# THE IMPACT OF URBAN GROWTH ON INDIGENOUS WOODY VEGETATION IN KASAMA TOWN AND ITS ENVIRONS, ZAMBIA

BY

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A dissertation submitted to the University of Zambia in partial fulfillment of the requirements of the degree of Master of Science in Geography.

Lusaka

2001

# DECLARATION

I, Bernard Chileshe, do declare that this dissertation was solely composed and written by me. It has not previously been submitted for a degree at this or another university. All published work or material from other sources, which have been incorporated, have been specifically acknowledged and reference thereby given.

Signed:.....

Date:15/01/04.....

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Signed:.....

Date:15/01/04.....

# DEDICATION

To my wife, Jessie, my children, Chileshe, Chanda, Mwaba and Bwalya and my parents, Chileshe and Anna.

## APPROVAL

**THIS DISSERTATION BY** BERNARD CHILESHE **IS APPROVED AS FULFILLING THE REQUIREMENT FOR THE AWARD OF THE DEGREE OF MASTER OF** SCIENCE (GEOGRAPHY) **BY UNIVERSITY OF ZAMBIA.**

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# ABBREVIATIONS

| | | |
|---|---|---|
| BNS | - | Basic Needs Standard. |
| BSA | - | British South Africa. |
| CBD | - | Central Business District. |
| Co. | - | Company. |
| CSO | - | Central Statistical Office |
| GRZ | - | Government of the Republic of Zambia. |
| IUCN | - | International Union for the Conservation of Nature. |
| MAFF | - | Ministry of Agriculture, Food and Fisheries. |
| PFEO | - | Provincial Forest Extension Officer. |
| RSCU | - | Regional Soil Conservation Unit. |
| SADC | - | Southern Africa Development Community. |
| SARA | - | Support for Analysis Research in Africa. |
| SARDC | - | Southern Africa Research and Documentation Centre |
| TAZARA | - | Tanzania Zambia Railways Authority. |
| UN | - | United Nations. |
| UNPF | - | United Nations Population Fund. |
| UNDP | - | United Nations Development Programme. |
| UNEP | - | United Nations Environment Programme. |
| USA | - | United States of America. |
| ZGA | - | Zambia Geographical Association |

# ABSTRACT

Zambia experiences an annual woodland loss of 0.5 percent. Much of this is from areas around urban areas. Woodland loss may lead to both environmental and socio-economic problems. The purpose of this study was to investigate the impact of the growth of Kasama on the surrounding indigenous woodlands and the effect of the subsequent deforestation in the area on the socio-economic welfare of the residents of Kasama and the ecology of the area. This study is important because it ventures into two rather neglected aspects of urbanization in Zambia. It diverts attention from concentration on the large settlements of Lusaka and those on the Copperbelt to smaller towns. It also broadens the perspective of study to consider both the socio-economic and the environmental impacts of urbanization.

The study made use of time series panchromatic air photographs and various types of maps to draw land-cover maps. A questionnaire and an interview guide were used to collect the data pertaining to respondents' participation in peri-urban cultivation and consumption of woodfuel. The data were analysed using percentages, means, and frequency distributions. They were represented graphically using tables, graphs and maps. The chi-square test was done to determine if there is a significant difference in the types of fuel used by the respondents for cooking and heating. The t-test was done to determine if there is any significant difference in the mean monthly incomes of those respondents using woodfuel and those using electricity.

The study established that deforestation is widespread in Kasama. The unprotected indigenous woodlands declined from 7 606 hectares in 1963 to 2 436 hectares in 1991, a loss of 68 percent. This has transformed the miombo woodland landscape of the area into either tree-less or scantly vegetated. This has led to an increase in erosion in the area. The removal of the indigenous woody vegetation has also contributed to the rise in the price of woodfuel. The residents have to spend about 28 percent of their income on acquiring it.

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# CHAPTER ONE

## INTRODUCTION

### 1.1 Background to the study

More and more of the world's 6 billion people are living in towns. In the industrialised nations of Europe and North America, about 75 percent of the population lives in towns (Matson, 1990). According to McDonnell and Pickett (1990), urbanization in the USA in 1989 stood at 74 percent and this is expected to increase to over 80 percent by the year 2025. In developing countries, urban areas have become the loci for most rapid population growth, estimated at 4.2 percent per annum (UNPF, 1993) though individual countries may have higher growth rates. In Turkey, for instance, urban population was increasing at a tremendous rate of almost 7 percent at the close of the 1970's (Yalcintas, 1971). Southern Africa has been no exception. In 1980, Lusaka, Harare, Luanda and Maputo had populations of just above 500 000 people. This increased to one million for Lusaka and Harare, 1.5 million for Maputo and 2 million for Luanda by 1990 (World Bank, 1990). In Zambia, towns have been growing rapidly since independence. According to GRZ (1992), the urban population increased from 20.5 percent in 1963 to 29.4 percent in 1969 and rose to 39.9 percent and 42.0 percent in 1980 and 1990, respectively.

Two features mark the growth of towns in human numbers worldwide. Firstly, as the town spreads outwards it expands onto land that is predominantly rural in character, converting it to an urban character. Secondly, urbanization leads to either the intensification of land use thereby increasing pressure on the resource base of the area immediately surrounding the town or the land is abandoned to idleness by the rural community as the town approaches (van den Berg, 1984). In developing countries, there is increased pressure on the forest resource base as the urban poor endeavour to meet their basic needs for food and energy (Bradley, 1994).

The removal of vegetation from the landscape has ecological as well as socio-economic consequences. It creates a new and artificial landscape which is accompanied by multiple ecological problems. These include soil erosion, silting and sedimentation of rivers, lakes and reservoirs, leaching of the soil, drying up of perennial rivers and streams and the destruction of

habitats for different organisms. Furthermore, the price of charcoal and firewood increases as the collecting points recede away from towns (Chidumayo, 1979).

Because of the insidious impact that urbanization has on the vegetal landscape, it is a major concern to urban geographers, planners, and ecologists and is, therefore, worthy of study. Solutions that ameliorate the situation must be found and implemented. They should be comprehensive and mutually harmonised to cater for both human and ecological needs (Curry-Lindahl, 1972).

## 1.2 Statement of the problem

Urbanization in Zambia, which started with the opening up of mining towns on the Copperbelt in the 1930's, is considered as one of the development actions that cause environmental impact in the country. The removal of vegetation is one such impact. This is achieved through: (a) the expansion of the built-up area into the wooded peri-urban areas as pressure for more housing, commercial and industrial expansion increases, (b) the cutting of trees for woodfuel in the peri-urban area to meet urban energy requirements, (c) clearing vegetation within the peri-urban areas for cultivation to produce supplementary food mainly for the urban low-income groups, and (d) cutting trees as polewood for construction.

The problem that arises is that the landscape around the urban areas is denuded of indigenous woody vegetation. Consequently, the climate, water supply, soil and the socio-economic status of the residents are affected. This study, therefore, investigated the extent and some of the consequences of vegetation removal in and around Kasama urban settlement.

## 1.3 Purpose and scope of the study

The aim of this study was to investigate the impact of urban growth on indigenous woody vegetation in Kasama. The specific objectives were as follows:

(a) To asses the extent, rate and pattern of deforestation in the study area;
(b) To determine the role of the expansion of the built-up area, peri-urban cultivation and wood fuel production in fostering the removal of indigenous woody vegetation in the study area;

(c) To determine the reasons behind the human activities which foster deforestation in the study area, and;

(d) To assess the socio-economic and ecological impacts of woodland loss in the study area.

This research could not hope to bring out the whole spectrum of problems pertaining to the impact of urbanization in the Kasama urban area. The study, being geographical, only looks at the impact of urbanization on indigenous woody vegetation in the spatial and temporal sense. It considers the human activities that are responsible for removing indigenous woody vegetation and why they are practised. The extent, rate and pattern of deforestation and what impact deforestation has on the vegetal landscape and the socio-economic welfare of the respondents are also considered.

## 1.4 Conceptual framework

It is assumed that urbanization is intimately accompanied by human activities which place pressure on the peri-urban areas. This pressure brings about marked changes in the indigenous woody vegetation in the peri-urban areas. This is summarised in Figure 1.1:

This study assumes that in developing countries like Zambia, pressure to destroy indigenous woody vegetation around urban areas comes from the attempt to meet the needs of the expanding urban population for woodfuel (firewood and charcoal), peri-urban cultivation for the expanding food requirements, and residential , commercial, industrial and the accompanying infrastructural development.

Research questions:

1. How far have woodfuel production, peri-urban cultivation and expansion of the built-up area affected the indigenous woody vegetation in Kasama area and environs?

