# Land and Natural Resource Use Assessment

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EXECUTIVE SUMMARY

Baobab Resources PLC intends to establish an iron ore mine in the Tete Province of Mozambique, located north of the provincial capital of Tete in the Chiúta and Moatiza districts (Figure 1.1). The proposed project will consist of the following infrastructure:

- Open cast mine
- Waste rock dump
- Processing plant
- Smelter
- Construction and operation accommodation
- Fuel storage area, parking and repair facilities

This report forms part of a series of biophysical specialist studies for the Baobab Iron Ore Mine Project, in the Tete Province of Mozambique. As part of the ESIA this report describes the land and natural resource use in the project affected area.

OBJECTIVES

A Land and Natural Resource Use study was undertaken as part of the Baobab Iron Ore Mine Project. The specific objectives of the study are to:

- Determine the suite of natural resources that are important to the livelihoods of the directly-affected population of the proposed project;
- Determine whether any rare and irreplaceable natural resources exist within the proposed mine footprint and describe the location of those natural resources;
- Examine concerns around natural resources that emerged from local stakeholders during the public participation process;
- Gauge the importance of the suite of natural resources to the livelihoods of the directly-affected population; and
- Assess the significance of any impacts the proposed project could have on natural resource use, and suggest ways to mitigate these impacts.

OVERVIEW

Natural resources provided by the flora and fauna as well as the rivers surrounding the proposed development site are an important component of the livelihoods of the potentially affected communities of the proposed Baobab Iron Ore Mine Project. As in many parts of Africa, the local communities around these forests and woodlands rely heavily on the resources offered by the natural environment for their livelihoods and survival. Consequently, any developments that might impact on the resource base could potentially threaten food security and livelihood strategies. The area is known for its multitude of resources including, but not limited to, fuelwood, mushrooms, wild fruit and vegetables, medicinal plants, wild bird and animal meat, fuel for slash and burn agriculture, wood for charcoal, and timber. The local rivers provide an abundance of fishing resources as well as potable water. Demand for natural resources is already stressed and over utilized in the area and is likely to increase, and supply decrease, as a direct result of the proposed project due to the required clearing of extensive areas of natural indigenous forest. This could affect natural resource availability and the lives of communities living nearby the proposed mine.

Consequently, the main objective of this study is to gain a clear understanding of the local community’s reliance on the natural resources in and around the study area. This included an investigation of the extent to which natural resources are used for basic household needs such as food, water, medicines, shelter, and household utensils, to gain an understanding of the levels of community knowledge and dependence on natural resource use, and also to determine current levels of exploitation of potentially endangered species. This dependence on natural resources also needed to be understood in the context of the diversity of other agricultural land uses and (off and on-farm) livelihood strategies which local households combine to reduce their vulnerability to
risk, ensure their survival and meet their needs. This information should also be used to inform the investigation of appropriate rehabilitation strategies for the concession area and how these could be integrated with existing land uses.

WATER RESOURCES

Local residents within the project affected area are heavily dependent upon the rivers in the study area for their livelihoods. Although agriculture is mainly rainfed, some manual irrigation does occur (buckets are filled with water and used to irrigate fields in close proximity to the river beds) during the dry season. In addition to this water from the river is used for consumption. In some areas shallow wells are hand dug in close proximity to the river to supply potable water. Local residents complained about the water quality in the area and stated that often “worms” are found within water obtained from the river, in which case water is left to settle overnight prior to being used. According to water quality samples taken by the health specialists no harmful worms are present within the water resources, however areas close to the villages did test positive for E.coli. It could thus be that the gastrointestinal symptoms described by local residents is related to E. coli in the water sources rather than from macroinvertebrates.

The proposed mining activities could impact on the water resources in the area through the abstraction of water and poor management practices.

CURRENT LAND USE

Agriculture in Mozambique, including fishing and forestry, is the mainstay of the economy accounting for 31.5% of the GDP in 2009 and 32% in 2011 and contributing approximately 20% to export earnings. More than 70% of poor households live in rural areas with agriculture being their main source of food and income. The main agricultural products are: cashew nuts, citrus, cotton, coconuts, tea, tabacco, timber and fish (mainly shrimps and prawns).

In the study area, agriculture is practiced throughout the area mainly on river/stream banks and in dry river/stream beds. The majority of land consist of ancestral land that is past down through generations. In cases where additional land (machambas) is required, agricultural land can be obtained through the chiefs and local traditional structure. Most machambas are relatively large, with most at least larger than 1 ha, for example locals in Mbuzi Village have access to approximately 2 ha of agricultural land per household. The majority of households practice shifting cultivation, which entails the clearing of new fields every 3 years or so as soil quality reduces. Lands are usually left fallow for approximately 3 years after which cultivation resumes. According to respondents these practices are mainly due to the fact that locals have no access to fertilizer or ploughing equipment. Land is mainly cleared by slash and burn practices. Land is cleared of large trees and shrubs using axes, pangas and hoes. The timber is placed in heaps along the border of the field and set a light. The field is then burned to clear the remaining vegetation. Both men and women are responsible for tending fields.

The major crops grown in the area consists of maize, tobacco and legumes (groundnuts and soybeans). In addition these various other crops such as sweet potatoes, groundnuts, sorghum, cassava, sugar cane and various vegetables (tomatoes, cabbage, potatoes, etc.) are grown sporadically throughout the area. Generally the period of January to April is important for agricultural practices.

In addition to crops, livestock farming is one of the livelihood activities adopted by households in the project affected villages. Local residents keep cattle, goats, pigs, ducks and chickens. Livestock is kept mainly for consumption and traditional practices, such as bridewealth. Livestock is however sold during times of need when additional monetary resources are required. The main animals sold are goats, chickens and pigs. Cattle is only sold on rare occasions and no mention was made of ducks being sold within the area.
NATURAL RESOURCE UTILISATION

Building Material

A variety of local tree species are used for construction purposes. The Mopane tree is preferred by all locals due to its hardness which also makes it termite resistant. Local residents also participate in the making of clay bricks for construction purposes. The majority of villages excavate clay from claypits dug within the village or on the outskirts thereof. Locals in Mbuzi Village, however, excavate clay from termite mounds. Building is a skill that is usually taught within the ancestral line.

Charcoaling

All of the villages within the project affected area with the exception of Tenge Makodwe Village participate in charcoal production. The production of charcoal is however limited to the Mbuzi Village and Nhambia Mtoli Village with only 5 and 2 charcoal producers present, respectively. Charcoaling is however practised extensively in Massamba Village and almost every household in this village (of which there are 377) is involved in charcoaling to some extent. The practice of charcoaling is regulated within Mozambique in terms of the Forestry and Wildlife Act 10/99 and thus any person producing charcoal for commercial purposes requires a licence. Charcoal is produced by cutting down hardwood trees that provide good quality charcoal. The preference and suitability of trees used for charcoal production varies with size, availability and accessibility of the tree species. Mopane (*Colophospermum mopane*) is the preferred species for charcoal production. Other species are utilised, however less frequently due to the fact that it results in charcoal of lesser quality than that produced by Mopane.

Fuelwood

All the villages visited appear to be able to access fuelwood easily in the immediate vicinity of the village or within one kilometer of the village. It is mostly dry wood that is used and there appears to be no particular preferences or selectivity in the type of woods used. Respondents indicated that one long branch of wood would be sufficient for one day of fuelwood. There are currently no households involved in the sale of fuelwood and no local market for fuelwood appears to exist. In Mbuzi Village and Nhambia Mtoli Village charcoal is not generally used for fuel by local residents but is sold to residents in Tete as described above. In Massamba Village charcoal is both used for fuel and sold.

Fishing

Artisanal fishing activities take place within all of the villages interviewed and provides an important source of protein to supplement the diet of the local people. A variety of fishing gear is used throughout the communities including, fish fences made from wooden stakes and reeds (constructed across the river channel to trap fish upstream), hook and line, dip nets and seine and gill nets. Fishing is undertaken during the dry season (May to early November) only, this is due to high water levels during the rainy season. One of the major threats to local fishermen within the project affected area is the vast number of crocodiles that populate the rivers within the study area and there have been numerous reports of injuries and death related to this particular reptile. Any crocodiles caught in nets are dragged to shore and killed and the carcasses burned.

Food Gathering

Various plants are utilised for consumption at different times during the course of the year (mainly during the dry season) to supplement food supplies.

Hunting

Hunting is another means of acquiring food, and takes place extensively throughout the project affected area. There are a variety of measures used for the hunting of animals, these include
utilizing packs of dogs, traps, snares and on the rare occasion guns. According to Article 46(2) of Decree No. 12 hunting is not permitted from the 1st of October to the 31st of March. Based on the information provided by focus group members it is clear that some hunting occurs during the closed season in the project affected area. In addition to this, according to Article 47(2) the use of snares, traps and tranquiliser guns are only permitted for research purposes by, for example, zoos and museums. Local residents in the area do not comply with these regulations as traps and snares are utilized throughout the area. There is also evidence that species listed as protected on Annex II of Decree No 12, such as the vervet monkey are actively being hunted in the area. Lastly, based on the information provided by respondents it is evident that hunting currently causes a significant impact on the environment and is not efficiently regulated within the region. The numbers of animals hunted are staggering and the slash and burn practices for hunting with dogs causes a significant impact on both the fauna and the flora within the area.

**Bee Keeping**

Bee keeping takes place in the majority of villages throughout the area. Local residents involved in this practice make artificial log hives from harvested trees. There is currently approximately 1500 hives within the project affected area. Each hive requires the felling of a tree.

**Beer Production**

Various villages within the potentially affected area engage in the production of beer. Beer is produced from sugar cane usually grown in close proximity to the villages and harvested throughout the year. Beer is only sold locally within villages and whatever is not sold is consumed.

**Medicinal Purposes**

According to respondents, there are no hospitals within the project affected area, the closest hospital is the Provincial Hospital in Tete, approximately 50 km from site. The closest government clinic is located at the administrative post of Kazula. For this reason the residents within the area rely heavily on traditional medicine and all villages have at least one herbalist. Respondents stated that only in extreme cases of illness will western medicine be sought. If someone becomes gravely ill, family members and friends will build a makeshift stretcher and the patient will then be carried to the bus stop from where the patient will travel by bus to the clinic in Kazula.

**MANAGEMENT OF NATURAL RESOURCES**

The Mozambican Constitution states that the people have a right to live in a clean environment and to use the natural resources for their benefit without harming their availability and quality for the next generation. In order to guarantee the previous statement an institutional and legal framework had to be adopted. Listed below are some of the relevant policies on renewable natural resources and the regulation of their use which have been recently adopted to guide sustainable development in the country:

- **Land**
  - Land law (19/1997)
  - Land law regulations (66/1998)
  - Technical appendix to the Land law (1999)
  - Land Planning Act (19/2007)
  - Regulation of the Land Planning Act (23/2008)

- **Environment**
  - Environmental law (20/1997)
  - Regulation for Environmental Impact Assessment (76/1998)
  - National Strategy and Action Plan for the Conservation of Biological Diversity
  - Control of Exotic Invasive Species Act (25/2008)

- **Forestry and Wildlife**
- Policy and Strategy for Development of Forestry and Wildlife (8/1997)
- Forestry and wildlife law (10/1999)
- Forestry and wildlife regulations (2002)

- **Agriculture**
  - Agricultural sector investment program, with a Forestry and Wildlife National Program adopted in 1998 (including a component in support of government initiatives towards the implementation of Community Based Natural Resources Management (CBNRM)).

- **Water**
  - Water Policy (7/1995)
  - Water License and Concessions Regulations (43/2007)
  - Water Act (16/1991)

- **Fisheries**
  - Fisheries Law (3/1990)

### IMPACTS

The impacts on natural resources identified during this study are summarized in the table below:

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<td><strong>Issue 1: Overexploitation or resources</strong></td>
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<td>Impact 6: Wild Foods</td>
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<td>Impact 9: Medicinal Plants</td>
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<td>Impact 10: Species of Special Concern</td>
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<td><strong>Issue 2: Existing impacts due to land use practices</strong></td>
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<td>Impact 1: Slash and burn clearing</td>
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<td><strong>Issue 3: Existing impacts on water resources</strong></td>
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<td>Impact 1: Growth of water hungry crops</td>
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<td><strong>IMPACTS OF THE PROPOSED MINING OPERATION</strong></td>
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1. INTRODUCTION

Baobab Resources PLC intends to establish an iron ore mine in the Tete Province of Mozambique, located north of the provincial capital of Tete in the Chiúta and Moatize districts (Figure 1.1). The proposed project will consist of the following infrastructure:

- Open cast mine
- Waste rock dump
- Processing plant
- Smelter
- Construction and operation accommodation
- Fuel storage area, parking and repair facilities

A full project description is provided in the Environmental and Social Impact Assessment (ESIA) Report.

Natural resources provided by the flora and fauna as well as the rivers surrounding the proposed development site are an important component of the livelihoods of the potentially affected communities of the proposed Baobab Iron Ore Mine Project. As in many parts of Africa, the local communities around these forests and woodlands rely heavily on the resources offered by the natural environment for their livelihoods and survival. Consequently, any developments that might impact on the resource base could potentially threaten food security and livelihood strategies. The area is known for its multitude of resources including, but not limited to, fuelwood, mushrooms, wild fruit and vegetables, medicinal plants, wild bird and animal meat, fuel for slash and burn agriculture, wood for charcoal, and timber. The local rivers provide an abundance of fishing resources as well as potable water.

Demand for natural resources is already stressed and over utilized in the area and is likely to increase, and supply decrease, as a direct result of the proposed project due to the required clearing of extensive areas of natural indigenous forest. This could affect natural resource availability and the lives of communities living nearby the proposed mine. Consequently, the main objective of this study is to gain a clear understanding of the local community's reliance on the natural resources in and around the study area. This included an investigation of the extent to which natural resources are used for basic household needs such as food, medicines, shelter, and household utensils, to gain an understanding of the levels of community knowledge and dependence on natural resource use, and also to determine current levels of exploitation of potentially endangered species. This dependence on natural resources also needed to be understood in the context of the diversity of other agricultural land uses and (off and on-farm) livelihood strategies which local households combine to reduce their vulnerability to risk, ensure their survival and meet their needs. This information should also be used to inform the investigation of appropriate rehabilitation strategies for the concession area and how these could be integrated with existing land uses.

