AN ASSESSMENT OF HUMAN IMPACTS ON DAMBO ENVIRONMENTS: THE CASE SHIKOSWE, KAFUE.

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DECLARATION

This report is a partial fulfilment of a Bachelor of Sciences (BSc.) programme in Natural Resources done in the Department of Geography in the School of Natural Sciences at the University of Zambia.

I, hereby, declare that all the work contained in this report were done by me and in instances where other works are used, they are fully acknowledged.

Sign: ...........................................

Moses Tembo
DEDICATION

This work is specially dedicated to Mr. and Mrs. Nyirenda, Mr and Mrs. Longwe, Pastor Mulenda and Mrs Mwenda, Bill J., Nchenga, Mum, my brother Zanic and last but not least the entire church of Bethel Christian Centre.

Thanks for your spiritual, moral and financial support rendered to me during this struggle.

May the good lord bless you richly and reward you accordingly.
ACKNOWLEDGEMENTS

Special thanks go to Dr. Mulenga, who has been more than a supervisor but a father to me. His criticisms and positive contributions towards this work were like a parent to a growing child. May the Lord bless you and add more years to your life. To Mr. Kapungwe, who has been like a brother and always told me to forge ahead even though things became hard. To Mr. Chalila, for his encouragement and help in the cartographic work. To Mr. and Mrs. Nyirenda, and the entire family, well, words are not enough to express my gratitude for letting me stay at their home for this long. To Billie for accommodating me at Campus. To Pastor Mwenda and Mrs Mwenda for their spiritual and material support which made me to see the sky as no limit for me. Finally, to all my friends. God Bless You All Richly.
ABSTRACT

Dambos are being used for various human purposes today. This can be attributed to factors such as rapid population increase, high urbanisation rate and pressure on agriculture land being experienced in many parts of the world presently. The impacts of the various human activities have resulted into threats to the existence of these environments.

In Zambia dambos – especially those found in urban areas – are being turned into settlement areas or agricultural lands. This has resulted in impacts such as clearance of vegetation and soil degradation.

This study was undertaken in Shikoswe dambo of Kafue as a case study to assess the human impacts on the dambo vegetation and soils. This was achieved through field interviews and surveys in the dambo area to establish the human activities taking place in the dambo and assess the nature and impacts of the identified human activities in the dambo, respectively.

The obtained data in the field was analysed using descriptive statistics such as averages, frequencies and percentages. The study was done in view of improving the way dambo environments are utilized by understanding the nature and effects of the human impacts in them.

The study revealed that the major human activities in the dambo as being construction and cultivation. Other activities identified in the dambo included mining and dumping activities.

The major impact on vegetation is clearance of the indigenous vegetation. Whereas, the impacts on soil includes erosion, compaction and alteration of the chemical composition, leading to the degradation of the soil.
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CHAPTER 1
INTRODUCTION

1.1 Background

Dambos are shallow linear depressions within high plateau areas into which runoff and seepage waters from the surrounding high grounds collects without a marked steam channel (Mackel, 1986). They are seasonally waterlogged and grass covered bearing no true woodland. The best developed dambos are confined to flat or gently undulating plateau regions. The shape of the surface in plan is variable, as in size. Dambos may extend several kilometres and up to several metres in width.

Because of the way they soak up and hold moisture during the rainy season and releases it during the dry season, dambos attract a lot of human activities such as settlements, cultivation and grazing because of the availability of moisture almost through out the year. Other activities on dambos have included mining, fire, and threshing of grass (Chabwela, 1999).

However, most of these human activities have resulted in impacts that are a threat to the dambo environments. Some of the impacts include disturbance of vegetation, soil degradation and change of the dambo morphology (Chabwela, 1999). This research therefore, sought to investigate the impacts of the various human activities on Shikoswe dambo, which are threatening its existence.
1.2 Statement of the problem

Dambos are under threat by impacts of various human activities being practised on them. The need to investigate the nature and extent of such threats influenced the undertaking of such a study.

1.3 Purpose of the study

The purpose of the study was achieved through the following aim and objectives.

1.4 Aim

The aim of the study was to assess the impacts of human activities on the vegetation and soils of the dambo. This was achieved through the following objectives.

1.5 Objectives

1.5.1 To identify the different human activities taking place in the dambo.

1.5.2 To determine the impacts of human activities on the vegetation and soils of the dambo.

1.5.3 To determine the spatial extent of the identified Human Impacts.

1.6 Rationale

The research provides information on the impacts of the human activities on the dambo environment. The information enhances the understanding of the impacts on the dambo,
which are a threat to its existence. The information would be vital for instituting conservation measures in the utilization of the dambo.

1.7 Definition of Concepts and Terms

In this research the following definitions of terms apply:

1.7.1 Environment: The physical characteristics of an area, which includes the vegetation, soils, drainage and morphology, and their interaction with the living organisms, which includes man.

1.7.2 Dambos: a shallow linear depression within high plateau areas into which runoff and seepage from the surround high ground collect with or without any marked stream.

