years under intensive irrigation. Some of the areas were cleared for purposes of settlement for workers and other infrastructure such as schools, clinics to mention but a few. When such areas are abandoned, miombo species start to colonise the old fields or the abandoned areas for settlements. This happens about five years after abandonment.

Table15 : Tree species regeneration within the farm area

	SPECIES	COUNT	STEMS/HA
1	Albizia adiantifollia	3	75
2	Albizia antunesiana	47	1175
3	Albizia versicolor	5	125
4	Anisophyllea boehmii	31	775
5	Baphia bequaertii	20	500
6	Brachystegia boehmii	53	1325
7	Combretum molle	1	25
8	Dalbergia nitidula	13	325
9	Diospyros batocana	4	100
10	Diplorhynchus condylocarpon	76	1900
11	Faurea saligna	11	275
12	Isoberlinia angolensis	35	875
13	Julbernardia paniculata	323	8075
14	Monotes africanus	6	150
15	Orchna pulchra	36	900
16	Parinari curatellifolia	10	250

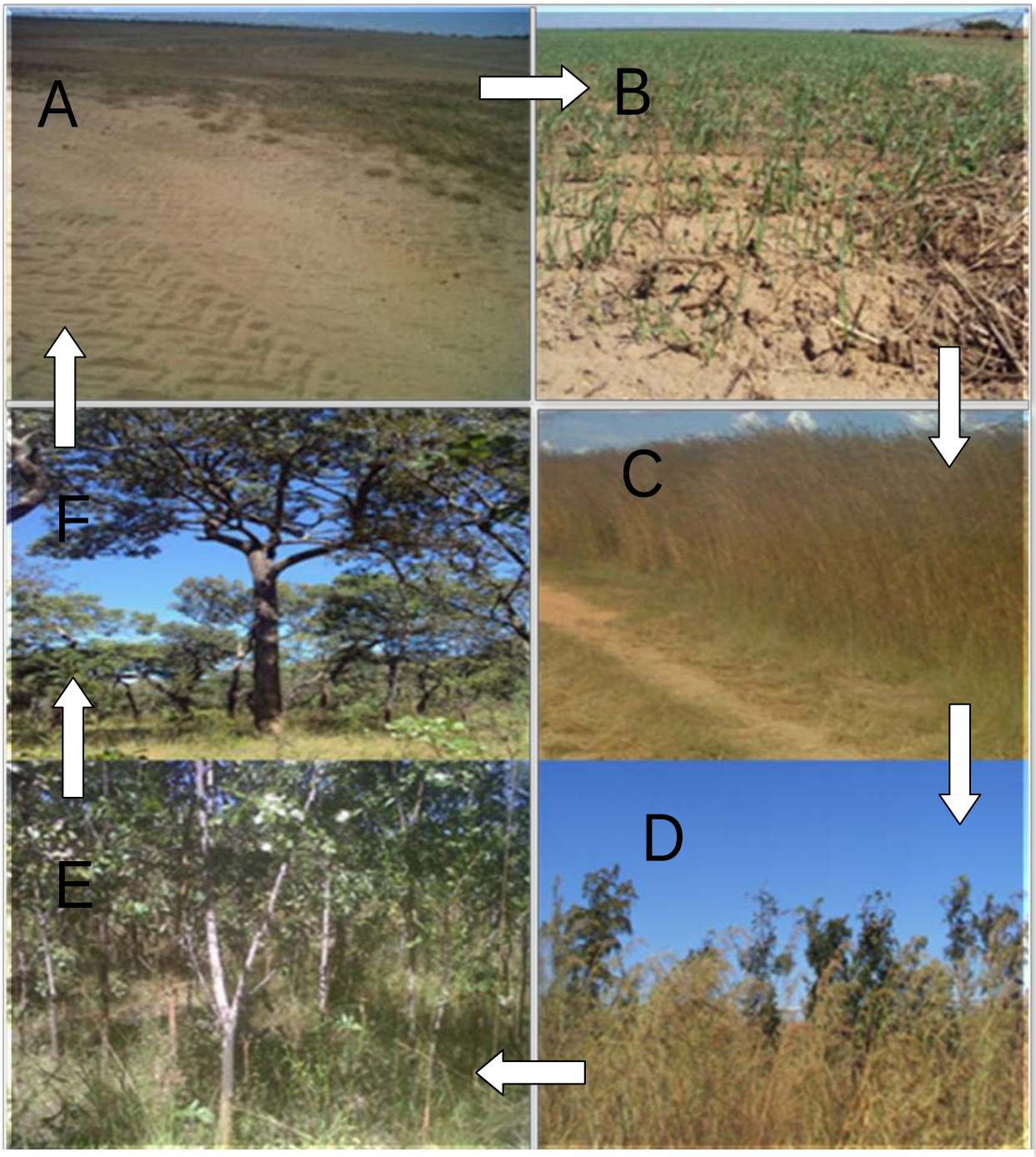
17	Pericopsis angolensis	24	600
18	Protea angolensis	8	200
19	Pseudolachnostylis maprouneifolia	58	1450
20	Pterocarpus angolensis	33	825
21	Rothmannia englerana	21	525
22	Strychnos cocculoides	2	50
23	Strychnos innocua	2	50
24	Strychnos spinosa	1	25
25	Swartzia madagascariensis	7	175
26	Syzygium cordatum	9	225
27	Uapaca kirkiana	61	1525
28	Uapaca sansibarica	9	225

However, in the first five years, these areas are colonised by tall grasses and beyond that period trees start to appear forming some kind of chipya woodland. The colonisation may occur through seedling recruitment, or through coppicing. Coppicing may occur from tree trunks that were not removed when the area was cleared, but may also occur from roots that were not eradicated when the field was cleared.

In this study, species richness in this beginning stage of miombo regeneration was found to be high, with an average species count per releve of 60. This figure was higher than what has been discovered by Chidumayo. According to Chidumayo (1987), his findings indicate that there is generally low species diversity in regenerating miombo. Therefore the strips of land with relatively undisturbed woodland that Somawhe has left between individual fields play a critical role in regeneration of Miombo and other vegetation once such areas cease to be agricultural fields.

After 10 to 15 years, the miombo thins out as it becomes taller, with the species richness decreasing and the herbaceous layer becoming that of typical miombo woodland. After 50 years, the miombo continues to grow, forming a canopy that ranges from 15 to 25 meters tall,

and sometimes reaching 30 meters. This miombo type forms the bulk of the patches that are left between fields. If this typical miombo is left undisturbed by both agriculture and fire for a number of years, the herbaceous and shrub layers increase their cover and the miombo becomes almost forest-like. This miombo is the primary, or climax miombo woodland, very little of which exists within the farm area. This primary miombo is mostly found on the undisturbed north eastern part of the farm The miombo succession within the farm area is illustrated in Figure 20. This growth and regeneration of miombo can be highly variable, with climate playing a huge role in variation of canopy phenology (Chidumayo 2001) and subsequently, regrowth of miombo.



Woodland is cleared and site prepared (A) to plant wheat, maize or soya beans (B). Once abandoned or left to go fallow, the area is colonised by tall grasses (c). After a period of over five years, various tree and herbaceous species start to colonise the area (D). The miombo woodland then starts to grow taller, and the trees begin to thin out, whilst still retaining a low basal diameter, forming a pole thicket (E). If not burnt or cleared for an extended period of time (anything from about 50 years), the herbaceous and shrub layer becomes thicker forming a forest-like form of miombo (F).

Figure 20: Succession in the miombo woodland within Somawhe

Chipya Woodland

Within the miombo areas of Somawhe, there are patches of chipya woodland mostly found in areas where there were some disturbances. This vegetation type occurs mainly in areas that historically were forest or transition woodland and thus is vegetation type formed by disturbance such as settlements, cultivation fire (Figures 3 and 4.) This vegetation type comprises trees (other than those dominant in Miombo) that grow in tall grass. Some herb species that are prevalent in the chipya of Somawhe area include; *Aframomum biauriculatum, Pteridium aqulinum* and *Smilax kraussiana*. Chipya woodland tends to be extremely variable depending on which stage of regeneration and what type of disturbance occurred within the area. A number of areas that were once settlements for employees of Somahwe but have been abandoned were observed. In some of these areas, even alien species such as *Lantana camara* is prevalent. The employees used the plant as live fences but eventually it is colonising the nearest bushes.

Figure 21: Chipya developing from miombo woodland (area once settled by farm workers)

Figure 22: An area once occupied by employees with lantana camara growing

Termitaria

Termite mounds or termitaria are common within Zambia and occur within several different vegetation types (White 1983). They themselves contain such a different set of vegetation than the surrounding landscape that they are, in fact, vegetation types themselves (White 1983).

Termitaria (termite mounds) are common within Somawhe. The average distance between these mounds was calculated to be 800m. In this survey, a total of 10 termite mounds were studied to assess the characteristics of this vegetation type within the entire farm area. From a total of 10 releves of this community type, only 12 species were recorded. The most common and important of these are given in Table 10. Most of the termite mounds that were studied were devoid of vegetation (Figure 5). They were stand-alone surrounded by miombo species. This may be due to their small size.

Table 16: Dominant Species within the termitaria

Species	**% of releves in which it occurs**
Boscia angustifolia	65
Pavetta schumanniana	51
Costus spectabilis	38
Cussonia arborea	35

Figure 23:Termite mound within the farm area

Riparian forest

This vegetation type occurs along the rivers/streams. Dominant trees include *Syzygium guineense*, *Diospyros mespiliformis* and *Homalium abdessammadii*. Other characteristic trees and shrubs include *Garcinia livingstonei*, *Croton megalobotrys*, *Antidesma venosum*, *Kraussia floribunda*, *Rhus longipes*, *R. pyroides*, *Phoenix reclinata*, *Oncoba spinosa*, *Carissa edulis*, *Tetradenia riparia*, *Diospyros senensis*, *Warneckea sansibaricum*, *Canthium glaucum*, *Azanza garkeana*, *Vangueria infausta*, *Cleistochlamys kirkii*, *Hippocratea indica*, *Diospyros quiloensis*, *Crotalaria pallidicaulis*, *Cussonia spicata* and *Vepris zambesiaca*.

Within the study area, a total of 6 riparian releves were studied to assess the characteristics of this vegetation type. From a total of 6 releves of this community type, 56 species were recorded. The most important of these are given in Table 17. The forest type is fairly well represented within Somawhe; it has not been extensively impacted by human activity, apart from some areas of the Impumbu River that are near the community settlements which have been affected by agriculture and fire. The riparian forest occurring close to human settlements in the area is thus mainly secondary, rather than primary forest, of which the widespread occurrence of *Syzygium cordatum* is proof. Very few studies have been conducted on the forest species and as

a result are difficult to identify, even though this is an important vegetation type within the project area. Riparian forest occurs along the banks of the rivers (Figure24)

Table 17: Dominant species in the Riparian forest

Species	% of releves in which it occurs
Erythrina abyssinica	61
Syzigium cordatum	58
Costus spectabilis	38
Harunguana madagascariensis	35
Syzygium guineense	30

Figure 24: Riparian forest along the Impumbu River

Dambos (Wetlands)

Dambos usually occur on the edges of rivers as well as at their headwaters. These are seasonally waterlogged grasslands and as such have an extremely seasonal species composition (Figure 24). The species richness of dambos is the lowest of all the community types described for Somawhe. Typical species tended to include grass and cyperus species with a few herbaceous species also occurring.

Figure 25: A dambo within the farm area dominated by grasses and surrounded by riparian forests

In total, three dambo releves were studied in order to determine the characteristics of this vegetation type within the entire farm area. From a total of four releves of this community type, 26 species were recorded. The most important of these are given in Table 18.

Table 18: Dominant species in the dambos

Species	% of releves in which it occurs
Commelina carsonii	45
Andropogon gaynuris	30
Hyperhennia hirta	21

The wetlands within and around Somawhe were assessed in order to determine their Present Ecological State (PES) scores. These were assigned “B” PES score, indicating that they had been subjected to limited disturbance. The cultivation of crops in dambos especially by the communities in surrounding areas is probably the single biggest issue observed with regard to

Figure 26: A woman selling fishing from Impumbu River

current anthropogenic impacts on wetland ecological state. To the contrary, the farming activities by Somawhe are done at safe distances from wetlands hence very minimal impact is done to the existing dambos.

The socio-economic and ecological potential of the Kafue River Basin can be witnessed from the activities along its entire stretch from Congo DR. into Zambia (throughout the Copperbelt Province to Lusaka) and into the Zambezi. These wetlands of the Copperbelt Province, including the Impumbu Dam catchment with the ensuing Impumbu River and adjacent Munsoshi stream of Mpongwe, collectively cover an average area of about 6-10% of the total surface area.

The commercial farmers on the other hand have dammed some major streams to provide water for irrigation (Figure 8). At Somawhe, like the rest of Nampamba, the wetlands are used by both commercial farmers and local people for various activities. The local people often fish (Figure 9), collect wild fruits, medicinal plants from the diversified ecology and often practice gardening in open dambo areas.

RAMSAR Wetlands of National and International Importance

Zambia is a signatory to the Ramsar Convention and has eight RAMSAR sites. The Convention on Wetlands of International Importance, called the Ramsar Convention, is an intergovernmental treaty that provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources.

The Ramsar Convention is the only global environmental treaty that deals with a particular ecosystem. The treaty was adopted in the Iranian city of Ramsar in 1971 and the Convention's member countries cover all geographic regions of the planet.

The Government of the Republic of Zambia (GRZ) ratified the convention on 28 December 1991. Table 19 shows an Annotated Ramsar List of Wetlands of International Importance. None of these occur within close proximity to Somawhe. Although there are some dambos within Somawhe, none of these dambos has been designated as a Ramsar site.

Table 19: List of Ramsar Sites in Zambia

Site	Date of Designation	Province	Coordinates	Ramsar Site Number	Surface Area (ha)
Bangweulu Swamps	*28/08/91*	Northern	11°25'S 029°59'E	531	1,100,000
Busanga Swamps	*02/02/07*	Northwestern	14º05'S 025º47'E	1659	200,000
Kafue Flats.	*28/08/91*	Southern & Central	15°41'S 027°16'E	530	600,500
Luangwa Flood Plains	*02/02/07*	Eastern	12°40'S 032°02'E	1660	250,000
Lukanga Swamps	*08/11/05*	Central	14°24'S 027°38'E	1580	260,000
Mweru wa Ntipa	*02/02/07*	Northern	14°24'S 027°38'E	1661	260,000
Tanganyika	*02/02/07*	Northern	08°31'S 030°53'E	1671	230,000
Zambezi Floodplains	*02/02/07*	Western	15°15'S 023°15'E	1662	900,000

Vegetation sensitivity and species of special concern

There are different types of species of concern. Species that could possibly be identified as species of special concern in the future due to confirmation of identifications or new identifications are classified as Possible Species of Concern (PSC). Species that are identified as being on the IUCN or CITES lists are noted as Species of Special Concern (SSC), as are those with

new records or limited distribution.

Species of Special Concern (SSC) with limited distribution and a new record for the area include *Nypmphaea divaricata, Oeceoclades saundersiana* and *Anthocleista vogelii*, all of which occur in riparian forest. *Aloe zebrina*, which occurs on termitaria is listed on CITES appendix II and is thus a confirmed SSC.

4.3 Fauna

The documentation of Zambia's species diversity, which is measured in terms of species richness and relative abundance of fauna and flora, is still far from completion especially in the insects' category. The study team however managed to identify most of the faunal species that were encountered within Somawhe. Species composition in the area varied from site to site according to topography, land use and anthropogenic factors that have been exerted on the land.

4.3.1 Mammals

Work has been done on mammals of Southern Africa and Zambia in particular. There over 160 mammal species known in Zambia. Ansell (1978) recorded at least 222 species of indigenous wild mammals which are found in Zambia. Ansell (1978) and Stuart *et al* (1990) stated that there are five mammals known to be endemic to Zambia (appendix 4). No recent detailed list of the mammals of Copperbelt exists.

There is considerable wildlife and a number of foot marks and dropping of some animals were observed. The historical large mammal fauna of the farm area is now largely reduced, with only small populations of duiker and bushbuck remaining in less-disturbed habitats within the farm area. Also present in large numbers are monkeys and mongoose and civet. At least 18 mammal fauna species were identified (See Table 20), some were not physically seen during the survey but were identified either from droppings or information from the local people. Alien mammals in the area include domestic cats and dogs.

Table 20: List of mammal fauna species observed within the farm area

NO	SCIENTIFIC NAME	COMMON NAME
1.	*Canis adustus*	Side-striped Jackal
2.	*Xerus inauris*	Bush Squirrel
3.	*Paraxerus cepapi*	Tree Squirrel
4.	*Atilax paludinosus*	Water Mongoose
5.	*Sylvicapra grimmia*	Common duiker
6.	*Lepus saxatilis*	Scrub hare
7.	*Thryonomys swinderianus*	Greater Cane Rat
8.	*Tragelaphus scriptus*	Bushbuck
9.	*Aepyceros melampus*	Impala
10.	*Proteles cristatus*	Aardwolf
11.	*Cercopithecus aethiops*	Vervet Monkey
12.	*Papio ursinus*	Chacma Baboon
13.	*Raphicerus sharpei*	Sharpe's Grysbok
14.	*Ourebia ourebi*	Oribi
15.	*Oreotragus Oreotragus*	Klipspringer
16.	*Potamochoerus porcus*	Bush Pig
17.	*Phacochoerus aethiopicus*	Warthog
18.	*Rattus rattus*	Black Rat

4.3.2 Reptiles

A Guide to Reptiles, Amphibians and Fishes of Zambia" by Simbotwe & Mubamba (1993) lists 152 species of reptiles in Zambia, but there are no records of reptiles endemic to Zambia. 146 reptiles, including eight chelonians, 62 lizards, 74 snakes and two crocodiles, have been recorded for Zambia. Many of these are wide-ranging, and tolerant of disturbed areas and they include a number of venomous species (Gaboon Viper, Puff Adder, Rhombic Night Adder, Boomslang, Twig snake, Black Tree Snake, Black-necked spitting cobra, Günther's Garter Snake,

Bibron's Burrowing Asp, etc, of which the Puff adder was the most common snake encountered during the surveys. Table 21 gives the list of reptiles that are found within the project area.

- No alien reptile species are known to have become established in Zambia. No species recorded in the project area are included in the International Union for the Conservation of Nature (IUCN) Red List 2010. IUCN is an international organisation dealing with the conservation of nature. It classifies certain species of animals and plants as endangered hence put on the Red List (implying such species are threatened of extinction).
- A number of species in the region are involved in international trade and listed on CITES Appendix II, e.g. chameleons, crocodiles, pythons, tortoises and monitor lizards, but none are exploited for trade locally.

Table 21: List of reptiles observed within the farm area

No	Scientific name	Common name
1.	*Python sebae*	African Rock Python
2.	*Bitis arietans arietans*	African Puff-adder
3.	*Naja nigricollis nigricincta*	Black–necked Spitting Cobra
4.	*Dendroaspis polylepis*	Black-mouthed Mamba
5.	*Thelotornis capensis capensis*	Twig or Vine Snake
6.	*Dispholidus typus*	Boomslang
7.	*Chamaeleon chamaeleon*	Common African Chameleon
8.	*Varanus exanthematicus*	Monitor lizard
9.	*Acanthocerus atricollis*	Southern Tree Agama

4.3.3 Birds

Although protected areas may be found in Zambia and throughout the world, few attempts have ever been made to assess, on a global scale, whether or not these areas are sufficient to conserve global biodiversity. In many cases, protected areas have been identified for reasons

other than biodiversity conservation (e.g., large mammal populations, scenic beauty, protection of watersheds or timber resources). The aim of Birdlife International's Important Bird Areas (IBA) Programme is to identify and protect a global network of sites that are critical for the long-term survival of all bird species and their habitats. One such area lies approximately 20 km from the farm site and is therefore not impacted by the farm activities.

Zambia has a rich avifauna and new records continue to be reported. Birds characteristic of miombo woodland and dambo grasslands were the main components. No threatened birds were observed in the project area during the faunal survey. No birds are strictly endemic to this area. Probably due to the long history of intensive farming, subsistence hunting and habitat burning, certain guilds of birds were absent or very rare in the farm area, including reed bed-nesting passerines (weavers, bishops, etc), game birds (francolin, etc), storks, plovers and Waterfowl, etc.

It is important to note that some threatened or near threatened bird species have been recorded as threatened on the Copperbelt province by Jeffery *et al* (1998) (Table 22).

Table 22: Species recorded as threatened on the Copperbelt Province

No	Scientific name	Common name
1.	*Egretta vinaceigula*	Slaty Egret
2.	*Falco naumanni*	Lesser Kestrel
3.	*Grus carunculatus*	Wattled Crane
4.	*Hirundo atrocaerulea*	Blue Swallow
5.	*Phoenicopterus ruber*	Greater Flamingo
6.	*Phoenicopterus minor*	Lesser Flamingo
7.	*Glareola nordmanni*	Black-Winged Pratincole

A number of birds within the farm area were observed and identified. At least 54 species of birds were identified in the project area. A detailed list is shown in appendix 6.

To protect the wildlife resources from harm, the management of Somawhe has put in place a Unit called the Environmental Protection Unit (EPU), which is headed by the farm manager, Brian Jenkins. The unit works to protect the wildlife within the farm land. The unit works in

enclose collaboration with Zambia Wildlife Authority (ZAWA) and at times conduct joint patrols to police the area. However, there is no deliberate policy to manage the wildlife resource with the local community.

4.3.4 Faunal Habitats

There are a number of habitats utilised by the surviving fauna. These include: miombo woodland, riparian forest, wetlands (dambos and dam), streams and rivers and Termite nests.

Sensitive Habitats for the Terrestrial Fauna

Amphibian diversity was greatest in streams and dambos. The current spatial coverage of vegetation and streams in the area adequately protects amphibian species diversity.

Reptile diversity was greatest in miombo woodland, and dambo grasslands. The importance of termite nests as refugia is likely, but unconfirmed. The current spatial coverage of vegetated areas adequately protects reptile species diversity.

Avian diversity was greatest in gallery forest, miombo woodland and dambo grasslands. Important habitats for sensitive mammal species include gallery forest and forest streams. The clearing of miombo woodland and gallery forest threatens dormouse, tree-roosting bats, squirrels, anomalures (scaly-tailed flying squirrels), monkeys and tree pangolin. The major habitats present within the farm area are shown in Table 23.

Table 23: List of habitats within the farm area

	Habitat	Description
1	Miombo Woodland	This habitat included predominately Julbernardia and Brachystegia tree species. Canopy layer was relatively closed. The ground flora cover was generally sparse, with dominance of a few, shade-tolerant species. Bare earth, leaf litter and a proliferation of fallen/felled trees and deadwood. This habitat supports most small mammals present within the farm area such as duickers, rabbits, bats to mention but few. Reptile diversity was greatest in miombo woodland and chipya woodland.
2	Riparian forest	The habitats are along the banks of Impumbu and Musonshi rivers within the project area. The main dominant species include: *Erythrina abyssinica, Syzygium cordatum, Costus spectabilis* and *Harungana madagascariensis.* This habitat type supports monkeys, birds and many other animals associated with riparian forests. This type of habitat is classified as sensitive.

3	Dambo	In this type of habitat, avian diversity was greatest. Birds were also many within the miombo and the riparian forests.
4	Termitaria	The termite mounds within the project area mostly support termite ants that inhabit these habitats.
5	Rivers/Streams	These habitats support a number of aquatic lives such as fishes and other organisms. Amphibian diversity was greatest in streams

4.4 Land Use

The land that borders Somawhe on the North-east and South-east is mainly customary land occupied by indigenous people and some immigrates seeking jobs from Somawhe. As such the traditional values and customs have influenced the existing land use in the surrounding areas. People within these surrounding communities are mostly peasant farmers engaged in maize, groundnuts and sweat potatoes cultivation mainly for consumption. Field surveys also revealed that very few people keep animals in the area and as a result there was no sign of over grazing. Charcoal burning is another economic activity that affected land use. This has led to depletion of vegetation in areas under customary land. Given that the catchment for Impumbu Dam partly falls under customary land, cutting of trees for charcoal has affected part of the catchment for impumbu dam.

The table below shows the irrigated fields under cultivation, and additional land cultivated only during rainy season.

Table 24: Irrigated land and Rain fed land under cultivation

Field	Irrigated land (Ha)		Rain fed Additional Land (Ha)
1a	72.0	1a extension	11
1b	72.0	1b extension	16
1c	72.0	1c extension	16
2a	106.4		
2b	106.4		
3a	83.5	3a east extension	15.5
3b	98.8	3a west extension	14.7
4a	100.0		
4b	98.8		
5a	98.1		
5b	99.8		
5c	98.9		
6a	90.0	6a extension	20
6b	58.0		
6c	55.3		
6d	40.0	6d extension	17

6e	50.0		
7a	100.1		
7b	98.2	7b extension	24.6
8a	99.9		
8b	99.7		
9a	121.6	9a extension	60
9b	122.5		
9c	119.6		
10	99.9		
11a	106.9		
11b	106.6		
12	115.7		
Totals	2590.7		194.8

Land use within Somawhe was found to be systematic and used in such a manner that facilitates cultivation of land for commercial purposes. Land that favours pivot irrigation system has been reserved for agricultural fields while that which is not suitable for irrigation due to factors such as steep slopes and poor soils have been designated for development of support infrastructure such as staff houses. Unlike surrounding areas under customary land, strips of land with relatively undisturbed vegetation were observed within many private commercial farms including Somawhe. This can be attributed to systematic planning of agricultural fields coupled with conservation measures that Somawhe has put in place.

Arable land utilisation at Somawhe is currently at less than 50% of the total arable land. However, management has over the years systematically been increasing the amount of irrigated land. Statistics obtained from the management team showed that land under irrigation has increased from 2,505ha in 2007 to 2,611ha in 2012. This does not include the rain fed strips of land utilised during the rainy season amounting to about 263ha. Some of the management strategies being applied by the management team have been to realign some fields that were initially half-circle fields to full circle fields.

4.4.1 Economic Activity and Infrastructure

Economic activities

Economic activities within the area are mainly trading in nature. A market within Somawhe

called Kanyuma market provides the infrastructure for trading. People from the surrounding areas and those from within Somawhe i.e. families of the workers are engaged in trading of second-hand clothes, fruits, fish, vegetables and other foodstuffs like fritters. The market is a hive of activity especially during pay days for the workers. In addition the market has a few stalls that act as quick road side shops for groceries and other home necessities.