A study for the investigation of the use of natural resources in and around the concession area was undertaken in April 2014 by Dr Chantel Bezuidenhout with assistance from Ms Carina Saranga (Local Consultant for CES Mozambique Office) and Mr Sérgio António Male (Translator and Facilitator). Complementary information was obtained from other specialist studies such as the Social Impact Assessment, the Botanical Assessment, the Faunal Assessment, and the Aquatic Impact Assessment and integrated into the findings of this report.

It is important to note that this report forms part of a series of biophysical specialist studies for the Baobab Iron Ore Mine Project, in the Tete Province of Mozambique. As part of the ESIA this report describes the land and natural resource use in the project affected area.
Figure 1.1: The study site in relation to the villages interviewed
1.1 Objectives

A Land and Natural Resource Use study was undertaken in response to this important issue as part of the Baobab Iron Ore Mine Project. The specific objectives of the study are to:

- Determine the suite of natural resources that are important to the livelihoods of the directly-affected population of the proposed project;
- Determine whether any rare and irreplaceable natural resources exist within the proposed mine footprint and describe the location of those natural resources;
- Examine concerns around natural resources that emerged from local stakeholders during the public participation process;
- Gauge the importance of the suite of natural resources to the livelihoods of the directly-affected population; and
- Assess the significance of any impacts the proposed project could have on natural resource use, and suggest ways to mitigate these impacts.

1.2 Terms of Reference

The specific terms of reference are as follows:

- Gain an understanding of community knowledge and dependence on natural resource usage, focussing on plants.
- Determine the reliance of local communities on different vegetation types for harvesting natural resources.
- Determine current levels of exploitation of birds, small mammals and reptiles, particularly endangered species and CITES Appendix-II species.
- Obtain information from the community regarding their understanding of the ecological functioning of their environment.
- Identify which plant/animal species are used for traditional healing.
- Discuss the effect of possible mining activities on the communities with regard to indigenous plant use.
- Identify the most widely used natural resources in the project area and determine whether any of these are spatially limited to certain locations where proposed mining areas will be located.
- Identify the main fuelwood trees and assess their abundance and replaceability;
- Assess the significance of the potential impacts of mining on the natural resources and the communities that utilise them.
- Identify suitable mitigatory actions that can reduce negative impacts and enhance positive impacts, where possible.

1.3 Assumptions and Limitations

The following assumptions and limitations apply to this study.

Assumptions:
- The participants in the study responded truthfully in the interviews;
- Translation accurately captured the meaning and intentions of the interviewees;
- The proposed project will not change significantly in its design; and
- Ongoing public participation will take place involving all local stakeholders.

Limitations:
- This study only focuses on natural resource and land use.
1.4 Report layout

This report describes natural resource use and land use in the project affected area in northern Mozambique. It demonstrates and quantifies, where possible, the importance of the forest and rivers to potentially affected communities of the proposed Baobab Iron Ore Mine Project from a land and natural resource use perspective. The report is divided into the following main sections:

- **Methodology** – provides the methods used for the land use and resource use sections.
- **Water Resources** – provides broad details on water resources in the area for consumption and irrigation of agricultural fields.
- **Land Use** – describes the agricultural techniques used, as well as a detailed description of the crops and livestock of the project affected area.
- **Natural Resource Use** – describes in detail the resources used by the local people in terms of the various habitats.
- **Trade and Bartering** – discusses general trade and bartering practices in the study area.
- **Local Management of Natural Resources** – discusses current management of forests and rivers in the area.
- **Impact Assessment** – provides a detailed impact assessment together with impact ratings.
- **Conclusions and Recommendations** – summarises the report.
2. METHODOLOGY

2.1 Sites

The resource users interviewed for this study were residents of the villages around the proposed mine site. Participation was voluntary and residents were asked to participate prior to interviews being conducted. Four villages were interviewed, these included Nhambia Mtoli Village, Massamba Village, Tenge Makodwe Village and Mbuzi Village. The location of these villages in relation to the study area is shown in Figure 1.1 above.

In addition, a number of focus group meetings were held to clarify specialised practises such as beer making, charcoaling, fishing, hunting, etc. These focus groups were held in villages where these practises were undertaken and a number of people participated (Plate 2.1).

Plate 2.1: Focus group meeting held in Massamba Village

2.2 Interviews and Translation

In each village, local residents were asked to volunteer in participating in interviews. In some cases, there were many residents in attendance and some of these contributed to the discussions.

In each case the interviews began with an introduction explaining who the researchers were and what the purpose of their visit and of the meeting was. Once the respondents were happy to proceed with the meeting, the interview began.

The respondents were asked about the following:
• Cultivation and the use of irrigated lands
• Livestock farming: extent to which residents engage in this activity
• Harvesting of natural resources for fuelwood, building materials, wild foods, wild meat, beekeeping, charcoaling, fishing and medicinal purposes.

The discussion around the harvesting of natural resources formed the main focus of the interviews. The issues discussed included:

• What resources are harvested from where and for what purpose?
• How much product is harvested and when?
• Identifying the specific species used.
• The management or regulation of use of natural resources.

There were some interviews however that focussed on one particular aspect of natural resource use. These were the interviews with charcoal producers/traders, fishermen, hunters, bee keepers, builders, farmers and traditional healers. In these cases the interviews were less structured and more open-ended.

Much of the information obtained was of a descriptive and qualitative form. However, some quantitative data on amounts of product harvested and prices were obtained, particularly with regard to hunting and for charcoal production.

2.3 Identifying Plants

One of the important aspects of the interviews was to identify what natural resources people were using. This was done by asking people what plants were used for building, food, charcoal production, fuelwood and medicinal purposes. The respondents had their own names for these plants and these were recorded. A list of local plant names were compiled (Table 5.1) and locals showed the interviewers what these plants looked like on the last day of the site visit. Plants were identified by Ms Tarryn Martin (Botanical specialist) and Dr Chantel Bezuidenhout on the last day of the site visit.
3. WATER RESOURCES

According to the Aquatic Ecology and Surface Water Quality Baseline Survey (CES, 2013), the project area lies entirely in the catchment of the Revuboe River. This catchment extends upstream of the project site in a northerly direction towards the border with Malawi in what is known as the Left Lower Zambezi Basin of the Zambezi River, and includes all the Zambezi River tributaries to the north of the Zambezi, south of Lake Malawi, and downstream of Cahora Bassa Dam (CES, 2013). The Revuboe catchment area covers approximately 15,500 km², and falls within a high rainfall area. December to March are the highest Rainfall months (Wet season), and the maximum mean monthly flows occur between February and March (Beilfuss, 2005). The estimated mean annual rate of runoff from the Revuboe catchment is 95 m³/s, with average maximum monthly flows peaking higher than 725 m³/s. Minimum monthly flows generally occur at the end of the dry season (October) (Beilfuss & dos Santos, 2001).

Naturally occurring high water flows (for short time periods) and low or no water flow (for longer periods) occur in the catchment drainage lines. The Revuboe River flows in a north-south direction, and bisects the Tenge-Ruoni deposit and flows into the Zambezi River at the city of Tete. Active channels are well defined and systems have a moderate to high sediment transport capacity. High rainfall and moderate to steep catchment slope result in naturally high sediment loads. Most streams in the area display well differentiated riparian zones, indicating year-round subsurface flow. Both the Zambezi and the Revuboe rivers are large, perennial, low gradient, mature systems with flood plain reaches (CES, 2013).

The Revuboe catchment also includes a number of seasonal/ephemeral rivers (Figure 3.1). To the west of the Revuboe River, the Musumbudze River (a seasonal river) flows in a south-easterly direction, joining the Revuboe River immediately north of the northern boundary of the project site. The Nhambia River flows in a south-easterly direction, changes direction to the east and joins the Revuboe River just south of the project area. Both these rivers are characterised by alluvial sediments with thick sandy river beds (CES, 2013). The flow in the upper reaches of these tributaries had become reduced to isolated pools with small areas of flow interconnecting these pools while the lower reaches of the river, closer to the confluence with the Revuboe, maintains continuous flow. The Ncacame and the Tshissi rivers contribute to the Nhambia River, joining this river at the point where flow direction changes from a south-easterly to an easterly direction. To the east of the Revuboe River the Ncondezi River joins the Revuboe River. These rivers are characterised by clear and fast flowing water; stones, boulders and loose sand stream beds; River banks are lined by large trees and riparian vegetation along the river banks.

Local residents within the project affected area are heavily dependent upon these rivers for their livelihoods. Although agriculture is mainly rainfed, some manual irrigation do take place (buckets are filled with water and used to irrigate fields in close proximity to the river beds) during the dry season. In addition to this water from the river is used for consumption. In some areas shallow wells are hand dug in close proximity to the river to supply potable water. Local residents complained about the water quality in the area and stated that often “worms” are found within water obtained from the river, in which case water is left to settle overnight prior to being used. According to water quality samples taken by the health specialists (refer to Health Impact Assessment, Digby Wells, 2013) no harmful worms are present within the water resources, however areas close to the villages did test positive for E.coli (refer to Figure 3.1). It could thus be that the gastrointestinal symptoms described by local residents is related to E. coli in the water sources rather than from macroinvertebrates.

The proposed mining activities could impact on the water resources in the area through the abstraction of water and poor management practices.
Figure 3.1: Rivers in the project affected area
4. LAND USE

4.1 Agriculture

Agriculture in Mozambique, including fishing and forestry, is the mainstay of the economy, accounting for 31.5% of the GDP in 2009 and 32% in 2011 and contributing approximately 20% to export earnings. More than 70% of poor households live in rural areas with agriculture being their main source of food and income. The main agricultural products are: cashew nuts, citrus, cotton, coconuts, tea, tabacco, timber and fish (mainly shrimps and prawns).

In the study area, agriculture is practiced throughout the area mainly on river/stream banks and in dry river/stream beds. The majority of land consist of ancestral land that is past down through generations. In cases where additional land (machambas) is required, agricultural land can be obtained through the chiefs and local traditional structure. Most machambas (Plate 4.1) are relatively large with most at least larger than 1 ha, for example locals in Mbuzi Village have access to approximately 2 ha of agricultural land per household. The majority of households practice shifting cultivation, which entails the clearing of new fields every 3 years or so as soil quality reduces. Lands are usually left fallow for approximately 3 years after which cultivation resumes. According to respondents these practises are mainly due to the fact that locals have no access to fertilizer or ploughing equipment. Land is mainly cleared by slash and burn practices. Land is cleared of large trees and shubs using axes, pangas and hoes. The timber is placed in heaps along the border of the field and set a light. The field is then burned to clear the remaining vegetation. Both men and women are responsible for tending fields.

The major crops grown in the area consists of maize, tobacco and legumes. A seasonal calendar for these crops is included in Table 4.1 below. In addition to the crops listed above various other crops such as sweet potatoes, groundnuts, sorghum, cassava, sugar cane and various vegetables (tomatoes, cabbage, potatoes, etc.) are grown sporadically throughout the area. Generally the period of January to April is important for agricultural practices.

Plate 4.1: Machamba planted with maize
Table 4.1: Seasonal calendar for the most prominent agricultural activities in the area (cash crops in red, all other crops indicated in blue, grey colouring refers to crops that are cultivated throughout the year, the rainy season is indicated in green)

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### 4.1.1 Crops

**Cash crops**

**Maize**

In Mozambique maize is one of the most common food crops cultivated by approximately 79% of farmers. Approximately 99% of the total maize produced in the country is produced by small-scale farmers. Between the year 2000 and 2004, maize production in Northern Mozambique reached an approximate of 813,000 tons. Of this approximately 699,000 tons was consumed while 4,000 tons was formally exported (Govereh et al., 2008). Between 2006/7 the total available maize supply exceeded the total domestic consumption needs by 90,000 meticais (MT). Total maize produced in 2007 ranged between 0.4 and 1.3 tonnes per hectare reaching a total gross production of 1,534,000 MT (FAO, 2007). In 2008 it was estimated that only between 0.3 and 0.9 tonnes maize per hectare is produced (TIA, 2005/2008). Between 2007 and 2009, the production of maize significantly increased and decreased in the 2 year period, this was due to the expansion of cultivated areas followed by unexpected weather conditions (drought and heavy floods), price volatility, high transportation and transaction costs.

The Tete Province produced 18% of the total maize produced for Mozambique in 2005 and increased production to 20% by the year 2008 (Dias, 2013). At least 80% of all maize produced is for subsistence production, while only a mere 20% is marketed. Harvest areas in the Tete Province have increased from 192,000 ha in 2006 to 224,000 ha in 2010, while yields decreased from 1.24 tonnes per ha in 2006 to 1.21 tonnes per ha in 2010. Overall maize production increased by 33,000 tonnes in the 4 year period (Dias, 2013; FAO/WFP, 2010). Generally the Northern regions including Tete Province only imports maize during the lean periods, being the major exporter and supplier for the remainder of the year (Dias, 2013).

Maize is considered to be a cash and subsistence crop in the study area. Maize is cultivated by all four villages in the project affected area and is usually planted in November and harvested in the months of April and May. Maize plots are prepared by using slash and burn practises, i.e. cutting and burning the forest to make land available for agriculture. The plots are generally abandoned after three years and left fallow for an additional 3 years before recultivating. Maize is left to dry in the fields prior to being harvested and then again directly after the harvest (Plate 4.2 A). Maize grains (Plate 4.3 B) are mixed with water to make a nutritious porridge (known as xima). Another form of porridge is made by mixing cassava flour and maize. Communities also roast or boil (fresh) maize (Dias, 2013). Maize consumption has decreased since the year 2000, mainly due to substitution with cheaper staples (e.g. cassava) and in some cases the improvement of living standards in the urban areas has resulted in the substitution of maize with rice.
Maize is sold both locally and in Tete. According to respondents, residents from Tete travel to the villages to buy maize and travel to Tete from the villages is limited. Maize is only sold in Tete during the months of June-September as agricultural activities take precedence for the remainder of the year. During harvest season maize is sold for 100-150 MT per 20kg. However outside season the prices increase to 200-220 MT per 20 kg.

According to focus group meetings each family within the project affected area can produce between 1 and 2 grainies (Plate 4.3) of maize per season. A granary can store approximately 400 kg of maize (20 kg bags x 20). If this is accurate and if only a third of the maize produced locally is sold, this could amount to an income of 367 000 MT within the project affected area. This is calculated assuming 1 granery is produced by each family and sold at 100 MT per 20 kg.