1.7.3 Human Activity: something done by people intentionally or unintentionally and has a special coverage.

1.8 Organisation of the Study

The report comprises of six chapters. The second chapter is the literature review. It looks at the relevant literature related to the study topic. The third chapter gives a description of the study area and the factors that led to the selection of the study area. The fourth chapter outlines the methodology employed in the study. The fifth chapter presents the research findings and discussions. The last chapter gives the conclusions and recommendations of the study.
CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Threats to dambo environments are mainly as a result of the impacts of various human activities practised in them. Rapid population increase, high urbanisation rate and pressure on agricultural land being experienced in many parts of the world today, have been identified as the major factors causing a high prevalence of human activities in the dambo environments (Chawwela, 1999; Breen et al 1999; Maecckel 1986). Due to these factors dambos are being turned into productive uses such as settlements, agricultural lands and industrial sites. Though such changes are beneficial to man, they culminate in serious environmental damages which threatening the dambo environments, if not carefully managed (Southwick, 1976).

2.1 World-wide Dambo Environments

Dambos are mostly confined to Tropical regions of the World (Adams, 1993). According to Adams (1993), the widest distribution of dambos is in the sub-Saharan Africa, Asia, Central and Southern America.

Dambo environments are associated with areas of low relief and gentle stream gradients. The gently sloping terrain promotes infiltration of water. However, some of this water seeps laterally into valley sites to maintain high water tables (Whitlow, 1984). Development of dambo environments occurs on gneisses or intrusive granite rocks (Rotary et al, 1953 and Whitlow, 1984). The development of dambos on these rock types
is associated with a number of factors. Some of which are the sand soils formed from weathering of these rocks which impede infiltration; the bed rock under laying these environments makes the water table to be high; and the heavy textural soils impede drainage (Butzer, 1976). It’s these characteristics that make these environments to be predominantly covered with grass vegetation because tree growth is inhibited by too much water (Butler, 1976). The physical characteristic of dambos enables them to effectively control floods, retain nutrients and perform roles such as agricultural areas, forage provision and water supply (Maeckel, 1986). Different terminologies and names are used to refer to them due to their peculiar nature. For instance in Zambia and Malawi, they are referred to as ‘Dambos,’ in Botswana they are known as ‘Seloko,’ in Nigeria they are referred to as ‘Fadamus,’ in Brazil they are termed as ‘Verzeas’ and in South Africa they are called ‘Vlei’ (Maeckel, 1986). As can be noted from the different terminologies and names used to refer to them, local people in different parts of the world tend to use their local phrases to name such environments. English words closest to describe these environments are ‘bog’ or ‘meadow’ (Maeckel, 1986).

2.2 Human Impacts on Mambo Environments – A Global View

Tropical dambo environments are increasingly disappearing as a result of developmental decisions (Barber, 1993). Dambos are being turned into productive lands for various developmental programmes on a daily basis. Some of the conversions are for agricultural purposes, urban expansion, industrial siting and other land uses (Barbier, 1993; Breen et al, 1997; and Chabwela 1999). Breen et al (1997) and Chabwela (1999) further noted that most of these conversions are done without considering the importance of dambos, and as such no conservation measures are put in place to mitigate the impacts. Therefore,
dambos, world-wide are threatened by human impacts arising from construction activities, cultivation activities, mining activities (mostly sand and clay mining), grazing, grass threshing and burning (Breen at al, 1997).

Studies carried out in the United States of America revealed that out of the 54% of it’s original ‘bog’ land (dambos), 87% has been lost to agricultural developments, 8% to urban developments and 5% to other conversions (Barbier, 1993). A survey done by Salathe (1999), in a number of European countries revealed that ‘bog’ environments have disappeared because most of them have been converted for agricultural or urban expansion purposes. Studies by Suzuki (1993) in Japan revealed that ‘bog’ lands have been turned into either agricultural lands or settlements. In developing countries where such environments are still wide spread, they are under threat because of increasing human impacts arising from activities such as construction, mining, grass threshing, cultivation, grazing and burning (Breen et al, 1997). Notable impacts have been observed in dambos of Nigeria where extensive erosion has been noted in areas where agricultural activities are practised (Adams, 1993).

The human impacts in dambos are mostly manifested on the vegetation and soils of the dambos (Adams, 1993). The impacts on vegetation are mainly the alteration of the natural vegetation of the dambo (Maeckel, 1986). This alteration of the vegetation arises due to the clearance of the natural vegetation to pave way for activities such as cultivation, construction, and mining. For cultivation purposes, the natural vegetation is cleared and replaced by crops on a temporal or permanent basis. For constructional purposes the cleared natural vegetation is replaced by a permanent building and for
mining purposes the cleared vegetation is replaced by scars such as barelands, ditches and pits (Breen et al 1997). Other causes of change in the dambo vegetation are burning and grazing (Maeckel, 1986 and Whitlow, 1984). Though fire is an important method for dambo vegetation management, frequent burning of dambos could lead to the appearance of fire tolerant species of grass in the dambo environments (Philipson, 1972). Dambos that have been extensively grazed normally result in the appearance of palatable species of grass in the environments (Maeckel, 1986). The overall impact of human activities on the dambo vegetation is the alteration of the biological diversity of the dambo (Phiri, 2000). Changes in the vegetation coverage result in the loss of the flora diversity, and the fact that the funa diversity of the environment mostly depends on the flora diversity, the funa diversity is also affected. This results in the disturbance of the whole biological diversity of the dambo environment (Odum, 1913).