Impumbu River acts as a boundary between Somawhe and Kawama Village under customary land to the south. The local people and immigrants in these surrounding communities largely depend on being employed by commercial farms. Considering the population of Kawama Village and other surrounding villages, it's evident that availability of manpower would not be a problem in an event that Somawhe expands its operations by increasing land under irrigation.

Infrastructure

Social economic infrastructure within Somawhe includes a market, a recreation club, football pitch, a school and clinic. The market has running water from a borehole, sanitation facilities and some stalls where groceries and toiletries are sold... However, the market requires rehabilitation particularly the sanitation facilities. The recreation club also offers the sale of basic necessities and provides a canteen used by staff. Certain services offered by the recreation club are open to the public while others are strictly for staff only.

4.4.2 Socio-economic Setting

The socio-economic survey conducted during our fieldwork targeted mainly the people within Somawhe and those living in surrounding areas. Information was gathered through one-on-one interviews with traditional leaders and management in charge of the respective area of the study. However in some cases the interviews were done in a meeting set up to allow people exchange views on certain issues.

Population and Demographics

Mpongwe District

Mpongwe district lies to the south west of the Copperbelt province with a population of about

64,000 people. It is mainly an agriculture area with most of the land occupied by commercial farmers such like Zambeef, Somawhe and Kampempa farms. Farming is the driving economic force in the area and the population around and within this area depends on employment offered by commercial farming entities as the main source of their income.

Project area population

The field survey covered about nine villages within the surrounding communities. The size of villages varied. Some had more households than others. Equally some have headmen while other did not. The social economic surveys revealed that the total population of these villages combined was about 2,000 people. The number of men was reported to be higher than women. This was attributed to males that have migrated to the area in search for employment. The table below shows the approximate population breakdown per village within the surrounding areas.

Table 25: Estimated Population Distribution

Village Name	Number
Kasambamanyambi village	400
Kawama compound	600
Chanda Village	350
Kabasha village	200
Katangala village	150
Kabasua village	300

Governance

The system of governance in the area is customary in nature. The area is under two chiefdoms. His Royal Highness Chief Mwinuna and Chief Ndubeni both of the Lamba-speaking people. In administering this system the chief is assisted by Headmen and the Ngambela (i.e. The Chief's Spokesman). The indigenous tribal grouping of this area is the Lamba people. However, other tribes have migrated to the area over the years in search of employment and have integrated with the local people. These included Tongas, Luvales, Kaondes and Bembas.

Cultural and Linguistic Characteristics

The local people are defined by Lamba culture which is the tribe grouping of the indigenous people under Chief Mwinuna within the Mpongwe District. This culture has however been influenced by other tribal groupings that have settled in the area. This was apparent from the field surveys that was conducted. Lamba remains the most widely spoken language in the area. Despite the numerous tribes in the area, Lamba cultural practices and beliefs have to a large extent been maintained in the area.

Settlement Patterns in the Project Area

The community settlement pattern stretches along the Impumbu Dam and Impumbu River beyond the farm area. This means that the said settlements are found along the Somawhe farm boundaries mainly on the east, south and south west of the farm. These settlements were influenced by availability of fertile land for cultivation along Impumbu River. These villages are organized in such way that the average distance between them range from 100 to 500 meters while in some cases especially in Kawama area, the distance is only about 10 to 20 meters apart being the most densely populated settlement in the area.

4.4.3 Social Services

Social services in the area included health centers, schools and churches. Some of the churches observed included the Catholic Church, Church of God, Pentecost Assemblies and New Apostle Church.

Health

The Mukumpu Clinic services a big population within the project area. The health center has an estimated catchment population of about 2,190 people. The clinic is managed by a certified clinical officer assisted by two nurses. The other health center within the area is Kanyuma sub clinic on the south end of the farm. There is a functional neighborhood health group in the area which supports the provision of mid-wife services to the community. The most prevalent diseases reported in the area include malaria, asthma, skin infection, sexually transmitted

diseases, respiratory infection, human animal bites and snake bites, epilepsy and hypertension.

Those that are not employed at Somawhe, a fee are charged for the clinic. The people from the surrounding communities are required to pay ZMK5000.00 (equivalent to 1US$) per visit.

Although the clinic is run by Somawhe, the Ministry of health in Mpongwe district extends its provisions of medicines to the clinic. The clinic has a referral system in place for cases that need specialised attention to Mpongwe district hospital. For such cases Somawhe provides the clinic with a vehicle to transport patients to the district hospital. The services offered by the clinic include out-patient, in-patient, antenatal and mother health, under five years of age clinic as well as patient referrals.

Education

Somawhe has a school within its boundaries called Impumbu Private School catering for primary and junior secondary school i.e. grade 8 to 9. The school provides education mainly to children of farm workers. According to school records, Impumbu School has been registering a pass rate of 100% for both grades 7 and 9 classes. This could be attributed to dedicated staff and good teacher pupil ratio.

Employment

The people in the surrounding areas like Chibangu, Kawama, Kasambamanyambi and other surrounding villages depend on Somawhe for employment. Employment levels fluctuate according to activities. During peak production times additional temporal workers are employed.

4.5 Local Economy and Livelihoods

Agriculture

Local communities within the surrounding areas are engaged in subsistence farming. The size of their fields range between 1ha and 2ha. Crops grown include maize, groundnuts and sweat potatoes mainly for home consumption while any surplus is sold at the market locally or transported to Mpongwe administrative center. There is not much animal keeping in the area with chickens and goats most common.

Sources of income

The sources of income for the surrounding communities included employment at Somawhe trade of crops and produce from vegetable gardens and farms, road side shops and stalls and

trading of charcoal. Furthermore, the project area is serviced by two mobile service providers namely MTN and Airtel. As a result some individuals have become entrepreneurs by selling recharge cards for mobile phones. Overall, the major source of income for the communities is earned from Somawhe.

Heritage Sites

There are no heritage sites within Somawhe. The heritage sites in the surrounding areas include Kasambamanyambi, Kalimba and Impumbu. *Kasambamanyambi* was described as a traditional site named after a village east of Somawhe. It is believed that there was a healing pond where wounded soldiers washed their wounds after war and would be healed immediately. *Kalimba site* is an area on the Impumbu River where it is believed people used to abandon their children born with disabilities. In the east side of Impumbu Dam lies barren land known as Impumbu where many believe the area is unfertile due to the influence of the spirits.

Traditional Land

The Kawama Village is traditional land located south of the Impumbu River. The land is used primarily by individuals who are employed at Somawhe.

4.6 Infrastructure and Present Technologies

Road Network

Other than the roads that are within private commercial farms, public roads in the area are not well maintained. Somawhe is connected to a public road commonly referred by the local people as the Government road . It connects Somawhe to Mpongwe District Boma. This road travels up to the Kafue River has been poorly maintained and in need of urgent repairs. Somawhe is also connected to Mpongwe District Boma by another alternative route which is much shorter and in good condition. This road runs through other commercial farms owned by Zambeef Plc, who is also responsible for its maintenance. The road serves as the main entrance to Mpongwe District and other parts of the area for transporting farm produce.

Water and Sanitation

People in surrounding communities mainly depend on river water and some isolated boreholes. The villages around the farm have very limited safe water for drinking. Areas such as Kasambanyambi Village has only one borehole servicing about 400 people while those in Kawama Village have no safe water for drinking and rely on the river and shallow wells.

Pit latrine system is widely used in the surrounding areas. Howver open bush sanitation is practiced in some communities such as Kawama village to the south of Somawhe. This practice can be attributed more to culture than lack of latrines. It was further observed that sanitation conditions in surrounding villages especially in Kawama Village was below minimum standards. In spite of high population in these areas, only a few people had dug pit latrines while the rest preferred to use the bush.

Somawhe has however, provided piped water from a number of boreholes in residential areas within the farm boundaries. In addition, septic tanks and soak way systems are used for sanitation. There are over 12 boreholes observed on the farm. These boreholes are fitted with submersible pumps supplying tap water to all the staff houses.

Electricity

Mpongwe District is supplied by an 88kV line from Kapiri Mposhi District in Central Province of Zambia. This is supported by three substations namely Nanpamba, Chambatata and Munkumpu. Both the Nampamba and Munkumpu transformers are running below full capacity. ZESCO plans to uprate the Chambatata transformer to allow for further future developments within the area.

Fuel storage

Somawhe's fuel storage capacity is adequate to meet current operations. With the anticipated increase in production levels, an additional storage facility may be required to support the operations. At present, there are two elevated tanks with a capacity of approximately 22,500 litre and 7,500 litre, two underground tanks of 10,000 litre and 22,500 litre and a 22,500 litre steel underground tank situated in the silo complex area.

Drying, storage and weighbridge

With the annual production of about 13,000 tonnes of summer crops and up to 18,000 tonnes of winter wheat, Somahwe has two sets of silos each with 10,000 tonnes of storage and a drying capacity of 25 tonnes per hour. The project has a number of silo bags used equally for storing grain.

Buildings

Buildings can be categorised as indicated in the table below. According to existing management the buildings are considered adequate for the current operations. The existing management team plans to upgrade and build additional new houses on an annual basis. This policy will be reviewed by Chobe and wil be taken under consideration.

Prefab Office Block	3 x Middle Management Houses	135 x Junior Staff Houses
Fertilizer Store	9 Supervisors Houses	Club
Workshop	School	Chemical Store
1 x Senior Management House	Clinic	

Roads / Airstrip

Somahwe has about 28km of road network within the establishment and an access road to the main gate of 12km stretch between the farm and the Chambatata Gate. Somawhe uses the road that passes through Zambeef farms instead of the public road (Government Road) to transport grain. However a toll fee is charged at US$2/ton. There is a 1.2km gravel airstrip on the farm, used primarily for crop spraying but also suitable for light aircraft.

Schools

Within Somawhe there is a school known as Impumbu School. It is constructed of a mono pitched roof of IT4 sheets resting on timber members devoid of ceilings. It comprises nine classrooms, two offices, staff room, library, home economic room, store room and verandas and occupies an area of 669.6 m^2.

4.7 Existing Polluting Influences

Aero Spray

Chemical spraying of crops using a small aircraft is practiced on the farm. This method of spraying can affect the air. However, no complaints have ever been recorded from the surrounding communities.

4.8 Corporate Image

Generally the corporate image of the previous owners is good and relationships with the local communities has been good and operated on an open door policy to discuss any concerns or grievances.

Under the ownership of Mpongwe Development Company sections of land were ceded to the north east of the property in 2005/6 to local villagers with the only outstanding issue being the small community of Kasambanyambi to the east of the property and close to the entrance of the Ipumbu river to the Ipumbu Dam. Previous owners of Somawhe Estates decided not to pursue a court case instigated by Mpongwe Development Company and instead chose to leave the Kasambanyambi community in place. It is suggested that Chobe engage with the community through local leadership and formalize this arrangement and demarcate the land area to prevent encroachment of this community.

Refer to pg 226 – minutes of meeting with Chief Mwinuna.

5. Review of Policy, Legal and Institutional Frameworks and Their Relevance to the Project

5.1 General Legal Framework

The National Environmental Policy of Zambia recognizes the need for any socio-economic development to be undertaken in such a manner that avoids environmental degradation. Awareness promotion at all levels of society and its relationship to socio-economic development and the necessity for rational resource use among all sectors of the country's economy is a vital part of the overall objective. Public participation in the environmental decision-making process is another important element of the Zambian Environmental policy. The aim of the National Environmental Policy of Zambia is to provide guidance on management and protection for the environment as well as control of pollution, as set out in the Environmental Management Act of 2011.

5.1.2 Company Environmental Policy

Although at the time of conducting our fieldwork, no clear environmental policy was evident, it is the intention that Somawhe will form part of the Chobe group. Chobe has social and environmental policies in place and is required to report to the World Bank, The Africa Agriculture and Trade Investment Fund (AATIF – a German government initiative) and its shareholders. As a result regular environmental inspections are conducted via its Chayton Africa group company.

5.1.3 Zambian Environmental Legislation

The following Acts are relevant to the project:

1. THE ENVIRONMENTAL MANAGEMENT ACT (EMA)

This is the principal Act governing and regulating environment issues in Zambia. Passed in 2011, to replace the EPPCA of 1990, this Act is the principal environmental law in Zambia and provides for the management, protection of the environment and the prevention of pollution.

This law is the primary legal basis for undertaking environmental assessment for the proposed project. This Act is therefore relevant to the project as it offers legal guidance to the operation of the project to ensure environmental sustainability. Besides the Environmental Management Act, Zambia has signed a number of protocols and international conventions, which contain environmental aspects important to this study.

Application: the EMA and its attendant regulations provide the overall environmental regulatory framework for the project.

Compliance there of: This EIA is being prepared in compliance with the above legal provisions.

2. THE WATER RESOURCE MANAGEMENT ACT 21, OF 2011

The Water Resources Management Act, enacted in 2011 provides for the establishment of the National Water Resources Management Authority to replace the current Water Board. However, the new Act is yet to be actualized through a Statutory Instrument. The Water Board established under the old Water Act has continued to administer the allocation of surface water through issuance of water rights until the new Act comes into force. Under the old Act, abstraction of water from a surface water body through direct pumping or impoundment using a weir or dam requires a water right.

Application: water resources management is of critical importance and sustainability project. The following sections of the Water Resources Management Act of 2011 are of particular importance:

- Part I, Section 6 states that the State is the trustee of all water in Zambia and any rights thereto are subject to annual review in accordance with the Act.
- Part III sets out the composition and functions of Catchment and Sub-Catchment Councils to design and control the use of water resources in catchments and sub-catchments.
- Part IV sets out the functions and processes for Catchment Management Plans to manage catchment water resources.

- Part V sets out the requirements for the control and monitoring of environmental flows, levels and volumes and the steps that may be taken to maintain water quality and prevent pollution.
- Part VIII defines the use of water and the regulations for monitoring of that use.
- Part IX sets out the procedures for establishing water abstraction rights.
- Part X, requires the registration of those designing and constructing dams, boreholes and other water structures.
- Part XI defines the need to make a request for the drilling or changes to a borehole.
- Part XII, sets out requirements for the registration, design, construction, construction supervision and maintenance of dams.
- Parts XIII and XIV establish easement conditions and provisions for flood,
- drought or spillage emergencies.
- Parts XV and XVI define water charges and enforcement provisions.

Compliance there of: The developer shall apply for a water right as soon as the proposed project is granted approval by ZEMA

3. THE NATIONAL HERITAGE CONSERVATION ACT (CAP 173)

Enacted in 1989, the Act provides for the Conservation of Ancient, Cultural and Natural heritage, relics and objects of aesthetic, historical, pre-historical, archaeological or scientific interest. It establishes the Commission and sets out its functions.

Application: this Act is unlikely to have direct relevance to the project as there are no known artefacts of archaeological or cultural significance on the farm, nor have recent cultural or burial sites been identified on the property.

Compliance there of: The developer will ensure that when such objects are discovered the authorities are informed immediately and following their procedures for recording, evaluation and if necessary protection or preservation of such objects.

4. THE ZAMBIA WILDLIFE ACT

Enacted in 1998, the Act provides for the conservation and management of ecosystems to preserve them from impacts of modern man's socio-economic activities. The Act also regulates

the type and extent of tourism activities that may be permitted in a National Park or Game Management area setting.

Application: Although the proposed development does not lie within a national park, the area is habitat to animal and bird life and conservation of habitat is critical.

Compliance there of: The developer shall put measures in place to protect small animals and birds that will be attracted to the area in accordance with the Act.

5. THE FORESTRY ACT

Enacted in 1974, the Forestry Act vests ownership of the forests and forest produce in the President and provides for among other things the following;

- The establishment of the Zambia Forestry Commission to replace the Forestry Department as the administrative body for the Act.
- The Participation of Local communities, traditional institutions, non-governmental organizations and other stakeholders in a sustainable forest management
- The conservation and sustainable use of forest and trees for the management of forest ecosystems and biological diversity.
- The implementation of the Conservation on Biological Diversity

The Act also provides for the protection of tree species nationally whether in a protected area or outside it. The provisions of this Act provide for protection of head waters to ensure sustained flow in the river and as such ensure headwaters are protected through conservation of vegetation where possible.

Application: This policy will not directly affect the project, but cognisance should be taken of the context of sustainable forest management and climate change mitigation in the draft Policy. If any issues regards to forest management that directly affect the project, Chobe will liaise closely liaise with the District Forest Officer.

Compliance there of: The developer will ensure that head waters of the stream within the area are protected to ensure sustained flow in the stream in accordance with Act.

6. THE LAND AND LAND ACQUISITION ACT

Enacted in 1995, the Department of Lands administers the Lands Act for alienation of land under statutory leaseholds. Under the Land Act, land has been divided into State, Local Authority and Traditional land.

Application: Land title transfers have been completed and the project is operational.

Compliance there of*: The developer will c*omply with all provisions of this Act in accordance with the requirements of State Land and Local Authority.

7. THE LOCAL GOVERNMENT ACT

Enacted and implemented in 1991, the Act provides for the establishment of Councils or Districts, the functions of local authorities and the local government system. Some of these functions relate to pollution control and the protection of the environment in general.

Application: The proposed project will be within the jurisdiction of Mpongwe District Council and its activities may impact on the environment.

Compliance there of: The developer will ensure that all identified impacts are properly managed as per requirement of the provisions of this Act.

8. THE TOWN AND COUNTRY PLANNING ACT 1962

Enacted in 1962, the Act provides for the appointment of planning authorities whose main responsibilities are the preparation, approval and revocation of development plans. It also provides for the control of development and subdivision of land. The Act however does not apply to Trust Land and Land in Reserve and Mining Areas.

Application: The necessary documentation will be submitted to the Council and approvals will be obtained for project implementation in accordance with the terms of the Act.

Compliance there of*: The developer has obtained approval of the development site plans from relevant Authorities*

9. THE FISHERIES ACT (CAP 314)

The Fisheries department administers the Fisheries Act (CAP 314). The Act regulates commercial fishing through registration of fishermen and boats, and prohibition of certain fishing methods and equipment.

Application: the Kafue River is a major fishery and contributes nutrient flows and possibly fish population recruitment into the artisanal fishery in the various impoundments on the river and may become subject to the revised Act through the development of Fisheries Management Areas. Any new impoundments on the river or its tributaries will also be required to abide by legislation controlling the accidental release of exotic fish species (e.g. the Nile Tilapia – Tilapia

nilotica and Common Carp - Cyprinus carpia), now widely used in Zambian aquaculture.

Compliance there of: The developer will ensure that any impoundment of the stream takes measures that minimize effects on fish movement in the water body in accordance with the provisions of this Act.

10. THE INVESTMENT ACT

Enacted in 1993, the Act provides a legal framework for investment in Zambia. The Act relates to the environment indirectly by providing incentives for tree planting, soil and water conservation activities. The Act further recognizes the role of other agencies including those responsible for environmental protection in authorities' specific projects.

Application: The proposed project will constitute a very important investment in the agriculture sector and hence it's subject to the provisions of the Investment Act.

Compliance there of*:* Obtaining the relevant Investment incentives provided for under this Act.

11. THE NATURAL RESOURCES CONSERVATION ACT

The act provides for the establishment of the Natural Resources Advisory Board whose main functions are to ensure the proper use, conservation and improvement of natural resources. Some of the provisions of the Act have since been repealed with the coming into force of the

then EPPCA which has also been replaced by EMA of 2011. This includes the abolition of the Natural Resources Advisory Board.

Relevance: The proposed project site will be surrounded by natural resources governed under this Act

Compliance there of: The developer will ensure that natural resources are sustainably utilised.

12. PLUMAGE BIRDS PROTECTION ACT

Enacted in 1915, it provides for the prohibition of dealing in plumage of wild birds except for scientific or education purposes. The project area is home to many bird species.

Relevance: The project area is home to many bird species and therefore this Act is very relevant.

Compliance there of: No dealing in plumage of wild birds will be allowed

13. NOXIOUS WEEDS ACT

Enacted in 1953, it provides for the declaration and eradication of noxious weeds.

Relevance: The presence of a reservoir and agricultural activities may lead to high nutrient loading resulting into proliferation of weeds

Compliance there of: The developer will ensure that noxious weeds are not introduced in the reservoir.

5.2 Regulatory Aspects of Pollution Control

5.2.1 The Hazardous Waste Management Regulations - Statutory Instrument No. 125 of 2001

Somawhe stocks a number of agro chemicals that are used in managing its crops at various stages i.e. from the time of preparing land for planting to harvest time and subsequent storage

before transportation. As a result hazardous waste in the form of used chemical containers and other packaging materials is generated. The Hazardous Waste Management Regulations regulates generation, transportation, storage and disposal.

Application: The project will generate some hazardous waste during the construction and perational phases and the handling and disposal of which will be subject to these regulations. Hazardous wastes may include materials such as agrochemical containers, paint materials, oils, hydraulic fluid and petroleum spills. Somawhe has been awarded a hazardous waste disposal license from ZEMA who also conducts regular inspections to ensure that conditions that accompany the license are adhered to. Somawhe is partially compliant to these regulations because of its open air burning practice.

Current non-compliance

The regulations require that an entity that stocks and uses agro-chemicals have an Emergency Procedure/Plan in place. Furthermore, these regulations require management to monitor contamination of the environment as a result of the stored materials. These results are to be submitted to ZEMA. It is also a requirement under these regulations that disposal of hazardous waste is done appropriately and not by open air burning which is the case at Somawhe.

This non-compliance will be addressed by Chobe once they have taken over management of the farm.

5.2.2 Water Pollution Control (Effluent and Waste Water) Regulations – Statutory Instrument

No. 72 of 1993

These regulations provide for ZEMA to regulate the treatment and discharge of sewerage and other effluents into the natural aquatic environment.

Application: The project will involve the expansion of a centre pivot irrigation system, which may create polluted effluent flows into the stream. The project will ensure that this regulation is complied with during construction and operation of the irrigation system and is monitored thereafter to ensure that standards stated in the Third Schedule are not exceeded, in particular those limits stated in the table below:

Not to be Exceeded Limits for Selected Substances in Effluents

Substance	Limits not to be Exceeded
Nitrates	50.0mg/l
Nitrites	2.0mg/l
Total hydrocarbons	10.0mg/l
Pesticides	0.5mg/l

5.2.3 Air Pollution Control Regulations – Statutory Instrument No. 141 of 1996

These are guidelines set out to assess the quality of ambient air in order to safeguard the general health safety or welfare of persons, animal and plant life, or property affected by the workers, industrial or business activities undertaken by an operator.

Application: The project will ensure that the general health of its workers is safeguarded, particularly during the dust-generating construction phase and in confined spaces. No gaseous emissions are anticipated other than from vehicle exhausts that will be limited to a small number of utility vehicles, tractors and harvesters, so unless the company chooses to develop a processing plant that will discharge polluting emissions, no licensing requirement is immediately required.

5.2.4 Pesticides and Toxic Substances Regulations - SI No. 20 of 1994

These provide for ZEMA to regulate the use and importation of pesticides and chemicals into the country.

Application: The project will be using a selection of agricultural chemical, some of which are toxic. The company will not be blending, trading or otherwise marketing these substances, but will be required to comply with regulations regarding the transport of these chemicals (particularly severely restricted pesticides), and their handling and use (particularly pesticides or toxic substances or labeled chemicals marked “very dangerous poison” or “dangerous poison”).

Compliance is also required with regulations regarding expired pesticides and toxic chemicals and will require a license from ZEMA.

5.2.5 Noise Regulations

The Noise and Vibration Abatement regulations of 2007 specifies facilities expected to be found within factories and industries that include metal fabrication machines, air compressors and blowers, crushes, grinders, screens and classifiers for earth, rock or minerals, Construction-material making machines, Cereal and flower mills, Lumber and pulp machines. The regulations further sets out maximum permissible noise levels continuous or intermittent from construction works and motor vehicles.

Application: Somawhe is not involved in processing and as a result, the noise pollution applicable relates to usage of farm equipment and vehicles.

5.3 Specific Legislation Influencing this Project

5.3.1 The Water Act Cap 198 of 1949

The Water Act Cap 198 of 1949 is the principle Zambian water law and provides for the establishment of the Water Board - a regulator for the allocation and use of water resources in Zambia. The Act is based on principles of common law but is restrictive in nature as its jurisdiction is limited to administration of water permits (rights) and does not elaborate on modern water resources management practices. Costs for water use resulting from issued water permits (rights) are considered as a major constraint to investment in agriculture production as the current rates are considered to be too high. Having completed the revision of the National Water Policy in February 2010, the government has revised the current Water Act into the Water Resources Management Act of 2011 to make it responsive to the needs of the country.

5.3.2 The Environmental Protection and Pollution Control Act, Cap 204 of 1990

The Act provides for the protection of the environment and the control of pollution and the establishment and functions of an environmental regulator - the Environmental Council of

Zambia. Subsidiary legislation to this Act is the Environmental Impact Assessment Regulations that guide the execution of the environmental impact assessment studies for projects such as irrigation and hydropower generation projects that have a likelihood of causing environmental damage; it also provide for the development of management plans on how to mitigate such envisaged damage to ensure that the project safeguards environmental sustainability

5.3.3 The Investment Act, CAP 385

The Investment Act was enacted in 1993 to provide a comprehensive legal framework for investment in Zambia, for the licensing of investors and the establishment of the Investment Centre. The functions of the Centre are to promote investment, register investors, formulate, implement and co-ordinate investment policies, facilitate investment in Zambia, establish investment guidelines and provide a support facility to investors. The Centre also monitors the performance of enterprises approved by it and enforces compliance with the terms and conditions of investment certificates approved under the Act. The Investment Centre mandates any ministry, government department, local authority or other relevant body permission, exemption, authorisation, license, bonded status, land and any other item required for the purpose of establishing or operating a business enterprise. It undertakes economic and sector studies, including market surveys, with a view to identifying investment opportunities. Any future investment into the project should comply with the provisions of the Investment Act.

5.3.4 The Noxious Weeds Act of 1953 Cap 231

Enacted in 1953, it provides for the declaration and eradication of noxious weeds. This is relevant to the project since the presence of a reservoir and agricultural activities may lead to high nutrient loading resulting into proliferation of weeds if not checked. The Noxious Weeds Act is the main legislative framework dealing with IAS, generally referred to as 'noxious weeds'. The Act provides for the eradication of noxious weeds. The Act places a duty on every occupier of land within any specified area to report the occurrence of and to eradicate noxious weeds. An occupier of land is further obligated to take reasonable steps to eradicate any noxious weed occurring within the boundaries of the land.