Plate 4.3: Granary filled with maize

_Tobacco_

Tobacco is one of the most important agricultural export crops in Mozambique and one of the major sources of income for 129 755 farmers in central and northern Mozambique (Dias, 2013). Of
this approximately 38% of farmers are associated with the Mozambique Leaf Tobacco (MLT) Company which is currently the biggest tobacco company operating in Mozambique (Dias, 2013). Apart from MLT, SONIL is the only other registered tobacco company currently operating in Mozambique. Approximately 98% of all tobacco produced in the country is by means of small scale farmers (Dias, 2013).

Tobacco production is one of the fastest growing agricultural sectors in Mozambique and has grown rapidly in the last 10 years. In the 80s and 90s tobacco production was a mere 1500 tonnes and has increased from 50 000 tonnes in 2004 to 86 000 tonnes in 2010 (Dias, 2013). In 2012/13 tobacco production reached a maximum of 78 000 tonnes (Jantilal, 2013). During this period the number of households growing tobacco increased rapidly from 6000 households to more than 120 000 households. Between 2009 and 2010 the total tobacco production area covered approximately 73 630 ha which is equivalent to approximately 1.3% of all the cultivated land in Mozambique (Dias, 2013).

In Tete Province, tobacco production increased by 23% between the years of 2006 and 2008. It is anticipated that this was mainly due to investments from Zimbabwe (during the period of collapse of tobacco production in the early 2000s) and the construction of the tobacco processing plant in the province in 2005 (Dias, 2013). Tete Province was also found to have better agro-ecological conditions to grow tobacco, including fertile soils and adequate rainfall. Between 2003 and 2004 Tete Province had approximately 32 381 ha of land planted with tobacco, produced approximately 27 032 tonnes with yields of 0.84 tonnes per hectare (Benfica et al, 2005).

The two major types of tobacco produced in Mozambique is “Burlley” and in smaller quantities of “Virginia”. All tobacco is exported in “leaf” form (Jantilal, 2013). Tobacco exports contribute approximately 34% of the total agricultural exports. The majority of tobacco produced is sold to processing factories, while farmers only keep a small amount of the dried leaf for their own consumption. In 2010, 67% of processed tobacco was exported from Mozambique, while unprocessed tobacco was exported mainly to Malawi and Zimbabwe (Dias, 2013). Between the year 2005 and 2011, processed tobacco exports increased significantly from 1 600 tonnes to 57 248 tonnes (Dias, 2013). During the same period the export of unprocessed tobacco reduced drastically from 41 090 tonnes to 1 127 tonnes. In 2009, Tobacco constituted 0.31% of the total GDP of Mozambique and approximately 1.17% of the annual Agricultural GDP.

Tobacco is cultivated in the study area for both personal use and as a cash crop. Tobacco is cultivated by all four villages in the project affected area, however in Nhambia Mtoli Village and Massamba Village tobacco is only grown for personal use. According to respondents in Nhambia Mtoli Village only a small quantity of tobacco is grown as the land available to them is not ideal for tobacco cultivation and due to the small size of the community and the limited amount of agricultural land available, it is preferred to grow food crops rather than tobacco. Respondents stated that should a Mozambiquen tobacco company supply them with seed and fertilizer then only will they produce tobacco as a cash crop because the market will then be assured. Respondents in Massamba Village stated that tabacco is only grow within fertile river beds as they have no access to fertiliser and thus cannot cultivate this crop in other areas. In addition to this it was stated that the land available within river beds close to the village was limited and thus large crops of tobacco cannot be cultivated. Large amounts of tobacco is however cultivated in Tenge Makodwe Village and Mbuzi Village and is usually planted in April-May and harvested in the months of August, September and October.

The study area villages that prodeuce tobacco as a cash crop sell tobacco both locally and at the Mozambique/Malawi Border. According to respondents, tobacco is not sold in Tete as better prices can be obtained from the border area. For example 1 kg of tobacco will sell for 30 MT in Tete and 50 MT at the Mozambique/Malawi Border. According to focus group meetings each family within the villages that produce tobacco can fill between 1 and 2 granaries of tobacco per season. The amount cultivated is dependent on rainfall, however it was stated that the norm is 2 granaries per family.
Legumes

Legume production in Mozambique is generally low compared to other cash crops such as maize and cassava. Grain legumes account for less than 20% of total cultivated area (Abate, 2012). Legumes are classified as groundnuts, pigeon peas, cowpeas, common beans and soybeans. Small scale farmers mainly cultivate legumes intercropped with cassava and maize in areas less than 0.5 ha, therefore resulting in low yields (ICRISAT, 2013). More than 60% of the planting material used is from farmers’ own-saved seed. Production of legumes such as beans is highly seasonal.

Of the 14,263 legume farmers in Mozambique approximately 4000 are groundnut farmers, 3899 are cowpea farmers and the majority (6374) are soybean farmers (Abate, 2012). In the year 2008 the legume production totalled 52,500 MT and the mean production per household was 144 kg (TIA, 2008). Between 2006 and 2007 communities consumed approximately 312,000 MT of the total 365,000 MT beans/peanuts produced (FEWS NET, 2006). Only 10,000 MT was imported and 5000 MT exported. The vast majority of farmers in the Tete Province mostly cultivate bean and groundnuts, these two crops will be concentrated on.

Groundnut production in Mozambique for the year 2005 was estimated at 130,000 MT, the bulk of which was produced in the provinces of Nampula, Inhambane, Zambezia and Cabo Delgado. Approximately 300,000 ha is cultivated with groundnuts resulting in an average yield of approximately 0.44 MT/ha (I-LIFE DAP, 2005). Between the year 2006 and 2007 groundnut production was at approximately 365,000 MT. Only 43,000 MT of surplus groundnuts was produced during this period (FEWS NET, 2006). In the year 2008, it was estimated that the total area cultivated for the production of groundnuts was approximately 315,000 ha which shows an increase since the year 2005 (ICRISAT, 2013). Northern Mozambique mainly grows large grain groundnuts from dormant seeds. These seeds can produce a yield of approximately 500-700 kg/ha (ICRISAT, 2013). In the year 2011, it was estimated that between 1370 and 1530 kg/ha groundnuts were produced (Abate, 2012). This production reduced substantially in 2013 with the country only producing 450 kg/ha of groundnuts. Mozambique exported approximately 9% of the total groundnut production in the year 2011 (DAFF, 2012).

Groundnuts are generally consumed in an unprocessed state, but also serve as raw materials for the manufacturing of various products such as peanuts, peanut butter, sweets and cooking oil. Groundnuts are also used in the preparation of porridges (I-LIFE DAP, 2005). In the year 2005, farmers were paid in the region US$300 a metric ton (MT) for groundnuts (I-LIFE DAP, 2005).

Cultivated soybean areas covered approximately 15,000 ha in 2008 (ICRISAT, 2013). In 2011, it was estimated that between 2585 and 2838 kg/ha of soybeans was produced with a total yield percentage between 29% and 41% (Abate, 2012). Large increases of soybean production was experienced between 1970 and 2009, with total production reaching a maximum of 220 million MT by 2009 (Abate, 2012).

Soybean consumption in the country is estimated at 32% for oil and oilcake, 60% for animal feed (especially in the broiler and egg industries) and 8% for human consumption.

Legumes such as beans and groundnuts are cultivated in the study area for both personal use and as a cash crop. Legumes are cultivated by all four villages in the project affected area. Beans are usually planted in April and harvested in August, whereas groundnuts are planted in February and harvested in April. Legumes are sold both locally and in Tete. According to respondents, residents from Tete travel to the villages to buy legumes and thus travel from the villages to Tete is limited. Legumes are only sold in Tete during the months of June-September as agricultural activities takes precedence for the remainder of the year. During harvest season legumes are sold for 35-40 MT/kg. However out of season the price increase to 50-60 MT/kg. According to focus group members in Tenge Makodwe Village and Mbuzi Village approximately 100 kg of legumes (mainly beans and groundnuts) can be produced by a single family in a single season.
Subsistence crops

Cassava is a core agricultural product and the second most important staple in Mozambique, together with maize, rice, beans and millet (Dias, 2012). Cassava is mainly used instead of maize due to the lower costs and produced for own consumption in the project affected area. Cassava production in Mozambique is largely dominated by the Nampula Province, along with northern Zambezia (Arlindo, 2007). This Province is situated approximately 350 km from the final market point namely Nacala, where cassava is sold as dry tuber (Arlindo, 2007). Cassava is very tolerant to drought and poor soils, making this a crop that can be grown throughout the year. Between the years 2000 and 2005, the Nampula Province contributed approximately 37% of the total cassava production in Mozambique (Arlindo, 2007). In 2007, Tete Province, only had approximately 2 000 ha of land cultivated with cassava compared to 484 000 ha in the Nampula Province (Arlindo, 2007). Tete Province only produced about 7 tonnes per ha cassava in 2007. In 2008 the maximum cassava production was 4.1 MT with yields of approximately 7.7 tonnes per ha (Dias, 2012). In 2008 Tete Province only contributed 1% of the total amount of cassava produced in Mozambique, while small and medium scale enterprises contributed about 8% to the total cassava production in the country (Dias, 2012).

Tete Province is extremely vulnerable to land degradation mainly caused by droughts, floods, land fragmentation, high population density and over cultivation (mostly maize) (CGIAR, 2013). The main causes of lower production in areas such as Tete Province is the use of low-yielding varieties of seed and the lack of technological support (Dias, 2012). The medium altitude regions of Tete Province are classified as having suitable agro-climatic conditions for cassava production, while the semi-arid regions of the southern parts of the province is classified as being more suitable for Maize production (AGROGES, 2007). The medium altitude regions are characterised by the following (AGROGES, 2007):

- Land that does not exceed 200 m in altitude;
- Rainfall ranging between 500 and 800mm (November to March); and
- Absence of rain and elevated evapo-transpiration rates during the cool season.

These factors all contribute to the low production of Cassava in the Tete Province.

Rice is only grown in Mbuzi Village for subsistence, eventhough it is one of the five key commodities produced in Mozambique and is primarily produced as an import substitute (Arlindo, 2007). The main producing provinces are the Gaza Province and Southern Zambezia. Countrywide approximately 630 000 households produce rice (Arlindo, 2007). The Zambezia province accounted for approximately 56% of Mozambique’s total rice production as well as 56% of the total cultivated land for rice production in 2006 (Arlindo, 2007). Zambezia is situated approximately 550 km from the final market point namely the Beira urban market, where it is sold as polished rice or approximately 50 km at the rural mill for paddy (Arlindo, 2007). In 2007, Tete Province, only had approximately 3 000 ha of land cultivated with rice compared to 92 000 ha in the Zambezia (Arlindo, 2007). Tete Province only produced about 0.07 tonnes per ha of rice in 2007. In 2007, rice production was estimated at approximately 167 952 MT, with Tete Province only contributing about 2% of this total (Arlindo, 2007). This contribution was reduced to 1% in 2010 (FAO/WFP, 2010).

As with many other cultivated crops in this province, rice is also mainly rain fed and produced mainly in low lying areas and in heavy soils (AGROGES, 2007). In 2010/11 large areas of rain fed rice was lost along the central-region as a result of the prolonged dry spell at the beginning of the season resulting in a 30% reduction in rice harvests (FAO/WFP, 2010). Many of these areas have subsequently not been re-cultivated by rice due to limited seed.

The main challenges faced in terms of rice production is the limited use of improved seeds, deteriorated infrastructure and a lack of irrigation investments, rice specialists and technology . Many farmers also depend on labour intensive practices (Arlindo, 2007). There is also limited uncultivated arable land available in this province.
In addition to the crops listed above, the majority of households within the project affected area have access to small food gardens. These food gardens contain mainly vegetables such as sweet potatoes, potatoes, onions, tomatoes, cabbage, etc. for own consumption. The majority of households also have access to a number of fruit trees, including mangos, lemons, papayas, bananas, etc. Villages also grow sugar cane which is used mainly for subsistence and the production of beer (refer to Section 5.8). Only 1 village, Massamba Village, grows sugar cane as a cash crop. Approximately one third of sugar cane produced is sold locally and in Tete. Sugar cane is sold in Massamba village for 5 Meticais and for 10 Meticais in Tete. Local residents also participate in the cultivation of sunflowers for the production of sunflower oil. The oil produced is used mainly for cooking and only the surplus (if any) is sold. Sunflowers are sold for 120 Meticais per 20 kg.

4.1.2 Livestock

Livestock farming is one of the livelihood activities adopted by households in the project affected villages. Local residents keep cattle, goats, pigs, ducks and chickens (Plate 4.4). Livestock is kept mainly for consumption and traditional practices, such as bridewealth. Livestock is however sold during times of need when additional monetary resources are required. The main animals sold are goats, chickens and pigs. Cattle is only sold on rare occasions and no mention was made of ducks being sold within the area. The prices for various species of livestock that is sold within the project affected area is as follows:

- Goats – 1 500 Meticais each
- Chicken – 120 Meticais each
- Pigs – 2 000 Meticais each

No households in the area indicated that their cattle or goats have specific grazing grounds or large enclosures outside the parameters of homesteads and animals are usually left to roam free within the general area.
4.1.3 Agricultural Techniques

Crop growing in the area uses the traditional shifting cultivation (i.e. plots of land are cultivated temporarily and then abandoned) In addition to this local villages also cultivate crops within riverbeds. The various methods of cultivation in the area are discussed in detail below.

The dominant form of shifting cultivation within the study area is slash and burn practises. This method involves the felling of smaller trees and shrubs which are then left to dry. Prior to the rainy season the dried timber is set alight and left to burn. These areas are mostly cultivated with maize, tobacco and legumes. The land is cultivated until it no longer yields sufficient produce (usually 3 years), at which time it is abandoned and naturally regenerated by forest. The areas may be cultivated again within approximately 3 years.

People within the project affected area are also involved in dry season cultivation in empty riverbeds. Various crops (specifically “thirsty” crops such as sugar cane and bananas) are planted after the last rising waters during the rainy season. This process is undertaken each year probably due to the fact that fertile alluvial sediment is washed downstream during flooding of the various river systems. In addition to this, hyporheic flow provides adequate water resources to sustain agriculture.