2. Why have these human activities become prevalent in the area?

3. What measures can be taken to ameliorate the problems caused by the impact of these activities?

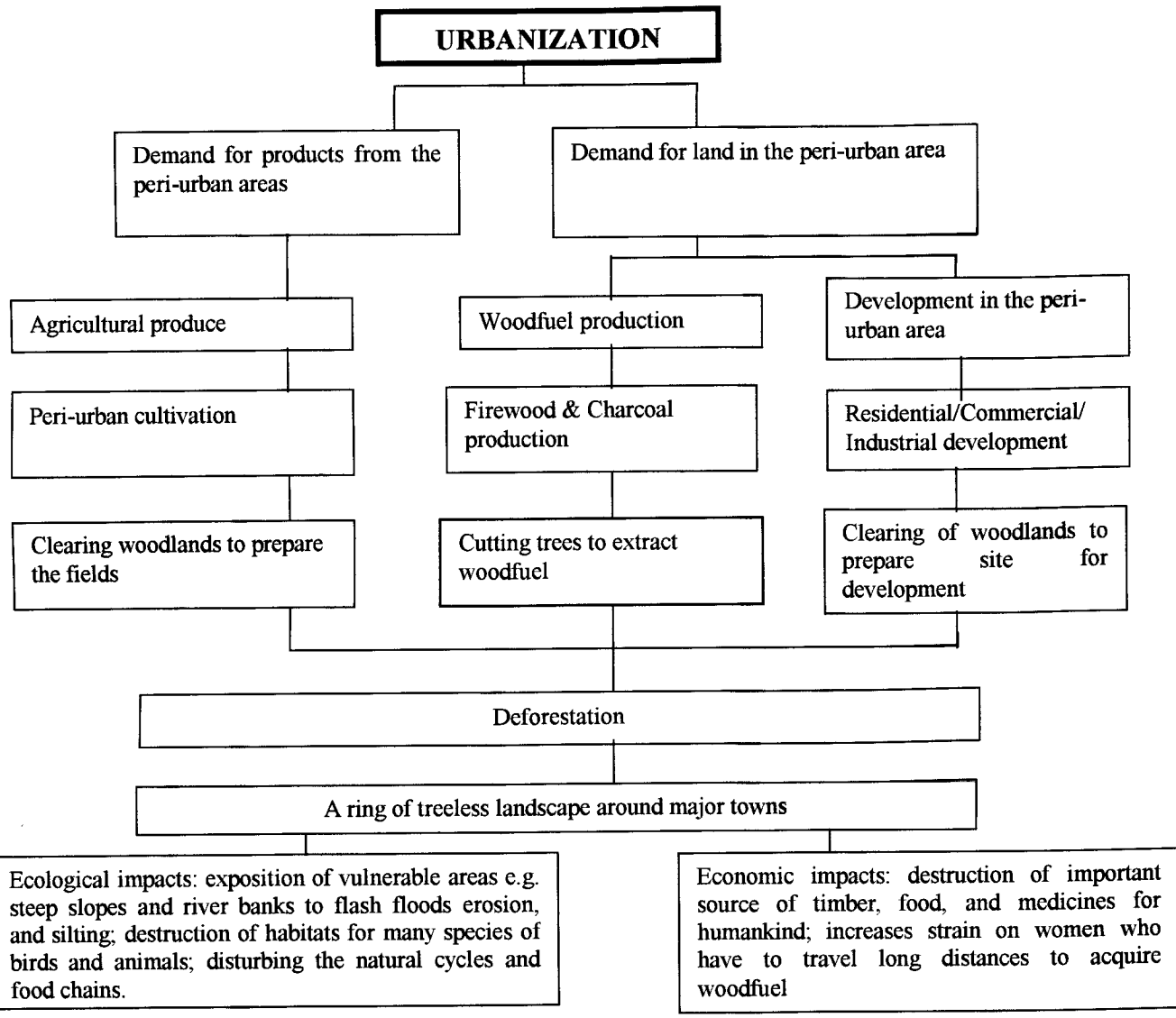



**Figure 1.1 Summary of the impact of urbanization on the peri-urban area**

## 1.5 Significance and relevance of the study

The study was conducted for several reasons. Firstly, the findings of the study will add to the already existing body of knowledge on the interaction between anthropogenic activities and the natural environment. Secondly, most studies conducted in Zambia have tended to concentrate on Lusaka and the Copperbelt towns. Studies on the small and medium urban centres have been very few. This study, therefore, has ventured into this rather neglected area. Thirdly, Kasama being one of the rapidly growing small urban centres in the country could be taken to represent the process of urbanization taking place in towns of similar size. The recommendations can, therefore, with modifications, be used to solve problems of a similar nature arising in the other

towns. Lastly, most studies on urbanization in Zambia have tended to concentrate on problems related to socio-economic aspects rather than the interaction of human activities and the physical or biotic environment. This study has, therefore, broadened the scope to consider some of the ecological as well as the socio-economic impacts of urbanization. The results could serve as a starting point for further research.

## 1.6 Operational definitions

**Built-up area** – This includes all land on which there are buildings and other infrastructure. This can be the main market area, institutional, residential or industrial areas.

**Dambos** – These are shallow linear depressions in the headwater zones of rivers without a marked stream channel. They are seasonally liable to flooding and grass-covered, bearing no true woodland vegetation. The surrounding woodland generally stops abruptly at the dambo margin (Mackel, 1986).

**Deforestation** – This is the change of the forest cover with the depletion of tree crown cover to less than 10 percent.

**Low-income groups (the urban poor)** – are those with incomes below an estimated basic needs standard (BNS). The BNS for Kasama was worked out using the criterion used by the Jesuit Centre for Theological Reflection (JCTR) to determine the food basket for Lusaka. It was K267 561.00 for Kasama at the time of the survey.

**Natural forests** – These are composed of tree species known to be indigenous to the area. In this study, they include both the forests and the woodlands.

**Other areas** – This term applies to all land where vegetation has been removed but where no buildings have been erected and no vegetation planted. It includes formal space like parks, playing fields, golf course, the area around the airport and bare areas not being used for peri-urban cultivation.

**Permanent buildings** – These are important institutional buildings occurring either individually or in groups, for example, schools, government offices, church buildings and hospitals.

**Peri-urban area** – This is land surrounding a town that is about to be taken over for urban activities. It also includes idle land within the built-up area of the town on which future expansion of the town is likely to take place. In this work, the term peri-urban is used to describe this area because, in the first place, it is more popular for the Third World situation and, secondly, it spells out the close proximity of this area to the town and the interdependence of the two areas.

**Peri-urban cultivation** – This includes all forms of cultivation taking place within the peri-urban areas of the town. In this study, emphasis is on cultivation related to meeting domestic food requirements. It does not, however, include backyard gardening.

**Planted forests (Plantations)** – These are forests established artificially by afforestation on land which previously did not carry forests within living memory or by reafforestation on lands which carried forests before. Usually, it involves the replacement of the indigenous species by a new and essentially different species or genetic variety.

**Under bounded city** – This is a city which has expanded beyond its legal or administrative boundaries.

**Urbanization (urban growth)** – In this study, these terms are used interchangeably to refer to the expansion of an urban area in terms of population growth (through immigration and natural increase) and the physical expansion of the built-up area.

**Urban sprawl** – This refers to the tendency of urban areas to extend over large areas of land.

**Woodfuel** – This includes charcoal and firewood.

**Woody vegetation** – In this study, woody vegetation refers to trees and shrubs only.

## 1.7 Organisation of the study

The study is divided into six chapters. Chapter One is the introduction. Chapter Two examines some of the available relevant literature on how urban growth affects vegetation. The chapter opens by looking at the process of urbanization and the formation of peri-urban areas before

proceeding to examining the effects of urbanization on vegetation, drawing examples from various parts of the world.

Chapter Three gives a description of the study area and the factors that influenced its selection. The location, physical characteristics, history and population growth of the area are discussed. Chapter Four presents the methods used in the collection and analysis of data while Chapter Five presents the results of the study and the discussion of the findings. Chapter Six deals with the conclusion of the study and makes recommendations for possible action and future research.

# CHAPTER TWO

## REVIEW OF LITERATURE

In this chapter, attention is given to the literature available on the process of urbanization and how urbanization affects the peri-urban areas in general and vegetation in particular. The chapter begins by looking at the process of urbanization and the structure of the peri-urban areas before looking at the human activities which foster deforestation in the peri-urban areas. This is followed by an examination of the reasons behind these activities. The impact of deforestation on the environment as well as the socio-economic well being of the residents is discussed next.

### 2.1 The process of urbanization

Urban growth, especially in Western countries, is associated with economic development manifested in higher material standards of living, more leisure time and higher income than in rural areas (Bryant, Russwurm and McLellan, 1982). The rural areas, on the other hand, especially in developing countries, usually lag behind in economic development. The agricultural sector is in a poor state of development, life is generally unattractive and dreary while returns from the land continue to diminish.

This disparity in economic development between the rural and urban areas, coupled with demand for labour in towns, is partly responsible for the rural-urban migration of people (Yalcintas, 1971). While the influx of the rural populations into urban areas leaves rural areas depopulated, it leads to a demand for land in towns. This demand for land has to be met by the towns' peri-urban areas.

### 2.2 The structure of the peri-urban area

The peri-urban area can be divided into two: an inner and an outer peri-urban area.

#### 2.2.1 The outer peri-urban area

The outer peri-urban area is an area dominated by rural-oriented activities (van den Berg, 1984). Its landscape is characterised by rural land, woodlands, farmlands, hunting and fishing grounds.

However, infiltration of urban-oriented activities, like market gardening and land speculation, is also obvious. Generally, the outer peri-urban area experiences the invasion of the urban uses and users.

### 2.2.2 The inner peri-urban area

This area is characterised by urban-oriented activities: land under construction, sub-division plans have been approved, new residential areas, roads and industrial estates are being laid out. There is little doubt over much of this land about its urban-oriented functions and ultimate conversion to urban uses (van den Berg, 1984). Recreation facilities, like golf courses and football pitches, and garbage dumps tend to be found in this zone.

## 2.3 Human activities which foster deforestation in the peri-urban area

Human activities that foster deforestation in the peri-urban areas as the urban area expands can broadly be divided into two (Figure 2.1). They are demand for land on which to lay infrastructures for transport, residential, commercial, recreational and industrial development and demand for products which meet food, raw material and energy requirements (Bryant, Russwurm and McLellan, 1982). In Third World countries, the rapid growth of urban population has necessitated the expansion of the built-up area while the accumulation of poor immigrants around the peri-urban areas has led to demand for woodfuel and peri-urban cultivation to meet domestic fuel and food requirements, respectively (Bradley, 1994). It is, therefore, assumed that much of the deforestation that takes place around urban areas is a result of these activities.

### 2.3.1 Woodfuel production

The endeavours by the urban dwellers to meet energy requirements through the acquisition of woodfuel leads to deforestation in the peri-urban areas. According to Smith (1981), woodfuel gathering is the principal cause of shrinking woodlands around many Third World cities. In Zambia, woodfuel supplies some 90 percent of urban demand for household fuel (GRZ/UN, 1996). As much as 1 675 kg of woodfuel is consumed per Zambian urban dweller per annum (Chidumayo, 1997). Figure 2.2 shows the percentage of households using different sources of energy in urban Zambia in 1990; the dominance of woodfuel is quite clear.

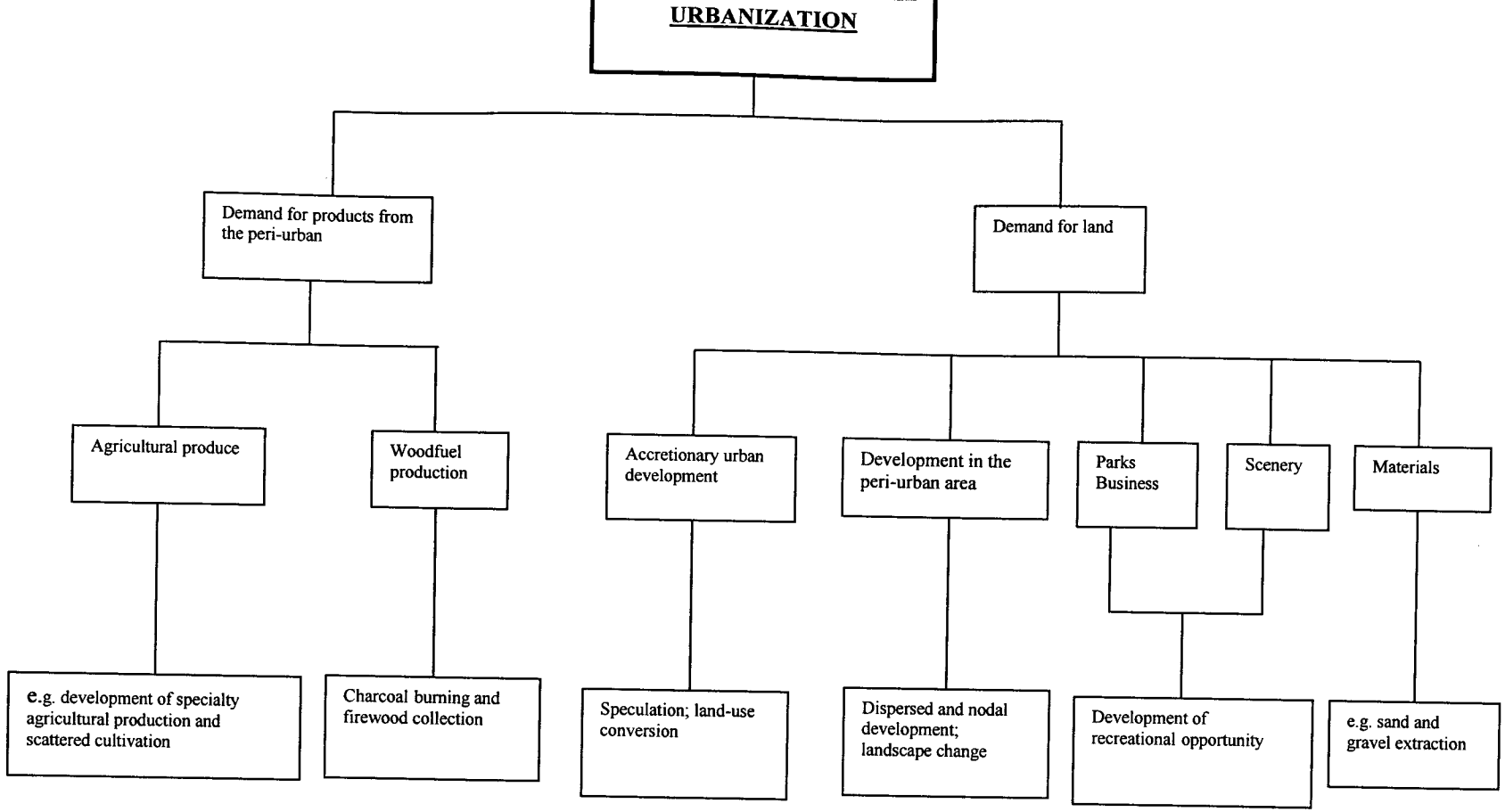



**Figure 2.1 The impact of urbanization on the peri-urban area.**

Source: Adapted and modified from Bryant, Russwurm and McLellan (1982:7).