Application: Chobe is responsible for ensuring that it does not knowingly introduce noxious weeds onto its properties. Furthermore, it is required to eradicate such weeds wherever they occur on land or impoundments where it has responsibilities.

5.3.5 The Plant Pests and Diseases Act, CAP 233

The Plant Pests and Diseases Act is the enabling framework for the eradication and prevention of the introduction and spread of plant pests in Zambia. The Plant Quarantine and Phytosanitary Service implement this act. As in the case of eradication of noxious weeds under the Noxious Weeds Act, Section 7 of the Plant Pests and Diseases Act requires an owner of land or premises to take all measures prescribed and any additional or alternative measures as are reasonably necessary for the eradication, reduction or prevention of the spread of a pest which an inspector may by notice in writing order him to take.

Application: The farm will be required to abide by the provisions of these acts.

5.3.6 The Plant Variety and Seeds Act, CAP 236

This Act was enacted in 1997 to provide for the regulation and control of the production, sale, import and export of seed and to provide for testing and for minimum standards of germination and purity. It also provides for the certification of seed. The Act is implemented by the Director of the Seed Control and Certification Institute (SCCI), the designated Authority, on behalf of the Minister of the Ministry of Agriculture and Cooperatives. The Cotton Act, Coffee Act and Plant Pests and Diseases Act also control the seed sub-sector.

The Act prohibits any person from operating as a seed importer or cleaner without registration with the Authority. The Authority may register an applicant if satisfied that the applicant complies with the prescribed requirements. The Act empowers the Minister to exempt any class of seed importer or cleaner from application of the Act. The Certifying Authority may license any seed company or institution as a certifying agency in any kind of seed or plant variety.

Application: The project will be required to abide by the provisions of these acts.

5.3.7 The Cooperative Act Cap. 397 of 1972:

The Act provides the registration, inspection, examination and supervision of cooperative societies which belong to the people who use their services, the control of which rests with their members in proportion to the use they make, and the gains from which are distributed among members in proportion to the use they make of these services or their interest in their society.

5.3.8 The Local Government Act, Cap 281 of 1991**:**

The Act outlines the functions of a Council which states "to provide and maintain supplies of water and, for that purpose, to establish and maintain water works and water mains", and "to take and require the taking of measures for the conservation and the prevention of the pollution of supplies of water."

Application: implementation and operation of the expanded development is subject to the procedures laid out by the local authorities of Mpongwe District Council. Chobe Agrivision will adhere to all applicable by-laws. The Mpongwe Council has significant responsibilities under the new Act to maintain environmental standards and regulations.

5.4 Natural Resources Policies and Plans

5.4.1 National Agriculture Policy 2004 – 2015

National Agricultural Policy (NAP), 2004-2015 guides the development of agriculture in Zambia up to the year 2015. The main thrust behind this policy is to ensure sustainable development of land and water resources for both rain-fed and irrigated agriculture for food security and income generation especially for rural populations where people depend on agriculture for their livelihood. In this regard, the development and use of wells, boreholes, dams and springs for irrigation throughout the country is highly emphasized by the policy. It is the policy of the Zambian Government to increase the national water reservoir capacity and consequently increase land utilization for agricultural purposes

Application: the project, falls within the general framework of the National Agriculture Policy of 2004 – 2015. The project's objectives of increasing food production yields, achieving year-round production, contributing to national and household food security, sustainable industrial

development, contribution to the national balance of payments, and generating income and employment for local people.

5.4.2 Irrigation Policy

The Irrigation Policy and Strategy (IPS), 2004-2015 was developed with the aim of guiding the development of the irrigation subsector in Zambia. Specifically, to put 70,000ha of new land under irrigated agriculture by 2011. Whether this has been achieved is yet to be established. Out of this plan, 10,000 ha is intended to be large scale commercial and 30,000ha for each emerging commercial and small scale farmers respectively. The IPS was supported by the National Irrigation Plan (NIP) that established the Irrigation Development Fund to compliment the implementation. It's the policy of the Zambia Government to deliberately create an enabling environment to ensure that the total land under irrigation is increased in order to reduce dependence on rain fed agriculture.

Application: the project will address several of the subsector objectives. This project aims to contribute to Zambia's irrigation policy of addressing the challenges of climate shock and increasing food yield production.

5.4.3 National Water Policy, 2010

Is the revised version of the 1994 edition. The earlier edition was promulgated primarily to guide the restructuring of the water sector with a strong bias to water supply and sanitation. The 2010 Policy has re-examined the role of water resources in an integrated manner and has provided guidance on the institutional and legal framework taking into account modern principles of water resources management (e.g. efficient and equitable water allocation to all users) and best international practices to promote sustainable national socio-economic development. One of the new measures advantageous to the farming community provided for by the National Water Policy of 2010 is the exclusion of traditional and small scale farmers with irrigation plots not to acquire water permits for their agricultural activities. Irrigation plots of less than 0.5ha will be exempted from water permits by the new water legislation. With regard to water for energy, the Policy is meant to ensure availability and accessibility to adequate and reliable

supply of water at reasonable and justified cost so as to promote national development especially agriculture for sustained growth, employment generation and wealth creation.

5.4.4 The National Policy on Environment 2007

Provides environment and natural resources management policies to address current and future threats to environment and to human livelihoods and provides policy guidelines for sustainable development. As such construction of dams and hydropower stations need to be done in a sustainable manner.

5.4.5 The Sixth National Development Plan (SNDP)

Embraces the integrated water resources management and water efficiency plans that seek to promote efficient utilization of water resources with a view to increase Zambia's agricultural capacity. As indicated earlier it aims at operationalising Vision 2030, which seeks ultimately to boost irrigated agriculture thus promoting commercialization of agricultural production;

5.4.6 The National Environmental Action Plan (NEAP), 1994

NEAP provides an overview of the country's environmental problems, existing legislation and institutions, and strategy options for improving environmental quality for sustainability of the environment. This applies to any development that may involve construction of dams and hydropower stations aimed at hydropower production.

Application: NEAP applies as a result of the intended irrigation expansion.

5.4.7 The Employment Act No. 15 of 1997, Cap 268 and Minimum Wages Act of 2006

The Employment Act is frequently updated and provides legislation relating to the employment of persons and makes provision for the engagement of persons on contracts of service and for the enforcement of contracts. It also makes provision for the protection of wages of employees. The Employment Act has added a chapter on HIV and AIDS which compels employers to respond to HIV and AIDS in the workplace, recognising that HIV and AIDS is a disease that undermines

production. The Act also makes it mandatory by law for companies to formulate comprehensive HIV/AIDS Workplace Policies.

The associated Employment of Young Persons and Children's Act regulates the employment of young persons and children (see also Multilateral Agreements).

Other legislation that may be applicable with regards to regulations governing general employment is the Minimum Wages and Conditions of Employment Act (Cap. 276) specifically Statutory Instrument 57 of 2006. This governs wages and conditions of employment for the general worker. The Minimum Wages and Conditions of Employment Act applies to all employees (including casual workers) in Zambia.

Application: the project will be required to adhere to the provisions of the Employment Act and its HIV/AIDS provisions, and to minimum wage provisions, as they will actively engage employment of local people in the area.

5.4.8 The Agricultural Marketing Act of 1969 and Proposed New Act Government intends to create a new Agricultural Marketing Act. The objective of the Act will be to:

- increase market access to all market participants,
- promote the efficiency of the marketing of agricultural commodities,
- optimise export earnings from agricultural commodities,
- enhance the viability and sustainability of the agricultural sector, and
- make marketing of agricultural commodities competitive both regional and international.

An Agricultural Commodity Exchange (now the Zambia Agricultural Commodities Exchange – (ZAMACE), and Agricultural Marketing Information Centre are two institutional objectives of the proposed Act. Both should substantially enhance the management of agricultural enterprises.

Application: the primary objective of the project is to increase the production and yield of irrigated cropland on its farmland in the Mpongwe area. This objective will therefore be in compliance with the Agricultural Marketing Act with regard to optimizing export earnings from

agricultural commodities and enhancing the viability and sustainability of agricultural sector. The institutional provisions of the

The Biosafety Act No. 10 of 2007

The Biosafety Act established Zambia's position on 'the regulate the research, development, application, import, export, transit, contained use, release or placing on the market of any genetically modified organism whether intended for use as a pharmaceutical, food, feed or processing, or a product of a genetically modified organism'. The Act amplifies the provisions of the Plant Variety and Seeds Act.

Application: Chobe is required to comply with this Act in the purchase and use of seeds and the use and sale of its crops.

5.5 Multilateral Agreements and Biodiversity Protocols

Zambia is a signatory to a number of international and regional agreements and conventions, which are related to the environment. Those of relevance to the project are described below.

5.6.1 Biodiversity Protocols

The Convention on Biological Diversity (CBD), the associated Catagena Protocol on biopiracy, and the African Forest Law Enforcement and Governance Agreement (AFLEG), are associated regulatory frameworks that have domesticated application through the Lusaka Agreement on Cooperative Enforcement Operations Directed at Illegal Trade in Wild Fauna and Flora (1994).

Application: Chobe is required to be compliant with the provisions of the Convention on Biological Diversity as they are incorporated into domesticated documentation (including the EMA), and these provisions are now incorporated in principle into the Chobe Agrivision Conservation Application Policy Manual.

Convention on International Trade in Endangered Species of Wild Flora and Fauna

The Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES) came into force in 1980 and was ratified by Zambia in 1981. It aims to provide protection to animal and plant species, which are deemed, threatened by international trade. On ratification to CITES a country is committed to implementing the required regulations and procedures to ensure the objectives of the Convention. Care was taken during the study, to ensure that the requirements of CITES would be given due consideration during the development and operational phases of this project.

Convention on Biological Diversity

The Convention on Biological Diversity was adopted in 1992 and aims to encourage and enable all countries to conserve biodiversity and use its components sustainably in support of National Development. A number of plans falling under the Department of Agriculture, Forestry, Fisheries and National Parks and Wildlife Service's integrate the philosophy of this Convention and the National Environmental Action Plan addresses many of the issues raised.

The Convention on Biological Diversity (Nairobi, 1992)

The Convention was adopted on 5th June 1992 and came into force on 29th December 1993. It was ratified by Zambia in 1993. The Ministry of Lands and Environment implemented the Convention in Zambia.

The objectives are the conservation of biological diversity, the sustainable use of its components and the fair and equitable sharing of the benefits arising from the use of genetic resources.[1] State parties to the Convention have committed themselves to identifying components of biological diversity of importance for conservation and sustainable use and that the policies and practices within individual jurisdictions should not cause damage to the environment of other states or to areas beyond their jurisdictions.

The Convention is the only globally applicable, legally binding instrument to address alien species introduction, control and eradication across all biological population and ecosystems.

[1] article 1

Parties are required as part of a suite of *in situ* conservation measures and as far as possible and appropriate, *"to prevent the introduction of, control or eradicate those alien species which threaten ecosystems, habitats or species*"[2]

The IUCN Guidelines For The Prevention Of Biodiversity Loss Caused By IAS 2000

In 2000, the IUCN Council approved the IUCN Guidelines for the Prevention of Biodiversity Loss Caused by IAS. These Guidelines contain, *inter alia*, trade-related provisions relating to the control of intentional introductions and prevention of unintentional ones.

The guidelines are designed to increase awareness and understanding of the impact of IAS and to provide guidance for the prevention of introduction, re-introduction, control and eradication of IAS.

5.6.2 Climate Change Protocols

United Nations Convention to Combat Desertification

The United Nations Convention to Combat Desertification (CCD) established in 1994 emphasizes desertification and mitigation of drought, but also aims to encourage long-term integrated strategies for improved production of land and rehabilitation, conservation and sustainable management of land and water resources. The CCD emphasizes the need for local participation in strategic programme implementation.

Zambia is a signatory to the CCD but has yet to ratify it. Among the obligations of the CCD relevant to Zambia and the project is the "encouragement of decentralisation and local resource tenure to strengthen local participation" The Soil Conservation and Agro-Forestry Extension Project (SCAFE) is an example of an extension program in place which addresses the issues raised in the Convention and a number of other international conventions. Central to SCAFE, which is established through the agriculture extension services, is the promoting of community awareness of land management and conservation in order to prevent land degradation and establish rehabilitation of degraded land.

[2] article 8 (h)

Application: the CCD will have implications for climatic and microclimate change around the project site through the promotion of climate adaptation measures that may impact on future land clearing and land and water management. The CCD also has relevance to the mechanisms of land development and land use management. The objectives of both Conventions are incorporated in the Chobe corporate social responsibility charter. There is increasing evidence that application of resources to these objectives and to the principles of biodiversity conservation contribute measurably to overall operating efficiency and profitability in the medium term.

5.6.3 Pesticide and Hazardous Chemical Protocols

The Basel Convention on the Control of Trans boundary Movement of Hazardous Waste and its Disposal, 1989

The Convention provides norms, rules and procedures governing movements and disposal of hazardous waste at international as well as national levels. The overall objective of the Convention is to protect, by strict control, human health and the environment against the adverse effects, which may result from the generation and management of hazardous wastes and other forms of waste.

Zambia acceded to the Convention on 15th November 1994. The Convention is implemented by ZEMA. Waste disposal, especially into water changes the nutrient load. In some cases this creates a favourable environment for the proliferation of certain invasive plant species.

Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade

The Convention provides for promotion of shared responsibility and cooperative efforts among Parties in the international trade of certain hazardous chemicals in order to protect human health and the environment from potential harm and to contribute to their environmentally sound use, by facilitating information exchange about their characteristics, by providing for a national decision-making process on their import and export and by disseminating these decisions to Parties. This Convention applies to banned or severely restricted chemicals and

severely hazardous pesticide formulations**.** Zambia acceded to the Convention in 2000. The Convention is implemented by ZEMA.

Application: many of the chemicals listed under the Rotterdam Convention are still in circulation in Zambia and Chobe's attention is drawn to the requirements of this Convention and to periodic additions and changes to the list.

Stockholm Convention on Persistent Organic Pollutants

The Convention provides for norms, rules and procedure governing accessibility and usage of persistent organic pollutants. It aims at protecting human health and the environment from persistent organic pollutants. Any party to the convention is expected to prohibit and/or take the legal and administrative measures necessary to eliminate its production and use of the chemicals listed in Annex A subject to the provisions of that Annex; and its import and export of the chemicals listed in Annex A in accordance with the provisions and restrict its production and use of the chemicals listed in Annex B in accordance with the provisions of that Annex. Further each Party is expected to take measures to ensure that a chemical listed in Annex A or Annex B is imported only for the purpose of environmentally sound disposal as set forth in paragraph or for a use or purpose which is permitted for that Party under Annex A or Annex B. Zambia is a party to the convention and ZEMA is the implementing agency.

Application: all three of these global conventions have been ratified by Zambia and are now largely domesticated into Zambian legislation, including the requirement to comply with utilisation frameworks established by these conventions and the periodic changes made to them. Chobe is required by law to abide by the restrictions of the Rotterdam and Stockholm Conventions and to attempt to attenuate or, if possible, remove traces of persistent chemicals from their properties.

5.7 Convention on Cultural and Natural Heritage

Convention on the Protection of World Cultural and Natural Heritage

The Convention on the Protection of World Cultural and Natural Heritage (WCNH) signed in 1973 aims to protect areas of universal value to science, conservation or natural and cultural heritage. It contains two legal principles, one of which states "There is a legal duty on the part of

all states to conserve and take responsibility for all natural and cultural heritage." Zambia acceded to the Convention in 1984.

Application: This policy will not directly affect the project, but cognisance should be taken of the context of the Convention.

5.8 Relevant Multilateral Investment Guarantee Agency Policy Guidelines

The Multilateral Investment Guarantee Agency (MIGA) is a member of the World Bank Group, which also includes the International Bank for Reconstruction and Development (IBRD), the International Development Association (IDA), and the International Finance Corporation (IFC). MIGA's business is to provide political risk insurance guarantees to private sector investors and lenders. It is MIGA policy that all its operations are carried out in an environmentally and socially responsible manner.

In this regard, MIGA projects must comply with applicable MIGA Environmental, Social and Disclosure Policies and Performance Standards. In addition, MIGA applies World Bank Group Environmental, Health and Safety guidelines to all projects.

MIGA environmental and social policies and Performance Standards are fundamental to the project appraisal, approval and supervision process.

5.9 Institutional Responsibilities

5.9.1 The Zambia Environmental Management Agency (ZEMA)

The Zambia Environmental Management Agency (ZEMA) formerly (Environmental Council of Zambia - ECZ), is established by the Act of Parliament of 2011. It reports to the Ministry of Lands, Environment and Natural Resources. It is responsible for environmental management and the protection and conservation of the environment and the sustainable management and use of natural resources. It has legislative responsibility for environmental impact assessment. It's responsible for enforcing environmental regulations and coordinating sectoral government agencies involved in environmental management in their sectors. It is empowered to among others to establish water quality and pollution controls standards and determine conditions for the discharge of effluents into the aquatic environment.

Under the Act ZEMA is responsible for preparation of the State of the Environment Report, environmental management strategies and other plans for environmental management and sustainable development; facilitation of strategic environmental assessments of proposed policies, plans and programmes likely to have an impact on environmental management; responsible for ensuring public participation in environmental decision-making and access to environmental information as well as facilitate the implementation of international environmental agreements and conventions to which Zambia is a party.

5.9.2 The Water Resources Management Authority (WRMA)

Water Resources Management Authority is yet to be formed. The process to establish the Authority is still underway and it's expected that sometime this year the Water Resources Management Act of 2011 will be put in force to pave way for establishment of the Authority.

Once its established the Authority will be responsible for promoting and adopting a dynamic, gender-sensitive, integrated, interactive, participatory and multisectoral approach to water resources management and development that includes human, land, environmental and socioeconomic considerations. The Authority shall identify and protect potential sources of freshwater supply; conserve, preserve and protect the environment, in particular, wetlands, quarries, dambos, marshlands and headwaters and take into account climate change and the challenges posed by climate change, plan for and ensure the sustainable and rational utilisation, management and development of water resources based on community and public needs and priorities, within the framework of national economic developmental policies

The Authority will have a Board of Directors appointed by the Ministry. The Board will appoint a Director General to run the affairs of the Authority. The Authority will be made up of Catchment Councils, Sub-Catchment Council and Water Users Associations.

6. Project Alternatives

6.1 Without and With Project Alternatives

6.1.1 Without Project Situation

Current operations at Somawhe are considered optimal given the 2,874ha of land being utilized. The yields are good but fall short of meeting market demand. Opting for the “Without Project” alternative would mean sticking to current production levels As a result, the operations would maintain the same number of staff and continue to minimally contribute to the agriculture sector. The “without project” scenario, is sustainable and profitable at present and may change in the future.

6.1.2 With Project Situation

Opting for the “with project” scenario would entail reinvestment in Somawhe in terms of capital resources and skills to actualize planned developments of an additional 1,200ha of land under irrigation. This would give Somawhe the potential of producing over 30,000 tonnes of wheat, 15% of Zambia's current requirement. This would require further capital development that will include additional water infrastructure. Consequently agriculture production levels at Somawhe will increase resulting in the creation of more jobs for the local community and ultimately increasing the contribution to both the local economy and national income levels.

6.2 Alternative Irrigation Systems

6.2.1 Irrigation System Options

Irrigation system options include surface irrigation (Border-strip irrigation, Contour irrigation, Wild flooding etc),Spray irrigation (Fixed centre-pivot, Movable centre-pivot, Rotating boom, Linear boom, Solid set impact sprinklers etc), Trickle irrigation (Subsurface dripline etc). There are a number of issues that should be considered when choosing an irrigation system option. These include cost, landscape and soil condition. Somawhe currently uses the spray irrigation with electrically powered, movable centre pivots of different sizes that match different field

sizes. There are no plans to change the system since the current system has been found to be appropriate given the prevailing landscape and soil conditions.

6.2.2 Irrigation System Selection

Some of the key factors to consider when selecting an irrigation system include physical, economic and social factors.

Physical factors include:

1. Wind. The uniformity of the water application of spray irrigation systems is impacted by wind.

2. Energy. Location of energy supply and cost influence the type of system used

3. Topography, layout and shape. The topography and overall farm layout, shape and fixed boundaries or obstacles such as power pylons have a significant influence on system choice

4. Flood. Flood risk flooding affect system operation

5. Soils. The water holding capacity of soils compared to application depth and soil infiltration rate compared to application rate

Except for a few patches of land that have high slopes or poor drainage, physical factors for most areas of the farm are generally good for centre pivot system.

Economic factors are very important when choosing the irrigation system option. Running an irrigation system is an investment that should benefit both the owners and the general public. The factors include annualized costs for operating the irrigation system, capital investment i.e. up-front cost of the system and economic efficiency. The existing irrigation scheme takes these factors into consideration and operates sufficiently to meet the requirements of management.

Social factors are often ignored when selecting an irrigation system. However, they play a significant impact on the success or failure of a given irrigation system. Some of the social factors that should be taken into account when selecting an irrigation system include acceptance by the general public, health and safety issues relating to staff and general public, available labour skills *as well as p*otential for vandalism.

When carrying out our field work, we found no records of any form of vandalism to the irrigation system, there was also no health and safety issues resulting from operation of the system nor was any lack of labour skills experienced.

However, general acceptance by the surrounding community is yet to be fully achieved mainly due misunderstandings between the community and management, as previously described.

6.3 Irrigation Layout Options

The farm layout and its boundaries influence selection of irrigation layout options. Physical factors that include topography, geographical features and soil type are some of the factors to take into consideration when selecting an irrigation layout option. The topography and geological features limits the choice of irrigation layout. (See figure 27). From the geographical point of view, the area is drained by the Impumbu River flowing from east to southwest. The Impumbu dam is located upstream of Impumbu on a much higher altitude compared to the Western end of the farm. The topography within Somawhe is such that upstream of the Impumbu River surrounding the dam, the area is a bit hilly with steep slopes while further away from the dam westward the land is generally flat with gentle slopes.

Given the above scenario, Somawhe opted to use the most cost effective option by taking advantage of the slope. Using the main canal, water from the dam is conveyed across the farm over a distance of 20km by gravity to agricultural fields that occupy generally flat areas appropriate for the operation of a centre pivot system. This has proved to be an efficient and cost effective irrigation layout. However, Somawhe has continued to realign individual agricultural fields to optimize land utilization. From Figure 27, it can be observed that fields that were initially half circle in shape have been realigned into full circles consequently gaining on land size under irrigation.

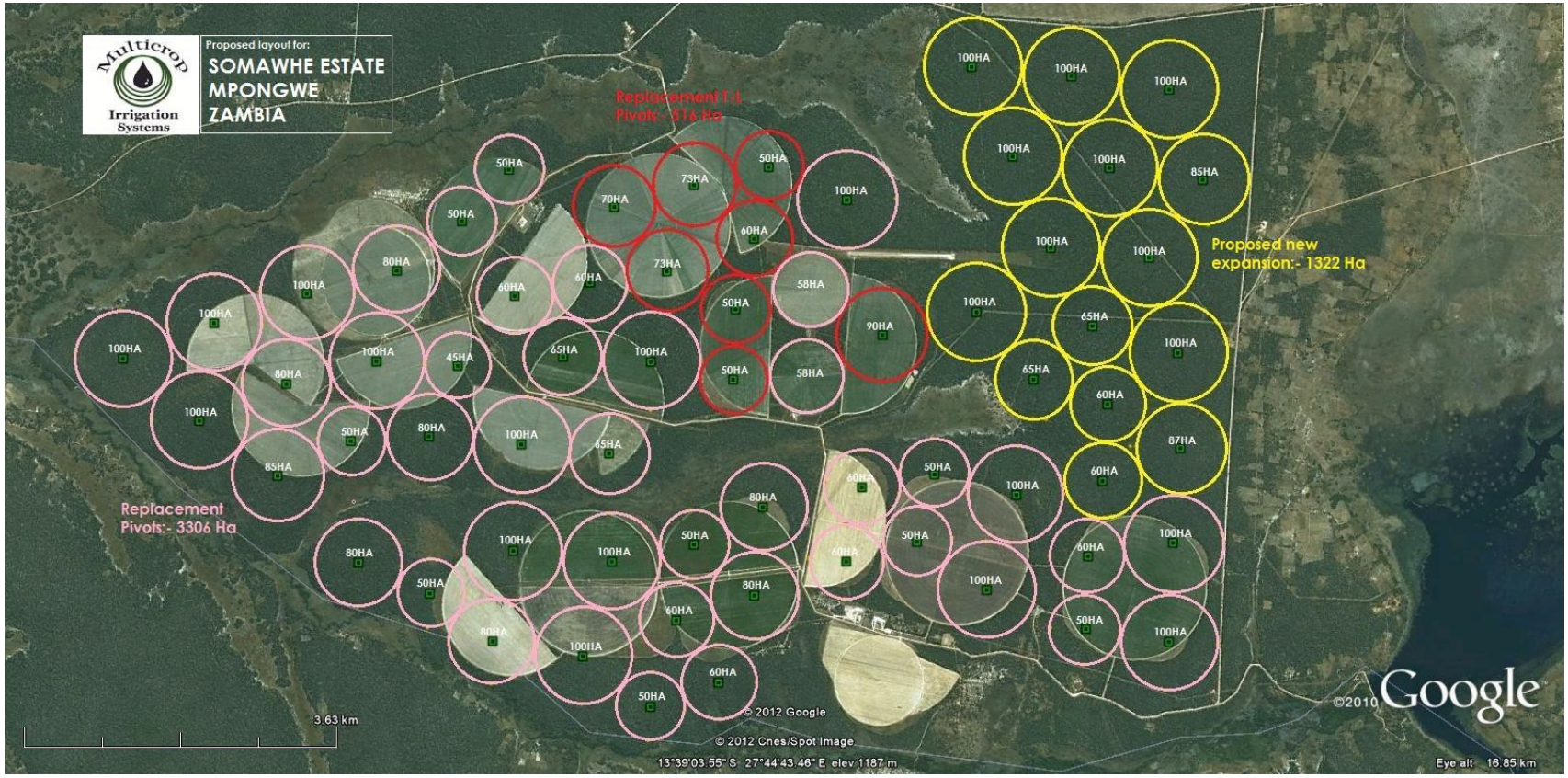


Figure 29: Irrigation System Layout at Somawhe

6.4 Materials Options

6.4.1 Material Options – Impoundment

Impumbu Dam on Impumbu River is the only existing impoundment at Somawhe and the current operation entirely depend on this reservoir for water supply. However there is potential for construction of another dam on Munsoshi Stream a tributary to the Impumbu River. Material options for dam construction depend on factors such as the site topography, size of the impoundment amongst other things. Considering that the proposed dam will have less capacity compared to Impumbu, local materials such as gravel and stones should be considered. Before such materials are used in the embankment they should be tested for cohesion, liquid limit, moisture content, permeability, shear and compression to ensure the embankment is stable. This will be the most cost effective material option.