Human impacts on dambo soils result in the erosion, compaction and change in the chemical composition of the soil (Donahue et al, 1983). Agricultural modifications of the dambos result in the clearance of the natural vegetation, and replaced by crops on a temporal or permanent basis. The cleared land is cultivated and planted with the selected crop. This culminates in induced erosion hazards and as dambo soils are exposed to erosion agents of water and wind before the crops grow (Robinson, 1978). Infact dambos having such modifications for agricultural purposes experience extensive sheet erosion at the on set of the rainy season (Maeckel, 1986). Intensive grazing on dambos also results in erosion, especially on pressure points such as water sources (Whitlow, 1984). Extensive use of machinery during construction activities result in the compaction of the soil (Breen et al, 1997). Compaction of soil also arises during the construction process.
Especially when laying the foundation of the building, which requires that the soil is compacted to make the foundation strong. Mining activities result in the total removal of the soil (Breen et al, 1997). As the sand is being mined the soil is removed leaving only, barelands, ditches and pits. Changes in the chemical composition of soils of dambos arise from draining of dambos, burning and excessive application of fertilisers (Donahue et al, 1983) Draining of dambos makes the bog soils to become dry. The reduction of moisture in the soil makes it acidic and consequently changing the chemical composition of the soil (Donahue et al, 1983). Frequent burning may also have an adverse impact on the long-term nutrient status of the dambos soils, resulting in the reduction in the productive of the soil (Robinson, 1978). This is because the nutrients from the ashes may be blown or washed away immediately after burning. Excessive use of ammonia fertilisers causes the acidification of the soil (Donahue et al, 1983). The reactions of moisture with the ammonia in the ammonium fertiliser produce a weak acid, which result in the acidification of the soil.

2.3 Human Impacts on Dambos in Southern African Region

A number of studies have been conducted in dambos in many parts of the Southern African Region concerning the human impacts and threats to dambo environments. One such study was undertaken by Breen et al (1997). In this study, dambos in eleven countries were studied focusing on the human impacts and threats to the dambos. The countries included in the study were Angola, Botswana, Namibia, Lesotho, Swaziland, Mauritius, Madagascar, South Africa, Zimbabwe and Zambia. The study revealed that the main human activities in dambos included construction, cultivation, grazing, mining and burning. The major impacts highlighted in the study on the dambo environments
were clearance of the vegetation leading to the alterations of the vegetation coverage, and soil degradation. The most affected dambos in Southern Africa are found in Zimbabwe where they have been extensively used for agricultural purposes (Breen et al, 1997).

The total dambo land of Zimbabwe is approximately 1.28 million hectares (Whitlow, 1984). About 78% of this land is under commercial farmers, 20% under peasant farmers and 2% is undisturbed (Whitlow, 1984). Dambos under commercial farms are used mainly for grazing and wetland maize production. Though conservation measures have been put in place to avoid erosion, the dambos are threatened by acidification due to draining and excessive application of fertilizers (Whitlow, 1984). The most threatened dambos are those under peasant farmers (Whitlow, 1984). According Whitlow (1984), the threats arise due to pressure on agricultural land as result of high densities of population leading to intensive agricultural practises. The impacts have been the total clearance of the natural vegetation and enormous erosion hazards leading to soil degradation (Whitlow, 1984). A detailed study was carried out on Zumunya communal lands, which are characterised by high densities of population (Whitlow, 1988). The high unemployment rate in these areas has been attributed to the rising agricultural practises thus, creating pressure on the land (Whitlow, 1988). Extensive erosion has been noted on these communal lands due to intensive agricultural practises. Overstocking of grazing land has also resulted in the erosion of soil on pressure points such as water sources in Zumunya communal lands (Whitlow, 1988).
2.4 Human Impacts on Dambos in Zambia

Many studies in Zambia on dambo environments alluded to the fact that these environments are being threatened by human impacts. Chabwela (1999) and Maeckel (1986) in their publications, revealed that major impacts on dambo environments arise from human activities such as construction, cultivation, grazing, mining, grass threshing and burning. Chabwela (1999) noted that the factors leading to such activities being highly prevalent on dambos as being; high urbanisation rate, uneven population distribution; and lack of knowledge on the importance of dambos. In Zambia, about 80% of the total population of the country live in urban areas and thus the most affected dambos are within and around peri-urban lands (Chabwela, 1999). The impacts have been the alteration of vegetation coverage and consequently the change in the biological diversity (Phiri, 2000). Other effects have been the degradation of soils due to erosion, and change in the dambo morphology. (Chabwela (1999).

An intensive study by Maeckel (1986) on dambos around the Chainama Hills revealed that there has been extensive sheet erosion from cultivated areas of the dambos at the onset of the rainy season resulting in the change of the dambo morphology.
CHAPTER 3
DESCRIPTION AND LOCATION OF THE STUDY AREA

3.1 Location and Size
Shikoswe dambo is one of the numerous dambos that drains into Kafue. Geographically, the dambo lies between latitude 15° 45'S and 15°46' S and between longitude 28°10'E and 28°13'E. The approximate size of the dambo is 4.46km² (see figure 1)

3.2 Geology and Soils
The dambo is on the highveld plateau with a basaltic parent material. The soils of the dambo are derived from the parent material and as such there are generally acidic (Smith, 1963). Despite the temporal variation of soils within the study area, the general soil types are Sandy and clay soils. Sandy soils are prevalent on drier parts of the dambo whereas clay soils are confined to the wetter parts of the dambo.