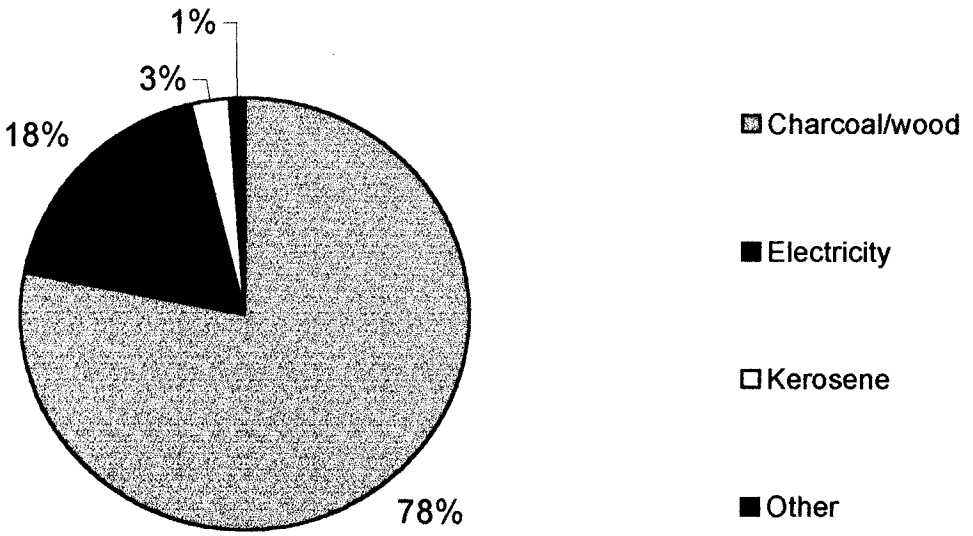



**Figure 2.2 Contribution of different energy sources to the gross energy used by urban households for cooking in Zambia in 1990.**

Source: Based on data from GRZ (1998).

This problem is not unique to Zambia only but is rather widespread among the Third World countries. Mazambani (1982) has observed for Harare, that the low-income families have energy supply problems; they cannot afford electricity and kerosene and so have to depend on woodfuel. Similarly, from Central Chile, Endlicker (1990) reports that Concepcion, the regional capital of Central Chile, consumes roughly 6 000 tonnes of charcoal per year or 100 000 square kilometres of timber. In Rwanda, the treed Savanna in the southeast of the country has been almost destroyed by the felling of wood to supply Kigali (the capital town) with charcoal to meet the needs of low-income groups (Klinert, 1987). For Lilongwe in Malawi, Potts (1989) notes that the low-income groups are inevitably lopping and felling trees in public open spaces to meet the great deficit of woodfuel. If the current trend in woodfuel consumption continues, the supplies will soon get exhausted and the billions of people who depend on it will experience a shortage of supply of the commodity. Already, UNEP's (1995) estimates were that by the year 2000, 2.7 billion people in the world would experience a shortage of woodfuel.

The main problem cited for high reliance on woodfuel in Zambia has been the inability by most households to shift to modern sources of domestic energy, in particular electricity (GRZ/UN,

1996). According to GRZ/UN (1996), as late as 1990, only 40 percent of the urban households in the country had electricity and the reason given is that most urban households cannot afford the installation costs of electricity because of poverty.

### 2.3.2 Peri-urban cultivation

According to Mazambani (1982), the rise in urban population causes three problems: the rates of unemployment rise; the number of low-income families increases; and the dependence ratio per urban employee also increases. The result of these problems is that many families experience difficulties in obtaining their daily household requirements in general and food in particular. In Zambia, the situation has been exacerbated by the rising cost of living, especially the cost of foodstuffs, and the declining purchasing power of the Kwacha, the local currency (Jaeger and Huckabay, 1986). According to GRZ/UN (1996), the decline in incomes and employment in Zambia has been the basic cause of many people's descent into poverty. In 1994, for example, the typical monthly salary of a Zambian middle-level civil servant was between K30 000.00 and K50 000.00 (a paltry 45 to 70 dollars). In addition, formal sector employment declined from 25 to 10 percent between 1980 and 1990. Closures of companies and retrenchments followed in succession since 1990, leading to a further fall in employment. The high inflation has led to a further decline in real income levels. The result has been that the low-income groups cannot afford to purchase all the food that they require (GRZ/UN, 1996).

Based on this premise, many families especially in the low-income group have had to find additional means of sustaining their livelihoods. This has included engaging in informal economic activities like peri-urban cultivation. Earlier studies have shown that peri-urban cultivation is more rampant in areas adjacent to the low-income residential areas. Mazambani's (1982) study of Harare in Zimbabwe showed that 70 percent of the peri-urban cultivators were from the low-income group. Out of 100 households studied in Kalingalinga, a high-density residential area in Lusaka, 73 households had peri-urban fields (Jaeger and Huckabay, 1986). In Malawi, the former president, Kamuzu Banda, is known to have encouraged peri-urban cultivation as part of his drive for national food self-sufficiency (Potts, 1989).

Peri-urban cultivation is, therefore, a thriving human activity in the peri-urban areas of most African towns. In Lusaka, the activity has increased to the point where almost every piece of

vacant land within the city has been taken up for cultivation (Jaeger and Huckabay, 1986). In the vicinity of Harare's low-income residential areas, peri-urban cultivation increased from 267 hectares in 1955 to 4,762 hectares in 1980 (Mazambani, 1982). In Ibadan, peri-urban cultivation reduced the dambo of the Ogunpa stream from 405 hectares in 1961 to 335 hectares in 1965 (Oyelese, 1971).

Although peri-urban cultivation itself may not always pioneer the removal of vegetation, it makes it difficult for regeneration to take place, unless the area is left fallow. This makes the activity relevant to this study.

### 2.3.3 Physical expansion of the built-up area

The physical expansion of the built-up area of a town as its population grows causes the growing edge of the town to extend into the adjacent woodlands and forests. This problem has a global dimension, active in both developing and developed countries.

In North America, urban areas have grown most rapidly since the Second World War (Hart, 1976). This has been mainly due to the development of the highway and high-speed automobile which allows the affluent to settle further away from the town centre. The result is the phenomenal urban sprawl which brings over 4 800 square kilometres of prime land under buildings, concrete, asphalt and reservoirs every year in the USA and Canada (Allen, 1980). In the USA alone, urban land increased from 6.3 million hectares in 1950 to 17.2 million hectares in 1970 (Haggett, 1983). The hectarage must have increased over the years. Developed countries have, however, been careful to incorporate greenbelts in their urban development plans to control the unregulated expansion of the built-up area into adjacent woodlands and forests.

A similar picture obtains in Asia. This is explicit from Wong's (1974:133) description of the impact of the growth of Hong Kong on the indigenous vegetation:

> *Due to an ever-increasing population, industrialisation and urbanization after the Second World War, the natural environment of Hong Kong has been given away. One can imagine how serious the problem is when one thinks of Hong Kong as one of the most densely populated regions in the world with over four million people inhabiting a place approximately 1046 km$^2$ in extent. Familiar and common*

*habitats of plants and animals which seemed safe from immediate destruction have been altered or destroyed by recent developments, such as housing schemes, construction of roads, reservoirs, etc. Large numbers of common plants and animals have been vanished or become extinct. One well known example of a drastically changing situation is that of the vegetation classification set up by Schimper..., Hong Kong which was classified as "evergreen broad-leaved forest" type vegetation. This classical type of vegetation has virtually disappeared ... due to different sorts of human activities, such as thinning, repeated cutting and burning, both intentional and accidental.*

In Africa, studies have shown the same effects of urban growth on the vegetation of peri-urban areas. Soon after independence in the 1960's, African towns expanded as a result of an influx of rural-urban migrants who occupied vacant lands within and around the towns either in illegal squatter settlements or low-density developments created following the official western legal procedures (van den Berg, 1984). These phenomena have led to the expansion of the built-up areas of the towns.

One of the significant studies done on African cities is Oyelese's (1971) study of the expansion of Ibadan City in Nigeria, between 1961 and 1965. This study revealed that in this period, the total area occupied by commercial, industrial and market centres of the town increased by 21 hectares, thereby impinging on rural land-uses in the peri-urban area. The high density modern housing areas reduced the hectarage of the Ogunpa dambo devoted to rural-use from 90 hectares to about 30 hectares.

For Lusaka, the expansion of the city from its original 2.59 square kilometres astride the railway line to over 139 square kilometres in 1970 led to the city's encroachment upon former prosperous farms and woodlands, especially to the east and south-east of the original settlement (van den Berg, 1984). Williams (1984) notes that this expansion has resulted in the removal of much of the original miombo woodlands in the vicinity of the city. The expansion of the built-up area, therefore, has an impact on the indigenous woody vegetation and makes this study worthwhile.

## 2.4 The impact of deforestation

Forests and woodlands have been described as environmental buffers (Mackean, 1995). They have a profound effect on climate, water supply and soil maintenance. For Curry-Lindahl (1972),

killing vegetation over large areas of land for the purpose of urbanization is tantamount to threatening human physical and mental health.

Urban growth causes the denudation of extensive areas around towns, leading to the development of stark landscape of bare hill terrain in and around towns. Exposing vulnerable areas such as steep slopes, banks of streams and dambos (vleis) could create major ecological problems like erosion and discharge of silt into rivers and streams. For instance, in Ibadan, cultivation along the banks of the Ogunpa stream led to the silting of the river and reservoir which supplies Ibadan with water (Oyelese, 1971). The resulting flash floods can be hazardous both to human life and to property and may cause the drying up of perennial streams and rivers. Figure 2.3 shows the changes that take place in mean stream flow and duration after wet miombo has been cleared. Wood carbonisation also increases the soil pH and exchangeable potassium and magnesium at the site of the kiln (Chidumayo, 1997).