6.4.2 Material Options – Pumping stations

There are a number of pumping stations constructed from concrete blocks and iron roofing sheets with concrete floors. These are fitted with pumps that are electrically powered from a control point off an 11kV/380V transformer. These are the most common types of pump stations used by many farms in Zambia due to the construction materials and cement being readily available. Other options may prove expensive as they may require importing.

6.4.3 Material Options – Pumping mains

Material options for pumping mains include using PVC pipes and steel pipes. These come in various sizes depending on requirements. These materials are all readily available on the Zambia market. However, the cost of each option and easy of usability vary. Somawhe uses high-pressure PVC for its pumping mains. These have been found to be cheaper and easy to manage. Hence this option offers a cheaper material option compared to using steel or asbestos pipes.

6.4.4 Material Options – Centre pivots

Centre pivot irrigation systems in operation at Somawhe are supplied and installed by a regional irrigation supplier and product support agent with offices in Zambia. Thus far, these have worked well and no consideration has been given to using other systems which may not have local after sale support in terms of maintenance and spare parts. The centre pivot system was chosen among other reasons due to low capital cost per irrigated hectare, low labour and energy requirements, ease of operation and prospect of increasing or maintaining yields while using less water.

6.5 Water Management Options

Water management options depend on the source of water supply whether groundwater or surface water. At Somawhe, surface water is abstracted from an impoundment on Impumbu River. Use of groundwater in the area is potentially not sustainable due to limited yields and high pumping costs involved. Therefore the water management option available to Somawhe is governed by the conditions and regulations set forth in the Water Act. However, relying on one reservoir for all irrigation activities is not sufficient in case of drought. Water flows under such circumstances may be subject to strict regulations in times of extreme low rainfall. However, the existence of another potential dam site offers a good water management option for long term sustainability.

6.6 Pollution Control

Preventing or minimizing risks associated with certain farm operation activities such as sanitary management, management of chemical usage and disposal as well as control of usage of agricultural fertilizers should be the objective of pollution control. . Other associated support activities such as machinery and equipment usage and maintenance may also lead to pollution of the environment.

Somawhe has proper sanitary systems in place for domestic waste from residential area and as such the risk of pollution is minimal. Usage of agricultural fertilizers and chemical are also controlled to ensure waste is at a minimum risk of pollution to soil, surface and groundwater systems. Equipment and vehicle maintenance is done in designated areas constructed for such purpose to avoid indiscriminate spills and polluting the environment.

However, there is still room for improvement with regard to management of chemical waste and disposal. Somawhe should avoid open air burning of chemical waste to avoid air pollution. A registered firm in waste management and disposal should be engaged to be collecting the waste for disposal. Following the acquisition of the farm by Chobe, Chobe will apply its guidelines in the disposal of chemical waste in accordance with the requirements of the environmental legislation.

7. Impact Assessment

7.1 General Considerations

The environmental impact assessment revealed no serious adverse impacts of exceptional importance that would be considered unprecedented or irreversible in nature. The positive and negative impacts identified with due consideration to issues discussed in earlier sections were based on the development design, project details, environmental and socio-economic baseline studies as well as expert judgment. Current land use practices were also identified in order to contextualise and understand the impacts of the farm activities on the ecosystem. The table below gives the criterion used and classification of possible impacts.

Table 26: Criterion and Classification of Impacts

Item	*Impact Criterion*	*Effect Consideration on Environment*	*Classification of Effect*	
			Expression	**Effect Description**
I	Positive or Negative	Will impact have positive or negative on environment	Positive	A positive impact
			Negative	A Negative impact
Ii	Likelihood of occurring	What certainty of occurrence is associated with potential impact	Certain	Impact will occur
			Unlikely	Impact may not occur
			Possible	Impact may occur
Iii	Duration	What timeframe or period is effect to be felt or last	Permanent	Will last a lifetime
			Short term	Will last up to end of construction activities
			Medium Term	Will last as long as operation activities
			Long Term	Will last beyond project operation life
Iv	Timing	At what stage will impact occur or felt	Immediately	Will occur upon starting project activities
			Near Future	Will occur during project operation activities

			Distance future	Will occur beyond project operation activities
V	Significance	How severe will the impact be	Low	Little impact
			Medium	Moderate impact
			High	High impact
Vi	Extent	Areal extent or coverage of impact	Project Area	Effect confined to project area
			Surrounding Environs	Effect to be felt by surrounding areas
			Beyond Surrounding Environs	Effect to be felt within, surroundings and beyond environs
Vii	Overall Rating	How important is Impact in project design	Insignificant	Impact not substantial needs no mitigation/ enhancement
			Low	Impact of little importance needs limited mitigation / enhancement
			Moderate	Impact has influence and requires mitigating/ enhancing
			High	Impact of great importance mitigation/ enhancement a must

7.2 Positive Impacts during the Operational Phase

7.2.1 Anticipated Positive Socio-Economic Impacts During the Operational Phase

- National and international level impacts

Zambia is blessed with abundant water resources, fertile soils and generally good climatic conditions favorable for most tropical crops. Despite temporal variability in climatic conditions, Zambia has the potential of being a food basket for the region. At current production levels, Somawhe is one of the major single contributors to grain crop production. With the planned future developments, the crop production will further increase. As a result this will have a positive impact on the overall grain crop production in Zambia. This could provide the opportunity of creating a surplus in Zambia leading to export opportunities. We believe, this will have a positive socio-economic impact on the

country's exports and will earn the country foreign exchange and have a positive multiplier effect on the overall regional trade among countries.

- General impacts

General positive socio-economic impacts being derived at current production level include improved income levels at household level, improved diet and general health of children and expectant mothers as well as improved socio-cohesion among the community.

- Economic multiplier effects at the national level

To sustain operations and further embark on future expansion developments, more inputs such as seed, chemicals, farm equipment and associated services are required. These will have to be out sourced from other firms and consequently provide increased opportunities for job creation. This will have an economic multiplier effect as, if successful,will result in more income for government through various taxes.Contributions to national food security from crop production

Zambia has the potential for a strong agricultural based economy. Out of the total territorial land area of 752,000 square meters, 58% (43.7 million hectares) is classified as medium to high potential for agricultural production given the abundance of water resources (NIP, 2004) . However, less than 15% of the 43.7 million hectares is under cultivation (MAFF, 2001) and as a result the country has failed to attain total food security. This has been attributed to Zambia's heavy dependence on rain fed agriculture which most times have been unreliable. Somawhe, being an irrigation scheme, therefore contributes positively to national food security through sustainable irrigated crop production. Expansion of such development will ensure food security not only at national level but the region is attained as well.

- Contributions to national fiscal benefits

Despite the country contributing over 40% of the water resources of the Zambezi Basin (NWRM, 1995), Zambia's economy remains heavily dependent on the mining industry. The government has recognized agriculture as one of the priority sectors that is capable of contributing significantly to the country's Gross Domestic product (GDP) and is blessed with soils and climatic conditions favourable for grain production. The current

production level of wheat, soya beans and maize at Somawhe is significant and contributes to the country's diversification programme of making agriculture one the main contributor to GDP. Provincial and district impacts

Sustained crop production at Somawhe have positive socio-economic impacts on Mpongwe District and the Copperbelt Province as a whole through improved employment opportunities and increased income in the form of taxes for local authorities. Consequently this has resulted in improved availability and access to social services. At district level, local people benefit from improved opportunities for training in various agricultural-related jobs making them more employable. This has resulted in increased income and improved standards of living.

- Employment, skills transfer and human resource capacity development

Agriculture contributes significantly to social economic development of the country. Statistics show that 80 percent of the population is dependent on agriculture with about 70 percent of the country's labour force being employed in the sector (FNDP, 2005). With the planned expansion of land under irrigation, more employment will be created and this will directly improve the wellbeing of the local people. Operation of the irrigation scheme could potentially result in skills transfer to many local people, an opportunity rarely provided in the area before.

- Local area and site impacts

Permanent and temporal employment opportunities are provided to the local people including the women in the area. This has resulted in improved income for the community and is also evident in the improved health care, improved diet and increased number of children attending school.

- Economic multiplier effects at the local level

The concentration of people as a result of the operations has led to the creation of a large market for trade in various items including food stuffs. Consequently some families within the surrounding communities are making a decent living by trading in food stuffs, groceries and other items on demand by Somawhe staff and their families. Improved housing, water supplies and sanitation facilities for employees

Housing for communities in surrounding areas is below acceptable standards. Most families in the area occupy thatched clay mud houses with no proper sanitation facilities.. For water supply these people rely on unprotected sources such as shallow wells and the river. However, the situation is different for communities within Somawhe. Staff and their families have been accommodated in permanent structures built out of bricks and cement, water supply is from boreholes and septic soakway systems for sanitation is used. This has positively impacted on employees resulting in increased productivity.

- Improved health and education facilities for employees

Health and education facilities are far from being adequate for the population in the area. With the existence of Somawhe, a school serving both lower and higher grade pupils and a health centre were constructed within Somawhe. These facilities are maintained by management and their primary objective is to service employees and their families. This has positively impacted on health conditions and literacy levels for employees and their families. Without these facilities, most employees children would not be able to go to school or access health services because of remoteness of the project.

- Management systems and effectiveness

Based on documentation accessed at Somawhe, observations and interviews with management, management systems were found to be adequate and effective in most areas. However, there is room for improvement in some areas especially in the area of internal environmental audit, waste management and catchment conservation. Overall, the impact on management systems and effectiveness is positive with potential for improvement.

7.2.2 Anticipated Positive Impacts on the Physical Environment during the Operational Phase

- Biodiversity contributions to sustainable agriculture

Appropriate land management practices involving preservation of strips of undisturbed vegetation has provided an environment for restoring woodland belts and interconnectivities critical for sustaining wildlife creating positive biodiversity. This has enhanced sustainable agricultural production through soil improvement and natural controls on pests and diseases.

- Contributions to ameliorating climate change

Compared to surrounding areas under customary law which is completely depleted of woodland, Somawhe through its good management practice has preserved strips of woodland in all areas that are not meant for development. As a result these areas have remained relatively undisturbed woodland that collectively contributes to mitigate climate change acting as a carbon sink reservoir. The vegetation strips in between agricultural fields within Somawhe are protected from illegal exploitation by a special environmental protection unit. This has enhanced the protection of vegetation species such as *Mukwa* and other habitat. Equally, wildlife within Somawhe continues to enjoy protection.

- Technology impacts to soil structure and water conservation

Improved agricultural practices that include limited tillage and strict nutrient management have positively contributed to lessen impacts on the soil structure. Use of an efficient and effective irrigation system, the centre pivot system coupled with well elaborated irrigation timing schedules have helped to conserve water. Other water conservation measures include regulating use of agro-chemicals ensuring that no water pollution takes place. Therefore technological impacts to soil are insignificant and effective irrigation provides comfort with regards to water conservation.

7.3 Negative Impacts Anticipated During the Operational Phase

7.3.1 Anticipated Negative Socio-economic Impacts during the Operational Phase

- Migration and temporary employment effects

Somawhe as an establishment has to some extent influenced the dynamism of the local population in the area. People from other areas seeking employment at Somawhe have migrated into surrounding communities thus impacting on utilization of available natural resources. As a result, customary land in surrounding areas under has been cleared of vegetation for either agricultural activity or charcoal burning. In addition, wildlife has been depleted.

- Unsociable behavior from increased disposable income

Availability of readily disposable income may result into unsociable behavior such as multiple sexual partners, thus increasing the risk of diseases such as HIV/AIDS. This can also lead to high cases of divorce. If not monitored these social ills can negatively impact . At Somwhe, certain staff, especially tempora workers exhibit unsocial behavior. However, the impact is minimal and it's difficult to attribute a correlation between earnings and social behaviour.

- Casualisation of labour

Labour casualisation negatively impacts on employee's welfare because of uncertainty that is created among workers. Somawhe has employed a significant number of permanent workers. However, at peak production times of the year, additional labour force is required and hence casual workers are employed to supplement existing workforce. Therefore the impact of labour casualisation is minimal at Somawhe.

- Limited education and health services for employees

Somawhe has an elaborate health and education policy for its employees. All employees have equal access to available health facilities and education. Thus, employee's access to education and health services are not limited.

- Population density-related disease impacts

The operation has resulted in increased economic activity in the area. Consequently more people have been attracted to the area in search of employment. Somawhe has within its boundaries residential areas for its workers. Records at the health centre showed that there has been no outbreak of diseases in the past associated with population density. Therefore the impact is insignificant.

- Impacts from poor sanitation practices

Poor sanitation may lead to environmental soil, water and air contamination which may lead to human health problems and ecological disturbance. At Somawhe impacts resulting from sanitation are insignificant due to a well-designed sanitation system currently in operation. Somawhe practices good sanitation by employing a septic tank – soak way system for managing domestic waste and prohibiting indiscriminate disposal of waste.

- Drowning accidents and disease implications of uncontrolled access to new impoundments

Incidents of drowning in Impumbu dam and the 20km long main canal are possible and the risk is high for children. However, Somawhe has put in place a 24 hour security ensuring that the dam is guarded to control access within the boundaries. However, the risk of drowning in the canal remains even though no such incidents were reported. No uncontrolled access to impoundments is allowed and consequently no outbreaks of water borne diseases attributed to impoundments were reported.

- Impacts on natural resources

In comparison to surrounding areas, impacts on utilization of natural resources are minimal due to good agricultural practices and conservation measurements put in place

by management. According to Somawhe management, population of wildlife has increased due to the favorable habitat created as a result of Somawhe's deliberate policy of leaving strips of land with undisturbed vegetation.

- Occupational health and safety (OHS) impacts

Grain storage facilities such as silos and similar confined space structures, such as chemical storerooms, can cause occupational negative health problems for workers due to inhalation of biotic dust and silica particles etc. However, constant sensitization of workers and training on safety procedures as well as provision of protective clothing and equipment has helped avoid OHS incidents. Records obtained from management and the health centre reflected that the common diseases that were being experienced was not as a result of the problems associated with OHS.

7.3.2 Anticipated Negative Environmental Impacts during the Operational Phase

- Soil loss from inappropriate land use practices

Within surrounding areas, communities are involved in subsistence farming and gardening especially in the wetlands which may cause soil loss. Use of inappropriate methods of farming by communities in surrounding areas pose a risk of erosion and river siltation that may affect ecological biodiversity of the wetlands.

Due to good agricultural practices adopted at Somawhe soil erosion is prevented. To the contrary

- Air quality deterioration

Dust is an important factor of environmental pollution. The generation of dust from the roads and fields during land preparation at Somawhe has an impact on the air quality especially during the dry season when wind speed is high. However, this is not a daily activity but periodic and therefore the impact on air quality tends to be minimal. The use of inappropriate method of disposing chemical waste through open air incineration of chemical waste/containers negatively impacts on air quality. There is need for properly

designed incineration facilities taking due cognisance of prevailing wind directions in both the dry and wet seasons to avoid air pollution.

- Noise pollution

Use of farm equipment and vehicles that are not regularly maintained can lead to noise pollution. However, the study revealed that the equipment and plant machinery at Somawhe are well maintained and in good condition such that noise emitted is within acceptable level. Normally accepted ambient noise levels are 50 dB (A). Therefore, noise pollution was not identified as a key impact area during the EIA study. In critical areas it was observed staff was using protective ear equipment while operating machinery. No complaints of noise from surrounding communities have ever been reported.

- Light pollution from centre pivots

The impact of light pollution from centre pivots is minimal at Somawhe. The agricultural layout of the fields coupled with interconnectivity of patches woodlands that separate the fields has greatly helped to minimize light pollution from the 30 centre pivots in operation.

- Polluting impacts of the storage, management, use and disposal of agricultural chemicals and containers

Somawhe has a well-designed infrastructure for storage of chemicals. Usage of the chemicals is managed through implementation of procedures in line with regulations set out by ZEMA. Therefore impacts of pollution from storage, management and use are insignificant. However, inappropriate disposal methods of chemicals and containers are being carried out.

- Impacts on surface water bodies, stream flows and water quality

Impoundment leads to variations in discharges and water levels in surface water bodies. The discharge regime becomes more regular compared to the conditions without impoundment and both low and high discharges occur less frequently. Hydrological changes in the river system have led to greater area of influenced both upstream and downstream. The morphological features of the Impumbu River have also changed over

time. However, the impact was found to be insignificant since the impoundment has guaranteed year round flow sustaining the ecosystem downstream.

Impoundment may increase or decrease (dilution) the pollutant load of receiving waters while withdraws may indirectly lead to an increase of pollutant loads. Therefore, impoundment of surface water bodies implies creation of a new environment, developing its own typical water quality problems that may affect the downstream section to some extent. Water quality can also be affected by receiving untreated human waste. Absence of proper sanitation facilities may result in human waste finding itself in stream water thus polluting it and posing a health risk to people who depend on stream water for domestic use. Results obtained from the analysis of water and soil samples collected at various sampling points showed no serious pollution of water or soil samples.

- Impacts on aquifers and groundwater water quality

Groundwater levels are likely to be impacted by the creation of an impoundment. Raised water levels upstream may result in a localized change to the water table. These changes to water levels may impact on groundwater upstream and downstream, resulting in water logging of soils or wells, and changes to catchment infiltration. However, this is mainly the case where the water table is too near to the surface which is not the case for Somawhe located in the Impumbu sub-catchment. Instead, enhanced recharge to groundwater is desired since the area has generally poor groundwater yields.

Since impoundment of a stream may lead to increased percolation of water to deeper levels, the percolating water if contaminated may lead to groundwater quality deterioration depending on soil type and condition. The impact on groundwater quality is insignificant as observed from the laboratory results for groundwater samples collected from Somawhe.

- Impacts on geomorphic processes in dambos, streams and rivers

The geomorphic processes in dambos, streams and rivers were found to be reasonably stable. The abundance of aquatic life recorded during the ecological survey was an indication of current status of health geomorphic processes in the area. Therefore, the operations had little impact on geomorphic processes. This can be attributed to good agricultural practices which have minimised the risk of soil erosion. Layout of agricultural

fields has been restricted to areas that are generally flat with good drainage whilst areas with steep slopes have been avoided. However, activities by communities in surrounding areas pose a risk to geomorphic processes.

- Impacts on ecological processes in dambos, streams and rivers

Unregulated usage of agricultural chemicals can be the source of water and soil pollution. This includes chemicals and fumigant materials used to control pests in the field and storage areas. These may negatively impact on both surface and underground water quality. Oil waste and scrap metal from the workshops is another source of environmental pollution in this respect. These may pose a risk to sustainability of the aquatic ecosystem thus diminishing benefits from ecosystem services. However, results of the ecological survey and water quality analysis showed that the impact on ecological processes in dambos, streams and rivers within Somawhe is still insignificant.

- Impacts on terrestrial ecological and ecosystem services processes

Current land use has an impact on the vegetation both within Somawhe and in the surrounding areas. The two impacts associated with this are fragmentation of vegetation and edge effects and invasion of alien species.

The removal of vegetation for creation of agricultural fields and associated infrastructure development definitely causes the loss of vegetation communities within the farm area. These are dynamic ecosystems that provide habitats that support all forms of life. Different types of communities (and habitats) exist in the farm area. Future planned expansion of the irrigation scheme will lead to the loss of some plant species thus disturbing the physical and biological characteristics of the mature closed *Miombo* woodland paving way to open Miombo (Chipya), young regeneration and finally to open grass lands or vice-versa. Therefore expected impacts include loss of miombo woodland, creation of riparian forest and dambos.

Another important impact on vegetation is fragmentation, especially when this creates breaks in previously continuous vegetation, causing a reduction in the gene pool and a decrease in species richness and diversity. However, this impact is expected to occur

when large areas are cleared for agriculture fields without leaving patches of vegetation connecting to each other through the area which is not the case at Somawhe.

The removal of existing vegetation creates 'open' habitats that will inevitably be colonised by pioneer plant and animal species. While this is part of a natural process of regeneration, which would ultimately lead to the re-establishment of a secondary vegetation cover, it may favour the establishment of undesirable species in the area e.g. the Lantana Camara present in some areas that were occupied by employees. Once established, these species are typically very difficult to eradicate and may then pose a threat to the neighbouring ecosystem.

- Loss of species of special concern and biodiversity

Clearing land for agriculture at Somawhe has a potential for loss of species of special concern, and perhaps other species important to the functioning of the ecosystem functioning. This could result in a loss of biodiversity.

- Loss and fragmentation of sensitive habitats

The clearing of land for agricultural fields at Somawhe and subsequent loss of the vegetation and surrounding areas, the development of road linkages and related infrastructure, including human habitations, workshops and dumps has to some extent led to loss and fragmentation of sensitive habitats such as Loss and fragmentation of:

  - *Miombo habitat*
  - *Dambos habitat*
  - *Riparian habitat*
  - *Transformed habitat*

- Loss of faunal diversity

Farming activities at Somawhe has potential to lead to habitat loss and mortalities directly or indirectly associated with specific farming actions and loss of faunal diversity. This cans vary between the vertebrate groups, depending upon their sensitivity to disturbance, the levels of existing impacts, and their dependence upon sensitive habitats.

- Impacts on climate change

The global phenomenon of the warming of the earth's atmosphere, once only conjecture, is now an observed reality. It is estimated that under current emissions trends, by 2100 average temperature will increase between 4° and 7° C, with potentially catastrophic social and environmental consequences, including rising sea levels, inundation of coastal cities, and large-scale ecosystem transformations (Moutinho and Schwartzman, 2002). Climate change issues are of both a local and global concern and all anthropogenic activities contribute to climate change. The activities at Somawhe have the potential to affect both the local and global climate due to clearance of woodland for agricultural fields.

The loss of natural habitat results in a loss of carbon stock, which in turn contributes to global warming. Thus, even relatively small changes in the climate will lead, over time, to large changes in the physical, chemical and ultimately biological composition of an ecosystem. Activities such as the destruction of vegetation (which acts as a carbon sink), use of fossil fuel energy and the improper disposal of biological non-processed waste all disrupt the natural atmospheric carbon balance by contributing excess atmospheric carbon dioxide (CO2) and methane (CH4).

- Aesthetic and landscape quality impacts of woodland removal

Woodland clearing for agricultural fields at Somawhe may have led to the loss of some plant species thus disturbing the physical and biological characteristics of the mature closed *Miombo* woodland and paving way to open Miombo (Chipya), young regeneration and finally to open grass lands or vice-versa. These impacts on the aesthetic affect conditions of the project area in the long run.

- Aesthetic and landscape quality impacts of centre pivots and farm structures

Poorly designed farm structures may affect the aesthetic condition of the area. In addition improper layout of agricultural fields may cloud centre pivots causing a visual impact. However, this impact is insignificant at Somawhe because the layout of the agricultural fields is well spaced and separated by undisturbed strips of woodland that is habitat to wildlife. The farm structure has also been designed and located in a manner

that maintains, as far as possible, the indigenous treas and leaves the natural environment undisturbed.

7.4 Impact Evaluation Mechanisms

Table 27: Impact Characterization

Environmental Aspect / Issue	Potential Environmental Impact	Environmental Impact Characterization							
		Positive /Negative Impact	**Intensity of Impact**	**Extent of Impact**	**Duration of Impact**	**Timing of Impact**	**Frequency of Impact**	**Likelihood of Impact Occurring**	**Risk To human Population**
1.0 PROJECT PHASE - SITE PREPARATION/CONSTRUCTION FOR PLANNED DEVEELOPMENTS									
(A) Biophysical Environment									
Flora and Fauna	May be affected due to clearing for wheat, maize, soya beans, settlements and other built structures. A total area of 3,000ha will be cleared.	Negative	Moderate	Within farm area	Short Term	Site preparation	Continuous	Certain	None
Air Quality	May be affected by emission form equipment used. Also dust generating especially during construction may affect air quality.	Negative	Moderate	Project area	Medium term	Clearing and Construction & Operation phases	Occasional	Likelihood	Low
Noise Quality	Heavy duty clearing and construction equipment may cause local noise disturbances.	Negative	Moderate	Project area	Medium term	Clearing, Construction & Operation phases	Infrequent	Certain	None

Land/Soil	Removal of soil will occur within the area specific areas where the land will be leveled for the centre pivot installation and other civil engineering works. Contamination of soil may occur due to oil spillages.	Negative	Low	Project area	Medium Term	Site Preparation	Continuous	Certain	None
Surface Water	Contamination of streams May occur due to accidental spillage of oils & lubricants.	Negative	Low	Project area	Short term	Site preparation	Continuous	Unlikely	Low
Ground Water	Contamination of streams May occur due to accidental seepage of oils/hydraulic fluids	Negative	Low	Project area	Short term	Site preparation	Infrequent	Unlikely	None
Habitat	Clearing of vegetation, digging may cause habitat fragmentation.	Negative	High	Project Area	Long term	Project life	Continuous	Certain	Low
Overall Biodiversity	Clearing of vegetation and digging of foundations/landscaping may have an effect on both terrestrial and aquatic biodiversity.	Negative	Low	Project area	Short term	Site preparation and Operation phases	Continuous	Unlikely	None
2.0 PROJECT PHASE – Current Operation									
Flora and Fauna	May be affected due to presence of people and movement of equipment. This may occur in on the farm are during operations.	Negative	Moderate	Project area	Short term	Operation & Closure phases	Continuous	Unlikely	None

Air Quality	May be affected by emissions from the machines farm tractors used.	Negative	Moderate	Project area	Medium term	Construction/ Operation & Closure phases	Continuous	Likelihood	Low
Noise Quality	May be affected during farming and harvesting operations.	Negative	Low	Project area	Long term	Operation	Occasional	Certain	Low
Land/Soil	Land/soil may be impacted by moving farm machines through compaction and contamination and oil leaks/seepages during operations.	Negative	Low	Project area	Short term	Operation	Infrequent	Unlikely	None
Surface Water	May be contaminated by leakages from machines during operation	Negative	Low	Project area	Short term	Operation & Closure phases	Infrequent	Unlikely	None
Habitat	The presence of people and operations of farm machines may disturb the peace of wildlife.	Negative	High	Project Area	Long term	Project life		Certain	Low
Overall Biodiversity	Clearing of vegetation and digging of foundations may have an effect on both terrestrial and aquatic biodiversity.	Negative	Low	Project area	Short term	Site preparation and Operation phases	Continuous	Unlikely	None
3.0 PROJECT PHASE – Closure									
Land use	Removal of structures and equipment will make land available for other uses	Positive	High	Project area	Long term	Post closure	Continuous	Certain	None

General safety	Access to site by people or animals may cause injury if foundations are not filled	Negative	Moderate	Project area	Long term	Post closure	Continuous	Certain	Low

8. Impact Mitigation and Enhancement Measures

8.1 Possible Mitigations and Enhancements of Anticipated Positive Socio-economic Impacts During the Operational Phase

8.1.1 National and international level impacts

To enhance positive national and international socio-economic impacts, Somawhe should increase its crop production levels by increasing the land under irrigation. This will not only increase overall size of land under irrigation but will positively contribute to grain production. This will result in meeting the national grain crop requirements especially wheat as well as contribute to surplus for export within and other markets beyond the region. As a result the country will earn the much needed foreign exchange and consequently lead to capacity to provide social services for its citizens. This will further have a positive multiplier effect on regional trade ties among countries.