3.3 Relief and Drainage
Shikoswe dambo is a small, shallow, linear depression within the Zambian highveld plateau surface into which interflows collect. During, and immediately after the rainy season, the dambo is waterlogged or even flooded, with ephemeral streams such as the Shikoswe stream actively flowing. But during the dry season, it dries out on the surface with no active channel.
3.4 Climate

The area experiences a savannah type of climate. The climate is characterised by three (3) distinct seasons; the cool and dry season, the hot and dry season, and the hot and wet season. The mean monthly temperatures during the cool and dry season are about 17.8°C. During the hot and dry season, the mean monthly temperature is as high as 22°C (Meteorological Department, 2001). The hot and wet season starts in mid October and ends in April. During this season the mean monthly temperature is about 20°C and the average rainfall is about 702 mm per annum (Meteorological Department 2001).

3.5 Vegetation

The vegetation of the area is characterised by distinct grass and sedge flora; woody species are less due to limitation of habitat. The predominant species are *Leesia hexandra*, *Panicum ripens* and *hyperaemia species*. *Leesia hexandra* and *Panicum ripens* are mostly confined to wetter parts of the dambo whereas *hyperaemia* species are confined to the drier parts of the dambo.

3.6 Socio-economic Aspect

The economy of Kafue Town is mostly industrial based, with the major industries being Kafue Textiles of Zambia (K.T.Z.) and Nitrogen Chemicals of Zambia (N.C.Z.). However, for the past 10 years the town has been experiencing a recession. And this has resulted in most of the people being out of employment. Therefore, most of the people living in Kafue are either in informal employment or unemployed. Some of the informal
activities taken up by people include farming, trading and small-scale industries such as sand mining in the dambo.

3.6 Land Use

Shikoswe dambo is zoned as a Residential Area on the land use plan of Kafue (Kafue land use plan, 1972). However other activities such as cultivation, mining and dumping are taking place illegally in the dambo area. The cultivation and mining activities can be attributed to the high unemployment levels, forcing people into gardening, plantations (banana or sugar), crop production and small-scale sand mining.

It's the increase in the number of human activities whose impacts are a threat to the dambo that influenced the undertaking of this study.
CHAPTER 4

METHODOLOGY

4.1 Introduction
The data used in this study were of two kinds, namely, primary and secondary. This chapter outlines the various sources of data, the techniques used in data collection, the sampling methods and the sample sizes, analysis and presentation, and limitations of the data.

4.2 Sources of data
Primary data was obtained by fieldwork in the study area. This mainly involved interviews and surveys in the study area. Secondary data was obtained from documented sources relevant to the study. The purpose of collecting secondary data was to supplement the primary data.

4.3 Selection of Research Techniques
The research techniques used in this study are described in the order in which they were undertaken and their purposes.

4.3.1 Interviews
This was the first technique used in the study. The purpose of carrying out interviews was to establish the activities that were taking place in the dambo. A total number of 30 people were interviewed and it was assumed that 30 people would be enough to adequately establish the activities taking place in the dambo. The interviewees were from
Kafue Estates and Shikoswe area. The people were selected by convenience and accessibility to where they lived.

4.3.2 Ground surveys

After the establishment of the human activities taking place in the dambo through interviews, ground surveys were conducted to verify the actual activities taking place. The verification of the activities taking place in the dambo was followed by further ground surveys to assess the impacts of the identified activities on the dambo environment. The assessment of the impacts of the identified activities was done as follows:

4.3.3 Cultivation

The impact of cultivation on the vegetation of the dambo was assessed through observation. Through observation evidences of disturbances of vegetation such as crop fields, plantations, and gardens were noted and recorded. The assessments of the impacts on the soils were done through the physical analysis of the soil structure in the field, and chemical analysis of soil samples, which were collected. The physical analysis of the soil involved the digging of profile pits up to 20 cm. The physical analysis of involved the analysis of the cultivated fields and uncultivated fields. This was done for the purpose of establishing the impact of cultivation on the soil structure of the dambo. The soil samples collected from cultivated and uncultivated fields were analysed for pH in the field using a pH Meter. This was done in order to establish the impacts of cultivation on the pH of the dambo.
4.3.4 Construction

The impact of construction on vegetation and soils were assessed as follows. Through observation the evidences of any disturbance of vegetation were noted and recorded. The impact on the soil was considered to be the impact of the construction of a building. This was also done through observation.

4.3.5 Dumping

The impact of dumping on vegetation was through observation of the dumping sites, and the vegetation growing on them was noted and recorded. The impact on the soil was done by assuming that the soil structure is compacted due to the waste accumulating on dumpsites. Samples of waste and the surrounding soils were collected and analysed for pH. The purpose of analysing samples of wastes was to ascertain the impact of the infiltrating chemical compounds from the wastes on the pH. condition of the soil underneath.

4.3.6 Mining

The assessment impacts by mining on vegetation was done through observation. Through observation, evidences of disturbance vegetation were noted. The impact on soil was done ascertaining the effect of mining activities on the soil. This was done through observation.

4.3.7 Sample size

The total sample size for the interviews was 30. A random sampling method was used to pick the sampling units. The sampling units were picked by convenience and
accessibility. In cultivation activities 10 fields were sampled. Their selection was based on their accessibility. 10 samples of dumps were also sampled randomly basing on their accessibility, also.

4.4 Data Analysis

The data obtained was analysed by descriptive statistics. Averages, frequencies, and percentages were used to analyse the data obtained. The presentation of the data was done through tables, plates and figures.

4.5 Limitations

There were several hindrances during the execution of the study, which were due to a number of factors. Some of the hindrances are discussed in this section.

**Limited Funds:** This was the major limitation because the study was self-sponsored and as such there was limited funding to the study. Because of this limitation the study only focused on the impacts and threats on vegetation and soils of the dambo.