Cultivation is done by hand with axes and hoes. Both men and women are responsible for tending to crops.
## 5. RESOURCE USE

### 5.1 Building Material

The Mopane tree is preferred by all locals for building purposes due to its hardness which also makes it termite resistant, a variety of other local tree species are also used. The species of trees used for various construction tasks such as building, furniture (Plate 5.1), tools and dug-out boats are listed in Table 5.1 below. It should be noted that none of the species presented are listed on IUCN, CITES or the Mozambique Red Data List.

#### Table 5.1: Species used for building purposes

<table>
<thead>
<tr>
<th>LOCAL NAME</th>
<th>SCIENTIFIC NAME</th>
<th>COMMENT</th>
<th>BUILDING PURPOSE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cagolo</td>
<td>Combretum zeyheri</td>
<td>Tree found in Open Zambezian Undifferentiated Woodland</td>
<td>Timber</td>
</tr>
<tr>
<td>Canhueiro</td>
<td>Sclerocarya birrea</td>
<td>Tree found in Village</td>
<td>Furniture</td>
</tr>
<tr>
<td>Chipepe</td>
<td>Sterculia c.f. rogersii</td>
<td>Tree found in Open Zambezian Undifferentiated Woodland</td>
<td>Fibres and weaving used for construction of dwellings</td>
</tr>
<tr>
<td>Mopane</td>
<td>Colophospermum mopane</td>
<td>Tree found in Mopane Woodland</td>
<td>Main material used for the construction of dwellings, however used for all building purposes</td>
</tr>
<tr>
<td>Mulambwa</td>
<td>Albizia sp.</td>
<td>Tree found in Open Zambezian Undifferentiated Woodland</td>
<td>Furniture</td>
</tr>
<tr>
<td>Mwawa</td>
<td>Ptaeroxyylon obliquum</td>
<td></td>
<td>Furniture</td>
</tr>
<tr>
<td>Nchololo</td>
<td>Commiphora mossambicensis</td>
<td>Tree found in Open Zambezian Undifferentiated Woodland</td>
<td>Wooden plates, bowles and stirring spoons</td>
</tr>
<tr>
<td>Ncuiu</td>
<td>Ficus sycomorus</td>
<td>Tree found in Riparian Woodland</td>
<td>Canoes</td>
</tr>
<tr>
<td>Njale</td>
<td>Sterculia africana</td>
<td>Tree found in Open Zambezian Undifferentiated Woodland</td>
<td>Canoes</td>
</tr>
<tr>
<td>Ndjendjema</td>
<td>Afzelia quanzensis</td>
<td>Tree found in Closed Zambezian Undifferentiated Woodland</td>
<td>Canoes and Furniture</td>
</tr>
<tr>
<td>Npacassa</td>
<td>Philenoptera violaceae</td>
<td>Tree found in Open Zambezian Undifferentiated Woodland</td>
<td>Canoes</td>
</tr>
<tr>
<td>Ntondo</td>
<td>Cordyla africana</td>
<td>Tree found in Open Zambezian Undifferentiated Woodland</td>
<td>Canoes</td>
</tr>
<tr>
<td>Simbite</td>
<td>Combretum imberbe</td>
<td>Tree found in Open Zambezian Undifferentiated Woodland</td>
<td>Timber</td>
</tr>
<tr>
<td>Udzu</td>
<td>Hypparhenia sp.</td>
<td>Tree found in Open Zambezian Undifferentiated Woodland</td>
<td>Thatching of roofs</td>
</tr>
<tr>
<td>Xivumbira</td>
<td>Pterocarpus rotundifolius</td>
<td>Tree found in Open Zambezian Undifferentiated Woodland</td>
<td>Axes, hoes and other tools</td>
</tr>
</tbody>
</table>
Plate 5.1: Chairs (600 Meticais each) and Tables (2 000 Meticais) sold within Nhambia Mtoli Village

Local residents also participate in the making of clay bricks for construction purposes. The majority of villages excavate clay from claypits dug within the village or on the outskirts thereof. Locals in Mbuzi Village, however, excavate clay from termite mounds (Plate 5.2). Various authors (Russel, 1973; Brady and Weil, 1999; Jouquet et al., 2004; Kaschuk et al., 2006; Adekayode and Ogunkoya, 2009; Dhembare, 2013) have shown that the clay content of the soils in termite mounds are significantly higher than that of the surrounding soil, this is probably due to the fact that termites transport soil from deep subsoil, that usually have a much higher clay content, for the construction of termite mounds. Based on the pers comm with the entomologist, Peter Hawkes, it is very likely that the termite mounds used for clay harvesting is from Macrotermes sp. It is unlikely that the current impact on these mounds are significant as the majority of the colony reside below ground. In addition to this only portions of the mounds are excavated and thus not removed in its entirety. The excavating of these mounds may however result in the opening of the mounds making the termites more vulnerable to various species of insectivores.

Plate 5.2: Clay is excavated from termite mounds

After the clay has been excavated, water is added and trodden (by foot) to mix the water with the clay. Once the clay and water is adequately mixed all impurities such as pebbles, boulders, sticks and twigs are removed from the mixture. The clay is then poured into brick moulds (Plate 5.3 A) made from wood approximately 15 cm high and 20 cm long and left to set for approximately 2 days. Once the clay has set the bricks are removed from the moulds and baked in clay ovens for approximately 7 days. The ovens used for brick making is a larger form of the clay ovens used for baking and cooking (Plate 5.3 B) and is usually 12 m long, 4 m wide and 2 m high and can hold up
to 3 000 bricks depending on the size. Bricks are sold within the community at a rate of 2.5MT per brick. The clay used for the making of bricks is also used to cement bricks together. The price of a dwelling usually depends on the size of the house. The average cost of a small dwelling is approximately 5 000 MT where one of average size costs around 10 000 MT. Building is a skill that is usually taught within the ancestral line.

Plate 5.3: (A) Brick moulds made from wood (B) Clay oven

5.2 Charcoaling

All of the villages within the project affected area with the exception of Tenge Makodwe Village participate in charcoal production. The production of charcoal is however limited to the Mbuzi Village and Nhambia Mtoli Village with only 5 and 2 charcoal producers present, respectively. Charcoaling is however practised extensively in Massamba Village and almost every household in this village (of which there are 377) is involved in charcoal production to some extent.

The practice of charcoaling is regulated within Mozambique in terms of the Forestry and Wildlife Act 10/99 and thus any person producing charcoal for commercial purposes requires a licence. In addition to this, the Ministry of Agriculture has several laws and procedural requirements that govern charcoal production and trade. Officially charcoal producers are required to obtain a forest exploration licence from the Ministry of Agriculture if they wish to produce charcoal at a certain location. This licence defines the maximum individual production of charcoal, the biomass sources (trees) that can be used and the boundaries of the exploration area. At present, a cap of 70 tonnes/year of charcoal per producer has been introduced by the Mozambican government with the intent to limit the increasing process of deforestation. Moreover, those commercializing the charcoal also need to obtain a licence from the Ministry of Agriculture. A fee is paid per number of charcoal sacks (each containing around 70 kg of charcoal) traded. If the number of sacks transported exceeds the amount stipulated in the licence, then a fine is issued. The Ministry of Agriculture is furthermore, responsible with regards to land use and forest plantations licences. Companies may lease plots of land for a 50 year renewable period, provided that they demonstrate economic activity on the totality of the land requested. Once the licence has been obtained, the project needs to be developed within a two year time span. Even though these regulations are in place they are extremely difficult to regulate and require a large presence within the region. There is no definitive means of establishing whether licenced charcoalers have reached their quota and that replanting is taking place. In addition to this illegal charcoaling still occurs within the region.

Charcoal is produced by cutting down hardwood trees that can be transformed into good quality charcoal. The preference and suitability of trees used for charcoal production varies with size, availability and accessibility of the tree species (below is a list of species currently used for charcoal production). Mopane (*Colophospermum mopane*) is the preferred species for charcoal production.
production. Other species are utilised, however less frequently due to the fact that it results in charcoal of lesser quality than that produced by Mopane. None of the species used for charcoaling (refer to Table 5.2) are listed in the IUCN, CITES or the Mozambique Red Data List. Large tree species with high caloric values (such as Mopane) are the most preferred; due to the large quantity of dense and hard charcoal they produce (NL Agency, 2010).

According to local charcoal producers in Mbuzi Village, the quantity of Mopane trees within the area has decreased significantly over the last 10 years, even though these trees are still relatively easy to find in close proximity to the village. In Massamba Village, however, respondents complained that Mopane trees were not easily located within the area due to harvesting by logging companies. The discrepancies in the description of availability of Mopane trees may be due to the fact that Mbuzi Village is not extensively involved in charcoaling, but also relatively isolated and thus no easy access is available for logging companies. In contrast, Massamba Village is involved in extensive charcoal production and situated along the main road, making the area around this village easily accessible. According to charcoal producers in Mbuzi Village charcoal is only produced during the majority of the dry season (June to December) as locals are preoccupied with agricultural practices during the remainder of the year. However, in Massamba Village charcoaling, is practised continuously throughout the year.
Table 5.2: Species used for charcoaling purposes

<table>
<thead>
<tr>
<th>LOCAL NAME</th>
<th>SCIENTIFIC NAME</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blancanga</td>
<td>Acacia sp.</td>
</tr>
<tr>
<td>Kagolo</td>
<td>Combretum zeyheri</td>
</tr>
<tr>
<td>Massaniqueira</td>
<td>Zizipus abyssinica</td>
</tr>
<tr>
<td>Mopane</td>
<td>Colophospermum mopane</td>
</tr>
<tr>
<td>Ndjendjema</td>
<td>Afzelia quanzensis</td>
</tr>
<tr>
<td>Simbite</td>
<td>Combretum imberbe</td>
</tr>
<tr>
<td>Txeteco</td>
<td>Burkea africana</td>
</tr>
<tr>
<td>Kagolo</td>
<td>Combretum zeyheri</td>
</tr>
</tbody>
</table>

Charcoal is produced by slow pyrolysis (thermochemical decomposition of organic material at elevated temperatures without the participation of oxygen). The wood is placed on the ground (in a heap with a height of approximately 1.5 m), covered with mud and set alight. This is referred to as an above ground kiln. The kiln is mostly sealed, although a few air pockets are left open for steam and smoke to escape. The wood in the kiln is left to burn for approximately 14 days. The entire process (cutting trees, building the kiln, burning, packaging, transporting and selling) takes approximately 1-2 months. Charcoal production is a skill that is usually taught within the ancestral line, however the 2 charcoal producers in Nhambia Mtoli Village stipulated that they learned the skill from members of surrounding communities.

Charcoal producers interviewed said that they produce approximately 100 bags of charcoal (25-30 kg per bag depending on the type of wood used) per month. These estimates of the volume of charcoal production per household can also be used to develop an estimate of the volume of wood being harvested per household. World Bank estimates of the volume of wood used to produce a kilogram of charcoal are 8.9 kg. Therefore if we use the minimum weight of the bags (25 kg) this equates to a total of 22 250 kg of wood used per charcoal producers per month (based on 100 bags per kiln). Thus if only half of the households in Massamba produce charcoal 6 times per year (i.e. every 2 month) this will equate 25 164.75 tons of wood per annum. Depending on the density of the stands this equates to a significant portion of the surrounding forest.

Plate 5.4: Charcoaling in Massamba Village

Charcoal is sold for 50 to 100 Meticais per bag (approximately 25 kg). According to respondents in Massamba, residents from Tete travel to the villages to buy charcoal approximately 3 times a week. Charcoal is also loaded onto bicycles and sold along the main road. On occasion villagers go to Tete to sell charcoal.

Residents complained that the production of charcoal lead to respiratory illnesses and severe back pain. There have been numerous studies on the effects of charcoal production on the respiratory system (Tzanakis et al., 2001 and Souza et al., 2010). The overall conclusion is that exposure results in increased respiratory symptoms and decreased pulmonary function. Residents in
Massamba maintain that they have no other alternative to subliment income from agricultural activities other than the production of charcoal.

5.3 Fuelwood

All the villages visited appear to be able to access fuelwood easily in the immediate vicinity of the village or within 1 km of the village. It is mostly dry wood that is used and there appears to be no particular preferences or selectivity in the type of wood used. Respondents indicated that one long branch of wood would be sufficient for one day of fuelwood. There are currently no households involved in the sale of fuelwood and no local market for fuelwood appears to exist. Charcoal is not generally used for fuel by local residents in Mbuzi Village and Nhambia Mtoli Village but is sold to residents in Tete as described above. In Massamba Village charcoal is both sold and used for fuel. Due to the easy accessibility of fuelwood it is unlikely that the construction of the proposed mine would impact on the use of fuelwood resources.

5.4 Fishing

All project affected villages occur within relative close proximity to the rivers within the study area. Artisanal fishing activities take place within all of the villages interviewed and thus provides an important source of protein to supplement the diet of the local people. A variety of fishing gear is used throughout the communities including, fish fences made from wooden stakes and reeds (constructed across the river channel to trap fish upstream), hook and line, dip nets and seine and gill nets. The preferred method of fishing seems to be via sein and gill nets with the aid of dug-out canoes. This practice is usually undertaken in groups of 5 people, where one person would paddle to approximately the middle of the river in a dug out canoe and drop the net. The other 4 people will remain on the river bank and drag the net in once dropped. Nets are bought in Tete for 150 Metica is each. Dug-out canoes are made locally from a variety of tree species, including Ficus sycomorus, Sterculia africana, Philenoptera sp., Cordyla africana and Sclerocarya birrea. These trees are felled and then “dug-out” with hand size tools similar to hoes. Respondents stated that hardwood species are preferred for the construction of canoes as these have a significantly higher lifespan (± 12 years) compared to those constructed from softwood trees (± 3 years). This is due to the fact that hardwoods are generally more resistant to decay.