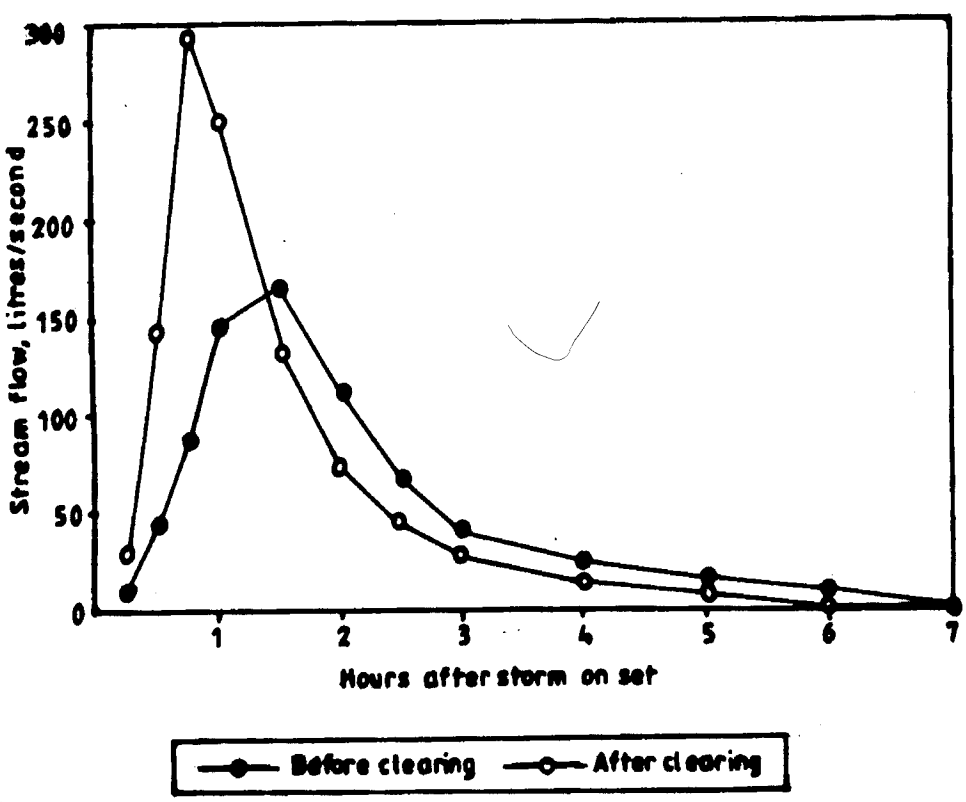



**Figure 2.3 Changes in mean stream flow and duration after wet miombo has been cleared.**

Source: Chidumayo (1997: 121)

The recession of woodlands increases the time and walking distances required by women for collection of firewood. Consequently, they have less time and energy to spend on other activities like caring for children or engaging in income generating activities (GRZ, 1996). Prices paid by the urban consumers for woodfuel rise, as the source of supply becomes more distant (Chidumayo, 1979; GRZ/UN, 1996).

Deforestation also deprives human beings of an important source of timber, food (e.g. insects, fruits, mushrooms, bush meat, and palm wine), medicine (e.g. quinine from cinchona), and other non-timber products that provide a means of earning an income (UNEP, 1995). Removing the forests, therefore, does not only impoverish the environment but also the people whose very subsistence depends on it. UNEP (1995) have argued, and rightly so, that the quest by the increasing population (of poor and landless people) to meet their short-term needs leads to resource degradation which creates more poverty and jeopardises survival in the long-term.

The negative impact of woodfuel production and peri-urban cultivation has brought about strong opposition against them on conservational, amenity and health grounds. For instance, Potts (1989), who studied peri-urban cultivation in Lilongwe (Malawi) and made comparisons with Harare (Zimbabwe), states that the activity was strongly criticised for altering the appearance of open spaces in the towns of Malawi. In Zimbabwe, there are strong legal restrictions on peri-urban cultivation and campaigns against the practice included destroying crops growing in ecologically fragile and sensitive areas. In Zambia, peri-urban cultivation is illegal and municipal by-laws expressly forbid cultivation on vacant land, although the authorities tolerate the practice (Jaeger and Huckabay, 1986).

## 2.5 Conclusion

The available literature has shown that as urban areas expand, they have an impact on the indigenous woody vegetation adjacent to them. Human activities related to the provision of woodfuel, food and settlement are the major reasons for the depletion of the indigenous woodlands. This understanding forms the basis for this study's enquiry into what impact the growth of Kasama has had on the indigenous vegetation in its vicinity.

# CHAPTER THREE

## SELECTION AND DESCRIPTION OF THE STUDY AREA

In this chapter, salient features of the study area like the location of the town, the physical characteristics, the history of the town, population growth and human activities are described.

### 3.1 Location of the study area

The municipality of Kasama is the centre of this study. It is the administrative headquarters of the Northern Province of Zambia. Located between latitudes 10° 9'S and 10° 15'S and longitude 31° 7' and 31° 12' E, the town is situated at a road junction and is served by the TAZARA (Figure 3.1). The district shares borders with Mungwi to the east, Mpika to the south, Luwingu to the west, Mbala to the north, Mporokoso to the north-west, Chilubi to the south-west and Chinsali to the south-east.

Since the peri-urban area is dynamic, the study area was fixed using lines of latitude and longitude which were deemed to be enclosing most parts of the town's 1991 peri-urban area. The advantage of this approach is that it gives the study a specific frame in which to work. The study area covers 12 462 hectares (approximately 12.5 square kilometres).

### 3.2 Physical characteristics of the study area

Interrelations exist between vegetation and physical attributes like geology, relief, drainage, climate and the soils of an area. These physical characteristics affect the physical forms of individual plants as well as of their assemblages and are, therefore, worthy of study.

Geologically, the area consists mostly of quartzites, sandstones, and grits of the Pre-Cambrian – Kibara System (Basement Complex). The presence of extensive horizons of quartzites is largely responsible for the existence of a plateau in the area (GRZ, 1978). The plateau is a part of the up-warped Mbala-Kawambwa Plateau, which is an extension of the main Congo–Zambezi

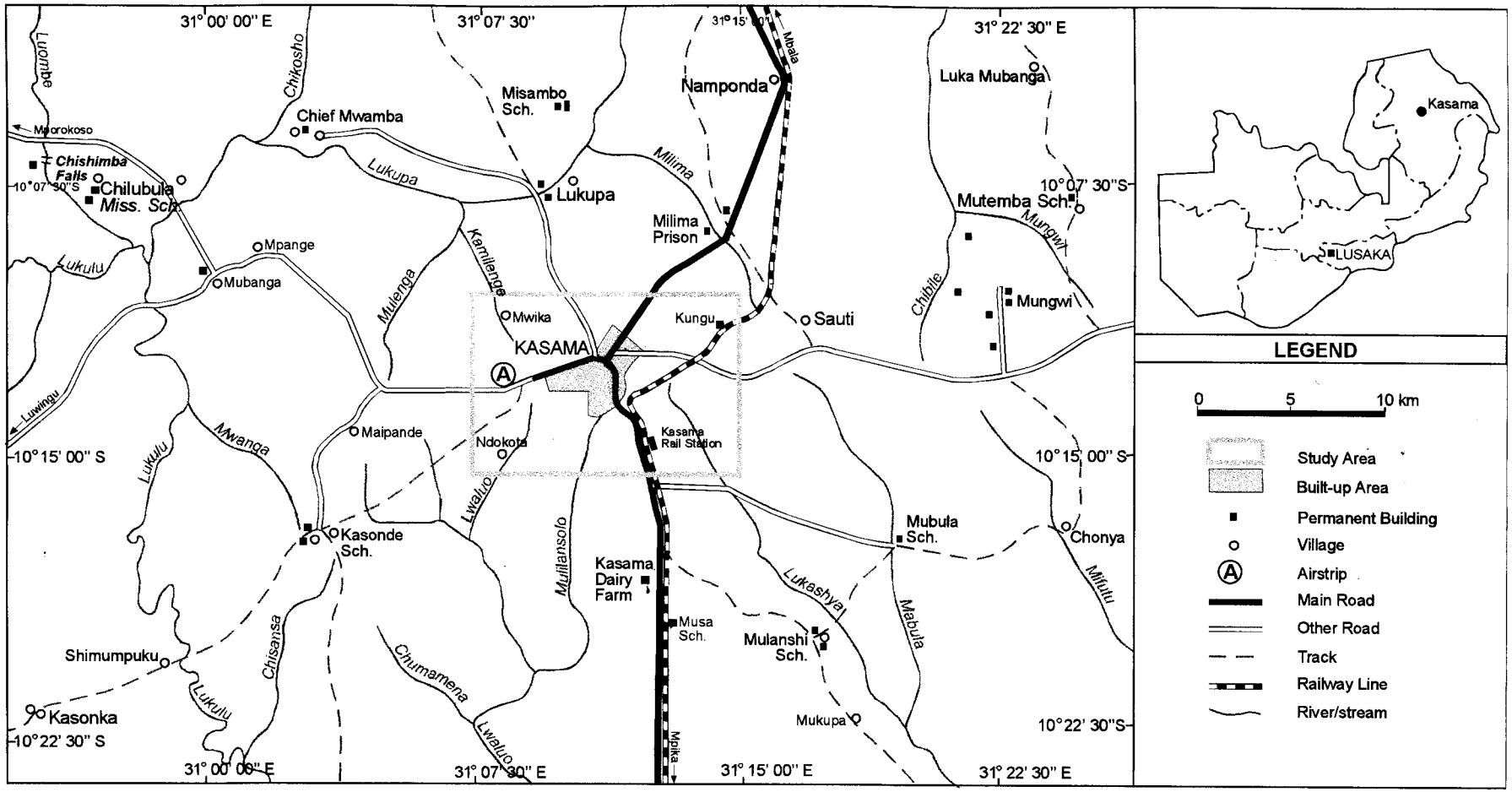



Fig. 3.1: The location of the study area

continental divide (Trapnell, 1996). The planation of the surface, which probably took place in the Gondwana (Late Mesozoic) or Early Cainozoic Age, has greatly reduced the height of the plateau. Average height at Kasama is about 1384 metres above sea level (GRZ, 1982), with local relief varying from 1 280 metres in the valleys of the streams to 1 458 metres in the hills to the east of Lukashya Trades Training Institute (Figure 3.2).

Streams like the Lukashya, Mulilansolo, and Lualuo have eroded the weaker rocks, carving out valleys in the surface of the plateau, culminating into an undulating topography. The CBD, Central Town and New Town lie on the convex cuesta type of interfluve that has a south-facing steep slope and a north-facing dip-slope. Location lies on the piedmont slope while the squatter settlements of Chitamba, Chisanga, Bwembya, Chiba and others lie on lower ground in the wide valley cut out by the Mulilansolo and other streams.

The interfluve on which Kasama lies is really a watershed that separates streams flowing into the Lukulu to the northwest and those flowing into the Chambeshi to the southeast. The drainage system of the area is part of the larger Chambeshi – Bangweulu drainage system.

Kasama's tropical and interior location gives it a tropical continental climate with three distinct seasons. The rains come in the hot, wet season that lasts from late October to April when the Congo Air mass meets the Southeast Trades and the Northeast Monsoon winds. Precipitation averages 1240 millimetres per annum (GRZ, 1982) and is mostly from convectional sources. The other two seasons are generally dry, one being cool and dry (between April and August), and the other hot and dry (between late August and late October).

The soils are generally typical of the high rainfall region (Kalima, 1983). They are strongly leached, chemically poor and of low fertility. Aluminium saturation may exceed 60 percent in the sub-surface horizons leading to aluminium toxicity. Free iron content (mostly haematite) is very high and is responsible for the reddish or brownish colours of the soils and presence of iron concretions.