**Time period:** The time or season the study was undertaken was not ideal for identification of other activities, which are carried out at different times of the year. Activities such as burning and threshing of grass take place during different seasons
CHAPTER FIVE

PRESENTATION OF RESEARCH FINDINGS AND DISCUSSIONS

5.1 Introduction

The purpose of this chapter is fourfold. Firstly, it identifies the dominant human activities in the dambo and the factors behind such activities. Secondly, to identify the impacts of each identified human activity on both vegetation and soil. Thirdly, to explain the effect of each impact on the dambo environment. Fourthly, to present the areal measurements of each impact on the dambo environment.

5.2 Human Impacts on the Dambo

An interview survey carried out revealed the following activities as the most prevalent in Shikoswe dambo. Table 5.1 presents the results of the survey.

TABLE 5.1 HUMAN IMPACTS ON THE DAMBO

<table>
<thead>
<tr>
<th>IMPACT</th>
<th>NUMBER OF RESPONDENTS</th>
<th>NUMBER OF RESPONDENTS AS A %</th>
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<tbody>
<tr>
<td>CONSTRUCTION</td>
<td>10</td>
<td>33.33</td>
</tr>
<tr>
<td>CULTIVATION</td>
<td>10</td>
<td>33.33</td>
</tr>
<tr>
<td>MINING</td>
<td>6</td>
<td>13.33</td>
</tr>
<tr>
<td>DUMPING</td>
<td>4</td>
<td>20</td>
</tr>
<tr>
<td>TOTAL</td>
<td>30</td>
<td>99.9</td>
</tr>
</tbody>
</table>

SOURCE: FIELD DATA

There are basically four main activities which were identified as most prevalent in the dambo environment (Table 5.1). Field verification Surveys also confirmed that the four activities are the main activities in the dambo. However, other activities such as burning, grass threshing, and grazing could not be identified during field surveys. Evidences of
burning and threshing of grass were not noted because of the period in which the study was undertaken. During the rainy season, it is difficult to note the evidences of fire, especially, towards the end of the rainy season. This is because the overgrown grass and flooding makes it almost impossible to survey the dambo for evidence of burning. Threshing of grass is done mainly during the cool and dry season, and as such evidences of grass threshing were not noticeable. Grazing activities are uncommon on Shikoswe dambo. This is because such activities are mostly associated with dambos in rural areas and rarely found in dambos within urban areas like Shikoswe.

As can be noted from Table 5.1 the major activities in the dambo are construction and cultivation. This can be attributed to two main factors, which are; the land use zone under which the dambo falls; and the economic status of Kafue Town. According to the Kafue landuse plan (1972), Shikoswe dambo falls under the residential zone, therefore, construction activities are legal. This explains why construction takes up a greater proportion of the dambo. The zonation of Shikoswe as a residential area was done in view of expanding Kafue Estate area. This is in line with the findings of Barbier (1993), Breen et al (1997) and Chawela (1999) where urban expansion was identified as one of the uses dambo environments are being turned into.

Despite being illegal, cultivation activities are prominent in the dambo. This could be attributed to the economic recess Kafue Town is experiencing. The economic recession of the Town has forced many residents to venture into informal activities which includes farming. Dambos being very suitable for agricultural activities, has made Shikoswe dambo to attract a lot of farming activities (Maeckel, 1986). The other two activities,
mining and dumping are greatly due construction activities. Sand mining is mainly for supplying construction activities in the dambo. Dumping is mainly from domestic sources. This was observed during field surveys in the dambo where the mined sand was being supplied to construction sites. Whereas most of the wastes on the dumpsites were composed of plastics, metal cans, ashes and other forms of domestic wastes. Most of the dumpsites were either near the market place or homes.

5.3 Human Impacts on the Dambo Vegetation

The impacts of the identified human activities on the dambo vegetation are presented and discussed in this section.

5.3.1 Gardening (Cultivation Activity)

Gardening creates a permanent scar in the indigenous vegetation whereas a banana plantation introduces new vegetation in the locality almost permanently.
Plate 1: Gardening in the Shikoswe Dambo

Plate 1. Shows that the indigenous vegetation of the dambo has been cleared and replaced by a vegetable garden in the foreground and bananas in the background. Thus the impact of cultivation activities on the dambo vegetation is the clearance of the indigenous vegetation. This is in conformity with the findings of Breen et al (1997) and Whitlow (1984) which revealed that vast areas of dambos have been cleared for agricultural purposes in most of Southern African Countries.

5.3.2 Construction Activity

During the construction process the indigenous vegetation is removed and replaced by a building at the house location (Plate 2)
Plate 2: Construction of houses in the dambo

As can be seen on plate 2, the indigenous vegetation in the area surrounding the house is cleared also and replaced by hedges and flowers. Drainage furrows are also created to facilitate drainage during the rainy season.

5.3.3 Mining Activities

Before the collection of sand commences, the area is cleared off the indigenous vegetation (Plate 3).
Plate 3: Sand Collection from the Dambo

As can be noted from plate 3, collection of sand from the cleared area leads to the creation of depressions. The depressions can either be permanent scars in the dambo or be with vegetation regrowth after the mining activities have been halted. This depends on the depth of the depression left behind by the collection of sand. The deeper the depression the more likely the scars become permanent, in this case vegetation is unlikely to regrow. However if the depression is shallow there is a possibility that vegetation regrows.