Fishing is undertaken during the dry season (May to early November) only, this is due to high water levels during the rainy season. During the dry season, the water level recedes and as a result fish accumulate in shallow pools and streams making fishing easier and resulting in greater catches. There are no informal or formal fish markets within the area for the sale of locally-caught fish, fish is usually only sold within each community. On the rare occasion that surplus are available the small fish are salted, dried and sold in Tete. The average price of fish within the various villages depends on the size of the catch and can be summarized as follows:

- 0.5 m in length – 100 Metica is
- 1 m in length – 150 Metica is
- 1.5 m in length – 250 Metica is
- 12 x Hand Size (± 19 cm) – 40 Metica is
- Heap of small fish (as shown in Plate 5.5 B) ± 60 fish per heap – 50 Metica is

According to the Fish Assessment (CES, 2013) undertaken for this project both the in-stream and riparian habitat integrity of the Revuboe River and Ncondezi River (Figure 1.2) in the Study Area are considered largely unmodified with the ecosystem functioning being essentially unchanged compared to the undisturbed state and there was no evidence that large-scale fishing activities take place in the Study Area. Based on this and the fact that fishing is restricted to the dry season (fish generally breed and spawn during the wet season), there is no evidence of overfishing occurring within the area. However, it should be noted that according to respondents in Mbuzi Village there has been a decline in the size of catches over the past 10 years. The reason for this remains unclear.
Plate 5.5: Fish caught in close proximity to Nhambia Mtoli Village

One of the major threats to local fishermen within the project affected area is the vast number of crocodiles that populate the rivers within the study area and there have been numerous reports of injuries and death related to this particular reptile. Any crocodiles caught in nets are dragged to shore and killed and the carcasses burned. Respondents noted that the crocodiles caught in the nets and subsequently killed are generally relatively small as the larger crocodiles easily escape the nets. Locals have reported crocodiles up to 2 m in length in the area. Crocodiles are not actively hunted and usually just avoided when spotted on the river banks.

5.5 Food Gathering

Various plants are utilised for consumption (Plate 5.6) at different times during the coarse of the year (mainly during the dry season) to supplement food supplies. A list of edible species is available in Table 5.3 below.

<table>
<thead>
<tr>
<th>LOCAL NAME</th>
<th>SCIENTIFIC NAME</th>
<th>COMMENT</th>
<th>EDIBLE COMPONENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Luni</td>
<td>Cleome gynandra</td>
<td>Tree found around villages</td>
<td>Leaves</td>
</tr>
<tr>
<td>Malambe</td>
<td>Adansonia digitata</td>
<td>Tree found in Open Zambezian Undifferentiated Woodland</td>
<td>Leaves</td>
</tr>
<tr>
<td>Malambe</td>
<td>Adansonia digitata</td>
<td>Tree found in Open Zambezian Undifferentiated Woodland</td>
<td>Fruit</td>
</tr>
<tr>
<td>Mango</td>
<td>Mangifera indica</td>
<td>Tree found around villages</td>
<td>Fruit</td>
</tr>
<tr>
<td>Canhueiro</td>
<td>Sclerocarya birrea</td>
<td>Tree found in Open Zambezian Undifferentiated Woodland</td>
<td>Seed</td>
</tr>
<tr>
<td>Massaniqueira</td>
<td>Zizipus abyssinica</td>
<td>Tree found in Riparian woodland</td>
<td>Fruit</td>
</tr>
<tr>
<td>Moringa</td>
<td>Moringa oleifera</td>
<td>Tree found around villages</td>
<td>Leaves</td>
</tr>
<tr>
<td>Mushrooms</td>
<td>All edible species</td>
<td>-</td>
<td>Leaves</td>
</tr>
<tr>
<td>Nchenge</td>
<td>Bridelia mollis</td>
<td>Tree found in Riparian woodland</td>
<td>Fruit</td>
</tr>
<tr>
<td>Location</td>
<td>Tree/Plant</td>
<td>Description</td>
<td>Resource Type</td>
</tr>
<tr>
<td>----------</td>
<td>------------</td>
<td>-------------</td>
<td>---------------</td>
</tr>
<tr>
<td>Njale</td>
<td>Sterculia africana</td>
<td>Tree found in Open Zambezian Undifferentiated Woodland</td>
<td>Seed/Leaves</td>
</tr>
<tr>
<td>Ntheme</td>
<td>Strychnos sp.</td>
<td>Tree found in Open Zambezian Undifferentiated Woodland</td>
<td>Fruit</td>
</tr>
<tr>
<td>Ntoa</td>
<td>Diplorhynchus condylocarpon</td>
<td>Tree found in Open Zambezian Undifferentiated Woodland</td>
<td>Edible Worms</td>
</tr>
<tr>
<td>Ntove</td>
<td>Diceroxyrum senecioides</td>
<td>Tree found in Open Zambezian Undifferentiated Woodland</td>
<td>Leaves</td>
</tr>
<tr>
<td>Ntondo</td>
<td>Cordyla africana</td>
<td>Tree found in Open Zambezian Undifferentiated Woodland</td>
<td>Fruit</td>
</tr>
<tr>
<td>Ocra</td>
<td>Abelmoschus c.f. esculentus</td>
<td>Tree found in Open Zambezian Undifferentiated Woodland</td>
<td>Seed Pods</td>
</tr>
<tr>
<td>Ussica</td>
<td>Tamarindus indica</td>
<td>Tree found in Open Zambezian Undifferentiated Woodland</td>
<td>Fruit</td>
</tr>
<tr>
<td>Xilhacue</td>
<td>Ficus sycamorus</td>
<td>Tree found in Riparian Woodland</td>
<td>Fruit</td>
</tr>
</tbody>
</table>

Plate 5.6: (A) Flower of *Diceroxyrum senecioides* (B) Seedpod of *Abelmoschus c.f. esculentus*

### 5.6 Hunting

Hunting appears to be another source of wild food, and takes place extensively throughout the project affected area. A large variety of animals within the area are hunted, including monkeys, buck, elephant, mice, rabbits, birds, bushpigs, tortoises and lizards. Hunting mainly takes place for consumption purposes, however meat is also sold locally within each village. No formal markets for the sale of meat were present in any of the villages visited. The only meat sold outside of the villages themselves are mice (on occasion sold in Tete) and buck (on occasion sold at the Malawi
There are a variety of measures used for the hunting of animals, these include utilizing packs of dogs, traps, snares and on the rare occasion guns. Large packs of dogs are found in every village within the project affected area (Plate 5.7). Hunters usually burn sections of the forest resulting in the removal of the majority of foliage within that section. The animals within that area seek shelter within the remaining foliage which makes them easy to spot by hunters. The hunters will then scare the animals by throughing rocks at them. Once the animals run for cover the dogs are let loose in order to catch the prey. This method is mainly employed for smaller game such as rabbits and monkeys. Another way of achieving this goal is by local residents standing guard on the outskirts of the area burning. As the animals flee from the fire local residents capture them. This method has been documented in other areas of Mozambique. Rabbits and monkeys are usually hunted towards the middle and the end of the dry season (August to September). Respondents claim that burning is more difficult in the rainy season and in addition to this the forest is too dense and rabbits and monkeys are thus not easily spotted. According to respondents involved in hunting in the study area the average number of rabbits caught varies significantly between hunters and villages. However, it was stated that up to 15 rabbits can be caught in a single day. Rabbits are sold for between 50-150 Meticais each, within the villages. According to participants in focus group meetings the quantity of monkeys within the area has been reduced considerably during the last five to ten years. According to one respondent in Mbuzi Village the number of monkeys caught 5 years ago could easily be as high as 5 per day. However, recently these numbers have decreased to 5 per year. In Nhambia Mtoli Village it was stated that a maximum of 1 monkey per month is caught, showing that the numbers caught vary significantly between villages, but are generally lower than other animals hunted. Respondents stated that the decline in numbers is due to the fact that “the monkeys have moved to the mountains”, however based on the numbers hunted it is more plausible that the reduction is due to severe overutilization by the local people. Monkeys are usually sold for 100-300 Meticais. Villagers stated that the meat from monkeys is not particularly appetizing, and thus sought after by very few people.

According to participants, Cercopithecus pygerythrus (vervet monkey) is listed on Annex II of Decree No 12 of June 6, 2002 as protected and thus hunting of this species is prohibited in Mozambique. This species was recorded on site by the faunal specialist in both the wet and dry seasons and it is highly likely that they are being hunted despite moratorium. The current fine imposed for hunting vervet monkey is 1 000 Meticais.

Plate 5.7: Domestic dogs used for hunting

Hunting is also undertaken by means of traps (Plate 5.8). Traps are made locally with materials purchased in Tete. The average traps cost approximately 300 Meticais to make and is sold for 400 Meticais to residents within the villages who are unable to make traps themselves. Hunters search for animals tracks within the forest and bury the traps in areas frequented by mainly a variety of species of buck including, impala, grysbok and bushbuck. Traps are covered with leaves and sand and left for 24 hours after which they are checked and if necessary reset. It was stated that these traps usually have a 5-6 year lifespan and thus do not need to be replaced very often. Buck are usually hunted towards the middle and the end of the dry season (August to September).
Respondents claim that during the wet season the forest is too dense and tracks are not easily spotted. According to respondents involved in hunting in the study area the average number of buck caught varies significantly between hunters and villages. However, it was stated that up to 3 buck can be caught in a single day. Buck are sold for between 400-500 Meticais each, within the villages and at the Malawi border. It should be noted that Oreotragus oreotragus (klipspringer) Hippotragus equinus (roan antelope) is listed on Annex II of Decree No 12 of June 6, 2002 as protected and thus hunting of this species is prohibited in Mozambique. According to the faunal assessment there is evidence of historical occurrence of these species in the study area. The current fine imposed for hunting these species are 2 000 and 8 500 Meticais respectively.

Plate 5.8: Traps used by local hunters

Snares are mainly used for hunting bushpigs. Noose snares are made from wire and secured to large trees approximately 0.5 m above the ground wherever tracks are found. The noose works by tightening around the animals neck and the noose is then too small to allow the animal to get its head out and it is unable to escape. Bushpigs are mainly hunted in Massamba Village during the months of May to December (dry season). This is due to the fact that tracks are difficult to spot during the wet season when the surrounding forest is dense. Respondents stated that a maximum of 2 bushpigs are caught a week. Bushpigs are sold for 1 200 Meticais each.

In addition to the animals listed above, elephants are also hunted within the area, although not actively. Local residents complained that elephants are an extreme nuisance within the area, since they destroy agricultural fields and consume crops prior to harvesting. There has also been reports of silos being destroyed and the content consumed by elephants, resulting in a shortage of food supplies and a reduction in income. The majority of respondents were adamant that no elephants are hunted within the area, mainly due to the fact that they do not own or have access to guns. In those instances elephants are simply chased away by making noise, playing drums, throwing stones, using fire, etc. However, some respondents did in fact admit to killing elephants due to the fact that they reduce crops and pose a safety hazard to the villagers. Locals are very aware of the fact that elephant poaching is illegal and are hesitant to discuss the hunting of elephant within the area. When asked what happens to the ivory from killed elephants locals simply stated that it was illegal to sell ivory in Mozambique. Elephant meat is sold within the villages for 40 Meticais a kilogram. It was noted that elephants are of particular concern during the dry season (March to December), probably due to the fact that the Revuboe River would be the closest water source during this period as smaller streams recede or dry up during the dry season.

It should be noted that elephants are not listed on Annex II of Decree No 12 of June 6, 2002 as protected and thus may be hunted if a hunting license is acquired. It should also be noted that elephants are listed on Appendix 1 of CITES, meaning that elephants in this area are threatened with extinction and thus the trade in specimens of these species is permitted only in exceptional circumstances. In accordance with CITIES the Government of Mozambique has compiled a strategy and action plan for the conservation and management of elephants in Mozambique.
(Ministry of Tourism, 2010). This strategy and action plan “seeks to maintain and, where possible, increase the numbers and range of elephant populations, their habitats and associated biodiversity, ensuring full economic benefit to national and local development, including the communities with whom they share the land”. It is stated that “this will be achieved by conserving elephants and their range through the provision of effective protection; managing elephant populations in collaboration with local stakeholders; reducing HEC through mitigation, spatial planning and increased community benefits; ensuring an efficient and effective institutional and organisational framework for elephant management; enhancing elephant conservation through policy and legislative change and unified management; and better communication at all levels and sectors of society.” (Ministry of Tourism, 2010).

Mice are also actively hunted in the project affected areas and up to 20 mice can be caught in a single day by a single hunter. Mice are hunted during the months of April to September. According to respondents mice are not caught during the months of November to March as this results in illness in the local people with symptoms including skin rashes, fever, nausea and coughing. This however has not been confirmed and no mention of diseases carried by rodents were made in the questionnaire distributed by the health specialist. Mice are sold both locally and in Tete. Ten mice are sold for 20 Meticais.

A number of reptiles are hunted opportunistically in the area, these include tortoises and lizards. Snakes are not hunted in the area as they are feared by the local people. Reptiles are caught when come across in the forest usually between the months of January and June. According to respondents in Tenge Village up to 60 tortoises could be caught in a single month. Tortoises are boiled in clay pots, removed from the shell, sliced and fried in oil and are sold for 50 Meticais each. Varamus albigularis (rock monitor) and Varamus niloticus (water monitor) are also hunted opportunistically within the area. The former are sold both locally (200 Meticais each) and in Tete (300 Meticais each). Approximately 15 of these reptiles are caught per annum. Varamus niloticus are only sold locally (200 Meticais). Up to 20 of these reptiles can be caught in a single month.

Birds are caught with the aid of latex from *Euphorbia c.f. cooperi* (Plate 5.9). The latex is heated in a clay pot until relatively hard and then smeared on a piece of a branch. The latex smeared branches are placed in nearby trees. Once a bird rests on the branch it gets stuck and is thus easily caught.
Hunting in Mozambique is governed by Law No. 10 of 7 July 1999 and Decree No. 12 of 6 June 2002. According to these legislation a hunting licence is required for exploitation, trade, use and transportation of forest and wildlife products by land, river, sea or air. There are three types of licences: (1) simple hunting licence, (2) sport hunting and (3) commercial hunting. Articles 21, 22, and 23 of Law 10 define the various hunting categories. According to Article 46(2) of Decree No. 12 hunting is not permitted from the 1st of October to the 31st of March. Based on the information provided by focus group members it is clear that some hunting does indeed occur during the closed season in the project affected area. In addition to this, according to Article 47(2) the use of snares, traps and tranquiliser guns is only permitted for research purposes by, for example, zoos and museums. Local residents in the area thus do not comply with these regulations as traps and snares are utilized throughout the area. Violations of these laws are punishable by a fine and mandatory measures to restore or compensate the damage caused. The Council of Ministers (competent authority) is responsible for regular updating of the amounts of the fines provided for in Law No. 10. If the fine is not paid voluntarily, the offender is subject to the consequences provided for in the criminal court in the jurisdiction where the offense was committed, regardless of the appropriate administrative and civil procedures.