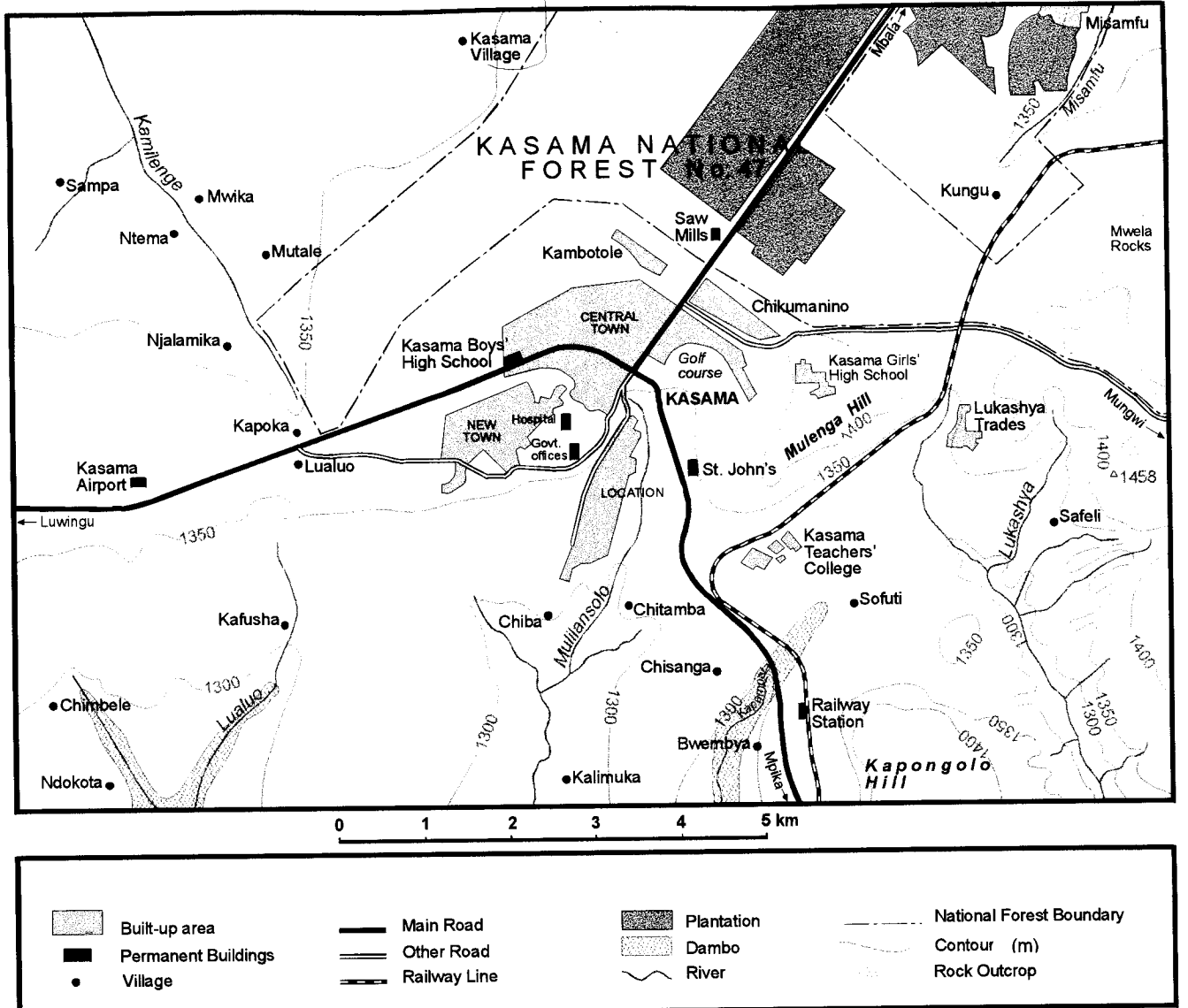



Fig. 3.2 Kasama: Relief, drainage and communications.

The interplay of the above factors favours the growth of the Brachystegia-Julbernardia - Isoberlinia or wet miombo woodland (Plate 1), which is a variant of the many vegetation sub-types of the Savanna vegetation, found in south central Africa. The woodland is two-storeyed, with trees growing to 15 – 21 metres high. It is characterised by species like *Brachystegia boehmii, Julbernardia paniculata, Isoberlinia angolensis, Burkea africana* and *Brachystegia utilis* with *Pericopsis angolensis, Anisophyllea pomifera , Erythrophleum africanuum* and *Parinari curatellifolia* as frequent associates (Fanshawe, 1971). The woodland is open to lightly closed and as such grass, sedges and shrubs form a thick undergrowth, 0.6 – 1.3 metres high. Grass is found in dambos which flank the streams. Dominant grass species include *Loudetia simple* and *Andropogon schrensis* (Chidumayo, 1997). Riparian vegetation is found along watercourses like the Mulilansolo and Lukashya.

## 3.3 Socio-economic characteristics of the study area

### 3.3.1 Brief history of Kasama

The Bemba tribe under the chieftaincy of Mwamba occupied the area in the vicinity of Kasama town. These people lived in small and fortified villages doing very little or no cultivation. The question of charcoal burning did not even arise. By and large, the impact of this indigenous population on the native vegetation was very negligible. The establishment of the town in the area, therefore, has a significant bearing on the present vegetation cover. It is, therefore, imperative to understand the events which led to the establishment and growth of the town.

The history of Kasama begins with the death of Chief Mwamba in November 1898. Prior to this date, it was difficult for the BSA Company to found an administrative post among the Bembas. On Mwamba's death, Bishop Dupont, a White Father and friend of Mwamba, who briefly acceded to the throne, made it possible for the company to found Kasama, the first administrative post in Lubemba. Initially, the town was located at Milima or Old Kasama, 5 km to the north of its present site. However, when in 1900 M.C. Leyer took over from Robert Young as Native Commissioner, he moved the station to the present site (GRZ, 1973).

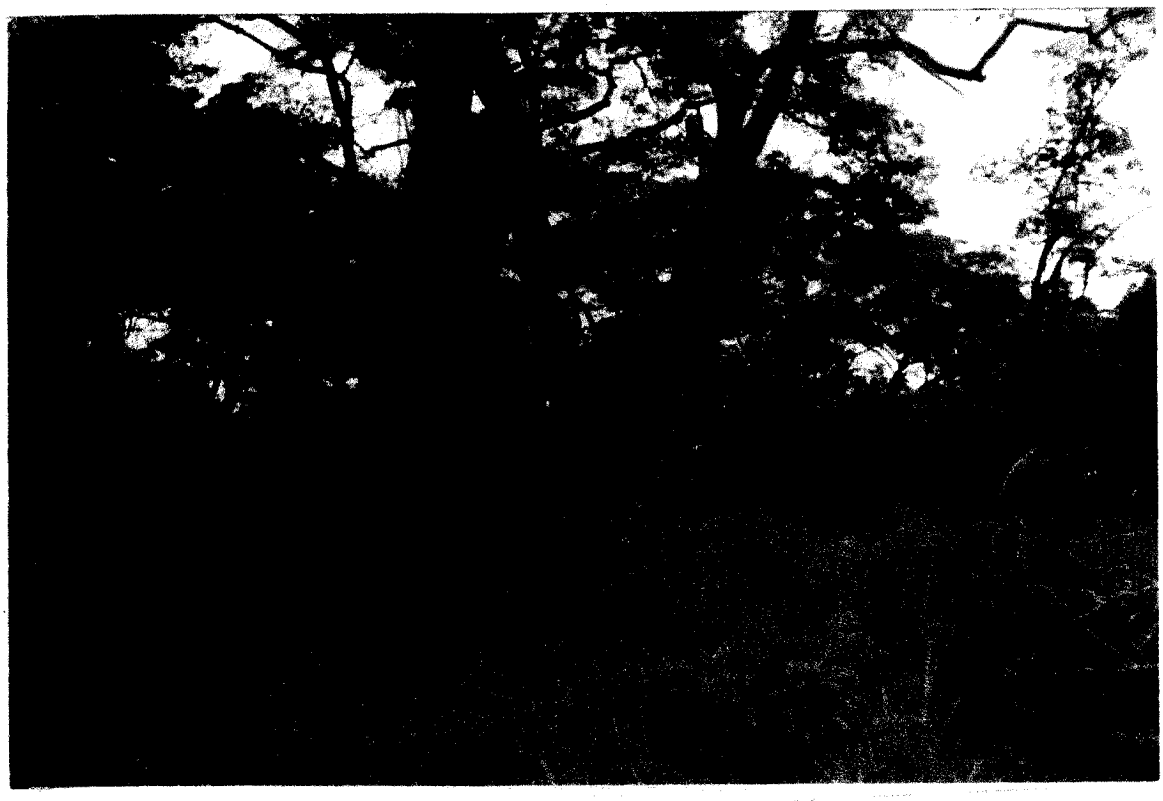


**Plate 1: Miombo woodland in the peri-urban areas of Kasama.**

The growth and expansion of Kasama was more rapid from 1949 when various government departments began to function. By 1954, Kasama had become the headquarters of the Northern Province, which included the present day Luapula Province (GRZ, 1973). In 1958, Kasama was designated a township (GRZ, 1973) and was accorded the municipality status in the 1990's. The town's growth has been greatly helped by its status as the provincial headquarters of Northern Province and its location on the TAZARA. The completion of the railway in June 1975 greatly alleviated transport problems to and from the town (GRZ, 1990).

### 3.3.2 Population growth of Kasama

In June 1963 when the first composite census of population was held, Kasama urban had a population of 6384 people (GRZ, 1965). This population rose to 8 924 people during the 1969 census (GRZ, 1974) and 36 269 people in 1980 (GRZ, 1990). By 1990, the population had risen to 48 470 people and was projected at 68 307 people for the year 2000 (GRZ, 2001). Table 3.1 below gives a summary of population growth for Kasama since 1963.

**Table 3.1 Changes in population and number of households in Kasama town**

| Year | Population | Mean household size | Number of households |
|---|---|---|---|
| 1963 | 6384 | 4.0 | 1596 |
| 1969 | 8924 | 4.9 | 1821 |
| 1980 | 36269 | 5.9 | 6147 |
| 1990 | 48470 | 6.0 | 8078 |
| 2000 | 68307 | 5.4 | 12670 |

(Source: C.S.O. from various censuses).

The growth of Kasama's population and the increase in the number of households in the town are significant because an increasing population exerts increasing demand on the available forest resources of an area. They have a direct bearing on the physical expansion of the town, the amount of charcoal consumed and the area taken up for peri-urban cultivation.

### 3.4 Selection of the study area

There are several reasons why the researcher selected Kasama as his study area. To begin with, the fact that Kasama is the researcher's hometown gave him the impetus to want to study the town. The researcher has for a long time been fascinated and interested by the growth of the town, particularly by the rapid growth since the late 1980's, manifested by the increased proliferation of constructional activities. The influence of topography on the sectoral development of the town has similarly intrigued the researcher and stimulated his interest. This academic endeavour to study the growth of the town in relation to wood clearance has provided him the opportunity to study the town in some meaningful way. The advantage is that the researcher is familiar with the ecology, landscape, local customs and language of the area and was, therefore, able to find his way around without much difficulty.

# CHAPTER FOUR

## METHODOLOGY

This chapter presents the methods used in the collection and analysis of data.