8.1.2 Economic multiplier effects at the national level

To enhance economic multiplier effects at national level, Somawhe should embark on a programme to expand the existing irrigation scheme. This would result in demand for more inputs such as seed, chemicals, farm equipment and associated services. This will result in a chain effect by creating demand for inputs from other firms who in turn be made to increase their production levels by acquiring more equipment and employing more staff. This will have an economic multiplier effect on the general economy of the country.

8.1.3 Contributions to national food security from crop production

Somawhe is already one of the sole contributors to national food security and crop production. However, current national crop production levels fall short of meeting national demand. Somawhe should therefore invest more in its farm equipment and support infrastructure such as dams. Such an investment will enable the operations to sustainably increase its crop production level thus ensuring national food security and indirectly regional food security.

8.1.4 Contributions to national fiscal benefits

Zambia continues to be heavily dependent on mining despite the country contributing over 40% of the water resources in the region coupled good soils and climatic conditions. This can only change if the farming community strives to expand their productivity. Somawhe should develop a long term strategic plan for the expansion of its current irrigation scheme in a manner that will have minimum environmental impacts while increasing crop production levels of wheat, soya beans and maize. If the company is to export, this could result in the agriculture sector contributing significantly to the country's Gross Domestic product (GDP) through increased earnings in foreign exchange.

8.1.5 Provincial and district impacts

To enhance provincial and local positive impacts, it is recommended that management improves its irrigation scheme to make it not only economically viable but environmentally sustainable by putting in place long term environmental management plans for optimum utilization of natural resources within and surrounding catchment. This would ensure improved employment opportunities and increased income in form of taxes for local authorities resulting into improved availability and access to social services.

8.1.6 Employment, skills transfer and human resource capacity development

To enhance employment opportunities, skills transfer and human resource capacity should be developed. The establishment of a robust human resources development plan should be put in place and incorporate systems to ensure that human resource development is carried out correctly. This should be done in a manner that will boost efficiency and effectiveness of crop production processes.

8.1.7 Local area and site impacts

Somawhe can boost local areas and site specific positive impacts by engaging in social enterprising. This means developing social economic programmes that will conserve natural resources within and surrounding areas while ensuring the irrigation scheme is not threatened by activities such as cutting of trees which may affect availability of water resources. Somawhe

should further ensure involvement of the local communities in planning and designing such social economic programmes to ensure acceptability and increased willingness for participation in implementing such programmes.

8.1.8 Contribution to household incomes and food security

To increase its contribution to household income and food security, Somawhe should aim at expanding its crop production levels by increasing the number of agricultural fields under irrigation and purposefully employing more women wheere appropriate. Employing more women will have a direct positive impact on the income of the household and improve the welfare of children.

8.1.9 Economic multiplier effects at the local level

To enhance economic multiplier effects at local level, Somawhe should assist in improving trading facilities by ensuring that sanitation facilities and safe water supply is available. As far as possible, Somawhe should support the communities in rehabilitating the infrastructure. This will ensure a well-organized trading environment thus encourage more people within and surrounding areas to engage into trading.

8.1.10 Improved housing, water supplies and sanitation facilities for employees

To improve housing, water and sanitation facilities for workers, Somawhe should embark on a long term housing development plan that will match the needs of its permanent workers. This will ensure that when more people are employed, available housing, water and sanitation facilities are available without compromising the environment.

8.1.11 Improved health and education facilities for employees

Somawhe's strategic focus should be to increase crop production levels. However, health and education facilities affect the well-being of its workers and their families. To ensure that the

strategic focus is not lost, Somawhe should aim at working together with relevant government departments and local authorities. Since these facilities may be accessed by people who are not employees or families of employees, it's important that the two facilities benefit from a wealth pool of human resources and other inputs available from the respective ministries.

8.1.12 Management systems and effectiveness

To enhance management systems and effectiveness, Somawhe should have in place elaborate systems in covering all production aspects. This should be complemented by constant training of relevant personnel internally and externally. Further, for critical positions people with the right qualification, experience and attitude towards work should be employed.

8.2. Possible Mitigations and Enhancements of Anticipated Positive Environmental Impacts during the Operational Phase

8.2.1 Biodiversity contributions to sustainable agriculture

To promote biodiversity to sustainable agriculture, Somawhe should ensure that appropriate land management practices including preservation of strips of undisturbed vegetation are fully embraced. This will provide an environment for restoring woodland belts and interconnectivities critical for sustaining wildlife, creating positive biodiversity consequently enhancing sustainable agricultural production through soil improvement and natural controls on pests and diseases.

8.2.2 Contributions to ameliorating climate change

Apart from ensuring that strips of undisturbed woodland are preserved within Somawhe, a deliberate policy should be put in place to engage communities in surrounding areas to preserve trees and practice conservation agriculture. This would positively mitigate climate change because the conservation intervention measures will cover a much larger area than it is currently.

8.2.3 Technology impacts to soil structure and water conservation

Somawhe applies good agricultural practices that include limited tillage and strict nutrient management. As a result, there are less impacts on the soil structure experienced. Nonetheless,

Somawhe should embrace new technology on the market that can improve the current situation. Somawhe should also invest in best practices in managing water resources for efficient and effective utilization of water resources. This would ensure that options are evaluated against efficiency and cost effectiveness without necessarily relying on product marketers.

8.3. Possible Mitigations of Anticipated Negative Socio-economic Impacts during the Operational Phase

8.3.1 Migration and temporary employment effects

Migration and temporary employments effects are a common feature in all areas where there are emerging economic activities due to high unemployment levels. This is beyond the control of Somawhe since it cannot directly be prevented. The more jobs created, the more people will migrate to the area. However, in the long term the economic multiplier effects tend to mitigate this impact and equilibrium is reached. Those not employed engage in other activities such as agricultural or trading to service the working community. Therefore, this can be mitigated by simply improving operations at the scheme.

8.3.2 Unsociable behavior from increased disposable income

To mitigate against unsociable behavior, management should design induction programmes for newly appointed workers and provide sensitisation and, behavioural change programmes for all workers. This will assist workers in managing their income and provide guidance for improved lifestyle choices In addition, Somawhe should promote social activities that include social infrastructure such as football grounds and women's clubs. Sponsoring of a social football club for its workers is another mitigation measure that can build a sense of community and minimize unsociable behavior.

8.1.3 Casualisation of labour

Negative impacts attributed to casualisation of labour at Somawhe are insignificant and therefore no mitigation measure is required. Somawhe employment policy is to employ

permanent workers based on labour needs that run throughout the year. However, at peak production times such as harvesting time, capacity of permanent employees becomes inadequate. Since the demand for more labour force is tied to these peak production times, it's prudent that temporary workers are engaged for a specific period of time based on demand to supplement existing work force. Beyond peak periods there is less work to warrant employing everyone on a permanent basis as this would not be economical for the financial feasibility of the company.

8.1.4 Limited education and health services for employees

Somawhe has provided school and health infrastructure for its staff. All Somawhe employees (both permanent and temporary workers) have unlimited access to these health and education facilities and as such no mitigation measure is required.

8.1.5 Population density-related disease impacts

To mitigate negative impacts attributed to population density related disease impacts, Somawhe should collaborate with other stakeholders such as local authorities and other commercial farms in the area in promoting community sensitization programmes. Somawhe should also promote community social activities such as women's clubs.

8.1.6 Impacts from poor sanitation practices

Somawhe has provided well designed sanitation facilities (i.e. septic tank/ soak way system) in all its residential areas. Negative impacts are insignificant and therefore no mitigation measure is required.

8.1.7 Drowning accidents and disease implications of uncontrolled access to new impoundments

To mitigate drowning accidents and disease implications of uncontrolled access to new impoundments, Somawhe should strengthen its 24 hour security by ensuring that the dam is guarded against uncontrolled access. This can be address by employing more security personnel

and ensure adequate personnel are deployed at any given time. Somawhe should also put up visible road signs at critical points along the 20km long canal. Further, protective barriers in form of poles should be erected at critical areas along the canal to prevent vehicles plunging into the canal in case accidents that could be as result mechanical failure especially that the road runs parallel to the canal.

8.1.8 Impacts on natural resources

In comparison to surrounding areas, impacts on utilization of natural resources within Somawhe are minimal due to good agricultural practices and conservation measurements resulting in increased population of wildlife due to the favorable habitat. Current measures are adequate and therefore no further mitigation measures are required.

8.1.9 Occupational health and safety impacts

No significant impacts were observed. However, Somawhe should continue with programmes for awareness and training of its workers on safety procedures as well as providing protective clothing and equipment.

8.2 Possible Mitigations of Anticipated Negative Environmental Impacts during the Operational Phase

8.2.1 Soil loss from inappropriate land use practices

Somawhe applies good agricultural practices that prevent soil loss and as such no mitigation measure is required. However, Somawhe should embark on community programmes that will sensitise communities in surrounding areas using inappropriate methods of farming leading to erosion and river siltation.

8.2.2 Air quality deterioration

Impact on air quality due to dust generation is minimal however open air incineration of chemical waste negatively impacts on air quality. As a mitigation measure, Somawhe should construct properly designed incineration facilities to avoid air pollution.

8.2.3 Noise pollution

Equipment and plant machinery at Somawhe are well maintained and in good condition such that noise emitted is within an acceptable level. Workers operating in areas were noise is emitted are provided with protective equipment. Therefore no mitigation measure is required.

8.2.4 Light pollution from centre pivots

The impact of light pollution from centre pivots is minimal at Somawhe due to systematic layout of agricultural fields coupled with interconnectivity of strips of woodlands that separate the fields. No mitigation is required.

8.2.5 Polluting impacts of the storage, management, use and disposal of agricultural chemicals and containers

Somawhe has a well-designed infrastructure for storage of chemicals. Management and use of these chemicals is equally done following laid down procedures in line with regulations set out by ZEMA. But has no proper facilities for disposal of chemical waste and containers. To mitigate this, Somawhe should construct properly designed incineration facilities to avoid air pollution. In addition, Somawhe should ensure that

- Chemical stores (including fuel, insecticides, etc) are bonded and locked at all times.
- Access to such stores is controlled at all times.
- Inventories of stored chemicals are maintained, and their use regulated.
- All cautions/recommendations with respect to storage and use of hazardous chemicals should be carefully followed and implemented.

8.2.6 Impacts on surface water bodies, stream flows and water quality

Impact on stream flows due to impoundment is insignificant and therefore no mitigation measure is required. Equally, water quality results were within acceptable limits and therefore no mitigation measure is required. However, Somawhe should ensure that no untreated waste is discharged in the water bodies and sanitation facilities are maintained.

8.2.7 Impacts on aquifers and groundwater water quality

The water table at Somawhe and surrounding areas is deep. Therefore impounding of Impumbu River has enhanced percolation of water thus boosting water levels. Water quality results for groundwater showed no serious contamination. Therefore no mitigation measure is required. However, Somawhe should ensure that no waste of any kind is indiscriminately disposed of.

8.2.8 Impacts on geomorphic processes in dambos, streams and rivers

The geomorphic processes in dambos, stream and rivers within Somawhe were found to be reasonably stable. The abundance of aquatic life recorded during the ecological survey was an indication of the current status of health geomorphic processes in the area. Therefore, impacts on geomorphic processes were insignificant and no mitigation measure is required. However, Somawhe will avoid development in floodplain and dambo habitats, erosion and sedimentation from roads and farming fields into dambos.

8.2.9 Impacts on ecological processes in dambos, streams and rivers

Results of the ecological survey and water quality analysis showed that the impacts on ecological processes in dambos, streams and rivers within Somawhe are insignificant and therefore no mitigation measures are required.

8.4.10 Impact on faunal diversity loss

To avoid loss of faunal diversity, Somawhe should ensure that

- clearing or damaging intact habitats is avoided where possible
- exploitation of sensitive reptiles, e.g. crocodiles, monitor lizards, chameleons and terrapins by communities and farm staff is prevented by running community workshops that explain sustainable resource use.
- training of employees (induction training) and local villagers (workshops) about the necessity of protecting wildlife are conducted.
- habitat connectivity, particularly to protected areas, via habitat corridors (through the offsite biodiversity offset) is maintained.
- undertake habitat clearance only during winter when birds are not breeding.

8.2.11 Impacts on terrestrial ecological and ecosystem services processes

To mitigate impacts due to terrestrial ecological and ecosystem services processes, Somawhe should ensure that when clearing land for additional agricultural fields, strips of land with undisturbed woodland connecting to each other are preserved throughout the area.

8.2.12 Loss of species of special concern and biodiversity

Ecological surveys showed no serious loss of species of special concern, and other species important to ecosystem functioning that may have resulted in loss of biodiversity. Therefore no mitigation measures are required.

8.4.13 Loss and fragmentation of sensitive habitats

For loss and fragmentation of sensitive Miombo habitats, Somawhe should implement mitigation measures that include;

- Avoiding clearing or damaging Miombo habitat where possible
- Where possible avoid creating isolated ‘islands’ of Miombo habitat of less than 100 ha in extent as they will not serve as meaningful refugia for large mammals, snakes, etc.

For loss and fragmentation of sensitive riparian forests, stream and river habitats, Somawhe should:

- Avoiding clearing or damaging riparian vegetation where possible, and limit river and stream crossings as far as possible.
- Avoid blockage or diversion of rivers and streams where possible.
- Avoid indirect effect of run-off erosion and sedimentation from roads that may lead to loss of riparian habitats.
- Monitor and maintain riparian habitat corridors and waterways in adjacent areas to maintain faunal connectivity and migration.

Overall mitigation measures to manage and minimise these impacts should include:

- Leaving aside patches of key representative portions of each vegetation type within the project area as conservation area.
- Keep all areas of riparian forest as continuous as possible to maintain corridors within the farming areas.
- Keep all areas of floodplains (and dambos) as continuous as possible to maintain corridors within the farming areas

8.2.14 Impacts on climate change

To mitigate against climate change, Somawhe should;

- Facilitate the planting of village woodlots within surrounding communities to offset loss associated with cleared areas.
- Avoid clearing woodlands which are in a mature or climax state.
- Where feasible, implement carbon emissions offsets elsewhere.
- Ensure use of well maintained, high efficiency diesel motors. Ensure use of energy efficient variable speed electric motors.
- Ensure use of energy efficient lighting, heating and ventilation in staff facilities.
- Ensure permanent and contracted staff does not harvest fuel wood or utilise charcoal from unsustainable harvesting.
- Where possible, utilize freight vehicles with emissions performance labelling.

- Ensure implementation of reduced speed limits.
- Ensure all vehicles remain at a high level of maintenance.

8.2.15 Aesthetic and landscape quality impacts of woodland removal

Mitigation measures should include promoting planting of woodlots within the project and surrounding areas as well as preserving strips of indigenous woodlands connected to each other within Somawhe.

8.2.16 Aesthetic and landscape quality impacts of centre pivots and farm structures

This impact is insignificant at Somawhe because the layout of agricultural fields is such that they are well spaced separated by undisturbed strip of woodland that is habitat to wildlife. Farm structures have also been designed and located in a manner that leaves the natural environment undisturbed. No mitigation is required.

Table 28: Summary of Mitigation Measures

Positive Socio-economic Impacts During the Operational Phase

Potential Impact	**Mitigation and Enhancement Measures**
National and international level impacts	increase its crop production levels by increasing the land under irrigation
Economic multiplier effects at the national level	embark on a programme to expand the existing irrigation scheme
Impact national food security from crop production	invest more in its farm equipment and support infrastructure such as dams
Impact national fiscal benefits	develop a long term strategic plan for the expansion of its current irrigation scheme
Provincial and district impacts	improve management of its irrigation scheme for optimum utilization of natural resources within and surrounding catchment
Employment, skills transfer and human resource capacity development	develop a human resources development plan and systems to ensure human resources development is done at the right time for the right people based on capacity building needs assessment
Local area and site impacts	engaging into social enterprising by developing social economic programmes
household incomes and food security impacts	expand crop production levels and deliberately employing more women where appropriate
Economic multiplier effects at the local level impacts	improve trading facilities by ensuring that sanitation facilities and safe water supply is available
Improved housing, water supplies and sanitation facilities for employees impacts	embark on a long term housing development plan that will match the needs of its permanent workers
Improved health and education facilities for employees impacts	work hand in hand with relevant government departments and local authorities in running its school and health facilities
Management systems and effectiveness	have an elaborate system in place covering all production aspects to ensure constant training of relevant personnel internally and externally

Negative Socio-economic Impacts during the Operational Phase

Potential Impact	**Mitigation and Enhancement Measures**
Migration and temporary employment effects	economic multiplier effects tend to mitigate this impact and equilibrium will be reached
Unsociable behavior from increased disposable income	design sensitisation programmes as well as induction programmes for newly recruited staff to prepared staff on how to manage income
Casualisation of labour	impacts attributed to casualisation of labour are insignificant and therefore no mitigation measure is required
Limited education and health services for employees	Staff have unlimited access to these health and education facilities and as such no mitigation measure is required
Population density-related disease impacts	Work with other stakeholders such as local authorities and other commercial farms to promote community sensitization programmes including community social activities such as women's clubs
Impacts from poor sanitation practices	Negative impacts are insignificant and therefore no mitigation measure is required
Drowning accidents and disease implications of uncontrolled access to new impoundments	strengthen 24 hour security by ensuring that the dam is guarded against uncontrolled access and put up visible road signs at critical points along the 20km long canal
Impacts on natural resources	Current measures are adequate and therefore no further mitigation measures are required
Occupational health and safety impacts	Impacts insignificant. Continue with sensitization programmes and training on safety procedures and provide protective clothing and equipment

Positive Environmental Impacts during the Operational Phase

Potential Impact	Mitigation and Enhancement Measures
Biodiversity contributions to sustainable agriculture	ensure that appropriate land management practices including preservation of strips of undisturbed vegetation are fully embraced
Contributions to ameliorating climate change	engage communities in surrounding areas to preserve trees and practice conservation agriculture
Technology impacts to soil structure and water conservation	Impacts are minimal. Embrace new technology on the market that can improve the current situation

Negative Environmental Impacts during the Operational Phase

Potential Impact	Mitigation and Enhancement Measures
Soil loss from inappropriate land use practices	embark on community programmes to sensitise communities in surrounding areas to use appropriate methods of farming
Air quality deterioration	Construct properly designed incineration facilities to avoid air pollution.
Noise pollution	noise emitted is within acceptable level, no mitigation measure is required
Light pollution from centre pivots	Impact very minimal. No mitigation is required
storage, management, use and disposal of agricultural chemicals and containers impacts	construct properly designed incineration facilities to avoid air pollution Bond and lock chemical stores (including fuel, insecticides)at all times. Controlled access to stores at all times. Maintain and regulate Inventories of stored chemicals.
surface water bodies, stream flows and water quality impacts	No impacts observed. no mitigation measure is required
Impacts on aquifers and groundwater water quality	ensure that no waste of any kind is indiscriminately disposed off

Impacts on geomorphic processes in dambos, streams and rivers	avoid development in floodplain and dambo habitats, erosion and sedimentation from roads and farming fields into dambos

Potential Impacts	**Mitigation/ Enhancement Measures**
Impacts on geomorphic processes in dambos, streams and rivers	No Impacts recorded. No mitigation measure is required
Impacts on ecological processes in dambos, streams and rivers	No impacts observed. No mitigation measures are required
Impact on faunal diversity loss	Avoid clearing or damaging intact habitats Prevent exploitation of sensitive reptiles, e.g. crocodiles, monitor lizards, chameleons conduct sensitisation on sustainable resource use. Conduct employees (induction training) and local villagers (workshops) about the necessity of protecting wildlife Maintain habitat connectivity, particularly to protected areas, via habitat corridors (through the offsite biodiversity offset Undertake habitat clearance only during winter when birds are not breeding.
Impacts on terrestrial ecological and ecosystem services processes	ensure strips of land with undisturbed woodland are preserved when clearing land for additional agricultural fields
Loss of species of special concern and biodiversity	No mitigation measures are required.

Loss and fragmentation of sensitive habitats	Avoiding clearing or damaging Miombo habitat where possible Avoid creating isolated 'islands' of Miombo habitat Avoiding clearing or damaging riparian vegetation where possible, and limit river and stream crossings as far as possible. Avoid blockage or diversion of rivers and streams where possible. Avoid indirect effect of run-off erosion and sedimentation from roads that may lead to loss of riparian habitats. Monitor and maintain riparian habitat corridors and waterways in adjacent areas to maintain faunal connectivity and migration.
Impacts on climate change	Facilitate the planting of village woodlots within surrounding communities to offset loss associated with cleared areas. Avoid clearing woodlands which are in a mature or climax state. Where feasible, implement carbon emissions offsets elsewhere. Ensure use of well maintained, high efficiency diesel motors. Ensure use of energy efficient variable speed electric motors. Ensure use of energy efficient lighting, heating and ventilation in staff facilities. Ensure permanent and contracted staff do not harvest fuel wood or utilise charcoal from unsustainable harvesting. Where possible, utilize freight vehicles with emissions performance labelling. Ensure implementation of reduced speed limits. Ensure all vehicles remain at a high level of maintenance

Aesthetic and landscape quality impacts of woodland removal	promote planting of woodlots within and surrounding areas as well as preserve strips of indigenous woodlands connected to each other within Somawhe
Aesthetic and landscape quality impacts of centre pivots and farm structures	No impacts recorded. No mitigation is required

9. Environmental and Social Management and Monitoring Plan

9.1 Introduction

An Environmental and Social Management plan (ESMP) has been elaborated under this section for purposes of addressing identified adverse and positive impacts. Due consideration has been given to various factors that include increased pressure on upland areas above the dam, on-site environmental deterioration as well as decrease in water quality and increase in sedimentation rates in the reservoir resulting from clearing of forest land for agriculture, grazing pressures, use of agricultural chemicals, and tree cutting for timber or fuel wood.

9.2 Environmental Monitoring Plan

Under the Environmental Monitoring Plan (EMP), various mitigation measures have been organised into a well-formulated plan, which will serve as a guide for operation phase of Somawhe (refer to table 29). While costs associated with implementing the EMP are often deemed unnecessary it's important that adequate resources are allocated to implementation of the EMP in order to comply with the monitoring commitments in the EMP as well as ensuring that unexpected effects resulting from operational activities are detected early enough for mitigation without causing irreversible damage to the environment.