5.3.4 Dumping Activity

The impact of dumping on vegetation is similar to clearance. Because dumping result in the waste burrying the indigenous vegetation as the waste accumulates on the dumpsite (Plate 4).
Plate 4: Dumping of domestic waste in the Dambo

Though certain sections of the dambo site appear to have healthy vegetation, the sections where a lot of waste is thrown, nevertheless, result in the burying of the indigenous vegetation by the waste (plate 4.)

All the impacts on vegetation by the four human activities result in the loss of the biological diversity of the dambo. This is due to the fact clearing or burying of the indigenous vegetation affects the flora diversity, and the fact that the funa diversity of an environment mostly depends on the flora diversity; the funa diversity is also affected. This leads to the alteration of the biological diversity of the dambo (Odum, 1913).

5.4 Human Impacts on Dambo Soils

The findings on the human impacts on the dambo soil are presented and discussed in this section.
5.4.1 Impacts of cultivation on the Dambo soils

The impact of cultivation on soil structure is presented in appendix 2 and summarised in Table 5.2

<table>
<thead>
<tr>
<th>Field sampled</th>
<th>Uncultivated field soil structure</th>
<th>Cultivated field soil structure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maize</td>
<td>Fine structureless thin platy</td>
<td>Very fine structureless thin platy</td>
</tr>
<tr>
<td>Vegetable garden</td>
<td>Massive structureless thick platy</td>
<td>Structureless, thin platy</td>
</tr>
<tr>
<td>Banana plantation</td>
<td>Massive structureless thick plasty</td>
<td>Structureless, thin platy</td>
</tr>
</tbody>
</table>

Source: field data (Appendix 2)

Table 5.2 clearly shows that cultivation leads to a change in the soil structure. The observed change in the soil structure is due to tillage during the preparation of the land at the onset of the growing season. Tillage of the land makes the soil to be more vulnerable to erosional hazards, especially at the start of the rainy season, when the vegetation is cleared and the land cultivated, exposing the soil to direct impact of rainy drops (Maeckel, 1986; Robinson, 1976). Continuous erosion might lead to loss of nutrients and eventually making it poor and unable to support both crops and vegetation – soil degradation.

The impact of cultivation on soil pH is given in Appendix 3. Table 5.3 shows the average values of soil pH, derived from appendix 3.
Table 5.3  pH values from different fields

<table>
<thead>
<tr>
<th>Type of cultivation</th>
<th>Cultivated field (pH)</th>
<th>Uncultivated field (pH)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maize</td>
<td>5.22</td>
<td>5.94</td>
</tr>
<tr>
<td>Vegetable</td>
<td>4.87</td>
<td>5.76</td>
</tr>
<tr>
<td>Banana</td>
<td>5.27</td>
<td>6.18</td>
</tr>
<tr>
<td>Average</td>
<td>5.34</td>
<td>5.81</td>
</tr>
</tbody>
</table>

Source:   field data (appendix 3).

As can be noted from Table 5.3 the difference between cultivated and uncultivated fields is very minimal. Consider the maize fields, the difference between the cultivated and uncultivated fields is 0.52. For gardening the difference is 0.88. As for the banana plantation, the difference between the two fields is only 0.91. A review of the 3 values shows that they are all less than one (1), which is very minimal. The minimal difference in the pH values of the cultivated and uncultivated fields is also reflected in the difference between the overall average pH values for the two fields, which is 0.47. This was mostly due to the measuring equipment used in the fields to measure pH. It is very difficult to obtain accurate results using a pH Meter in the field. However, the results in Table 5.3 indicate that there is a relationship between the two fields. As can be noted the average pH values of soils from all the uncultivated fields were higher than those from the cultivated fields. Implying that cultivation lowers the pH of the soil (Table 5.3). Therefore, there is a level of acidification that is introduced in the soil due to cultivation activities. This could be attributed to among other factors, the application of ammonia fertilisers on the field, which lowers the pH of the soil.
5.4.2 Impact of construction on the Dambo soils

From the field observations carried out on the dambo, the major impact on the soil by construction activities is the compaction of the soil. This impact firstly, arises from the construction of accessibility roads to housing or building sites. Secondly, the use of heavy machinery in the transportation of building materials such as sand, roofing sheets and many other materials in order to construct houses like the ones shown on plate 2. Compaction also arises during the building process of a house. Foundation laying of a house requires that the soil be compacted before starting to building on it. This impact also comes about as a result of the people living in the houses tramping on the surrounding soils. Chemical analysis of the soils could not be done because soil samples could not be obtained from the building site.

5.4.3 Impacts of mining on the Dambo soils

During field surveys on the dambo it was established that the mining activities – in this case collection of sand – result in the removal of the soil leading to a change in the landscape of the dambo. This was evidenced by permanent scars left on the land such as barelands, depressions and pits – like the depression shown in plate 3. This is in order with Breen et al (1997) and Chabwela (1999) research conclusion, which pointed out mining as one of the activities in the dambo environments which damages the landscape of these environments. Chemical analysis was not carried for these activities because the topsoil was removed from the mining sites whereas the surrounding areas had their topsoil not removed. And such if chemical analysis for pH was carried out it could have been difficult to compare the results from the two areas – mined and surrounding soils – because of the difference in the depth where the soil samples could have been obtained.
5.4.4 Impact of dumping on the dambo soil

The impact on the soil structure was assumed to be compaction as a result of dumping. Considering plate 3, the waste seen on the dumpsite exerts pressure on the soil, which leads to compaction. Especially as waste accumulates on the dumpsite as more waste is thrown there.