### 4.1 Sources of data

Data were obtained from both primary and secondary sources. Primary data were obtained from fieldwork, which included interviews and extensive field surveys. Secondary data were obtained from archival sources, which included, inter alia, textbooks, topographical maps and aerial photographs.

### 4.2 Data collection methods

The collection of data was done through the interpretation of air photographs and the use of questionnaires.

#### 4.2.1 Air photograph interpretation

In order to plot Kasama's physical extent from 1963 to 1991, time series panchromatic air photographs of the area were interpreted. This enabled the researcher to assess the spatial trends in deforestation, using sequential comparison to study deforestation from 1963 through 1974, 1982 to 1991. Air photographs were used in preference to maps because they were available for more years than maps.

The 1963 air photographs were used as the starting point because they are the earliest air photographs available for Kasama at the Survey Department and were taken just a year before independence when people started to flock into towns in large numbers. The intervals between the time the photographs were taken allowed for the study of the change in the vegetation of the area over time.

For each of the years 1963, 1974, 1982 and 1991, the air photographs were demarcated into the categories built-up area, indigenous woody vegetation, cultivation (including plantations of tropical pine, eucalyptus, gmelina and coffee) and dambo, using topographical maps of Kasama

as base maps. Land-uses and human activities that do not fall within these categories were classified as 'other areas'. Land-cover maps, standardised to a scale of 1: 50 000 to make them comparable, were then drawn from these photographs. A square method was used to measure the area covered by each category. This was done by counting the squares falling within each category and then converting the number of squares into the number of hectares. In this way, time series data were obtained. Furthermore, the volume of the vegetation removed each year was calculated by multiplying the area of vegetation removed by 93 t/ha, which is the average volume of wet miombo in Zambia (Chidumayo, 1997).

### 4.2.2 Questionnaires

A questionnaire (Appendix 1) was used and 60 randomly selected households in Kasama were interviewed. To begin with, stratified random sampling was used in order to draw samples from all the residential categories of low, medium and high density. From each category, an equal-sized sub-sample of 20 households was further selected using simple random sampling. This form of stratification was used because it ensures comparability between the sub-samples which is important for this research (Ebdon, 1985). For instance, to decide if respondents in the low-density areas use more charcoal than those in the high-density areas, it was necessary to have the same number of respondents from each category. If proportional sampling were used in this study, for instance, 45 respondents would have come from the high-density residential area category and only 5 from the low-density area category. The number of respondents from the latter category would have been too small to give a reliable result on the hypothesis.

Simple random sampling was used to choose the 20 households in each residential area category. A municipal council register for each selected residential area was used to allocate a number to the households in that residential area. This number was written on a piece of paper and placed in a box. The pieces of paper were thoroughly mixed and then drawn at random.

Kasama has only one residential area in each of the three categories, namely Central Town/Mulenga Hill area (low-density), New Town (medium-density) and Location and the adjacent villages, like Chiba, Chitamba, and Bwembya (high-density). Emergent low-density areas like Chikumanino and Kambotole are really appendages to the main low-density area of Central Town.

It was hoped that the sample of 60 respondents would suffice because (a) the economic constraints could not allow for a larger group; (b) the questionnaire only complemented other methods of investigation; and (c) a sample of 60 is large enough for most statistical tests.

The questionnaires were administered with a view to obtaining information pertaining to:

(i) the categories of urban dwellers involved in peri-urban cultivation and deforestation;

(ii) the area of forest removed as a result of charcoal burning;

(iii) reasons behind peri-urban cultivation and charcoal burning;

(iv) the impact of deforestation on the socio-economic being of the residents of Kasama as well as the ecology of the area.

The researcher filled in the responses to the questions to ensure that all the questionnaires were completed and the interpretation of the meaning of the questions was the same throughout.

An interview was held with the PFEO to find out the prevalent activities which lead to deforestation around Kasama and what the Forestry Department is doing to discourage deforestation in the area (Appendix 2).

### 4.3 Data analysis

Percentages and means were used to assess the area of land under each of the categories built-up area, peri-urban cultivation and woodfuel production. They were also used to determine how many respondents were involved in peri-urban cultivation and use of woodfuel. To calculate the rate of deforestation, the formula in Appendix 3 was used.

The chi-square test was used to test the following hypotheses:

**Hypotheses:**

1. $H_o$: There is no significant difference in the type of fuel used for cooking among the different residential area category.

$H_1$: The fuel used for cooking differs from one type of residential area to another.

2. $H_o$: There is no significant difference in the type of fuel used for heating among the different categories of residential area.

   $H_1$: The fuel used for heating differs from one type of residential area to the other (Appendix 5).

The t-test was used to test the following hypotheses:

**Hypotheses:**

$H_o$: There is no significant difference in incomes between electricity users and woodfuel users.

$H_1$: There is a significant difference in incomes (Appendix 6).

To calculate the area of land deforested as a result of charcoal burning, the formulas given in Appendix 7 were used.

Graphical presentation was done using tables and maps.

## 4.4 Limitations of the data

In conducting this study, several unforeseeable problems cropped up which made it difficult to collect and analyse certain data. The major constraint was certainly limited funds. This constraint could not allow for a larger sample of respondents to be interviewed. The main limitation of the data, however, has to do with the sampling procedure. Since disproportionate sampling was used to obtain the data, the data could not be taken to universally represent the whole population of the study area but apply only to the respondents interviewed. In addition, because air photographs were available for four years only, rigorous tests, like the Pearson Product Moment correlation could not be used to analyse the data.

# CHAPTER FIVE

## PRESENTATION OF RESULTS AND DISCUSSION

This chapter deals with the presentation and discussion of the results of the study.

### 5.1 The rate, extent and pattern of deforestation

#### 5.1.1 The rate of deforestation

The rate of deforestation was computed from time series data obtained from the interpretation of air photographs of the area and land-cover maps were drawn (Figures 5.1 to 5.4). Some of the salient features of the maps are:

(a) The fluctuation of the area of Kasama Airport from year to year, depending on how much clearing has taken place around the airport.

(b) The unchanging areas of dambos even though they are increasingly being used for vegetable growing. This is because at this scale, it is not possible to show the small vegetable gardens.

(c) The expansion of the area under plantation between 1963 and 1974 because of the establishment of a coffee plantation at Misamfu and the forest plantation on Mbala road. The area increased again between 1982 and 1991 with the expansion of the forest plantation.

(d) The increasing area taken up by cultivation and built-up between 1963 to 1991, and therefore, the dwindling area of indigenous woody vegetation.

For each of the years 1963, 1974, 1982 and 1991, the area covered by the indigenous woody vegetation was measured and calculated as a percentage of the 1963 coverage. Table 5.1 shows the result.