Table 29: Environmental Monitoring Plan

Category of impacts	Potential Impact	Mitigation measure to reduce impact	Monitoring method	Frequency of monitoring	Responsibility
Land Clearing Phase	Reduction of both quality and quantity of vegetation	Only areas needed for farming operations and civil structures will have trees cut. This will ensure that certain areas remain forested.	Regular site inspection	Daily	Environmental & community Liaison Officer and the Managing Director
	Biodiversity loss due to removal of some trees.	Only areas needed for farm operations and civil structures will have trees cut. This will ensure that some trees are left standing to support the ecosystem of the area.	Regular site inspection	Daily	Environmental & community Liaison Officer and the Managing Director
	Increased soil erosion due to land clearance.	Land clearing will be carried out during dry season	Site inspection	Ad-hoc	Environmental & community Liaison Officer and the Managing Director
	Reduction of space on the site by pilled removed vegetation	Utilizable parts will be taken for use by management for construction and other purposes	Site inspection	Weekly	EPU and the Managing Director
	Soil and water pollution by spilled oil and diesel	Oil and diesel will be stored in designated places to avoid spillages.	Site inspection	Daily	Environmental & community Liaison Officer and the Managing Director
	Soil and water pollution by leaked oil and diesel from vehicles	All vehicles will be serviced regularly to avoid leakages of oil and diesel	Vehicle service records	Ad-hoc	Environmental & community Liaison Officer and the Managing Director
Development Phase	Increased siltation into the streams from the erosion (Suspended solids).	All the soils of ant-hills to be run down will be spread apart and used to level the grain fields.	Site inspection	Daily	Environmental & community Liaison Officer and the Managing Director
	Disturbance of the soil surface during digging of foundations	Only portions used for foundations will be disturbed leaving other areas intact.	Site inspection	Daily	Environmental & community Liaison Officer and the Managing Director
	Water and soil pollution by waste water from mixing of cement	Cement mixing will be done from a designated place with concrete to ensure no waste water is drained into the environment.	Site inspection	Daily	Environmental & community Liaison Officer and the Managing Director
	Reduced space on site by rejected pieces of timber	Re-cycled on site Given to local community	Site inspection	Weekly	Environmental & community Liaison Officer and the Managing Director
	Reduced space on site by rejected building blocks	Re-used in pavements	Site inspection	Weekly	Environmental & community Liaison Officer and the Managing Director

Category of impacts	Potential Impact	Mitigation measure to reduce impact	Monitoring method	Frequency of monitoring	Responsibility
Operation Phase	Soil and water pollution by spilled oil and diesel	Oil and diesel will be stored in designated place to avoid spillages Polluted ground will be cleaned with saw dust and latter be deposited at the designated dump site.	Site inspection	Daily	Workshop Manager and Environmental & Community Liaison Officer
	Soil and water pollution by leaked oil and diesel	All equipment will be serviced regularly to avoid leakages of oil and diesel	Vehicle service records	Ad-hoc	Workshop Manager and Environmental & community Liaison Officer
	Soil erosion from disturbed areas due to movement of heavy duty machinery and ploughing activities on the farm and gravel roads.	Open storm water drainage will be constructed throughout the fields and roads. Silt traps will be constructed along specific intervals along the farmland drainage net-work.	Site drainage inspection will be conducted	Periodically	Environmental & Community Liaison Officer
	Water and soil pollution by agricultural chemicals and fumigants.	The application of the chemicals will be as provided for on the Material Safety Data Sheets (MSDS) and will be applied by skilled personnel with equipment.	Chemical application equipment to be monitored and serviced by skilled personnel	Routinely	Farm & Stores Managers, and Environmental & community Liaison Officer
Demolition Phase	Air pollution by application of fumigants	Only the appropriate chemical proportions will be applied with approved apparatus (fumigation equipment sealing. Operators will be provided with suitable personal protective clothing.	Site inspection	Daily	Stores Manager, and Environmental & Community Liaison Officer
	Air pollution by dust particles from the roads	Dust on the roads will be washed down with a water bowser in suppression.	Site road inspections	Daily	Workshop Manager and Environmental and Community Liaison Officer
	Pollution of surface and ground water and soil due to spillage/seepage of agricultural chemicals in storage areas	Any dripped chemicals on the concrete floor will be cleaned in line with the MSDS. All chemical storage will be in impermeable troughs and drip trays.	Routine inspection and monitoring of the mixing storage areas	Daily	Stores Manager and Environmental and Community Liaison officer

9.3 Environmental Management Plan

Arising from adverse/positive impacts identified earlier and taking into account the need to clear more land for crop irrigation, further mechanization of the irrigation scheme, use of agricultural chemicals and the needs of surrounding communities, it is imperative that measures are elaborated and outlined so as to manage the effects that are associated with the operational activities. This can be achieved through elaborated detailed environmental management plan (EMP). Specifically, the EMP will assist in managing issues relating to;

- Storage, management and disposal of agricultural chemicals/ waste
- Solid waste disposal
- Air quality and noise pollution
- Workplace health and safety
- Water and soil pollution from agricultural chemicals
- Geomorphic process, soils and land use
- Hydrological, hydrogeological systems and water quality
- Climate change

Table 30: BRIEF ENVIRONMENTAL MANAGEMENT PLAN

Positive Socio-economic Impacts During the Operational Phase

Potential Impact	Mitigation and Enhancement Measures	Objective	By Who	By When
National and international level impacts	increase its crop production levels by increasing the land under irrigation	To boost contribution to national crop production	Director Farm Manager Finance Manager	During Operation stage
Economic multiplier effects at the national level	embark on a programme to expand the existing irrigation scheme	To boost national economic growth	Director Farm Manager Finance Manager	During Operation stage
Impact on national food security from crop production	invest more in its farm equipment and support infrastructure such as dams	Contribute to attainment of food security	Director Farm Manager Finance Manager	During Operation stage
Impact national fiscal benefits	develop a long term strategic plan for the expansion of its current irrigation scheme	Boost grain crop production	Director Farm Manager Finance Manager	During Operation stage
Provincial and district impacts	improve management of its irrigation scheme for optimum utilization of natural resources within and surrounding catchment	To contribute to economic growth at local level	Director Farm Manager Finance Manager	During Operation stage
Employment, skills transfer and human resource capacity development	develop a human resources development plan and systems to ensure human resources development is conducted at the appropriate time and for the appropriate people based on	To ensure human resources development	Farm Manager	During Operation stage

	capacity building needs assessment			
Local area and site impacts	engaging into social enterprising by developing social economic programmes	To boost social acceptance of the scheme	Director Farm Manager Finance Manager	During Operation stage
household incomes and food security impacts	expand crop production levels and deliberately employing more women were appropriate	To improve people's well being	Farm Manager	During Operation stage
Economic multiplier effects at the local level impacts	improve trading facilities by ensuring that sanitation facilities and safe water supply is available	To improve living standards of local communities	Farm Manager	During Operation stage
Improved housing, water supplies and sanitation facilities for employees impacts	embark on a long term housing development plan that will match the needs of its permanent workers	To attain workers satisfaction for high productivity	Director Farm Manager Finance Manager	During Operation stage
Improved health and education facilities for employees impacts	work together with relevant government departments and local authorities in running its school and health facilities	To ensure highly productivity workers	Director Farm Manager Finance Manager	During Operation stage
Management systems and effectiveness	have an elaborate systems in place covering all production aspects ensure constant training of relevant personnel	To boost economic viability of the scheme	Director Farm Manager	During Operation stage

Negative Socio-economic Impacts during the Operational Phase

Potential Impact	**Mitigation and Enhancement Measures**	**Objective**	**By Who**	**By When**
Migration and temporary employment effects	economic multiplier effects tend to mitigate this impact and equilibrium will be reached	To minimize over utilization of natural resources	Farm Manager	During Operation stage

Unsociable behavior from increased disposable income	design sensitisation programmes as well as induction programmes for newly recruited staff to educate staff on managing their income	To create conducive environment for everyone	Director Finance Manager	During Operation stage
Casualisation of labour	impacts attributed to casualisation of labour are insignificant and therefore no mitigation measure is required	To attain workers satisfaction for increased production	-	-
Limited education and health services for employees	Staff have unlimited access to these health and education facilities and as such no mitigation measure is required	To reduce illiteracy levels	-	-
Population density-related disease impacts	Work with other stakeholders such as local authorities and other commercial farms to promote community sensitization programmes including community social activities such as women's clubs	To create a health environment	Director	During Operation stage
Impacts from poor sanitation practices	Negative impacts are insignificant and therefore no mitigation measure is required	To avoid outbreak of diseases	Farm Manager	During Operation stage
Drowning accidents and disease implications of uncontrolled access to new impoundments	strengthen 24 hour security by ensuring that the dam is guarded against uncontrolled access and put up visible road signs at critical points along the 20km long canal	To safe guard the lives of people	Director Farm Manager	During Operation stage
Impacts on natural resources	Current measures are adequate and therefore no further mitigation measures are required	To avoid unsustainable use of resources	Director Farm Manager	During Operation stage
Occupational health and safety impacts	Impacts insignificant. Continue with sensitization programmes and safety training procedures and provide protective clothing and equipment	To ensure a health working environment	Environmental, Health Safety Officer	During Operation stage

Positive Environmental Impacts during the Operational Phase

Potential Impact	Mitigation and Enhancement Measures	Objective	By Who	By When
Biodiversity contributions to sustainable agriculture	ensure that appropriate land management practices including preservation of strips of undisturbed vegetation are fully embraced	To promote sustainable agriculture	Farm Manager Irrigation engineer	During Land Preparation stage
Contributions to ameliorating climate change	engage communities in surrounding areas to preserve trees and practice conservation agriculture	To contribute to climate change adaptation	Farm Manager Human Resources manager	During Preparation and Operation stage
Technology impacts to soil structure and water conservation	Impacts are minimal. Embrace new technology on the market that can improve the current situation	To ensure sustainable agriculture	Farm Manager Irrigation engineer	During Land Preparation and operation stage

Negative Environmental Impacts during the Operational Phase

Potential Impact	Mitigation and Enhancement Measures	Objective	By Who	By When
Soil loss from inappropriate land use practices	embark on community programmes to sensitise communities in surrounding areas to use appropriate methods of farming	To avoid siltation and sedimentation of rivers	Farm Manager Irrigation engineer	During Land Preparation / operation stage
Air quality deterioration	Construct properly designed incineration facilities to avoid air pollution.	To avoid air pollution	Environmental, Health and Safety Officer	During preparation and Operation stage
Noise pollution	noise emitted is within acceptable level, no mitigation measure is required	To prevent noise pollution	-	-

Light pollution from centre pivots	Impact very minimal. No mitigation is required	To minimize light pollution	-	-
storage, management, use and disposal of agricultural chemicals and containers impacts	construct properly designed incineration facilities to avoid air pollution Bond and lock at all times Chemical stores (including fuel, insecticides). Access to stores is controlled at all times. Maintain and regulate inventories of stored chemicals.	To avoid contamination of soil, water and air	Environmental, Health and Safety Officer	During Operation stage
surface water bodies, stream flows and water quality impacts	No impacts observed. No mitigation measure is required	To avoid disturbance to aquatic ecosystems	-	-
Impacts on aquifers and groundwater water quality	ensure that no waste of any kind is haphazardly disposed off	To avoid groundwater pollution	Farm Manager Environmental, Health and Safety Officer	During preparation and Operation stage
Impacts on geomorphic processes in dambos, streams and rivers	avoid development in floodplain and dambo habitats, erosion and sedimentation from roads and farming fields into dambos	To avoid habitat destruction	Farm Manager Environmental, Health and Safety Officer	During preparation and Operation stage

Potential Impacts	**Mitigation/ Enhancement Measures**	**Objective**	**By Who**	**By When**
Impacts on ecological processes in dambos, streams and rivers	No impacts observed. No mitigation measures are required	To preserve the ecosystem	-	-

Impact on faunal diversity loss	Avoid clearing or damaging intact habitats Prevent exploitation of sensitive reptiles, e.g. crocodiles, monitor lizards, chameleons conduct sensitisation on sustainable resource use. Conduct employees (induction training) and local villagers (workshops) about the necessity of protecting wildlife Maintain habitat connectivity, particularly to protected areas, via habitat corridors (through the offsite biodiversity offset Undertake habitat clearance only during winter when birds are not breeding.	To preserve faunal diversity	Farm Manager Irrigation Engineer	During preparation and Operation stage
Impacts on terrestrial ecological and ecosystem services processes	ensure strips of land with undisturbed woodland are preserved when clearing land for additional agricultural fields	To ensure health ecological processes	Farm Manager Irrigation Engineer	During preparation and Operation stage
Loss of species of special concern and biodiversity	No mitigation measures are required.	To minimise loss of special species	-	-

Loss and fragmentation of sensitive habitats	Avoiding clearing or damaging Miombo habitat where possible Avoid creating isolated 'islands' of Miombo habitat Avoiding clearing or damaging riparian vegetation where possible, and limit river and stream crossings as far as possible. Avoid blockage or diversion of rivers and streams where possible. Avoid indirect effect of run-off erosion and sedimentation from roads that may lead to loss of riparian habitats. Monitor and maintain riparian habitat corridors and waterways in adjacent areas to maintain faunal connectivity and migration.	To avoid Fragmenting sensitive habitats	Farm Manager Irrigation Engineer	During preparation and Operation stage

Impacts on climate change	Facilitate the planting of village woodlots within surrounding communities to offset loss associated with cleared areas. Avoid clearing woodlands which are in a mature or climax state. Where feasible, implement carbon emissions offset elsewhere. Ensure use of well maintained, high efficiency diesel motors. Ensure use of energy efficient variable speed electric motors. Ensure use of energy efficient lighting, heating and ventilation in staff facilities. Ensure permanent and contracted staff does not harvest fuel wood or utilise charcoal from unsustainable harvesting. Where possible, utilize freight vehicles with emission performance labelling. Ensure implementation of reduced speed limits. Ensure all vehicles remain at a high level of maintenance	To minimise effects of climate change	Farm Manager	During preparation and Operation stage
Aesthetic and landscape quality impacts of woodland removal	promote planting of woodlots within the project and surrounding areas as well as preserve strips of indigenous woodlands connected to each other within Somawhe	To preserve aesthetic conditions of the area	Farm Manager	During preparation stage
Aesthetic and landscape quality impacts of centre pivots and farm structures	No impacts recorded. No mitigation is required	To preserve aesthetic conditions of the area	Farm Manager	During preparation and Operation stage

10. Recommendation and Conclusion

10.1 Recommendations

Based on the ecological assessment and the sensitivity of the ecology and potential of the farm to develop and increase in wheat, maize and soya beans production, the following are recommended:

1. Implement all ecological and mitigation measures and strategies as outlined in the Environmental Management Plan presented herein.
2. Undertake regular more detailed ecological assessments to be able to monitor the impacts of the farm activities.
3. The *Lantana* plants should be removed from the woodland and communities made aware not to plant it in their surroundings.
4. In collaboration with community members, identify areas that will need to be replanted with trees.
5. Conduct periodic detailed assessments of biodiversity integrity of the vegetation patches left between fields. They must be assessed in terms habitat quality, carbon potential and capacity to protect remaining fauna species in the area.
6. Develop a detailed land use map for the various uses at Somawhe.
7. Adopt an integrated water resource management approach in collaboration with neighboring land owners and local people.
8. Employ a qualified professional to coordinate ecological functions of the organization. This person should guide the environmental and social aspects of the community and also focus on production, whilst continue to act within the law.
9. Management should engage the surrounding communities with a view of reaching consensus on best practices to ensure the conservation of natural resources.

10.2 Conclusion

It is the opinion of the study team that social economic and environmental impacts resulting from operations at Somawhe can effectively be managed and reduced to acceptable levels as

long as proposed mitigation measures are applied. Consequently, the benefits arising from operations of Somawhe as a developmental project outweigh the environmental costs.

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Annex 1. Details of soil tests and results

REPUBLIC OF ZAMBIA

FORESTRY DEPARTMENT

Forestry Research Branch

SOIL PHYSICAL/MECHANICAL ANALYTICAL DATA SHEET

LOCATION: SOMAWHE FARM AREA (Mpongwe) Analyst: M. Kambikambi Date: 09/05/12

Lab No	GPS N/E	Depth cm	Clay %	Silt %	Coarse Sand %	Fine Sand %	Total Sand	Texture	Colour (mussel)	Total Porosity %	Bulk Density g/cm^3	Remarks
9	8487855, 578486	0-20	2.2	6.76	40	53.24	93.24	Sand	Brown	N/A	N/A	
10	8491993, 584370	0-20	3.6	10.70	24	65.30	89.30	Loamy Sand	Dry Brown	N/A	N/A	
11	8491354, 582211	0-20	1.8	10.76	52	37.24	89.30	Loamy Sand	Very Dark Brown	N/A	N/A	
12	8493207, 576326	0-20	0.5	4.82	40	55.18	95.18	Sand	Very Dark Brown	N/A	N/A	

Lab No.	GPS N/E	Depth cm	pH	CEC me/100g	N %	K Ppm	Na ppm	Ca me/100g	Mg me/100g	Organic carbon %	Organic Matter %	Total carbon%	C/N
9	8487855, 578486	0-20	4.61	N/A	N/A	14.3	7	0.20	0.30	0.411	0.882	0.547	N/A
10	8491993, 584370	0-20	5.15	N/A	N/A	13.3	5	0.30	0.10	0.695	1.390	0.924	N/A
11	8491354, 582211	0-20	3.41	N/A	N/A	13.0	10	0.30	-	0.394	0.788	0.524	N/A
12	8493207, 576326	0-20	4.51	N/A	N/A	10.0	8	0.35	0.10	0.697	1.390	0.927	N/A

Annex 2: Stock report for chemicals and pesticides used at the farm

Stock Report

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Code:	Category	Group	Description	Quantity in Stock	Unit	Unit cost	Value
CHEMATR170	CHEMICALS	ATRAZINE		35.00	KG	3.50	122.50
CHEM2	CHEMICALS	2 4D AMINE		835.00	LITRES	4.90	4,091.50
CHEMAUT170	CHEMICALS	AUTHORITY		22.10	KG	128.00	2,828.80
CHEMBAN170	CHEMICALS	BANVEL		485.00	LITRES	33.00	16,005.00
CHEMBAS170	CHEMICALS	BASAGRAN		8.00	LITRES	19.00	152.00
CHEMBAT17005	BATELEUR GOLD	18.70		LITRES	27.00	504.90	
CHEMBRO170	CHEMICALS	BROAD STRIKE		3.50	KG	5.50	19.25
CHEMBRO170	CHEMICALS	BROMOXYNIL		1,062.50	LITRES	6.20	6,587.50
CHEMBUL170	CHEMICALS	BULLET		11.50	LITRES	7.00	80.50
CHEMCLA170	CHEMICALS	CLASSIC		2.96	KG	132.00	391.38
CHEMCOM170	CHEMICALS	COMMAND		20.00	LITRES	34.00	680.00
CHEMCOG170	CHEMICALS	COGER		5.00	LITRES	5.00	25.00
CHEMCOM170	CHEMICALS	COMPLEMENT		890.20	LITRES	5.20	4,629.02
CHEMDUA170	CHEMICALS	DUAL MAGNUM	960EC	6.00	LITRES	17.00	102.00
CHEMETH170	CHEMICALS	ETHEPHON		75.00	LITRES	7.00	525.00
CHEMFOM170	CHEMICALS	FOMESAFEN		65.00	LITRES	18.00	1,170.00
CHEMGES170	CHEMICALS	GESAPRIM	90WG	3.40	KG	8.50	28.90
CHEMGRA170	CHEMICALS	GRANISTER		7.05	KG	5.00	35.25
CHEMGRA170	CHEMICALS	GRAMOXONE		2,185.00	LITRES	5.50	12,017.50
CHEMHAR170	CHEMICALS	HARNESS		13.00	LITRES		0.00
CHEMLAS17022	LASSO	MT	1,175.00	LITRES	5.70	6,697.50	
CHEMMCP170	CHEMICALS	MCPA		2,127.00	LITRES	4.00	8,508.00
CHEMMET170	CHEMICALS	METAGUN		10.70	LITRES		0.00
CHEMNOV170	CHEMICALS	NOVANULRON		0.45	KG		0.00
CHEMNOV170	CHEMICALS	NOVASULFRON		0.12	LITRES		0.00
CHEMSEN170	CHEMICALS	SENCOR		2.00	LITRES	16.00	32.00
CHEMSER170	CHEMICALS	SERVIAN		2.75	KG	465.20	1,279.30
CHEMTER170	CHEMICALS	TERBUTRYN		220.00	LITRES	6.18	1,359.60
CHEMTRI1703	CHEMICALS	TRIFLUREX		740.00	LITRES	107.00	79,180.00
CHEMTOP170	CHEMICALS	TOPIK		5.00	LITRES	102.50	512.48
CHEMVUM170	CHEMICALS	VUMA		1,428.60	LITRES	28.00	40,000.80

CHEMDUR170	CHEMICALS	DURSBAN		37.00	LITRES	12.00	444.00
CHEMFEN170	CHEMICALS	FENDONA		1.00	LITRES		0.00
CHEMGOL170	CHEMICALS	GOLLAN		16.00	LITRES	12.58	201.28
CHEMMOL170	CHEMICALS	MOLLYFLOIT		40.00	LITRES	20.00	800.00
CHEMMON170	CHEMICALS	MONOCHROTOPHOS		1.80	LITRES	6.08	10.94
CHEMNOV170	CHEMICALS	NOVACETAM		661.00	LITRES	19.50	12,889.50
CHEMNOV170	CHEMICALS	NOVACHLOPRID	200SL	288.50	LITRES	25.00	7,212.50
CHEMNOV170	CHEMICALS	NOVACHLOPRID	500SL	20.00	LITRES	21.12	422.40
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		SIGNATURE					

Stock Report

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Code:	Category	Group	Description	Quantity in Stock	Unit	Unit cost	Value
CHEMNOV170	CHEMICALS	NOVACHLOPRID	700SL	8.00	KG		0.00
CHEMCAR170	CHEMICALS	CARBOFURAN (NOVAFURAN)		3,924.25	KG	3.50	13,734.88
CHEMSOY170	CHEMICALS	SOYFLO		155.00	LITRES	25.00	3,875.00
CHEMTER170	CHEMICALS	TERMIDAN		2.50	LITRES		0.00
CHEMBLA17065	BLAD BUFF	1,877.60		LITRES	4.00	7,510.40	
CHEMAMI17066	AMISTER PRO/TOP	LTRS	1,358.50	LITRES	32.00	43,472.00	
CHEMART170	CHEMICALS	ARTEA	330EC	2.94	LITRES	28.00	82.32
CHEMIND17076	INDOSULFAN	40.00		LITRES	6.50	260.00	
CHEMFLO170	CHEMICALS	FLOWERBLE SULPHER		2,020.00	LITRES	1.36	2,747.20
CHEMGET170	CHEMICALS	GET DOWN		6.50	KG	4.62	30.03
CHEMIMI1707	CHEMICALS	IMIBOOST		55.85	LITRES	2.50	139.63
CHEMKEL17080	KELP P MAX	248.50		LITRES	7.00	1,739.50	
CHEMMAX170	CHEMICALS	MAXIFLOW		9.00	LITRES		0.00
CHEMMOL170	CHEMICALS	MOLLYBOR		210.00	LITRES	6.00	1,260.00
CHEMNOV170	CHEMICALS	NOVA SUPERVAX		70.00	LITRES		0.00
CHEMORG170	CHEMICALS	ORGANOCELL		1,246.00	LITRES	7.00	8,722.00
CHEMORI17087	ORIUS	64.00		LITRES	23.40	1,497.60	
CHEMORT170	CHEMICALS	ORTIVA		7.00	LITRES	55.20	386.40
CHEMPOW170	CHEMICALS	POWER UP		181.75	LITRES	1.50	272.63
CHEMRUS170	CHEMICALS	RUSH		950.00	LITRES	8.50	8,075.00
CHEMTRO170	CHEMICALS	TRONIC		300.00	LITRES	5.00	1,500.00
CHEMTRY170	CHEMICALS	TRYCOCIDE		1.00	LITRES		0.00
CHEMTWI17094	TWIN N	0.19		KG	4,000.00	744.00	
CHEMNOV171	CHEMICALS	NOVATRYN		155.00	LITRES		0.00
CHEMLEA17095	LEAF GRIP	200.00		LITRES	0.00		
CHEMMET170	CHEMICALS	METRIBUZINE		190.00	LITRES	15.82	3,005.80
CHEMATS17097	ATS MOZICON	30.13		KG	60.00	1,807.50	
CHEMSUP170	CHEMICALS	SUPA KILL BLOCK		22.30	KG		0.00
CHEMHAM171	CHEMICALS	HAMMER		28.50	LITRES	28.50	812.25
CHEMTRI1710	CHEMICALS	TRIOSPRAY-FLO		400.00	LITRES		0.00
CHEMECO171	CHEMICALS	ECOT		331.50	KG	120.00	39,780.00
CHEMATS17105	ATS METHOMYL 900SP	KG	586.54	KG	23.40	13,725.04	
CHEMCHL171	CHEMICALS	CHLOREMEQUAT	LTRS	4,760.30	LITRES	5.50	26,181.65

CHEMSPO171	CHEMICALS	SPOOR & BOOR		20.00	LITRES	8.00	160.00
CHEMNOV171	CHEMICALS	NOVAZOLE		37.50	LITRES	25.00	937.50
CHEMLAM171	CHEMICALS	LAMBDA	(KARATE)	503.76	LITRES	9.00	4,533.84
CHEMPAN171	CHEMICALS	PANTELA		15.00	LITRES	18.00	270.00
CHEMABA171	CHEMICALS	ABACUS		143.50	LITRES	29.58	4,244.73
CHEMSIL1711	CHEMICALS	SILWET		2.00	LITRES	45.00	90.00

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SIGNATURE

Stock Report

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Code:	Category	Group	Description	Quantity in Stock	Unit	Unit cost	Value
CHEMMAM171	CHEMICALS	MAMBA MAX 480L	(round up)	2,107.50	LITRES	7.25	15,279.38
CHEMAQU171	CHEMICALS	AQUARITE		200.00	EACH	4.50	900.00
CHEMDEF171	CHEMICALS	DEFT 200WDG	15G	1,588.00	EACH	4.08	6,479.04
CHEMAPR171	CHEMICALS	APRON STAR	42WS	9.28	KG	163.00	1,512.64
CHEMVIN17123	CHEMICALS	VINKING (GLYPHOSTE 480)		803.60	LITRES	8.00	6,428.80
CHEMFRO171	CHEMICALS	FRONTIER		42.00	LITRES	25.00	1,050.00
CHEMPUN171	CHEMICALS	PUNCH XTRA		160.70	LITRES	26.00	4,178.20
CHEMDIF17126	CHEMICALS	DIFENOCANAZOLE		64.50	LITRES	34.00	2,193.00
CHEMFLI1713	CHEMICALS	FLINT		1.50	KG	94.50	141.75
CHEMEXT17132	EXTREME	1.18		KG	120.00	142.08	
CHEMIMA17131	IMAZETHAPYR	38.00		LITRES	30.00	1,140.00	
CHEMCAR171	CHEMICALS	CARBOXIN/THIRAM		720.00	LITRES	11.00	7,920.00
CHEMPOL171	CHEMICALS	POLYTRIN C440 EC	INSECTICIDE	496.00	LITRES	15.39	7,633.44
				Total Value	US$		456,141.51

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Stock Report

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Code:	Category	Group	Description	Quantity in Stock	Unit	Unit cost	Value
CHEMATR170	CHEMICALS	ATRAZINE		35.00	KG	3.50	122.50
CHEM2	CHEMICALS	2 4D AMINE		835.00	LITRES	4.90	4,091.50
CHEMAUT170	CHEMICALS	AUTHORITY		22.10	KG	128.00	2,828.80
CHEMBAN170	CHEMICALS	BANVEL		485.00	LITRES	33.00	16,005.00
CHEMBAS170	CHEMICALS	BASAGRAN		8.00	LITRES	19.00	152.00
CHEMBAT17005	BATELEUR GOLD	18.70		LITRES	27.00	504.90	
CHEMBRO170	CHEMICALS	BROAD STRIKE		3.50	KG	5.50	19.25
CHEMBRO170	CHEMICALS	BROMOXYNIL		1,062.50	LITRES	6.20	6,587.50
CHEMBUL170	CHEMICALS	BULLET		11.50	LITRES	7.00	80.50
CHEMCLA170	CHEMICALS	CLASSIC		2.96	KG	132.00	391.38
CHEMCOM170	CHEMICALS	COMMAND		20.00	LITRES	34.00	680.00
CHEMCOG170	CHEMICALS	COGER		5.00	LITRES	5.00	25.00
CHEMCOM170	CHEMICALS	COMPLEMENT		890.20	LITRES	5.20	4,629.02
CHEMDUA170	CHEMICALS	DUAL MAGNUM	960EC	6.00	LITRES	17.00	102.00
CHEMETH170	CHEMICALS	ETHEPHON		75.00	LITRES	7.00	525.00
CHEMFOM170	CHEMICALS	FOMESAFEN		65.00	LITRES	18.00	1,170.00
CHEMGES170	CHEMICALS	GESAPRIM	90WG	3.40	KG	8.50	28.90
CHEMGRA170	CHEMICALS	GRANISTER		7.05	KG	5.00	35.25
CHEMGRA170	CHEMICALS	GRAMOXONE		2,185.00	LITRES	5.50	12,017.50
CHEMHAR170	CHEMICALS	HARNESS		13.00	LITRES		0.00
CHEMLAS17022	LASSO	MT	1,175.00	LITRES	5.70	6,697.50	
CHEMMCP170	CHEMICALS	MCPA		2,127.00	LITRES	4.00	8,508.00
CHEMMET170	CHEMICALS	METAGUN		10.70	LITRES		0.00
CHEMNOV170	CHEMICALS	NOVANULRON		0.45	KG		0.00
CHEMNOV170	CHEMICALS	NOVASULFRON		0.12	LITRES		0.00
CHEMSEN170	CHEMICALS	SENCOR		2.00	LITRES	16.00	32.00
CHEMSER170	CHEMICALS	SERVIAN		2.75	KG	465.20	1,279.30
CHEMTER170	CHEMICALS	TERBUTRYN		220.00	LITRES	6.18	1,359.60
CHEMTRI1703	CHEMICALS	TRIFLUREX		740.00	LITRES	107.00	79,180.00
CHEMTOP170	CHEMICALS	TOPIK		5.00	LITRES	102.50	512.48
CHEMVUM170	CHEMICALS	VUMA		1,428.60	LITRES	28.00	40,000.80
CHEMDUR170	CHEMICALS	DURSBAN		37.00	LITRES	12.00	444.00