The following violations are punishable by a fine of 2,000 Meticais to 100,000 Meticais:

- Practicing any acts that disturb or harm the wildlife in protected areas;
- Hunting without a license or in breach of the conditions established by law;
- Importing and/or exporting forest and wildlife resources without a license, or in breach of the conditions established by law;
- Abandoning forest and wildlife products that are the object of a license.

In addition to this, according to article 254 of the Mozambican Penal Code, a person who hunts during the months when hunting is prohibited, or in the months when hunting is permitted but by using prohibited means, is punishable with three days in prison and a fine.

Based on the information above it is evident that hunting currently places a significant impact on
the environment and is not efficiently regulated within the region. The number of animals hunted is staggering and the slash and burn practices for hunting with dogs causes a significant impact on both the fauna and the flora within the area. It is possible that mining may add additional pressure on these resources due to the influx of people to the area.

5.7 Bee Keeping

Bee keeping takes place in the majority of villages throughout the area. Local residents involved in this practice make artificial hives (Plate 5.10) by cutting a portion (usually 1.5 m in length with a diameter of 0.5 m) of a specific species of tree (mainly the Marula tree, Sclerocarya birrea) and then carefully stripping off the bark, maintaining the cylindrical shape. The artificial hive is closed off on one side and then hoisted into and hung from a tree either in close proximity to the village or in the forest. Locals gather dried grass, set it a light and place it inside the hive. Heat from the burning grass magnifies resins within the bark which attracts bees to the artificial hive. Once the hive is established it is left for approximately 3-4 months after which the honey is harvested from the hive. According to the locals once bees start to accumulate on the outside of the hive it is a sign that the hive contains honey and that it can be harvested. This is done by placing a roll of burning grass inside the hive, which causes the bees in the hive to move out of the way so that the honey can be removed. This is usually done at 6pm. Locals complained that they do usually get stung significantly during the harvesting process and it is on occasion so intense that it results in harvesting being unsuccessful. Bee stings are treated by heating the area of skin around the sting to reduce swelling.

According to respondents, approximately 20 litres of honey can be harvested from a hive of average size (1.5 m in length with a diameter of 0.5 m), approximately 3 times per annum. Honey is both consumed and sold locally within the villages at 30-40 Meticais per 500 ml. The smallest village within the project affected area is Nhambia Mtoli which consists of 54 families. According to the chief the village had approximately 100 hives at the time of the focus group meetings. Thus, based on 20 litres of honey per hive at 30 Meticais per 500 ml of honey and harvesting 3 times per annum, beekeeping has the potential of generating an income of 360 000 Meticais per annum. In Massamba (the largest village with 377 families, 8-10 people per family) it is reported that there are more than 1000 hives, resulting in an annual income of 3.6 million Meticais. Bee-keeping is thus an important source of income within the project affected area. However, according to Dr Garth Cambray (a specialist in this field), the harvests suggested by the local beekeepers seems to be overestimated. This is based on his personal experience in both Mozambique (Beira) and the Democratic Republic of Congo (Kinshasa) where harvests from log hives were documented to be 10kg per year and 5 kg per year respectively. This, however, still results in an income of 600 000 Meticais per annum in Massamba.

Plate 5.10: Constructed beehive

The proposed mine may impact directly on bee keeping within the area since beehives are kept within the forest and could thus be removed during clearing for mining and the construction of associated infrastructure. The mine could also indirectly impact on beekeeping activities by
reducing the availability of suitable material for the construction of artificial hives as approximately 8 000 ha of vegetation will be cleared. However, it should be noted that current community beekeeping activities in itself has a large impact on the woodlands in the area since trees are felled for the contraction of hives. The quality of the honey produced is low due to grass, sticks and other impurities present in the hive. One option worth exploring is the initiation of a beekeeping project and the supply of hives as part of the proponent’s social corporate responsibility scheme may reduce the impact on vegetation caused by the communities and reduce the impact on the loss of community hive material by the proponent as well as have a positive impact on the quality of honey produced. Box 1 below shows some simple interventions to increase the value of honey (Dr Garth Cambrey, pers. Comm.).

Box 1: Interventions to increase the value of honey within the project affected area
(Source: Dr Garth Cambrey)

<table>
<thead>
<tr>
<th>Intervention 1: Honey Grading</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beekeepers are provided with dedicated honey buckets - when robbing a hive the honey is removed and placed into three buckets depending on grade - ie - virgin white comb (gives grade A export honey) white and yellow comb (Grade B honey for local market) and brown comb (Grade C) which is industrial honey which can be exported at low price, or sold locally.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Intervention 2: Simple Hives</th>
</tr>
</thead>
<tbody>
<tr>
<td>There are a number of simple hives which can be made with introduced yet abundant industrial materials that are better than log hives. These include drum hives, tyre hives etc. These increase honey quality, but not necessarily yield.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Intervention 3: Modern Hives</th>
</tr>
</thead>
<tbody>
<tr>
<td>Such as expanded polyurethane foam hives - which termite resistant, and which can allow a beekeeper to produce very high quality honey</td>
</tr>
</tbody>
</table>

It should be noted that there is currently probably not a market for high grade honey within the area, thus it is suggested that any proposed community project starts with the grading of honey and work on a long term goal to very gradually upgrade beekeepers to commercial hives over a ten year period.

5.8 Beer Production

Various villages within the potentially affected area engage in the production of beer. Beer is produced from sugar cane usually grown in close proximity to the villages and harvested throughout the year. Once harvested, the sugar cane is crushed and cut into small pieces. In addition to this the pulp is mixed with maize crop residue, left over from the harvest. A clay pot is then half filled with the sugar cane and residue mixture and water. This mixture is left standing for 7 days after which the clay pot is sealed and heated on a fire. The clay pot is attached to a still (Plate 5.11), which is made from a hollowed out tree that is filled with water and fitted with a steel pipe. These steel pipes are bought in Tete and lasts approximately 1 year. The heat from the fire causes the juice to evaporate and the vapour passes through the still and the pipe. The water in the hollowed out tree serves to cool the still so that the vapour is condensed back to a clear liquid which is collected at the other end. The beer is stored in 20 litre plastic jugs.

Beer is only sold locally within villages and whatever is not sold is consumed. Beer is usually sold for 35 Meticais per 500 ml.
5.9 Medicinal Use

According to respondents, there are no hospitals within the project affected area, the closest hospital is the Provincial Hospital in Tete, approximately 50 km from site. The closest government clinic is located at the administrative post of Kazula. This information has been confirmed by the proponent. There are however, 3 First Aid Care Units run by Red Cross Mozambique (Cruz Vermelha de Moçambique). One is located in Muchena, the second in Massamba (within project affected area) and the third in Mateacale. For this reason the residents within the area rely heavily on traditional medicine and all villages have at least one herbalist. Respondents stated that only in extreme cases of illness western medicine will be sought. If someone becomes gravely ill, family members and friends will build a makeshift stretcher and the patient will then be carried to the bus stop from where the patient will travel by bus to the clinic in Kazula.

Local herbalists in the area did not want to discuss the use of traditional medicine as they are dependent upon their secrets for their livelihoods, however some of the more common species are listed below in Table 5.4.

Table 5.4: Plants used for medicinal purposes

<table>
<thead>
<tr>
<th>LOCAL NAME</th>
<th>SCIENTIFIC NAME</th>
<th>COMMENT</th>
<th>PREPARATION</th>
<th>USE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chicio</td>
<td>Acacia c.f. galpnii</td>
<td>Tree found in open Zambezian undifferentiated woodland</td>
<td>Pods are crushed and the juice used as ear drops</td>
<td>Ear Ache</td>
</tr>
<tr>
<td>Gorongoza</td>
<td>Terminalia sericea</td>
<td>Tree found in open Zambezian undifferentiated woodland</td>
<td>Roots are chopped into small pieces, then place in a clay pot with water. The mixture is consumed after approximately 4 hours.</td>
<td>Stomach Ache</td>
</tr>
<tr>
<td>Kanvula Nkalamba</td>
<td>Heart shaped creeper (not identified)</td>
<td>-</td>
<td>Roots are chopped into small pieces. The pieces are then consumed with water.</td>
<td>Stomach Ache</td>
</tr>
<tr>
<td>Kapande</td>
<td>Lecaniodiscus</td>
<td>Tree found in</td>
<td>Roots are chopped into</td>
<td>Malaria and</td>
</tr>
<tr>
<td>LOCAL NAME</td>
<td>SCIENTIFIC NAME</td>
<td>COMMENT</td>
<td>PREPARATION</td>
<td>USE</td>
</tr>
<tr>
<td>------------</td>
<td>----------------</td>
<td>---------</td>
<td>-------------</td>
<td>-----</td>
</tr>
<tr>
<td>fraxinifolius</td>
<td>closed Zambezian undifferentiated woodland</td>
<td>small pieces and left in the sun to dry. Once dried, roots are ground into a powder. Shallow cuts are made along the temples and forehead. The powder from the roots are then smeared into the cuts.</td>
<td></td>
<td>Headache</td>
</tr>
<tr>
<td>Mulangane</td>
<td>Combretum imberbe</td>
<td>Tree found in open Zambezian undifferentiated woodland</td>
<td>Juice from leaves are used as eyedrops</td>
<td>Sore Eyes</td>
</tr>
<tr>
<td>Mulangane</td>
<td>Combretum imberbe</td>
<td>Tree found in open Zambezian undifferentiated woodland</td>
<td>Leaves are crushed and the juice consumed</td>
<td>Stomach Ache</td>
</tr>
<tr>
<td>Moringa</td>
<td>Moringa oleifera</td>
<td>Tree found around villages</td>
<td>Leaves are crushed and the juice consumed</td>
<td>Urinary Tract Infections</td>
</tr>
<tr>
<td>Nchinge</td>
<td>Bridelia mollis</td>
<td>Tree found in riparian woodland</td>
<td>Roots are cut and placed in the bath water</td>
<td>Wash newborns up to 2 month old</td>
</tr>
<tr>
<td>Ncolobue</td>
<td>Unidentified species</td>
<td>Leaves are crushed and the juice is placed on the wound</td>
<td></td>
<td>Snakebites</td>
</tr>
<tr>
<td>Ndama</td>
<td>Combretum adenogonium</td>
<td>Tree found in open Zambezian undifferentiated woodland</td>
<td>Crush roots is placed in a clay pot and mixed with water. Locals will wash their faces in this mixture at sunrise and sunset</td>
<td>Difficulty with vision</td>
</tr>
<tr>
<td>Nonde</td>
<td>Xeroderis stuhlmanni</td>
<td>Tree found in open Zambezian undifferentiated woodland</td>
<td>Juice from leaves are used as eyedrops</td>
<td>Sore Eyes</td>
</tr>
<tr>
<td>Ntongo</td>
<td>Cordyla africana</td>
<td>Tree found in Riparian Woodland</td>
<td>Roots are chopped into small pieces, then place in a clay pot with water. The mixture is consumed after approximately 2 hours</td>
<td>Cough</td>
</tr>
<tr>
<td>Ntxeteco</td>
<td>Burkea africana</td>
<td>Tree found in open Zambezian undifferentiated woodland</td>
<td>Roots are chopped into small pieces and left in the sun to dry. Once dried, roots are ground into a powder. Shallow cuts are made along the temples and forehead. The powder from the roots are then smeared into the cuts</td>
<td>Malaria</td>
</tr>
<tr>
<td>Ntxinga</td>
<td>Albizia anthelmintica</td>
<td>Tree found in open Zambezian undifferentiated woodland</td>
<td>Bark is placed in the bath water</td>
<td>Pimples</td>
</tr>
<tr>
<td>Nvumbo</td>
<td>Kigelia africana</td>
<td>Tree found in open Zambezian undifferentiated</td>
<td>Fruit heated on fire pressed on abscess</td>
<td>Abscess</td>
</tr>
<tr>
<td>LOCAL NAME</td>
<td>SCIENTIFIC NAME</td>
<td>COMMENT</td>
<td>PREPARATION</td>
<td>USE</td>
</tr>
<tr>
<td>------------</td>
<td>----------------</td>
<td>---------</td>
<td>-------------</td>
<td>--------------</td>
</tr>
<tr>
<td>Tsionk</td>
<td><em>Euphorbia c.f. cooperi</em></td>
<td>Tree found in open Zambezian undifferentiated woodland</td>
<td>Thin slice of bark placed on wounds</td>
<td>Wounds and Scratches</td>
</tr>
</tbody>
</table>
6. MANAGEMENT OF NATURAL RESOURCES

6.1 Knowledge

Our interviews with respondents demonstrated that most local residents, including very young children, had considerable knowledge of the plants and trees used for food consumption and construction purposes. They also had a clear understanding of the boundaries of their village’s resource areas, and of the rules and laws of use. Most people confirmed that they understood that charcoal production was regulated and the hunting of certain animals were prohibited. This knowledge stems from considerable reliance on these resources for basic household needs and livelihood activities.

6.2 Management

After a number of constitutional amendments in 1990 had introduced the need to revise the legal framework for land and natural resources, the government of Mozambique embarked upon a rather piecemeal process to develop a new policy and institutional framework for natural resource management. The main pillars of this framework consist of various pieces of legislation dealing with specific natural resources, such as the Land Law, the Forestry and Wildlife Law, the Mining Law and their related regulations and annexes. These sector packages have tended to be developed in isolation of one another and on the basis of sector-specific objectives.