The impact of dumping on soil pH is presented in appendix 3 and summarised Table 5.4

Table 5.4 Average pH values for wastes and the surrounding soils

<table>
<thead>
<tr>
<th>Sample source</th>
<th>pH (Averages)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waste</td>
<td>7.24</td>
</tr>
<tr>
<td>Surrounding soils</td>
<td>5.39</td>
</tr>
</tbody>
</table>

Source: field data (Appendix 4)

From Table 5.4 it is clear that there is a great difference between the average pH of the wastes and the surrounding soils. A difference of 1.95 is large enough to cause a change in the chemical composition of the soil beneath the wastes (Donahue, 1983). This high pH value can affect the chemical characteristics of the soil as the chemical compounds from the wastes dissolve and infiltrate in the soil.

The large difference in the pH values is can be attributed to the source of the waste, which could have made the pH values of the wastes to be high. During field surveys it was noted that most of the wastes was from domestic sources, which are mostly unsorted. Referring to plate 4, the dumpsite shown in the foreground is near the market and as such most of the waste is due to domestic consumption.
5.5 **Area Extent of the Human Impacts**

The areal coverage of the human impacts are presented in Table 5.5

<table>
<thead>
<tr>
<th>Impact</th>
<th>Areal extent (km²)</th>
<th>Extent as a % of the dambo</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction</td>
<td>2.77</td>
<td>62.1</td>
</tr>
<tr>
<td>Cultivation</td>
<td>1.137</td>
<td>25.5</td>
</tr>
<tr>
<td>Mining</td>
<td>0.003</td>
<td>0.07</td>
</tr>
<tr>
<td>Total</td>
<td>3.91</td>
<td>87.6</td>
</tr>
</tbody>
</table>

**Source: Field Measurements**

Out of the total area of 4.46 km² of the dambo, about 3.91km² has been affected by human impacts. Construction activities have the largest areal coverage mainly because Shikoswe dambo is under the residential zone on the land use map of Kafue Town (Kafue landuse plan, 1972). These activities alone cover about 2.77 9 km² of the dambo area – which 62.1% of the dambo. These are followed by cultivation activities covering about 1.137 km², which accounts for 25.5% of the total dambo area. Mining activities have the smallest areal coverage, occupying an area of 0.003 km², accounting for 0.07% of the dambo (figure 2). This is due to the fact that mining involves digging, that is, going into the heart of the earth in a vertical dimension. Whereas, construction and cultivation follow a horizontal dimension. The dambo environment is, therefore, mostly under the impacts of cultivation and construction activities. These two activities cover a total area of 3.907 km² of the total area under human impacts, accounting for 99.92% of the total are under human impacts.
FIG 2  SKETCH MAP OF THE AREAL COVERAGE OF HUMAN IMPACTS

LEGEND

Cultivation
Construction
Undisturbed
Mining (Sand)
With more housing plots being allocated to people and more people venturing into the informal sector, construction and cultivation activities are bound to increase on the dambo, respectively. An increase in construction activities would entail an increase in the collection of sand to carter for the increase in the demand for building sand. It would also result in an increase in dumping, as the number of residents increase in the dambo area. An increase in vegetation being cleared and more erosional hazards on the dambo would be the consequences as more people venture into cultivation activities. Eventually the whole dambo would be under the influence of human activities.
CHAPTER 6

CONCLUSIONS AND RECOMMENDATIONS

6.1 Summary of study

The purpose of this chapter is two folds. Firstly, to summarise the major research findings and secondly, to provide policy recommendations for improving the way human activities are practised on the dambo in order to reduce their impacts on the dambo environment.

6.2 Conclusions

The summary of the major findings of this study is based on the findings from each of the identified activities. The summary is presented as follows.

6.2.1 Construction Activities

The impact of construction on the dambo vegetation is the loss of the indigenous vegetation and the introduction of new species around homes. Construction activities also result in the compaction of the soil. Consequently, loss of the dambo environment.

6.2.2 Cultivation Activities

Cultivation leads to loss of indigenous vegetation in favour of selected crops. It also leads to increased soil erosion. Cultivation activities change the nutrient status of the soil as well.
6.2.3 Mining Activities

The major impact of mining activities on the dambo vegetation is the clearance of the natural vegetation. Despite having the least areal coverage of the dambo, mining activities have an enormous impact on the soils. In that it involves the removal of the soil, leaving permanent scars such as barelands, depressions and pits, leading to a change in the landscape of the dambo.

6.2.4 Dumping Activities

Dumping Activities result in the burying of the indigenous vegetation as the wastes accumulate on the dumpsite. These activities are also assumed to cause compaction of soil as the waste exerts pressure on the soil below the waste. Depending on the source and type of waste, dumping causes a change in the chemical composition of the soils. In this study it has been established that the wastes from the domestic dumping sites may cause an increase of the pH of the soil beneath the wastes.