CHEMFEN170	CHEMICALS	FENDONA		1.00	LITRES		0.00
CHEMGOL170	CHEMICALS	GOLLAN		16.00	LITRES	12.58	201.28
CHEMMOL170	CHEMICALS	MOLLYFLOIT		40.00	LITRES	20.00	800.00
CHEMMON170	CHEMICALS	MONOCHROTOPHOS		1.80	LITRES	6.08	10.94
CHEMNOV170	CHEMICALS	NOVACETAM		661.00	LITRES	19.50	12,889.50
CHEMNOV170	CHEMICALS	NOVACHLOPRID	200SL	288.50	LITRES	25.00	7,212.50
CHEMNOV170	CHEMICALS	NOVACHLOPRID	500SL	20.00	LITRES	21.12	422.40
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Stock Report

Code:	Category	Group	Description	Quantity in Stock	Unit	Unit cost	Value
CHEMNOV170	CHEMICALS	NOVACHLOPRID	700SL	8.00	KG		0.00
CHEMCAR170	CHEMICALS	CARBOFURAN (NOVAFURAN)		3,924.25	KG	3.50	13,734.88
CHEMSOY170	CHEMICALS	SOYFLO		155.00	LITRES	25.00	3,875.00
CHEMTER170	CHEMICALS	TERMIDAN		2.50	LITRES		0.00
CHEMBLA17065	BLAD BUFF	1,877.60		LITRES	4.00	7,510.40	
CHEMAMI17066	AMISTER PRO/TOP	LTRS	1,358.50	LITRES	32.00	43,472.00	
CHEMART170	CHEMICALS	ARTEA	330EC	2.94	LITRES	28.00	82.32
CHEMIND17076	INDOSULFAN	40.00		LITRES	6.50	260.00	
CHEMFLO170	CHEMICALS	FLOWERBLE SULPHER		2,020.00	LITRES	1.36	2,747.20
CHEMGET170	CHEMICALS	GET DOWN		6.50	KG	4.62	30.03
CHEMIMI1707	CHEMICALS	IMIBOOST		55.85	LITRES	2.50	139.63
CHEMKEL17080	KELP P MAX	248.50		LITRES	7.00	1,739.50	
CHEMMAX170	CHEMICALS	MAXIFLOW		9.00	LITRES		0.00
CHEMMOL170	CHEMICALS	MOLLYBOR		210.00	LITRES	6.00	1,260.00
CHEMNOV170	CHEMICALS	NOVA SUPERVAX		70.00	LITRES		0.00
CHEMORG170	CHEMICALS	ORGANOCELL		1,246.00	LITRES	7.00	8,722.00
CHEMORI17087	ORIUS	64.00		LITRES	23.40	1,497.60	
CHEMORT170	CHEMICALS	ORTIVA		7.00	LITRES	55.20	386.40
CHEMPOW170	CHEMICALS	POWER UP		181.75	LITRES	1.50	272.63
CHEMRUS170	CHEMICALS	RUSH		950.00	LITRES	8.50	8,075.00
CHEMTRO170	CHEMICALS	TRONIC		300.00	LITRES	5.00	1,500.00
CHEMTRY170	CHEMICALS	TRYCOCIDE		1.00	LITRES		0.00
CHEMTWI17094	TWIN N	0.19		KG	4,000.00	744.00	
CHEMNOV171	CHEMICALS	NOVATRYN		155.00	LITRES		0.00
CHEMLEA17095	LEAF GRIP	200.00		LITRES	0.00		
CHEMMET170	CHEMICALS	METRIBUZINE		190.00	LITRES	15.82	3,005.80
CHEMATS17097	ATS MOZICON	30.13		KG	60.00	1,807.50	
CHEMSUP170	CHEMICALS	SUPA KILL BLOCK		22.30	KG		0.00
CHEMHAM171	CHEMICALS	HAMMER		28.50	LITRES	28.50	812.25
CHEMTRI1710	CHEMICALS	TRIOSPRAY-FLO		400.00	LITRES		0.00
CHEMECO171	CHEMICALS	ECOT		331.50	KG	120.00	39,780.00
CHEMATS17105	ATS METHOMYL 900SP	KG	586.54	KG	23.40	13,725.04	
CHEMCHL171	CHEMICALS	CHLOREMEQUAT	LTRS	4,760.30	LITRES	5.50	26,181.65

CHEMSPO171	CHEMICALS	SPOOR & BOOR		20.00	LITRES	8.00	160.00
CHEMNOV171	CHEMICALS	NOVAZOLE		37.50	LITRES	25.00	937.50
CHEMLAM171	CHEMICALS	LAMBDA	(KARATE)	503.76	LITRES	9.00	4,533.84
CHEMPAN171	CHEMICALS	PANTELA		15.00	LITRES	18.00	270.00
CHEMABA171	CHEMICALS	ABACUS		143.50	LITRES	29.58	4,244.73
CHEMSIL1711	CHEMICALS	SILWET		2.00	LITRES	45.00	90.00
SIGNED AND VERIFIED BY		STOREMAN					
		SIGNATURE					

Stock Report

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Code:	Category	Group	Description	Quantity in Stock	Unit	Unit cost	Value
CHEMMAM171	CHEMICALS	MAMBA MAX 480L	(round up)	2,107.50	LITRES	7.25	15,279.38
CHEMAQU171	CHEMICALS	AQUARITE		200.00	EACH	4.50	900.00
CHEMDEF171	CHEMICALS	DEFT 200WDG	15G	1,588.00	EACH	4.08	6,479.04
CHEMAPR171	CHEMICALS	APRON STAR	42WS	9.28	KG	163.00	1,512.64
CHEMVIN17123	CHEMICALS	VINKING (GLYPHOSTE 480)		803.60	LITRES	8.00	6,428.80
CHEMFRO171	CHEMICALS	FRONTIER		42.00	LITRES	25.00	1,050.00
CHEMPUN171	CHEMICALS	PUNCH XTRA		160.70	LITRES	26.00	4,178.20
CHEMDIF17126	CHEMICALS	DIFENOCANAZOLE		64.50	LITRES	34.00	2,193.00
CHEMFLI1713	CHEMICALS	FLINT		1.50	KG	94.50	141.75
CHEMEXT17132	EXTREME	1.18		KG	120.00	142.08	
CHEMIMA17131	IMAZETHAPYR	38.00		LITRES	30.00	1,140.00	
CHEMCAR171	CHEMICALS	CARBOXIN/THIRAM		720.00	LITRES	11.00	7,920.00
CHEMPOL171	CHEMICALS	POLYTRIN C440 EC	INSECTICIDE	496.00	LITRES	15.39	7,633.44
Total Value			US$ 6,141.51				

Annex.3 Location of water sampling point

NAME	ELEVATION	S°	E°
1. Kanyuma Camp	1183m	13.67969	027.76766
2. Kabasha lodge (Mgt)	1209m	13.68431	027.81239
3. Tap compound	1186m	13.67633	027.75917
4. Musoshi Clinic	1172m	13.63295	027.71799
5. Musoshi River Bridge	1164m	13.62097	027.73163
6. Field 6B	1184	13.65379	0.27.74522
7. Munsoshi Compound	1162m	13.63162	0.27.70553
8. Impumbu School	1177m	13.64915	027.75901
9. Workshop compound	1183m	13.63301	027.74971
10. Kalimba guest house 1	1181m	13.67770	027.74526
11. Kalimba guest house 2	1173m	13.67859	027.74205

Annex 4: Water Quality Results

REPUBLIC OF ZAMBIA

DEPARTMENT OF WATER AFFAIRS

RESULTS OF WATER QUALITY ANALYSIS

Site Name: Kalimba Guest 1			
District: **Mpongwe**			
Location : Somawhe			
Province: **Copperbelt**			
Date of Analysis: **07/05/2012**			
DESCRIPTION		**RESULTS**	**WHO STANDARD**
Potassium	mg/L	1.3	-
Sodium	mg/L	2.1	200
Magnesium	mg/L	9.72	-
Calcium	mg/L	8.8	200
Alkaline	mg/L	0.33	500
Manganese	mg/L	<0.1	0.50
Total Hardness	mg/L	62	500
Zn	mg/L	0.2	5.0
Iron	mg/L	0.1	0.30
Lead	mg/L	0.02	0.005
Nitrates	mg/L	0.2	10.0
Chlorides	mg/L	16.5	250
Sulphates	mg/L	0.45	250
T.D.S	mg/L	60	400
Ph		5.70	6.5- 8.5
Eh	mV	26.8	

Conductivity	µS/cm	120	3000
Temperature	°C		-
Faecal Coli forms	#		0

REPUBLIC OF ZAMBIA

DEPARTMENT OF WATER AFFAIRS

RESULTS OF WATER QUALITY ANALYSIS

Site Name: Kalasha Lodge (BH2)		
District: **Mpongwe**		
Location : Somawh e		
Province: **COPPERBELT**		
Date of Analysis: **07/05/2012**		
DESCRIPTION	**RESULTS**	**WHO STANDARD**
Potassium mg/L	1.1	-
Sodium mg/L	1.3	200
Magnesium mg/L	48.1	-
Calcium mg/L	47.2	200
Alkalinity mg/L	1.67	500
Manganese mg/L	1.2	0.50
Total Hardness mg/L	316	500
Zinc mg/L	<0.1	5.0
Iron mg/L	<0.1	0.30
Lead mg/L	0.02	0.005
Nitrates mg/L	<1	10.0
Chlorides mg/L	11.5	250

Sulphates	mg/L	0.15	250
T.D.S	mg/L	230	400
pH		7.2	6.5- 8.5
Eh	mV	-58.5	
Conductivity	µS/cm	470	3000
Temperature	°C		-
Faecal Coli forms	#		0

REPUBLIC OF ZAMBIA

DEPARTMENT OF WATER AFFAIRS

RESULTS OF WATER QUALITY ANALYSIS

Site Name: Musoshi River @ Bridge			
District:	**Mpongwe**		
Location : Somawhe			
Province:	**COPPERBELT PROVINCE**		
Date of Analysis:	**07/05/2012**		
DESCRIPTION		**RESULTS**	**WHO STANDARD**
Potassium	mg/L	0.1	-
Sodium	mg/L	2.8	200
Magnesium	mg/L	7.10	-
Calcium	mg/L	8.8	200
Alkalinity	mg/L	0.13	500
Manganese	mg/L	<0.1	0.50
Total Hardness	mg/L	51.2	500
Zn	mg/L	<0.1	5.0

Iron	mg/L	<0.1	0.30
Lead	mg/L	0.02	0.005
Nitrates	mg/L	<1	10.0
Chlorides	mg/L	17.0	250
Sulphates	mg/L	0.65	250
T.D.S	mg/L	50	400
Ph		6.0	6.5- 8.5
Eh	mV	-89.4	
Conductivity	µS/cm	110	3000
Temperature	°C		-
Faecal Coli forms	#		0

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DEPARTMENT OF WATER AFFAIRS

RESULTS OF WATER QUALITY ANALYSIS

Site Name: Musoshi Clinic (BH5)			
District:	**Mpongwe**		
Location : Somawhe			
Province:	**COPPERBELT**		
Date of Analysis:	**07/05/2012**		
DESCRIPTION		**RESULTS**	**WHO STANDARD**
Potassium	mg/L	4.2	-
Sodium	mg/L	4.0	200
Magnesium	mg/L	6.32	-
Calcium	mg/L	11.2	200

Alkalinity	mg/L	0.15	500
Manganese	mg/L	<0.1	0.50
Total Hardness	mg/L	54	500
Zn	mg/L	<0.1	5.0
Iron	mg/L	0.2	0.30
Lead	mg/L	0.02	0.005
Nitrates	mg/L	0.21	10.0
Chlorides	mg/L	18.0	250
Sulphates	mg/L	0.8	250
T.D.S	mg/L	50	400
Ph		6.8	6.5- 8.5
Eh	mV	-75.9	
Conductivity	µS/cm	100	3000
Temperature	°C		-
Faecal Coli forms	#		0

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DEPARTMENT OF WATER AFFAIRS

RESULTS OF WATER QUALITY ANALYSIS

Site Name: Kalimba Guest House(BH)
District: Mpongwe
Location : Somawhe
Province: Copperbelt
Date of Analysis: 07/05/2012

DESCRIPTION		RESULTS	WHO STANDARD
Potassium	mg/L	1.8	-
Sodium	mg/L	1.6	200
Magnesium	mg/L	11.18	-
Calcium	mg/L	8	200
Alkalinity	mg/L	0.02	500
Manganese	mg/L	<0.1	0.50
Total Hardness	mg/L	66	500
Zn	mg/L	<0.1	5.0
Iron	mg/L	<0.1	0.30
Lead	mg/L	0.02	0.005
Nitrates	mg/L	0.23	10.0
Chlorides	mg/L	11.5	250
Sulphates	mg/L	0.5	250
T.D.S	mg/L	60	400
pH		5.7	6.5- 8.5
Eh	mV	-31.1	
Conductivity	µS/cm	130	3000
Temperature	°C		-
Faecal Coli forms	#		0

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DEPARTMENT OF WATER AFFAIRS

RESULTS OF WATER QUALITY ANALYSIS

Site Name: Tap Comp (BH3)

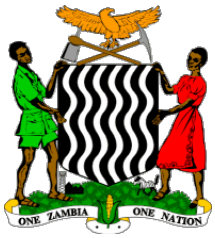
District: **Mpongwe**		
Location : Somawhe		
Province: Copperbelt		
Date of Analysis: **07/05/2012**		
DESCRIPTION	**RESULTS**	**WHO STANDARD**
Potassium mg/L	0.8	-
Sodium mg/L	3.6	200
Magnesium mg/L	8.26	-
Calcium mg/L	28.0	200
Alkalinity mg/L	0.42	500
Manganese mg/L	<0.1	0.50
Total Hardness mg/L	104	500
Zn mg/L	0.3	5.0
Iron mg/L	<1	0.30
Lead mg/L	<0.1	0.005
Nitrates mg/L	<1	10.0
Chlorides mg/L	16.0	250
Sulphates mg/L	0.85	250
T.D.S mg/L	80	400
pH	6.6	6.5- 8.5
Eh mV	-9.9	
Conductivity µS/cm	180	3000
Temperature °C		-
Faecal Coli forms #		0

REPUBLIC OF ZAMBIA

DEPARTMENT OF WATER AFFAIRS

RESULTS OF WATER QUALITY ANALYSIS

Site Name: Kanyuma Comp (BH1)			
District:	**Mpongwe**		
Location : Somawhe			
Province:	**Copperbelt**		
Date of Analysis:	**07/05/2012**		
DESCRIPTION		**RESULTS**	**WHO STANDARD**
Potassium	mg/L	1.7	-
Sodium	mg/L	3.1	200
Magnesium	mg/L	18.0	-
Calcium	mg/L	16.0	200
Alkalinity	mg/L	0.31	500
Manganese	mg/L	<0.1	0.50
Total Hardness	mg/L	90	500
Zn	mg/L	<0.1	5.0
Iron	mg/L	<1	0.30
Lead	mg/L	<0.1	0.005
Nitrates	mg/L	0.47	10.0
Chlorides	mg/L	13.5	250
Sulphates	mg/L	<1	250
T.D.S	mg/L	90	400
pH		6.8	6.5- 8.5
Eh	mV	-12.1	
Conductivity	µS/cm	200	3000
Temperature	°C		-
Faecal Coli forms	#		0



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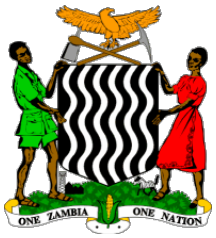
DEPARTMENT OF WATER AFFAIRS

RESULTS OF WATER QUALITY ANALYSIS

Site Name: Musoshi Comp (BH)		
District: **Mpongwe**		
Location : Somawhe		
Province: **Copperbelt**		
Date of Analysis: **07/05/2012**		
DESCRIPTION	**RESULTS**	**WHO STANDARD**
Potassium mg/L	1.2	-
Sodium mg/L	1.6	200
Magnesium mg/L	1.46	-
Calcium mg/L	13.6	200
Alkalinity mg/L	0.31	500
Manganese mg/L	<0.1	0.50
Total Hardness mg/L	40	500
Zn mg/L	<0.1	5.0
Iron mg/L	<1	0.30
Lead mg/L	0.01	0.005
Nitrates mg/L	<1	10.0
Chlorides mg/L	17.5	250
Sulphates mg/L	1.45	250
T.D.S mg/L	20	400
pH	5.6	6.5- 8.5
Eh mV	22.7	

Conductivity	µS/cm	50	3000
Temperature	°C		-
Faecal Coli forms	#		0



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DEPARTMENT OF WATER AFFAIRS

RESULTS OF WATER QUALITY ANALYSIS

Site Name: Impumbu River Downstream			
District: **Mpongwe**			
Location : Somawhe			
Province: **Copperbelt**			
Date of Analysis: **07/05/2012**			
DESCRIPTION		**RESULTS**	**WHO STANDARD**
Potassium	mg/L	0.5	-
Sodium	mg/L	2.0	200
Magnesium	mg/L	30.62	-
Calcium	mg/L	23.2	200
Alkalinity	mg/L	1.11	500
Manganese	mg/L	<0.1	0.50

Total Hardness	mg/L	184	500
Zn	mg/L	<0.1	5.0
Iron	mg/L	<1	0.30
Lead	mg/L	0.01	0.005
Nitrates	mg/L	<1	10.0
Chlorides	mg/L	7.5	250
Sulphates	mg/L	1.95	250
T.D.S	mg/L	160	400
pH		7.6	6.5- 8.5
Eh	mV	-38.1	
Conductivity	µS/cm	340	3000
Temperature	°C		-
Faecal Coli forms	#		0

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DEPARTMENT OF WATER AFFAIRS

RESULTS OF WATER QUALITY ANALYSIS

Site Name: Workshop Comp (BH)
District: Mpongwe
Location : Somawhe
Province: Copperbelt
Date of Analysis: 07/05/2012

DESCRIPTION		RESULTS	WHO STANDARD
Potassium	mg/L	2.1	-
Sodium	mg/L	6.6	200
Magnesium	mg/L	8.75	-
Calcium	mg/L	22.4	200
Alkalinity	mg/L	0.33	500
Manganese	mg/L	<0.1	0.50
Total Hardness	mg/L	92	500
Zn	mg/L	0.2	5.0
Iron	mg/L	<1	0.30
Lead	mg/L	<0.1	0.005
Nitrates	mg/L	<1	10.0
Chlorides	mg/L	20.0	250
Sulphates	mg/L	0.9	250
T.D.S	mg/L	90	400
pH		6.3	6.5- 8.5
Eh	mV	5.3	
Conductivity	µS/cm	180	3000
Temperature	°C		-
Faecal Coli forms	#		0

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DEPARTMENT OF WATER AFFAIRS

RESULTS OF WATER QUALITY ANALYSIS

Site Name: Workshop (BH4)		
District: **Mpongwe**		
Location : Somawhe		
Province: **Copperbelt**		
Date of Analysis: **07/05/2012**		
DESCRIPTION	**RESULTS**	**WHO STANDARD**
Sulphates mg/L		250
T.D.S mg/L	100	400
pH	6.1	6.5- 8.5
Eh mV	35.5	
Conductivity µS/cm	220	3000

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DEPARTMENT OF WATER AFFAIRS

RESULTS OF WATER QUALITY ANALYSIS

Site Name: Impumbu School (BH)		
District: **Mpongwe**		
Location : Somawhe		
Province: **Copperbelt**		
Date of Analysis: **07/05/2012**		
DESCRIPTION	**RESULTS**	**WHO STANDARD**
T.D.S mg/L	90	400
pH	6.1	6.5- 8.5

Eh	mV	40.1	
Conductivity	µS/cm	200	3000

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DEPARTMENT OF WATER AFFAIRS

RESULTS OF WATER QUALITY ANALYSIS

Site Name: Field 6B (BH)			
District: **Mpongwe**			
Location : Somawhe			
Province: **Copperbelt**			
Date of Analysis: **07/05/2012**			
DESCRIPTION		**RESULTS**	**WHO STANDARD**
T.D.S	mg/L	50	400
pH		5.9	6.5- 8.5
Eh	mV	43.0	
Conductivity	µS/cm	120	3000

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DEPARTMENT OF WATER AFFAIRS

RESULTS OF WATER QUALITY ANALYSIS

Site Name: Canal Water PT 1		
District: Mpongwe		
Location : Somawhe		
Province: Copperbelt		
Date of Analysis: 07/05/2012		
DESCRIPTION	**RESULTS**	**WHO STANDARD**
T.D.S mg/L	180	400
Ph	8.1	6.5- 8.5
Eh mV	-80.9	
Conductivity µS/cm	380	3000

Annex 5 : GPS Points for flora sample plots taken

WAY POINTS	PLOT NO.	LATITUDE	LONGITUDE	COMMENT
67	1	8487400	587858	Near Directors lodge
70	2	8486927	587941	
72	3	8487904	586529	within abandoned settlement area
80	4	8493228	584973	
82	5	8487505	582682	
83	6	8486859	582212	
87	7	8486999	582359	
88	8	8487958	583396	
89	9	8487865	583081	
90	10	8492627	581302	
91	11	8492722	581342	
93	12	8493207	576326	
97	13	8494240	575701	
105	14	8488520	581668	No under-growth.
108	15	8487855	578486	
110	16	8491354	582211	
111	17	8491993	584370	
112	18	8492623	582521	
Camp F	19	8488053	580389	

Annex 6: Main Plot Data Collection Form

TREE PARAMETERS DATA FORM						*FORM A*
Altitude……	**Plot No……..**	**Date……**		**Quadrant No……**		**Plot Size……..**
Centre of Plot (GPS Reading UTM) N…….. E……		**Vegetation Type……**				
Recorder……						
SPECIES (TREE ≥ 5CM)	**HEIGHT (M)**	**DBH (CM)**	**CROWN SIZE** a Width	b Length	**STEM HT (M)**	**NOTES****

** Indicate any noticeable
damage, crookedness, fungal attack
browsing signs, form, fire occurrence etc.

Plant Species Identification Codes:

√ ? -- Genus identified, species uncertain; (Write GENUS name and ?)

+ / - -- Identification not sure; (Write SUSPECTED NAME and + / -)

?? – Plant not identified (Write: SPP, Id No. and Plot No.)

Annex 7: Regeneration Plot Data Collection Form

TREE REGENERATION DATA FORM				*FORM B*
Altitude……	**Plot No……..**	**Date……**	**Quadrant No……**	**Plot Size……..**
Centre of Plot (GPS Reading UTM) N…….. E……		**Vegetation Type…….**		
Recorder……..				

SPECIES	COUNT	NOTES**

** Indicate any noticeable
damage, crookedness, fungal attack
browsing signs, form, fire occurrence etc.

Plant Species Identification Codes:

√ ? -- Genus identified, species uncertai + / - -- Identification not sure; ?? – Plant not identified
(Write GENUS name and ?) (Write SUSPECTED NAME an (Write: SPP, Id No. and Plot No.)