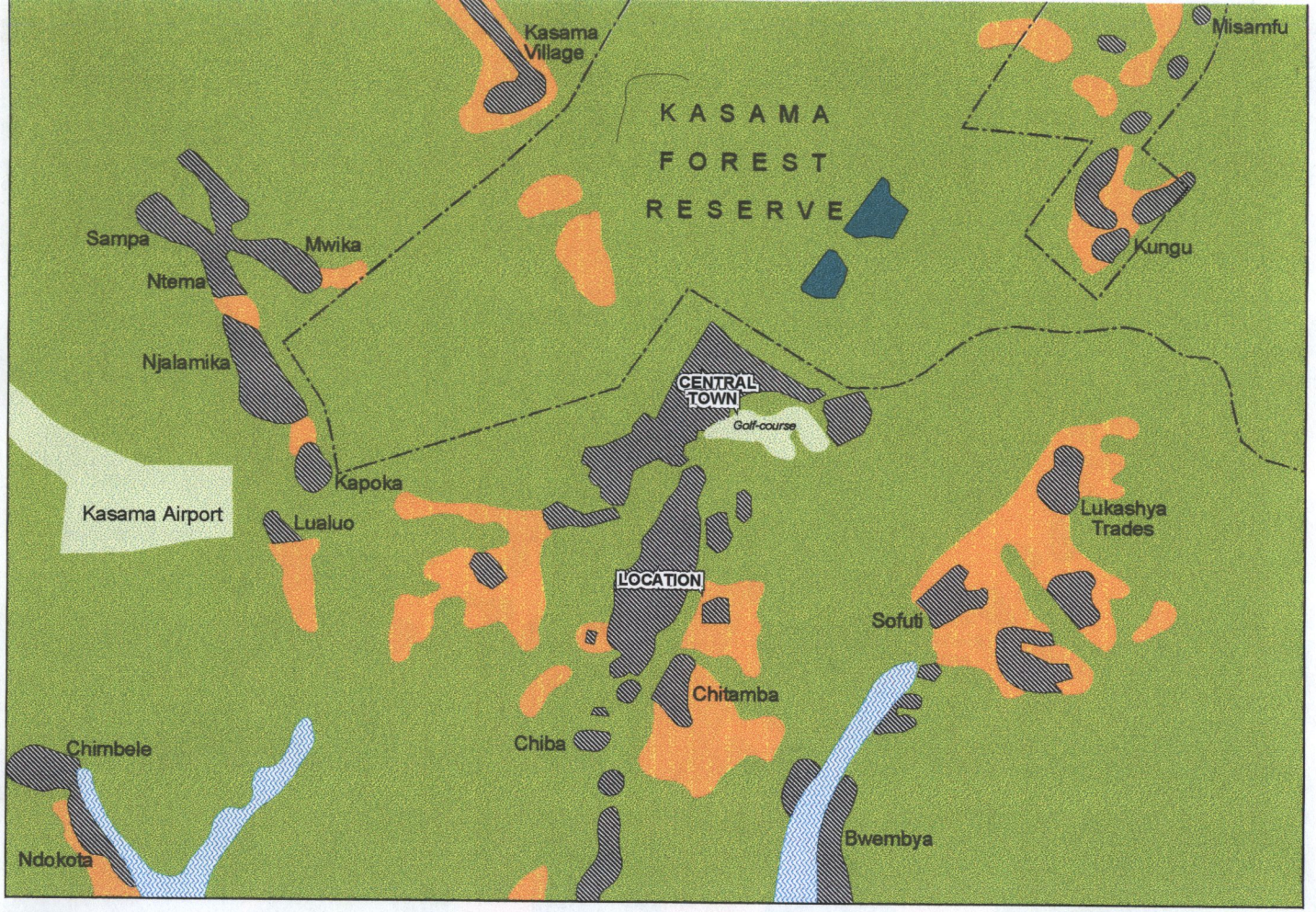



Fig. 5.1: Land-cover map of Kasama for 1963

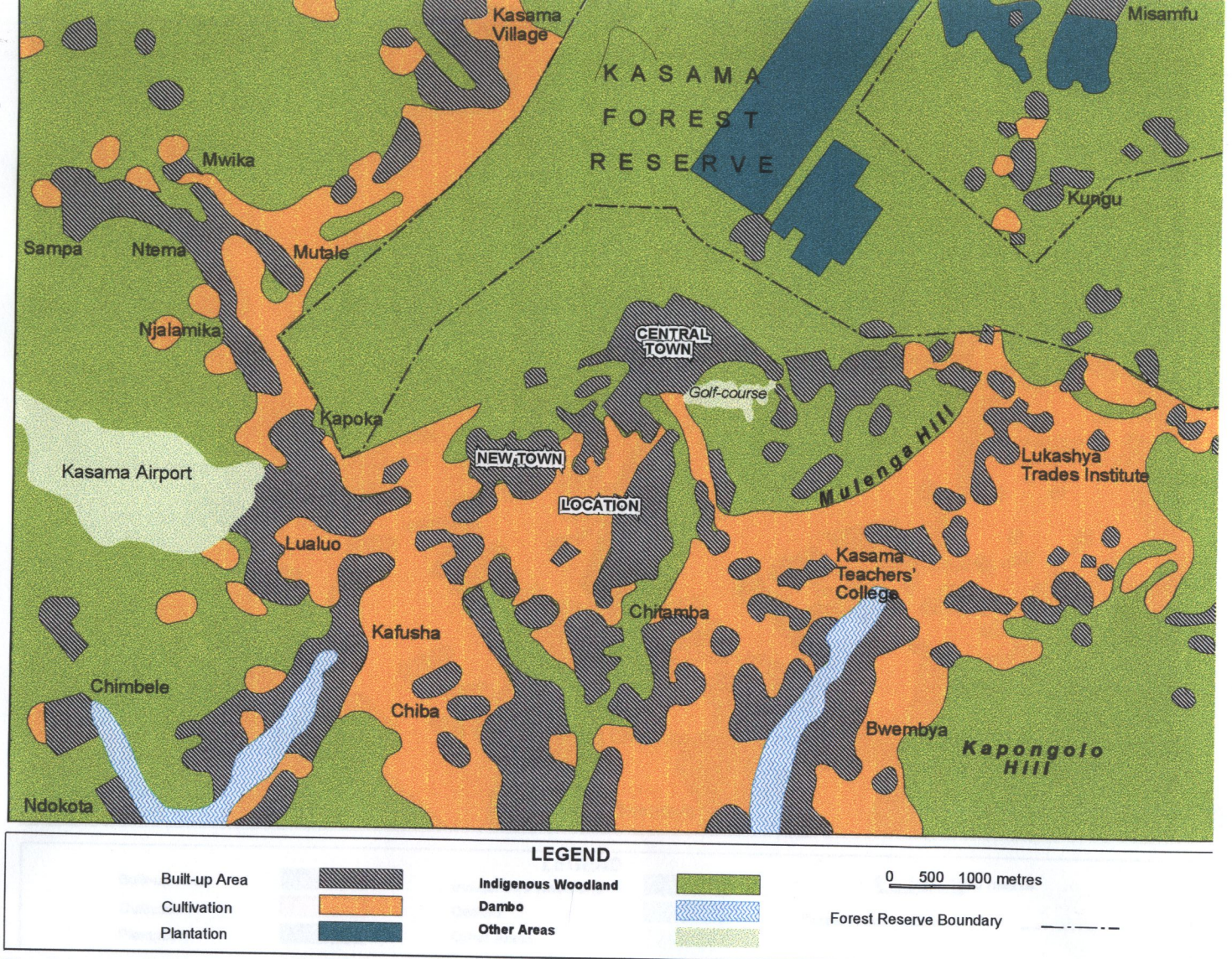



Fig. 5.2: Land-cover map of Kasama for 1974.

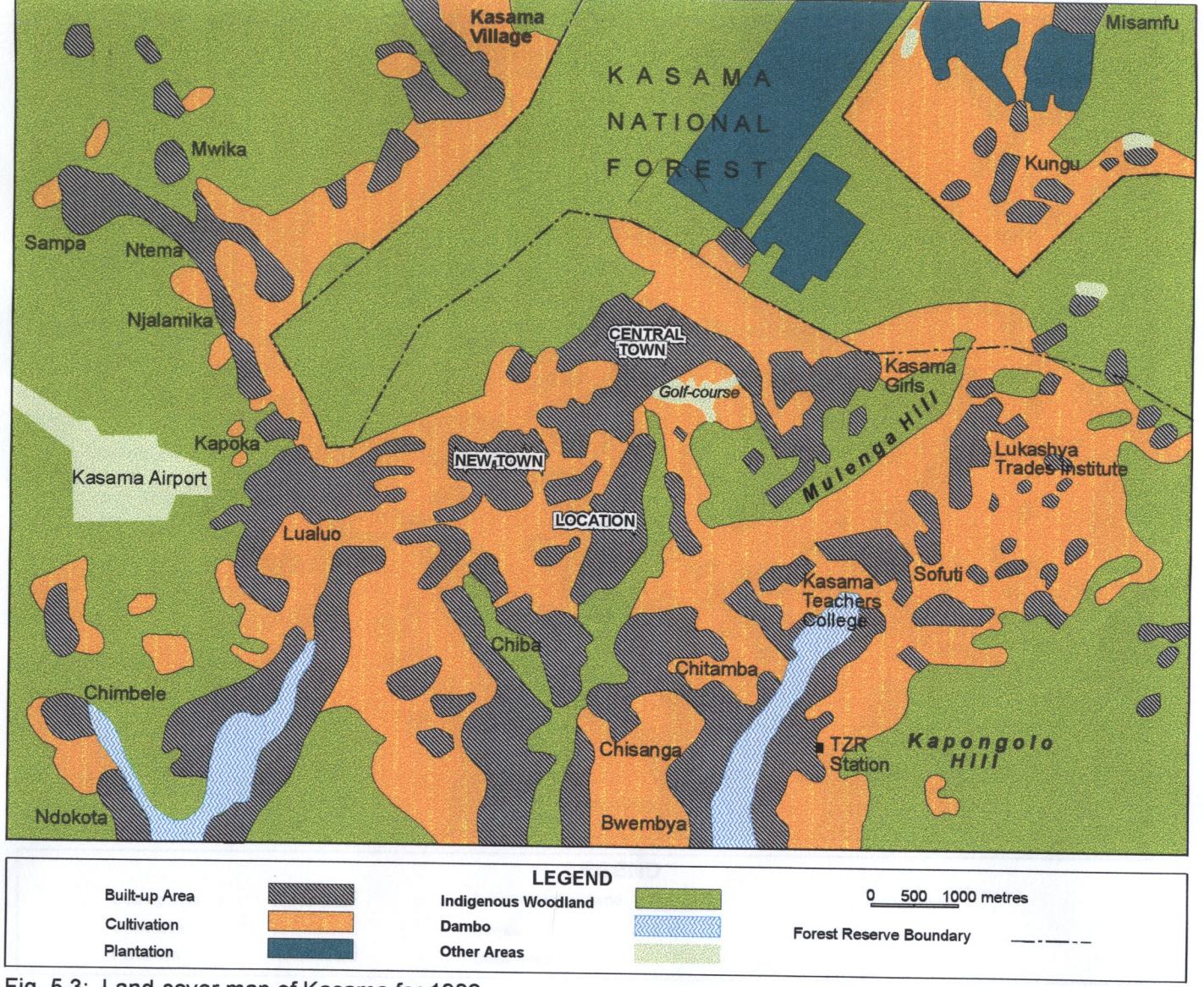



Fig. 5.3: Land-cover map of Kasama for 1982.

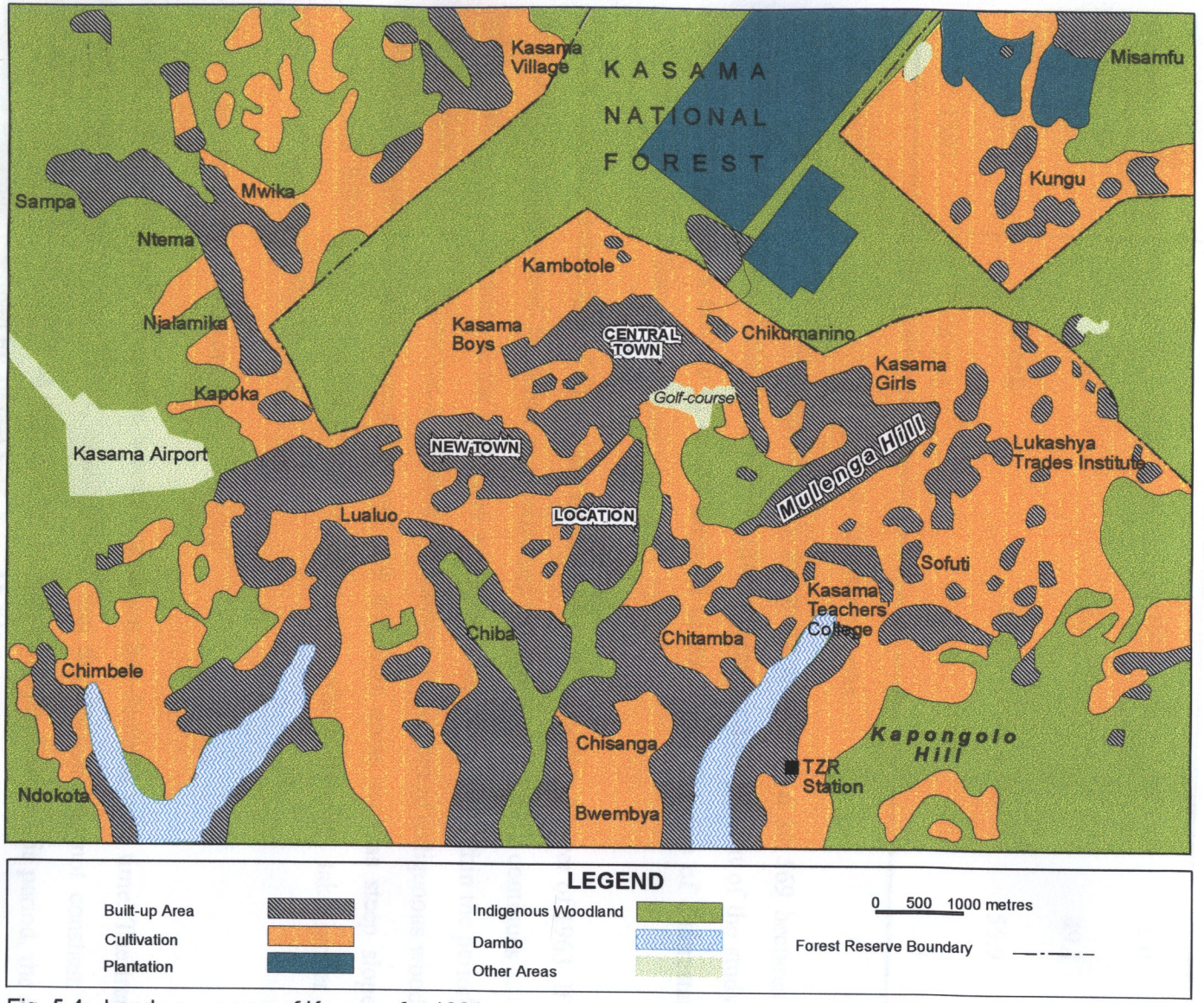



Fig. 5.4: Land-cover map of Kasama for 1991.

**Table 5.1 Area of indigenous woody vegetation, 1963 to 1991.**

| Year | Area of indigenous forest (ha) | Percentage of 1963 forest cover | Percentage of 1963 forest cover removed |
|---|---|---|---|
| 1963 | 10 569 | 100 | 0.0 |
| 1974 | 5 379 | 50.9 | 49.1 |
| 1982 | 4 658 | 44.1 | 55.9 |
| 1991 | 4 124 | 39.0 | 61.0 |

Source: Air photographs

In 1963, the indigenous woody vegetation in the study area totalled 10 569 hectares (or 84.8 percent of the study area). This declined to 4 124 hectares (or 33.1 percent of the study area) in 1991. This represents a decline of 6 445 hectares in 29 years. The rate of deforestation was therefore about 222.2 hectares per year (Appendix 3).