6.3 Recommendations

Basing on the research findings in this study the following have been suggested as a way forward in order to improve the utilisation of the dambo and reduce human impacts:

6.3.1 There is need to carry out environmental awareness campaigns around the dambo area. The purpose of the campaigns would be to sensitisre the local communities on the importance of the dambo environments. This should also incorporate the need to have a sound community based solid waste management to ensure that there is a clean environment and reduce impacts from the wastes.
6.3.2 Government should create an enabling environment, which should encourage investors to invest in the industrial sector of the Town. This would reabsorb most of the residents into the formal sector as the economy starts thriving. This would reduce pressure from cultivation activities on the dambo. However, in certain sections of the dambo cultivation - especially gardening – should be supported by the local authorities. This can be done through encouraging farmers to use organic fertilisers to avoid acidification of the soil. They should also be encouraged to use certain farming strategies in order to reduce the threat of soil erosion.

6.3.3 Mining activities should be closely monitored by the local authorities because of their adverse effect on the landscape of the dambo. People collecting sand from the dambo should only be allowed to collect sand up to a particular depth. This would avoid the leaving of permanent scars on dambo after mining activities have stopped.
REFERENCES


Meteorological Department (2000). Rainfall and temperature data. Meteorological station, Lusaka


APPENDIX 1

UNIVERITY OF ZAMBIA

SCHOOL OF NATURAL SCIENCES

DEPARTMENT OF GEOGRAPHY

GEO 474 PROJECT

INTERVIEW SHEET

Date: ................................................ Location: ............................................. No:..............

1. Name of Respondent: ........................................................................................................

2. Occupation of Respondent: ................................................................................................

3. How long have you lived in this area? ..................................................................................

4. What type of human activities do you know that are practised on Shikoswe dambo area?:
............................................................................................................................................
................................................................................................................................................
### APPENDIX 2

<table>
<thead>
<tr>
<th>Field sampled</th>
<th>Soil structure uncultivated field (0-20cm)</th>
<th>Soil structure Cultivated field (0-20cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maize</td>
<td>Fine structureless, thin platy</td>
<td>Very fine structureless, thin platy</td>
</tr>
<tr>
<td>Maize</td>
<td>Structureless, thin platy</td>
<td>Fine structureless, thin platy</td>
</tr>
<tr>
<td>Garden</td>
<td>Massive structureless, thick platy</td>
<td>Fine structureless, thin platy</td>
</tr>
<tr>
<td>Banana</td>
<td>Massive structureless, thick platy</td>
<td>Fine structureless, thin platy</td>
</tr>
<tr>
<td>Maize</td>
<td>Fine structureless, thick platy</td>
<td>Very fine structureless, thin platy</td>
</tr>
<tr>
<td>Garden</td>
<td>Massive structureless, thick platy</td>
<td>Structureless, thin platy</td>
</tr>
<tr>
<td>Banana</td>
<td>Massive structureless, thick platy</td>
<td>Structureless, thin platy</td>
</tr>
<tr>
<td>Maize</td>
<td>Fine structureless, thick platy</td>
<td>Very fine structureless, thin platy</td>
</tr>
<tr>
<td>Banana</td>
<td>Massive structureless, thick platy</td>
<td>Structureless, thin platy</td>
</tr>
<tr>
<td>Garden</td>
<td>Massive structureless, thick platy</td>
<td>Structureless, thin platy</td>
</tr>
</tbody>
</table>

### APPENDIX 3

<table>
<thead>
<tr>
<th>Field</th>
<th>Uncultivated field</th>
<th>Cultivated field</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maize</td>
<td>5.01</td>
<td>5.66</td>
</tr>
<tr>
<td>Maize</td>
<td>5.46</td>
<td>5.84</td>
</tr>
<tr>
<td>Garden</td>
<td>4.85</td>
<td>5.58</td>
</tr>
<tr>
<td>Banana</td>
<td>5.5</td>
<td>5.69</td>
</tr>
<tr>
<td>Maize</td>
<td>5.34</td>
<td>6.03</td>
</tr>
<tr>
<td>Garden</td>
<td>5.12</td>
<td>5.48</td>
</tr>
<tr>
<td>Banana</td>
<td>5.23</td>
<td>6.45</td>
</tr>
<tr>
<td>Maize</td>
<td>5.18</td>
<td>5.76</td>
</tr>
<tr>
<td>Banana</td>
<td>5.09</td>
<td>6.41</td>
</tr>
<tr>
<td>Garden</td>
<td>4.64</td>
<td>5.23</td>
</tr>
</tbody>
</table>

**SOURCE: FIELD DATA**
### APPENDIX 4

<table>
<thead>
<tr>
<th>DUMP SITE NO. 1</th>
<th>pH OF WASTE</th>
<th>pH OF SURROUNDING SOILS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>9.65</td>
<td>5.03</td>
</tr>
<tr>
<td>2</td>
<td>7.06</td>
<td>4.85</td>
</tr>
<tr>
<td>3</td>
<td>5.84</td>
<td>5.66</td>
</tr>
<tr>
<td>4</td>
<td>8.12</td>
<td>5.84</td>
</tr>
<tr>
<td>5</td>
<td>6.29</td>
<td>5.76</td>
</tr>
<tr>
<td>6</td>
<td>7.77</td>
<td>5.46</td>
</tr>
<tr>
<td>7</td>
<td>9.02</td>
<td>5.33</td>
</tr>
<tr>
<td>8</td>
<td>6.01</td>
<td>5.11</td>
</tr>
<tr>
<td>9</td>
<td>4.86</td>
<td>5.61</td>
</tr>
<tr>
<td>10</td>
<td>7.80</td>
<td>5.27</td>
</tr>
<tr>
<td>AVERAGE</td>
<td>7.24</td>
<td>5.39</td>
</tr>
</tbody>
</table>

**SOURCE FIELD: FIELD DATA**