Appendix 8: Fauna Data Collection form

Mammals

	Species		No. Seen		Signs - write details	Other faunal species
1						
2						**Reptiles**
3						
4						
5						
6						
7						
8						
9						
10						
12						
13						
14						**Amphibians**
15						

Birds

	Species		No. Seen		Signs - write details	
1						
2						
3						
4						
5						
6						
7						**Invertebrates**
8						
9						
10						
12						
13						
14						
15						

Fire occurrence

☐ Recent

☐ Old

Notes

Annex 9: Indicators for various species within the farm area

Species	Stems	RF (%)	RD (%)	RBA (%)	Stems/Ha
Acacia albida	1	6.3	0.2	0.2	25
Acacia polyacantha	5	6.3	1.2	0.1	125
Albizia Amara	1	6.3	0.2	0.1	25
Albezia Andianthifollia	1	6.3	0.2	0.0	25
Albizia antunesiana	4	18.8	1.0	0.2	100
Albizia Versicolor	5	18.8	1.2	1.3	125
Anisophyllea boehmii	13	37.5	3.2	1.4	325
Baphia bequaertii	4	18.8	1.0	0.4	100
Brachystegia boehmii	52	50.0	12.7	22.0	1300
Brachystegia longifolia	15	25.0	3.7	5.8	375
Brachystegia speciformis	19	18.8	4.6	5.2	475
Combretum molle	1	6.3	0.2	0.1	25
Dalbergia nitidula	1	6.3	0.2	0.1	25
Diospyros batocana	21	37.5	5.1	2.2	525
Diplorhynchus condylocarpon	22	25.0	5.4	2.5	550
Erythrophleum africanum	9	25.0	2.2	2.1	225
Hymenocardia acida	2	6.3	0.5	0.1	50
Isoberlinia angolensis	28	56.3	6.8	10.1	700
Julbernardia paniculata	93	100.0	22.7	32.1	2325
Lannea discolor	12	6.3	2.9	1.5	300
Marquesia macroura	1	6.3	0.2	0.1	25
Monotes africanus	5	25.0	1.2	0.4	125
Olax obtusifolia	1	6.3	0.2	0.0	25
Orchna pulchra	3	18.8	0.7	0.2	75
Parinari curatellifolia	9	31.3	2.2	3.4	225
Pericopsis angolensis	6	18.8	1.5	1.4	150
Protea angolensis	7	31.3	1.7	0.3	175
Pseudolachnostylis maprouneifolia	21	62.5	5.1	3.2	525
Pterocarpus angolensis	4	25.0	1.0	0.3	100
Rothmannia englerana	1	6.3	0.2	0.1	25
Swartzia madagascariensis	15	25.0	3.7	1.4	375
Syzygium guineense	1	6.3	0.2	0.1	25
Syzyguim cordatum	2	12.5	0.5	0.4	50
Uapaca kirkiana	19	25.0	4.6	0.9	475
Uapaca nitida	1	6.3	0.2	0.1	25
Uapaca sansibarica	1	6.3	0.2	0.1	25
Vitex doniana	3	6.3	0.7	0.2	75
Zanha africana	1	6.3	0.2	0.1	25

Annex 10: Indicators for various species within the farm area

No	Scientific name	Common name
1	*Kobus leche smithemani*	Black Lechwe
2	*Kobus leche kafuensis*	Kafue Lechwe
3	*Connochaetes taurinus cooksoni*	Cookson's Wildebeest
4	*Giraffa camelopardalis thornicrofti*	Thornicroft's Giraffe
5	*Mus neavei*	Pygymy mouse

Threatened species of mammals found in Zambia are listed below:

No	Scientific name	Common name
1	*Diceros bicornis*	Black Rhinoceros
2	*Loxodonta African*	African Elephant
3	*Lycaon pictus*	Wild Dog
4	*Hippotragus equinus*	Roan Antelope
5	*Kobus leche kafuensis*	Kafue Lechwe
6	*Kobus leche smithemani*	Black Lechwe
7	*Alcelaphus lichtensteini*	Lichtenstein's Hartebeest
8	*Plerotes anchietae*	Broad Faced Fruit Bat
9	*Crocidura ansellorum*	Pygmy Shrew
10	*Rhynchocyon cirnei*	Checkered Elephant Shrew
11	*Mus neavei*	Pygmy Mouse
12	*Beamys majer*	Greater Hamster Rat

Annex 11: List of birds observed in the Farm area

No	Scientific name	Common name
1.	*Coracias caudatus*	Lilac-breasted Roller
2.	*Bucorvus leadbeateri*	Southern Ground Hornbill
3.	*Lybius torquatus*	Black-collard Barbet
4.	*Pogoniulus chrysoconus*	Yellow-fronted Tinkerbird
5.	*Dendropicos namaquus*	Bearded Woodpecker
6.	*Mirafra rufocinnamomea*	Flappet Lark
7.	*Hirundo rustica*	European Swallow
8.	*Oriolus larvatus*	Black-headed Oriole
9.	*Corvus albus*	Pied Crow
10.	*Turdoides jardineii*	Arrow-marked Babbler
11.	*Phyllastrephus terrestris*	Terrestrial Brownbul
12.	*Cossypha heuglini*	Heuglin's Robin-Chat
13.	*Sylvia borin*	Garden Warbler
14.	*Cisticola juncidis*	Zitting (Fan-tailed) Cisticola
15.	*Terpsiphone viridis*	African Paradise-Flycatcher
16.	*Lanius collaris*	Common Fiscal Shrike
17.	*Laniarius aethiopicus*	Tropical Boubou
18.	*Dryoscopus cubla*	Black-backed Puffback Shrike
19.	*Cinnyricinclus leucogaster*	Violet-Backed (Plum-coloured) Starling
20.	*Zosterops senegalensis*	African Yellow White-Eye
21.	*Cinnyris venustus*	Variable (Yellow-Bellied) Sunbird
22.	*Cinnyris talatala*	White-Bellied Sunbird
23.	*Cinnyris cupreus*	Copper (Coppery) Sunbird
24.	*Cinnyris manoensis*	Miombo Double-Collared Sunbird
25.	*Chalcomitra amethystina*	Amethyst (Black) Sunbird
26.	*Chalcomitra senegalensis*	Scarlet-Chested Sunbird
27.	*Anthreptes longuemarei*	Western Violet-Backed Sunbird
28.	*Ploceus bicolor*	Forest weaver
29.	*Ploceus cucullatus*	Village (Spotted-Backed) Weaver
30.	*Anaplectes melanotis*	Red-headed weaver
31.	*Ploceus velatus*	Masked Weaver

32.	*Centropus senegalensis*	Senegal Coucal
33.	*Quelea quelea*	Red-billed Quelea
34.	*Euplectes orix*	Southern Red-bishop
35.	*Euplectes afer*	Yellow-Crowned (Golden) bishop
36.	*Euplectes capensis*	Yellow Bishop (Cape/Yellow-Rumped widow)
37.	*Spermestes cucullata*	Bronze Mannikin
38.	*Uraeginthus angolensis*	Blue Waxbill
39.	*Estrilda astrild*	Common Waxbill
40.	*Vidua macroura*	Pin-tailed Whydah
41.	*Urocolius indicus*	Red-faced Mouse bird
42.	*Colius striatus*	Speckled Mousebird
43.	*Halcyon senegalensis*	Woodland Kingfisher
44.	*Halcyon albiventris*	Brown-headed Kingfisher
45.	*Halcyon chelicuti*	Striped kingfisher
46.	*Streptopelia decipiens*	African Mourning Dove
47.	*Pycnonotus tricolor*	Dark-Capped (Black- Eyed) Bulbul
48	*Streptopelia semitorquata*	Red-Eyed Dove
49.	*Streptopelia capicola*	Cape Turtle (Ring-Necked) Dove
50.	*Turtur chalcospilos*	Emerald-Spotted Wood-Dove
51.	*Oena capensis*	Namaqua Dove
52	*Treron calvus*	African Green Pigeon
53	*Bubulcus ibis*	Cattle Egret
54	*Poicephalus suahelicus*	Grey-Headed Parrot

Annex 12: Environmental Management Policies

SOCIAL AND ENVIRONMENTAL MANAGEMENT PROGRAMME *(To be Adopted from Chobe)*

1.0 Purpose

1.1 This procedure provides for the development of the social and environmental programmes required to achieve the objectives and targets, and provides for the process of developing action plans for those identified social and environmental programmes.

1.2 By preparing action plans, Somawhe can focus its efforts and resources on environmental and social programmes and areas of greatest impact and/or greatest concern to internal and/or external stakeholders.

2.0 Purpose

2.1 Action Plans are developed for environmental and social management programs that result from the commitments expressed by the Environmental Health and Safety (EHS) Policy.

2.2 Action plans and timing for these programmes are developed from those aspects that the EHS steering committee considers of highest priority based on the significance of impact to the environment and farming community, and the commitment to continual improvement.

3.0 Responsibility

3.1 The Farm Manager is responsible to coordinate the activities associated with the development of the Environmental and Social Programs.

3.2 The Management Committee under the auspices of the Executive Committee, is responsible to:

- Review the environmental and social aspects and their impacts as identified by the Environmental Impact Assessment (EIA) report conducted by an independent consultant.
- Review the legislative and other requirements
- In consultation with the farm managers set appropriate objectives and targets per the Management Action Plan (MAP), and assist with identifying programmes that support the objectives.
- Provide MAP for review and approval by the Executive Committee.
- Assist the farm managers to develop budgets for the approved MAP.

4.0 Procedure

4.1 The Executive Committee participates in consultation with the farm managers and assists the relevant levels and functions with the action plans for the environmental programs.

4.2 Additional programmes may result from the EIA which must also be addressed and recorded using MAP

4.3 The Farm managers at their monthly management meetings are responsible to develop and detail the required action plans, taking into consideration following project management items such as:

- An objective and measurable target
- Action items to be taken
- Responsibility for the project
- Start and target completion dates for action item
- The results expected to be achieved
- The identification of milestone/significant dates
- A time frame for regular planned progress reviews

5.0 Reviews of objectives and targets for environmental management programmes

5.1 Included on the agenda of the monthly farm management meeting is a detailed report on the status of the items identified in MAP.

5.2 This report is presented at the monthly Executive Committee meetings. The progress of each relevant level and function in achieving the objectives and targets are discussed and where risks are attached, the necessary mitigating steps are identified and actioned.

5.3 Should reviews indicate unsatisfactory progress, the Executive Committee directs the appropriate manager to

institute corrective and preventive action.

5.4 The appropriateness of environmental and social programs as a result of changing requirements, new environmental aspects, nonconforming incidents, emergency events, regulatory requirements, and corporate change.

6.0 Records

6.1 Action Plans and Action Plan updates are issued using MAP

7.0 Revisions

Revision	Date	Section	Paragraph	Summary of change	Authorised by
A				Initial issue	

Annex 13: Proposed Environmental, health and Safety Policy (*To be Adopted from Chobe*)

1.0 Purpose

1.1 Chobe Agrivision Company Limited (the Company) aims to apply the best international standards of practice in all aspects of its operations which relate to the health and safety of its employees at work and non-company personnel on company premises and the conservation of the physical environment and to give a high priority to these activities.

1.2 We will work closely with our contractors, the community, industry and the Environmental Council of Zambia to establish procedures by which our staff can make a positive contribution towards innovative and cost-effective environmental outcomes.

2.0 Scope

2.1 The Company is committed to:

- Providing and maintaining safe and healthy working environments including safe systems of work for all its employees and non-company personnel on company premises.
- Promote the open exchange of environmental information with our customers, suppliers and the community to improve environmental awareness and to obtain feedback on our environmental performance.
- Paying due regard to all impacts of its activities on the physical environment.
- Comply with all applicable national and international laws and regulations affecting our business activities.
- Establish procedures for assessing and reviewing the environmental, health and safety impacts of its present and future activities on a regular basis.
- Seek continually to identify pro-active and cost effective measures which it can take to safeguard the health and safety of its employees and non-company personnel on company premises, and, the physical environment.
- Promote waste minimisation and energy management within our day to day operations.

2.2 This is a commitment which the Company seeks to apply throughout its supply chain, from the application of high standards of agricultural practice in crop production and the specification and procurement of materials for its products to the recovery and disposal of waste materials and post-consumer packaging where this is appropriate.

2.3 The Company expects all its employees and non-employees on company premises to fulfil their part of these responsibilities by being alert at all times for any possible unsafe or unsatisfactory acts or situations and ensuring directly or through others that they are eliminated.

2.4 The Company has overall responsibility for environmental, health and safety management. Each operating and end-market company must appoint a director or top team executive manager with responsibility for environmental, health and safety management.

3.0 Procedure

3.1 The Environmental Management System (EMS), will set a clear policy direction for environmental issues and objectives

3.2 The establishment of a Conservation Activity Plan addressing the operations impact on the environment.

3.3 Legal compliance reviewed on a monthly basis at the Monthly Management meeting. (Create a schedule with all Acts impacting Chobe, and whether we in compliance)

3.4 Management review to evaluate the success of the EHS policies and identify and changes required.

3.5 The policy will be reviewed periodically by the Executive Management Committee (Exco).

4.0 Revisions

Revision	Date	Section	Paragraph	Summary of change	Authorised by
A				Initial issue	

Annex 14: Proposed Human Resources Policy and Procedure Manual

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Mission
HR Vision
Key Definitions

1. BROAD POLICY AREAS

a) Labour Relations
b) Employment Equity Policy
c) Training & Development
d) Chronic /Life Threatening Diseases
e) Sexual Harassment

2. RECRUITMENT & SELECTION POLICY

f) Recruitment & selection Policy
g) Job Specification
h) Application Forms
i) Interviewer Guidelines
j) Example of Regret Letter
k) Recruiting from Culturally Diverse Groups

3. EMPLOYMENT POLICY & PROCEDURE

a) Employment Policy
b) Requisition for new staff
c) Letter of Appointment – Salaried Staff
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a) Policy
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a) Annual Bonus
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e) Conflicts of Interest
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h) Injuries and diseases at work
i) Annual Leave
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k) Unpaid Leave
l) Maternity Leave
m) Sick Leave
n) Study Leave
o) Long Service Awards
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q) Medical Examination
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a) The Process and Performance Cycle
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9. THE COUNSELLING & DISCIPLINARY PROCEDURE

10. THE COUNSELLING PROCEDURE

a) The Procedure
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c) Counseling Forms

11. DISCIPLINARY PROCEDURE

a) The Procedure
b) Disciplinary Flowchart
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a) The Procedure
b) Model of Grievance Procedure
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13. RETRENCHMENT POLICY & PROCEDURE

14. SAFETY

a) Key Policy Issues
b) Safety Agreement

Annex: 15: Somawhe HIV/ AIDs Policy Draft Document

Somawbc HIV and /AIDS policy Draft J)ocument.

1.1 Introduction.

Globally th ere are about 38.6 m i llion people infected with th e Hu ma n I m muno-deficiency Virus (HIV), with more than two thirds of all infected people living in the sub Sahara Africa. Zambia is among the countries with the highest HIV prevalence .-atcs in the world. Out of a population of nearly 12.5 million, about 14.6% of adult population aged between 15 – 49 years is infected (state of the Nation on HIV and AIDS report – UNOAS 2006/7). women and girls being particularly more vulnerable.

It is evident that the epidemic is disproportionately increasing and causing death in the economically productive age groups of 15 -49 years and will continue to impact on all workplaces; as well as human and economic development in Zambia.

On business its effects are far reaching in that it results in:

Loss of skilled labour
Reduced production outputs
Increased production costs and
- Reduced profit margins....

Somawhe is an agro business enterprise, engaged in the production of Wheat, Soya. mai7e for both dom est ic and export con sumption . Its operation s largely arc labour intensive as such its greatest asset the human resource. In recognizing its need to be proactive in pro mot ing. safe guardin g and sustaining the health of its employees. Somawhe estates through th is pol icy seeks to reduce the social and economic consequences of 1-IIV by encouraging its employees and their families to adopt health life styles

Basing on key concepts and principles of fair labour practices of the *fLO code of pra ctice oıı HIV alld AIDS alld the world of work*, as well as the recommendation of the Ministry Labour and Social Security that all organis..tions in Zambia to adopt a code on *fi/V alld AIDS, as outlill ed ill the Emp loyment ill southern Afr ican development community (SADC)* and in line with the *Natiollal H/ V/A/DS/ST/s/TB Policy;*

1.1 Aim

I he aim of this pol icy is to provide a frame work to plan, implement, monitor & evaluate the impact of its various 1-IIV and AIDS interventions and effects over time.

1.2 Go:al

The goal of this pol icy is to promote and sustain health, safe workin g environment and practices among its workforce, and to mitigate the socio-economic impact of IIIV on employees and their families.

Annex 16: Check list for the Ecological Assessment

CHECKLIST USED FOR THE ECOLOGICAL ASSESSMENT

1. Fauna and Avifauna status of the area
    a. Animals present within the farm area (some were identified)
    b. What is the company's management strategy for the animals present within the farm boundary?
    c. What measures has the company put in place to protect, monitor and manage the wildlife within the farm area?
    d. What types of birds are present within the farm area?
    e. What is the company doing to protect the birds?

2. Flora status of the area
    a. List of the tree species introduced on the farm (non native)
    b. What is the company's management strategy for the vegetation (natural and exotic vegetation) present within the farm boundary?
    c. What measures has the company put in place to protect, monitor and manage the wildlife within the farm area?

3. Weather Data (From January 1998-April 2012
    a. Monthly Reports
    b. Summaries
    *(rainfall, humidity, evaporation, Air temperature, soil temperature and wind speed

4. Historical data on soil and water

5. Maps
    a. Detailed land use map – *soft copy* (showing the sizes in hectares of each Landuse type within the farm area)
    b. Map of the farm in relation to other surrounding areas or neighbors – *soft copy* (location map)
6. People responsible for environmental management within the organization
    a. Who is responsible for environmental management within the organization
    b. What are their roles and duties?
    c. Do you have an environmental section within the company?
    d. Do they do regular monitoring of weather, water, soil fauna and vegetation?
    e. How is the data used by the company?

7. Community involvement in natural resource management
    a. Are members of the community involved in the management of the environment
    b. Does that company conduct environmental awareness activities within the surrounding communities?
    c. Are there structures that have been formed within the communities so as to management the environment especially the rivers/stream systems?

8. Environmental threats
    a. Do you have any environmental threats you foresee in the near future that may impact on your operations?
    b. If the threats exist, identify and rank them according to their significance (start with the most significant)

Annex 17: Progressive Increase in Land Usage at Somawhe

	2000	2001	2002	2003	2004	2005	2006	2007			2008			2009			2010			2011		
Field	T/ha	T/ha	T/ha	T/ha	T/ha	T/ha	T/ha	HA	T	T/ha	HA	T	T/ha	HA	T	T/ha	HA	T	T/ha	HA	T	T/ha
1A	7.2		5.8	7.1	5.3	6.2	5.3	108	687	6.4	50	325	6.5	70	474	6.8	72	577	8,013	72	645.31	8.96
1B	7.7		6.1	7.2	6.3	7.3	4.6	108	648	6	70	454	6.5	35	226	6.5	72	585	8.13	72	644.62	8.95
1C									0		70	473	6.8	70	513	7.3	72	449	6.241	72	613.81	8.53
2A	7.7	8.2	7.1	8.2	4.4	7.3	4.7	106	817	7.7	106	845	7.9	106	795	7.5	106	806	7.599	106	868.74	8.2
2B	7.8	7.8	7.2	8.1	4.5	7.9	4.2	106	830	7.8	76	698	9.2	76	676	8.9	76	565	7.429	106	898.54	8.48
3A	6.5	8.1	7.6	6.9	6.5	7.7	6	84	660	7.9	84	645	7.7	84	696	8.3	83	652	7.861	83	712.97	8.59
3B		7.65	6	6.9	6	5.9	5.5	99	657	6.7	85	578	6.8	90	584	6.5	90	602	6.684	99	736.67	7.44
4A		7.4	7	7.7	6.6	6.9	6.8	100	701	7	85	665	7.8	90	696	7.7	90	786	8.732	100	835.97	8.36
4B	7.4	7.1	6.9	7.1	6	7.1	6.5	99	535	5.4	84	665	8	96	670	7	100	766	7.658	99	724.95	7.32
5A	7.9	7.7	7.1	5.5	6.6	7.6	6.4	98	535	5.5	85	637	7.5	98	777	7.9	90	632	7,018	98	856.18	8.74
5B	7.4	7.3	6.7	6.9	6.5	7	6	99	519	5.3	85	643	7.6	100	766	7.7	90	518	5.751	100	833.1	8.33
5C	7.4	7	5.2	5.1	6.3	7.9	4.1		0		85	627	7.4	80	405	5.1	80	593	7409	99	713.13	7.2
6A	7.7	7	6.8	8.3	4.7	5.2	5	100	701	7	85	714	8.4	90	611	6.8	90	694	7.715	90	716.04	7.96
6B	7.5		7.5	6.9	5.6	6.2	7.8	100	745	7.5	100	860	8.6	100	817	8.2	90	591	6.561	58	428.64	7.39
6C	7.3	7	6.8	8.5	3.4	7	7	58	434	7.5	58	430	7.4	58	454	7.8	58	467	8.054	55	493.85	8.98
6D	7.1	8.4	6.1	8	4.6	7.3	7.3	55	436	7.9	55	419	7.6	55	434	7.9	55	542	9.863	43	296.57	6.9
6E																				50	373.01	7.46
7A	7.6	8.3	7.5		5.5	7.3	6.4	100	692	6.9	85	617	7.3	100	759	7.6	90	736	8.179	100	770.35	7.7
7B	7		6.9	8.3	3.7	7.4	7	91	648	7.1	82	548	6.7	90	458	5.1	80	477	5,959	98	732.6	7.48
8A	7.6	7.1	7.8	5.2	5.5	7.5	7	101	844	8.4	85	621	7.3	90	736	8.2	80	500	6.245	80	592.01	7.4
8B	7.7	6.1	5.7	7	6.4	7.5	7.3	100	714	7.2	85	632	7.4	90	696	7.7	90	759	8.429	100	832.48	8.32
9A				6.2	4.9	6.9	6.4	122	938	7.7	122	960	7.9	120	910	7.6	120	944	7.9	120	863.17	7.19
9B	6.1	8.4		7.8	4.2	6.7	5	122	769	6.3	85	637	7.5	85	761	9	90	703	7.811	100	679.16	6.79
9C	8			8.4	4.8	6.1	3.7	120	829	6.9	85	579	6.8	85	531	6.3	90	698	7.755	100	876.01	8.76
10	6.9			7.2	5.6	6	6.5	100	650	6.5	100	837	8.4	90	535	5.9	90	726	8.068	100	837.61	8.38
11A	7.3	7.5	6.5	7.9	5.6	3.5	6.2	107	681	6.4	107	874	8.2	107	800	7.5	106	787	7.424	106	762.29	7.19
11B	7.2	7.5	6.6	7.4	6.1	3.5	6.5	107	649	6.1	76	683	9	76	616	8.1	76	578	7.604	86	643.21	7.48
12	7.5	7.9		6.7	5.5	4.5	7.1	116	639	5.5	85	664	7.8	85	610	7.2	90	540	6.001	100	577.28	5.77
TOTAL								**2505**	**16,958**	**6.8**	**2259**	**17,329**	**7.7**	**2,316**	**17,006**	**7.3**	**2,316**	**17,271**	**7.5**	**2,492**	**19,558**	**7.85**
Average	**7.4**	**7.5**	**6.7**	**7.2**	**5.4**	**6.6**	**6**	**6.8**	**7.7**	**7.3**	**7.5**											

Annex 18: Laboratory Test Results for Pesticides

ZAMBIA BUREAU OF STANDARDS

(Established by an Act of Parliament)
ALL CORRESPONDENCE TO BE ADDRESSED TO THE DIRECTOR

Attn: Mr. Kenneth Nyundu

Date Reported: 18.05.2012
Report No. 2012/05/TL 5009

Type of Samples: Water Sample
Date Submitted: 07.05.2012
Date Tested: 07-18.05.2012

LABORATORY TEST REPORT

Table 1

CUSTOMER'S SAMPLE ID			Water 11		Water 12	
LABORATORY'S SAMPLE ID			TL 5009/1		TL 5009/2	
SAMPLE DESCRIPTION			Water		Water	
PARAMETER	UNITS	SPECIFICATION ZS 190:1990	TEST RESULTS	COMPLIANCE TO SPECIFICATION	TEST RESULTS	COMPLIANCE TO SPECIFICATION
DDT	ppb	1000 max	Not detected	Satisfactory	0.0002	Satisfactory
Aldrin	ppb	30 max	Not detected	Satisfactory	0.0008	Satisfactory
Chlordane	ppb	300 max	Not detected	Satisfactory	Not detected	Satisfactory
Glyphosate	ppb	-	Not detected	Satisfactory	Not detected	Satisfactory

Table 2

CUSTOMER'S SAMPLE ID			Water 13		Water 14	
LABORATORY'S SAMPLE ID			TL 5009/3		TL 5009/4	
SAMPLE DESCRIPTION			Water		Water	
PARAMETER	UNITS	SPECIFICATION ZS 190:1990	TEST RESULTS	COMPLIANCE TO SPECIFICATION	TEST RESULTS	COMPLIANCE TO SPECIFICATION
DDT	ppb	1000 max	Not detected	Satisfactory	0.0005	Satisfactory
Aldrin	ppb	30 max	Not detected	Satisfactory	Not detected	Satisfactory
Chlordane	ppb	300 max	Not detected	Satisfactory	Not detected	Satisfactory
Glyphosate	ppb	-	Not detected	Satisfactory	Not detected	Satisfactory

Comment: **The results were interpreted in accordance with** *ZS190:1990, the Zambian standard for Drinking Water Quality.*

COMPILED BY: Andrew M. Basil Signed: .....

APPROVED BY: Laboratories Manager Signed: .....

ZAMBIA BUREAU OF STANDARDS
13 MAY 2012
TEST
P.O. BOX 50259, LUSAKA

Disclaimer: The above results only relate to the sample(s) tested. This report shall not be reproduced without the written permission of the Laboratories Manager- ZABS, and if transmitted electronically, will only be valid when supported by the original document.

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Annex 19: Minutes of meetings with stakeholders

1. Minutes for the Meeting with Chief Mwinuna

The meeting with Chief Mwinuna was organized by the village headman Musonda of Kasambanyambi village. This meeting took place at Chief Mwinuna's palace on the 3rd of May. Present at the meeting was the Chief Mwinuna himself, his Ngambelas (advisors), Village headman Mr. Musonda and his immediate councilors and the Socio- economic consultant.

After self- introduction by the study team, the Chief welcome everyone to the palace. He then gave audience to the study team. The study team briefed the Chief of their mission and their observations during their study period. The team further briefed the Chief the outcome of their interactions with the community and their concerns. These included concerns from communities in Kasambanyambi over the issue of not being allowed by Somawhe management to access the entire dam for fishing. Further the issue of not being allowed to cut trees within Somawhe. The villages were also concern of the restriction over passing through Somawhe premises to cross over to the villages across Impumbu stream.

The Village headman Mr. Musonda and his entourage reaffirmed the concerns outlined by the study team as being true. The headman then requested the chief to comment on the lamentations by the local communities.

The Chief made his stand very clear by reminding the Headman and his entourage that people should understand that Somawhe was a private property under Title and people in the surrounding had no right to encroach the land that belonged to Somawhe. He expressed his displeasure over the manner in which the Headman were handling the issue and called upon them to work together with Somawhe in order to bring further development in the area.

Regarding fishing, the Chief expressed concern that most people were engaged in i n appropriate fishing methods such as using mosquito nets and as such he pointed out that Somawhe had a right to stop such people from fishing to avoid depletion of fish spices.

Regarding cutting of trees, the Chief reminded said that the trees need to be preserved and not cut indiscriminately. He gave an example of the other side of the village where trees have all been cut for charcoal burning and the resulting consequences. The Chief also bemoaned the poor sanitation and water supplies in his chiefdom but added that people needed to work hard and implored on government to improve the situation.

In conclusion, it was agreed that the headman should work towards promoting good relations between the people and Somawhe. He also called upon Somawhe to initiate community projects that will help preserve the natural resources. The Chief called upon Somawhe to undertake detailed dialogue with the communities in order to improve relationships for the sake of development

2. Minutes for the meeting with the Executive Director of Somawhe

The meeting with Executive director took place in his office on the 3rd of May 2012 at about 8h30. in his introductory remarks, Mr. Brian Jenkins the executive director said Somawhe was doing well since he took over from the previous owners MDC Ltd Company. He pointed out that since 2006 up to date production has been on the increase every year. He further said that Somawhe produces both winter crop and summer crop.

He further said that the workers have always worked hard and that is the reason why production is always on the increase. He stated that workers complaint were minimum due to good conditions of service that Somawhe has put in place. Particularly, he said that he employs an open door work policy where any worker can walk into his office any time to air his or her concerns. Besides he alluded to the fact that workers have a Union to represent them. He also said that there is good market for the crop and that current production still falls short of meeting the demand.