The Mozambican Constitution states that the people have a right to live in a clean environment and to use the natural resources for their benefit without harming their availability and quality for the next generation. In order to guarantee the previous statement an institutional and legal framework had to be adopted. In 1995, the Ministry for Coordination of Environmental Affairs (Ministério para a Coordenação da Acção Ambiental - MICOA) and a National Environmental Management Program (NEMP) were established. In 1997, the Environmental law (Law Nº 20/97) was passed. It provided the legal framework for managing the use of natural resources and the outflows of pollutants into the environment. It also aimed at ensuring the sustainable development of Mozambique. Listed below are some of the relevant policies on renewable natural resources and the regulation of their use which have been recently adopted to guide sustainable development in the country:

- Land
  - Land law (19/1997)
  - Land law regulations (66/1998)
  - Technical appendix to the Land law (1999)
- Environment
  - Environmental law (20/1997)
  - Regulation for Environmental Impact Assessment (76/1998)
- Forestry and Wildlife
  - Policy and Strategy for Development of Forestry and Wildlife (8/1997)
  - Forestry and wildlife law (10/1999)
  - Forestry and wildlife regulations (2002)
- Agriculture
  - Agricultural sector investment program, with a Forestry and Wildlife National Program adopted in 1998 (including a component in support of government initiatives towards the implementation of Community Based Natural Resources Management (CBNRM)).
- Water
  - Water Policy (7/1995)
- Fisheries
  - Fisheries Law (3/1990)
These policies are relevant due to the fact that they determine access to resources by the almost 80% of the rural population who are considered to live below the poverty line (less than one dollar a day, to use the universal indicator). The Forestry Law regulates the use of forest resources. The Forest and Wildlife Act (Nº 10/99) promotes the conservation, protection and sustainable use of forest and wildlife resources. The Water law (Nº 16/90) regulates the use of watercourses both at the national and regional scale. The Fishery Law provides the management, licensing and control mechanisms for this activity. Environmentally related regulations are also concerned with mining and maritime activities. The Forestry and Wildlife Policy aims to have greater involvement of local communities in the management of natural resources and ensure that they receive benefits from those resources. The main foundation for implementation of this strategy is the existence of the Land Law, which establishes that communities can have access to land through land delimitation process and acquisition of a Land Use Certificate. However, the challenge has been for the communities to secure these rights. The Forestry and Wildlife legislation introduces the concept of participatory management, delegation of responsibilities and empowering local communities for management and control of their natural resources and creating legal mechanisms of sharing of benefits. Although, the legislation is supposed to have direct links with the communities, we may find that in many cases the community-based organizations are very poor consequently institutional linkages are weakened.

The Land law (Law Nº 19/97) constitutes another important regulation for the management of natural resources. It more particularly contributes to the protection and management of the environment as it regulates the use of land and natural resources. It states that all Mozambicans have a right to use the land. In accordance, land cannot be bought or sold and all natural resources in Mozambique belong to the State. In other words, no private ownership of resources is possible. The land law does however recognise the rights of people or communities to use the land and sell assets on it. The only possibility of conferring ownership over the right of use on land is given by the State through renewable concession titles, which are also transferable. The Land law also designates areas for special protection and conservation (total and partial protection zones). Total protection zones are those for nature conservation or preservation activities and those for state security. Partial protection zones are located in the interior water banks and cover the strip of 100 meters from the natural sources of water. Thus, activities along the rivers or natural sources of water should be carried out respecting this law.
7. IMPACTS OF MINING ON NATURAL RESOURCES

This Chapter has been divided into two sections. This first (Section 7.1) deals with existing impacts on natural resources such as current land use activities i.e. slash and burn practices to acquire farmland, charcoaling, hunting, etc. The second sections (Section 7.2) deals with the potential impacts of the mine on land and natural resource use.

7.1 Existing impacts on natural resource use

7.1.1 Issue 1: Over-exploitation of resources

At present there is a considerable degree of resource utilisation; people collect plants and wild animals from the project affected area that provide for their needs with respect to health, shelter, food and income.

Impact 1: Harvesting of wood for building purposes

**Cause and comment:** The Mopane tree is preferred by all locals for building purposes due to its hardness which also makes it termite resistant, even though a variety of other local tree species are also used. Wood is harvested for the production of furniture, construction of dwellings, tools and dug-out boats. The amount of wood required for these purposes is relatively low when compared to other resource uses in the area as structures do not have to be replaced very often. In addition to this, brick-making also occur within the area, releasing some of the pressure on wood resources required for construction.

**Significance Statement:** It is probable that communities will continue to harvest wood for construction purposes. The nature of the impact is considered to be medium term due to the fact that alternatives are available (bricks) and that structures are not replaced very often and thus it is anticipated that some regrowth may occur. The impact is of low severity and of LOW significance.

<table>
<thead>
<tr>
<th>Temporal scale</th>
<th>Spatial scale</th>
<th>Likelihood</th>
<th>Severity</th>
<th>Significance</th>
<th>Severity</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medium Term</td>
<td>Study area</td>
<td>Probable</td>
<td>Low</td>
<td>LOW</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Impact 2: Excavation of termite mounds

**Cause and comment:** Locals in Mbuzi Village excavate clay from termite mounds for the making of bricks. Only portions of the mounds are excavated, however this may result in the opening of the mounds resulting in termites being more vulnerable to various insectivores.

**Significance Statement:** It is possible that communities will continue to excavate clay from termite mounds. The nature of the impact is considered to be medium term due to the fact that only portions of the termite mounds are excavated. The impact is of low severity since the majority of the colony reside below ground and thus of LOW significance.

<table>
<thead>
<tr>
<th>Temporal scale</th>
<th>Spatial scale</th>
<th>Likelihood</th>
<th>Severity</th>
<th>Significance</th>
<th>Severity</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medium Term</td>
<td>Localised</td>
<td>Probable</td>
<td>Low</td>
<td>LOW</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Impact 3: Harvesting of wood for the production of charcoal

**Cause and comment:** Charcoal is produced by cutting down hardwood trees that provide good quality charcoal. All of the villages within the project affected area with the exception of Tenge Makodwe Village participate in charcoal production, however it is only extensively practiced in Massamba Village. Up to 100 bags of charcoal can be produced per household per month, which
equates to 22 250 kg of wood utilized per household per month.

**Significance Statement:** It is *definite* that communities will continue to produce charcoal in the project affected area, due to the need to supplement income. The nature of the impact would be permanent as the above mentioned utilization is considered to be unsustainable. The impact is of high severity and of **HIGH** significance.

<table>
<thead>
<tr>
<th>Temporal scale</th>
<th>Spatial scale</th>
<th>Likelihood</th>
<th>Severity</th>
<th>Significance</th>
<th>Severity</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Permanent</td>
<td>Study area</td>
<td>Definite</td>
<td>High</td>
<td><strong>HIGH</strong></td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

**Impact 4: Fuelwood**

**Cause and comment:** All the villages visited appear to be able to access fuelwood easily in the immediate vicinity of the village or within 1 km of the village. For this reason fuelwood is not readily sourced from the forest.

**Significance Statement:** It is *probable* that communities will continue to harvest fuelwood, however it is unlikely that this will be from the proposed project area. The nature of the impact would be medium term. The impact is of low severity and of **LOW** significance.

<table>
<thead>
<tr>
<th>Temporal scale</th>
<th>Spatial scale</th>
<th>Likelihood</th>
<th>Severity</th>
<th>Significance</th>
<th>Severity</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medium Term</td>
<td>Localised</td>
<td>Probable</td>
<td>Low</td>
<td><strong>LOW</strong></td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

**Impact 5: Fishing**

**Cause and comment:** There are several active fisheries in the area (seine netting, line fishing, gill netting and fish trapping); these fisheries are important to the local fishermen, and provide an important source of protein to the local communities. No evidence of over-fishing was found in the study area. This was confirmed by the Ichthyologist, Dr Anton Bok.

**Significance Statement:** It is *probable* that communities will continue to fish in the area as fish is an important source of protein the the region. The nature of the impact is considered to be medium term as fishing only takes place during the dry season and not during the wet season when breeding and spawning usually occurs. The impact is of low severity and of **MODERATE** significance.

<table>
<thead>
<tr>
<th>Temporal scale</th>
<th>Spatial scale</th>
<th>Likelihood</th>
<th>Severity</th>
<th>Significance</th>
<th>Severity</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medium Term</td>
<td>Region</td>
<td>Probable</td>
<td>Low</td>
<td><strong>MODERATE</strong></td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

**Impact 6: Wild Foods**

**Cause and comment:** Various plants are utilised for consumption particularly at the end of the rainy season and during the dry season when food is scarce.

**Significance Statement:** It is probable that communities will continue to harvest wild foods from the forest. The nature of the impact is considered to be in the medium term as the majority of these plants are also grown within the villages. The impact is of low severity and of **LOW** significance.
Impact 7: Hunting

**Cause and comment:** Hunting is an important source of wild food, and takes place extensively throughout the project affected area. Hunting uses a variety of methods. These include utilizing packs of dogs, setting traps and snares, and on the rare occasion guns. According to Article 46(2) of Decree No. 12 hunting is not permitted from the 1st of October to the 31st of March. Based on the information provided by focus group members it is clear that some hunting does indeed occur during the closed season in the project affected area. In addition to this, according to Article 47(2) the use of snares, traps and tranquiliser guns are only permitted for research purposes by for example zoos and museums. Local residents in the area thus do not comply to these regulations as traps and snares are utilized throughout the area and throughout the year. There is also evidence that species that are listed as protected on Annex II of Decree No 12, such as the vervet monkey is actively being hunted in the area. Lastly, based on the information provided by respondents it is evident that hunting currently causes a significant impact on the environment and is not efficiently regulated within the region. The numbers of animals hunted are staggering and the slash and burn practices used for hunting with dogs is destructive and causes a significant impact on both the fauna and the flora within the area.

**Significance Statement:** It is definite that communities will continue to hunt in the area and due to the extent of overutilization this is considered to be on a regional scale. The nature of the impact would be permanent as current practices are not considered to be sustainable. The impact is considered to be very severe and of VERY HIGH significance.

Impact 8: Bee Keeping

**Cause and comment:** Bee keeping takes place in the majority of villages throughout the area. Local residents involved in this practice make artificial log hives from harvested trees. There is currently approximately 1500 hives within the project affected area, and each hive requires the felling of a tree.

**Significance Statement:** It is probable that communities will continue to harvest trees for the construction of log hives. The nature of the impact would be medium term. The impact is of moderate severity and of MODERATE significance.

Impact 9: Medicinal Plants

**Cause and comment:** A large number of plants are utilised for medicinal purposes. These plants however are not harvested on a regular basis but on a needs basis. In addition to this the majority of the plants utilised are not removed in their entirety since only specific parts of plants such as the roots, leaves, stems etc. are used for any particular cure.

**Significance Statement:** It is probable that communities will continue to harvest plants for
medicinal purposes. The nature of the impact would be medium term. The impact is of low severity and of **LOW** significance.

<table>
<thead>
<tr>
<th>Without mitigation</th>
<th>With mitigation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Temporal scale</strong></td>
<td><strong>Spatial scale</strong></td>
</tr>
<tr>
<td>Medium Term</td>
<td>Study area</td>
</tr>
</tbody>
</table>

**Impact 9: Species of Special Concern**

**Cause and comment:** None of the plant species utilised by local residents appear on the Mozambique Red Data List or the IUCN list. Only one species, *Euphorbia c.f. cooperi* is listed on CITES. A number of animal species utilized in the area, however do occur on the Mozambique Red Data List, IUCN and CITES, these include but are not limited to: bushbuck, grysbok, suni, impala, bushpig, elephants, aardvark, etc.

**Significance Statement:** It is definite that communities will continue to hunt and harvest species of special concern as currently their livelihoods depend upon this. The nature of the impact would be long term. The impact is of very high severity and of **VERY HIGH** significance.

<table>
<thead>
<tr>
<th>Without mitigation</th>
<th>With mitigation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Temporal scale</strong></td>
<td><strong>Spatial scale</strong></td>
</tr>
<tr>
<td>Long Term</td>
<td>Regional</td>
</tr>
</tbody>
</table>

7.1.2 **Issue 2: Existing impacts due to land use practices**

**Impact 1: Slash and burn clearing**

**Cause and comment:** The dominant form of shifting cultivation within the study area is slash and burn practices. This method involves the felling of smaller trees and shrubs which are then left to dry. Prior to the rainy season the dried timber is set alight and left to burn. These areas are mostly cultivated with maize, tobacco and legumes. The land is cultivated until it no longer yields sufficient produce (usually 3 years), at which time it is abandoned to naturally regenerate. The areas may be cultivated again within approximately 3 years.

**Significance Statement:** It is definite that communities will continue to clear land for farming using slash and burn practices. The nature of the impact would be long term. The impact is of high severity and of **HIGH** significance.

<table>
<thead>
<tr>
<th>Without mitigation</th>
<th>With mitigation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Temporal scale</strong></td>
<td><strong>Spatial scale</strong></td>
</tr>
<tr>
<td>Long Term</td>
<td>Study Area</td>
</tr>
</tbody>
</table>

7.1.3 **Issue 3: Existing impacts on water resources**

**Impact 1: Pollution of water resources**

**Cause and comment:** Water resources are used for anthropogenic activities such as bathing, swimming, etc. According to the Aquatic Ecology and Surface Water Quality Baseline Survey (CES, 2013), water in the region is generally of good quality. However, certain areas did test positive for *E.coli*.

**Significance Statement:** It is definite that communities will continue to utilise the water resources in the area. The nature of the impact would be long term. The impact is of moderate severity and of **MODERATE** significance.
### 7.2 Impacts of the proposed mining operation

#### 7.2.1 Impact 1: Loss of natural resources

**Cause and comment:** Approximately 8,000 ha of vegetation will be cleared for the construction of the mine and associated infrastructure. This will result in significant impacts on natural resource use since these resources provide households with building materials, food, medicine and income (namely charcoal production, bee keeping, etc.).

**Mitigation measures:**

- Villages must have controlled access to the proposed mining area prior to clearing commencing to harvest all available resources.
- Measures that would allow local residents to access the forest resources that are cleared must be implemented as this could help to meet local needs and reduce the pressure on the remaining forest resources in the short term.
- Any rehabilitation programmes must involve a stakeholder engagement process to determine the needs of the local communities and how these can be integrated into rehabilitation programmes.
- As part of the social corporate responsibility funding should be made available for the initiation of community projects such as a bee keeping project, establishment of woodlots, etc. These projects should be established in degraded areas in close proximity to villages and not in indigenous forest. This will also help to alleviate existing impacts on natural resources.

**Significance Statement:** It is definite that the removal of vegetation will be required for the construction of the mine and associated infrastructure. The nature of the impact would be long term as this is an open cast mine and thus rehabilitation options are limited. The impact is severe and of HIGH significance as these areas would have been regularly harvested and even cleared for agricultural purposes in time to come. The mine makes resources within its footprint unavailable to local communities. With mitigation measures in place this impact could be reduced to MODERATE significance.

#### 7.2.2 Impact 2: Loss of land during mining

**Cause and comment:** During the construction and operational phases of the project land will be disturbed to the extent that productive land use (agriculture) will not be possible. In addition to this local people will be excluded from this area and unable to utilise the land for grazing in the long term, as it is likely that the mining area will be fenced off.

**Mitigation Measures:**

- It is not possible to mitigate this impact.

**Significance Statement:** It is definite that access to parcels of land for agricultural purposes will be unavailable to local residents during the mining process. The nature of the impact would be long...
term as this is an open cast mine. The impact is of moderate severity and of MODERATE significance as this land would have been cleared and used to grow crops if mining did not take place.

<table>
<thead>
<tr>
<th>Temporal scale</th>
<th>Spatial scale</th>
<th>Likelihood</th>
<th>Severity</th>
<th>Significance</th>
<th>Severity</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Long Term</td>
<td>Study area</td>
<td>Definite</td>
<td>Moderate</td>
<td>MODERATE</td>
<td>Moderate</td>
<td>MODERATE</td>
</tr>
</tbody>
</table>

7.2.3 Impact 3: Clearing virgin land for small scale farming as a result of agricultural displacement

**Cause and Comment:** There are a number of agricultural land parcels within the proposed concession area. Locals who are economically displaced by the proposed development will need to clear additional, previously uncleared (virgin) areas within the forest to continue these livelihoods, resulting in an induced secondary impact.

**Mitigation Measures:**

- Baobab Resources will assist with the replacement of any arable land parcels that are lost due to their mining activity as part of the Resettlement Action Plan (RAP). This replacement must consider the ecological sensitivity of the replacement sites, and areas of high sensitivity must be avoided.
- Facilitate (including sourcing potential funders) alternative and environmentally sustainable forms of local economic and agricultural development. For example, establishing woodlots for charcoaling, bee keeping projects, improving agricultural practices to produce larger yield on existing land parcels etc.
- Monitor vegetation clearing activities by employees in the general project area, beyond the Baobab Iron Ore Mine Project boundaries, to determine if induced secondary impacts are taking place.
- Implement a programme to monitor the rate of vegetation clearing. Annual monitoring during the planting season must be carried out and must consist of monitoring the presence of and impacts on identified intact areas within the project area.

**Significance Statement:**

It is probable that communities will clear the adjacent forest due to being displaced by the mine. The nature of this secondary impact would be long term. The impact would be severe and of HIGH significance. The mitigation measures provided would reduce the extent of clearing, and avoid sensitive areas. The severity will become moderate, resulting in a MODERATE post-mitigation rating of the impact.

<table>
<thead>
<tr>
<th>Temporal scale</th>
<th>Spatial scale</th>
<th>Likelihood</th>
<th>Severity</th>
<th>Significance</th>
<th>Severity</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Long Term</td>
<td>Study area</td>
<td>Probable</td>
<td>Severe</td>
<td>HIGH</td>
<td>Moderate</td>
<td>MODERATE</td>
</tr>
</tbody>
</table>

7.2.4 Impact 4: Increasing demand for natural resources

**Cause and comment:** The proposed development is likely to result in the in-migration of job seekers, the employment and accommodation of mine staff, increased tourism (linked to improvements in infrastructure and increased demand for accommodation, meals and entertainment by mine staff), and increase trading opportunities. This influx of people needing accommodation, meals and entertainment and improved infrastructure is likely to increase the demand for charcoal, building materials, thatch and other natural resources. Of particular concern is increased pressure on the fauna in the area due to the purchase of bush meat by employees.
Mitigation Measures:

- An influx management plan must be developed to deal with the issue of in-migration in its entirety.
- The purchase of bush meat by employees must be strictly prohibited.
- Employees must be made aware of the illegality of hunting practices in the area, and be banned from doing so.
- As part of the corporate social responsibility funding should be made available for the initiation of community projects that will assist in reducing the need for bush meat, such as a animal husbandry project.
- Baobab Resources should discuss the possibility of establishing game guards in the area in conjunction with the regional authorities.

Significance Statement: It is probable that there will be in-migration to the area due to the potential for employment. The nature of this secondary impact would be long term and very severe and of VERY HIGH significance. The mitigation measures provided would reduce the severity slightly, but the impact is likely to remain of HIGH significance after mitigation, as some of the mitigation is difficult to implement and the effectiveness is unknown.

<table>
<thead>
<tr>
<th>Temporal scale</th>
<th>Spatial scale</th>
<th>Likelihood</th>
<th>Severity</th>
<th>Significance</th>
<th>Severity</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Long term</td>
<td>Study area</td>
<td>Probable</td>
<td>Very Severe</td>
<td>VERY HIGH</td>
<td>Severe</td>
<td>HIGH</td>
</tr>
</tbody>
</table>

7.2.5 Impact 5: Capacity of institutions to manage use of natural resources

Cause and comment: The capacity of local management institutions to effectively regulate the use of natural resources and ensure compliance with rules is expected to be undermined as a result of 1) the loss of forest resources and increasing pressure from existing population, 2) increasing demand for resources due to the influx of job seekers, mine employees, and tourists, 3) the lack of knowledge and reduced compliance with rules due to in-migration. It is already clear that local management institutions have struggled to control and restrict hunting practices amongst local residents in recent years. While there are rules and legislation in place, there is no compliance and the local authorities appear to have little ability to discipline offenders and ensure compliance. This impact will affect the concession area and immediate surrounds, but may also impact on areas further afield.

Mitigation Measures:

- Baobab Resources must discuss the possibility of establishing game guards in the area in conjunction with the regional authorities.
- The establishment of woodlots, a community bee keeping project and agricultural programmes must be considered as they could result in a reduction in harvesting from forested areas - which may alleviate some of the stress placed on local management institutions – and reduced hunting pressure.

Significance Statement: At present existing capacity to manage the natural resource use is limited, and degradation of the environment and over exploitation of wild life continues, resulting in a long term severe impact. The impact is of high severity and of HIGH significance. The mitigation measures would help to improve existing capacity, and mitigate this capacity constraint, resulting in an impact of MODERATE significance.

<table>
<thead>
<tr>
<th>Temporal scale</th>
<th>Spatial scale</th>
<th>Likelihood</th>
<th>Severity</th>
<th>Significance</th>
<th>Severity</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Long term</td>
<td>Regional</td>
<td>Probable</td>
<td>Severe</td>
<td>HIGH</td>
<td>Moderate</td>
<td>MODERATE</td>
</tr>
</tbody>
</table>
7.2.6 Impact 6: Pollution of water resources

**Cause and comment:** Local residents are heavily reliant on water resources in the project affected area. Various substances may result in the pollution of surface and groundwater sources. Construction and operation activities may lead to sediment being deposited into riverine areas or lakes, pollution from litter and general construction and operation wastes due to improper site management. Washing down of vehicles and equipment may result in the pollution of surface and groundwater sources, and pollution may occur from poor vehicle maintenance and improper storage of hazardous materials such as fuel, etc.

**Mitigation measures:**

- No rock, silt, cement, grout, asphalt, petroleum product, timber, vegetation, domestic waste or any deleterious substance should be placed or allowed to disperse into any river, wetland and/or lake.
- All construction equipment and vehicles are to be free of leaks from oil, fuel or hydraulic fuels.
- Concrete must not be mixed directly on the soil surface.
- Materials must be kept out of the rain to control runoff contamination at the source.
- Designate a contained area for vehicle parking, vehicle refuelling and routine equipment maintenance, away from wet areas and bermed if necessary.
- Major equipment or vehicle repairs should be conducted away from the construction site.
- Place dustbins and recycling receptacles around the site to minimise litter.
- A litter control programme must be implemented during the construction and operation phase to ensure that litter is contained on site. Litter should be disposed of at a registered waste disposal site.
- Clean up leaks, drips and other spills immediately to prevent contamination.
- Mud and sediment should not be allowed to be transported off site on to connecting roads.
- Wash water should not be allowed to disperse directly into natural wet areas.

**Significance statement:** There is a strong possibility that the development will create pollution during the construction phase. This impact is considered to be short term and can be minimized by various mitigation measures as included below. If mitigation is enforced the impact could be reduced to a LOW significance.

<table>
<thead>
<tr>
<th>Temporal scale</th>
<th>Spatial scale</th>
<th>Likelihood</th>
<th>Severity</th>
<th>Significance</th>
<th>Severity</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Short Term</td>
<td>Study Area</td>
<td>Probable</td>
<td>Severe</td>
<td>MODERATE</td>
<td>Slight</td>
<td>LOW</td>
</tr>
</tbody>
</table>
8. CONCLUSIONS AND RECOMMENDATIONS

This report has documented the extensive use made of natural resources by local residents in the forests and woodlands in and around the mine site. These resources are used by local residents to meet their basic needs for shelter, food and medicine. They are also used as important sources of supplementary household income. The clearing of areas of the forests and woodlands to make way for the mine will therefore result in considerable long term loss of access to valuable resources for local residents. Although the mine is planning to rehabilitate sections of the land used, the arid nature of the local climate means that it will take time for the forests to be restored to their current state.

The following existing and predicted impacts were assessed in this report.

<table>
<thead>
<tr>
<th>ISSUE /IMPACT</th>
<th>SIGNIFICANCE</th>
<th>Without Mitigation</th>
<th>With Mitigation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>EXISTING IMPACTS ON NATURAL RESOURCES</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Issue 1: Overexploitation or resources</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Impact 1: Harvesting of wood for building purposes</td>
<td>LOW</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>Impact 2: Excavation of termite mounds</td>
<td>LOW</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>Impact 3: Harvesting of wood for charcoal production</td>
<td>HIGH</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>Impact 4: Fuelwood</td>
<td>LOW</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>Impact 5: Fishing</td>
<td>MODERATE</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>Impact 6: Wild Foods</td>
<td>LOW</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>Impact 7: Hunting</td>
<td>VERY HIGH</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>Impact 8: Bee Keeping</td>
<td>MODERATE</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>Impact 9: Medicinal Plants</td>
<td>LOW</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>Impact 10: Species of Special Concern</td>
<td>VERY HIGH</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>Issue 2: Existing impacts due to land use practices</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Impact 1: Slash and burn clearing</td>
<td>HIGH</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>Issue 3: Existing impacts on water resources</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Impact 1: Growth of water hungry crops</td>
<td>MODERATE</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td><strong>IMPACTS OF THE PROPOSED MINING OPERATION</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Impact 1: Loss of natural resources</td>
<td>HIGH</td>
<td>MODERATE</td>
<td></td>
</tr>
<tr>
<td>Impact 2: Loss of land during mining</td>
<td>MODERATE</td>
<td>MODERATE</td>
<td></td>
</tr>
<tr>
<td>Impact 3: Clearing virgin land for small scale farming as a result of agricultural displacement</td>
<td>HIGH</td>
<td>MODERATE</td>
<td></td>
</tr>
<tr>
<td>Impact 4: Increasing demand for natural resources</td>
<td>VERY HIGH</td>
<td>HIGH</td>
<td></td>
</tr>
<tr>
<td>Impact 5: Capacity of institutions to manage use of natural resources</td>
<td>HIGH</td>
<td>MODERATE</td>
<td></td>
</tr>
<tr>
<td>Impact 6: Pollution of water sources</td>
<td>MODERATE</td>
<td>LOW</td>
<td></td>
</tr>
</tbody>
</table>

This report therefore recommends that the following mitigatory measures are undertaken:

- Villages must have controlled access to the proposed mining area prior to clearing commencing to harvest all available resources.
- Measures that would allow local residents to access the forest resources that are cleared must be implemented as this could help to meet local needs and reduce the pressure on the remaining forest resources in the short term.
- Any rehabilitation programmes must involve a stakeholder engagement process to determine the needs of the local communities and how these can be integrated into rehabilitation programmes.
- As part of the social corporate responsibility funding should be made available for the initiation of community projects such as a bee keeping project, establishment of woodlots, etc. These projects should be established in degraded areas in close proximity to villages and not in indigenous forest. This will also help to alleviate existing impacts on natural resources.
• Baobab Resources will assist with the replacement of any arable land parcels that are lost due to their mining activity as part of the Resettlement Action Plan (RAP). This replacement must consider the ecological sensitivity of the replacement sites, and areas of high sensitivity must be avoided.
• Facilitate (including sourcing potential funders) alternative and environmentally sustainable forms of local economic and agricultural development. For example, establishing woodlots for charcoaling, bee keeping projects, improving agricultural practices to produce larger yield on existing land parcels etc.
• Monitor vegetation clearing activities by employees in the general project area, beyond the Baobab Iron Ore Mine Project boundaries, to determine if induced secondary impacts are taking place.
• Implement a programme to monitor the rate of vegetation clearing. Annual monitoring during the planting season must be carried out and must consist of monitoring the presence of and impacts on identified intact areas within the project area.
• An influx management plan must be developed to deal with the issue of in-migration in its entirety.
• The purchase of bush meat by employees must be strictly prohibited.
• Employees must be made aware of the illegality of hunting practices in the area, and be banned from doing so.
• Baobab Resources should discuss the possibility of establishing game guards in the area in conjunction with the regional authorities.
• No rock, silt, cement, grout, asphalt, petroleum product, timber, vegetation, domestic waste or any deleterious substance should be placed or allowed to disperse into any river, wetland and/or lake.
• All construction equipment and vehicles are to be free of leaks from oil, fuel or hydraulic fuels.
• Concrete must not be mixed directly on the soil surface.
• Materials must be kept out of the rain to control runoff contamination at the source.
• Designate a contained area for vehicle parking, vehicle refuelling and routine equipment maintenance, away from wet areas and bermed if necessary.
• Major equipment or vehicle repairs should be conducted away from the construction site.
• Place dustbins and recycling receptacles around the site to minimise litter.
• A litter control programme must be implemented during the construction and operation phase to ensure that litter is contained on site. Litter should be disposed of at a registered waste disposal site.
• Clean up leaks, drips and other spills immediately to prevent contamination.
• Mud and sediment should not be allowed to be transported off site on to connecting roads.
• Wash water should not be allowed to disperse directly into natural wet areas.
9. REFERENCES


Department of Agriculture, Forestry and Fisheries (DAFF) (2012). Groundnut Market value chain profile.