The decline represents a loss of 61 percent of the indigenous woodland cover of 1963. If demand for woodfuel and new land for urban expansion and peri-urban cultivation continues at this rate, indigenous woody vegetation in the study area would be completely lost within the period of 18.5 years starting from 1991. However, much of the remaining 39 percent of indigenous woodlands is either in the more difficult, inaccessible and less attractive areas such as steep slopes, rock outcrops and hilly areas or in the protected forest area where it might take longer for the vegetation to be completely cleared.

### 5.1.2 The extent of deforestation

Figure 5.5 shows how the indigenous woody vegetation has declined with time. The trend line showing deforestation is curvilinear, which shows that the decline was not constant. It was greatest between 1963 and 1974 as depicted by the steeper slope. During this period, the area of indigenous woodland declined by almost half, from 10 569 hectares to 5 379 hectares. Thereafter,

the line flattens out with time, showing a reduction in the area of woodland cleared. Between 1974 and 1991, only 1 255 hectares were cleared.

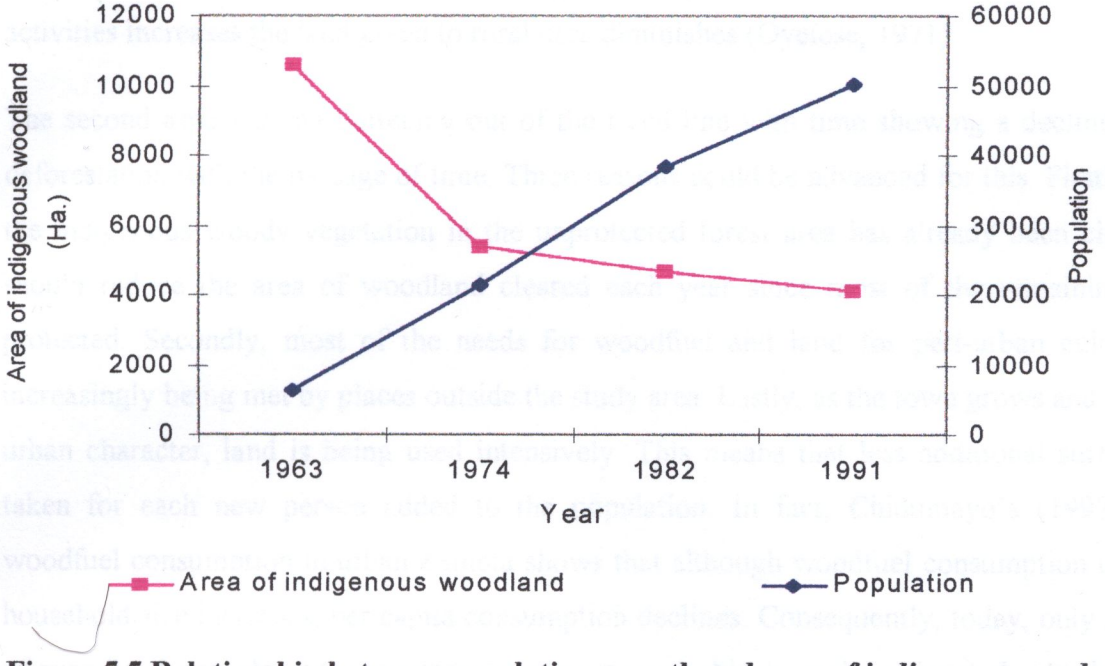



**Figure 5.5 Relationship between population growth and area of indigenous woody vegetation.**

Source: Field data.

Figure 5.5 brings out two aspects. The first one is that the period of time in itself cannot causally be taken to be responsible for the recession of the vegetation. Instead, the explanation should be found in the rapid increase in the town's population since 1963. Although population size might not necessarily be the only variable that influences the rate and magnitude of deforestation, it is an important factor since the impact might be adverse when a population reaches a certain threshold. The increased population in Kasama has certainly led to increased demand for land for peri-urban cultivation, settlement, and woodfuel production. Figure 5.5 shows that the area of indigenous woodland declined with increasing population.

Studies done elsewhere have also shown that there is a relationship between population growth and the area of land used for urban-related human activities. Mazambani's (1982) study of Harare

shows that there is a relationship between population increase and the extension of urban land uses. Hart's (1976) study of 248 urban areas in the USA also showed a similar relationship between the area occupied by urban land uses and population size. As the land taken up by urban activities increases the land given to rural uses diminishes (Oyelese, 1971).

The second aspect is the flattening out of the trend line with time showing a decline in area of deforestation with the passage of time. Three reasons could be advanced for this. Firstly, much of the indigenous woody vegetation in the unprotected forest area has already been cleared. This should reduce the area of woodland cleared each year since most of the remaining forest is protected. Secondly, most of the needs for woodfuel and land for peri-urban cultivation are increasingly being met by places outside the study area. Lastly, as the town grows and takes on an urban character, land is being used intensively. This means that less additional surface area is taken for each new person added to the population. In fact, Chidumayo's (1997) study of woodfuel consumption in urban Zambia shows that although woodfuel consumption increases as household size increases, per capita consumption declines. Consequently, today, only 20 hectares of woodland are cleared per year on average, and this is mainly done clandestinely in the protected forest area (personal communication).

### 5.1.3 The pattern of deforestation

Hypothetically, the expansion of Kasama should proceed at a smooth, wave-like form, depending on a regular distance decay effect. If this were so, the speed of expansion of the town would be the same in all directions and deforestation would proceed equally in all the directions of the town. This pattern of deforestation could only be distorted by the presence of development features that attract development in certain parts of the peri-urban areas than in others.

To determine the pattern of expansion of Kasama and that of deforestation, the distance of the nearest area of indigenous woody vegetation was measured from the CBD (centred on the post office) in each of the eight major compass points North, South, East, West, North-east, North-west, South-east and South-west. This was done for each of the years 1963, 1974, 1982 and 1991. The distances were used to draw a generalised diagram to depict the pattern of deforestation around the town (Figure 5.6). The diagram ends abruptly on the southern edge because settlement along the Kasama-Mpika Road is linear and therefore continues for some distance south of the

borderline. The pattern that emerges shows that deforestation around Kasama has not proceeded at the same pace in all the directions. This is because the development of the town has not been the same in all directions. The lop-sided development could be attributed to the fact that Kasama has not been expanding on an isotropic plane. Four main factors have determined the uneven development.

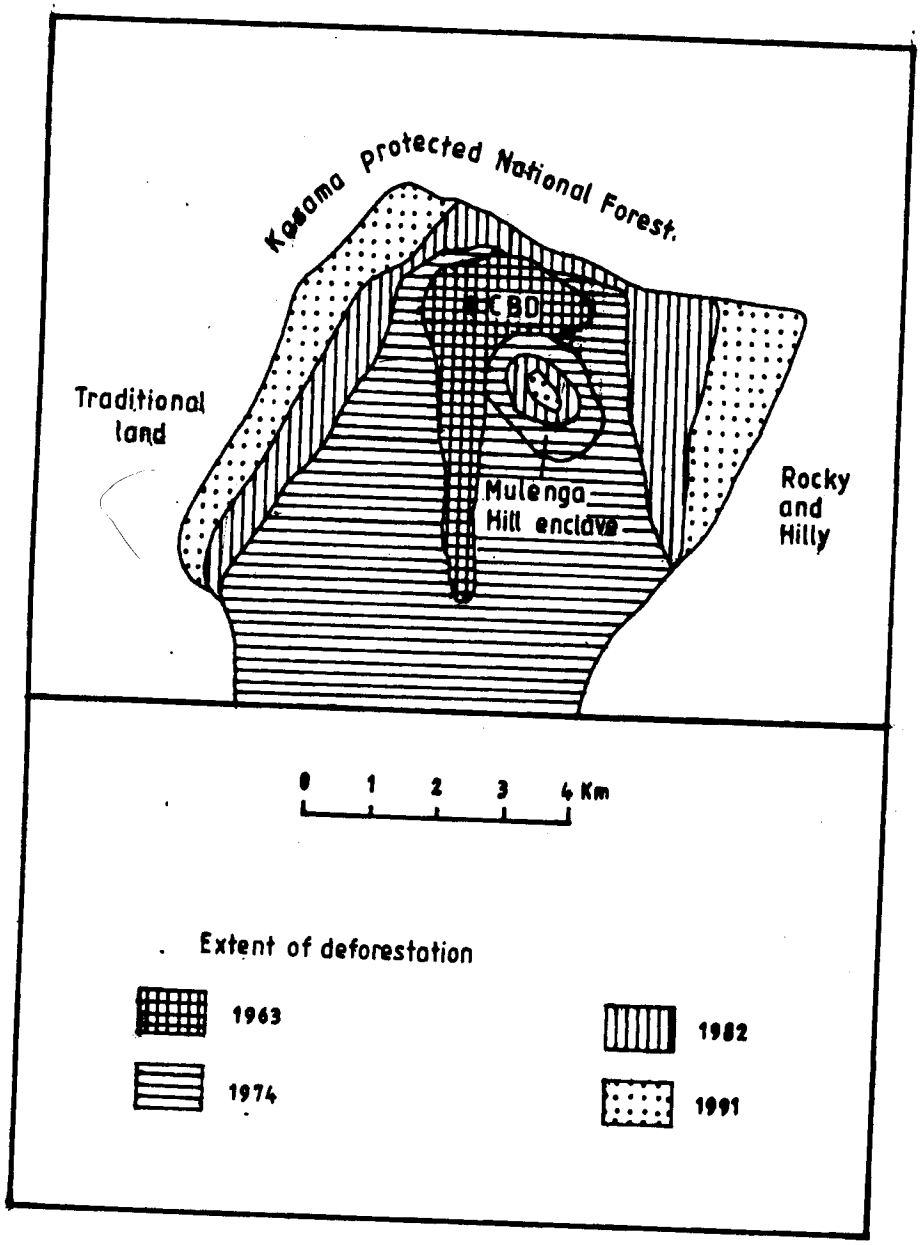



**Figure 5. 6 Generalised pattern of the deforestation around Kasama.**

Source: 1963, 1974 1982 and 1991 Air photographs.

First, the presence of hilly and rocky terrain in the south-eastern part of the study area has discouraged human settlement and cultivation in this area (although tree-cutting for charcoal and construction still goes on). This has led to the concentration of high-density settlement in the valleys of the Lukashya and Mulilansolo streams.

Secondly, the establishment of a forest plantation and the creation of a protected forest immediately to the north of the town have made it difficult for any development to take place in that area. In view of this, all developments in the area have been confined to the south of the town, where much of the indigenous woody vegetation has now been lost.

The third restraint to the expansion of the built-up area in Kasama has been that the town has reached the frontiers of traditional land, making further expansion difficult. This includes land immediately to the west of the protected forest area on the Luwingu road and the area east of Kasama Girls' High School on the Mungwi road. Officially, all built-up areas falling in these areas (for example, Mulenga Hill) are outside the jurisdiction of the municipal council. It might therefore be necessary to revise the municipality boundaries because at the moment the town is under-bounded.

The fourth consideration is the sectoral development of the town. This has led to the concentration of squatter settlements around the high-density residential area of Location. Apart from contributing the largest share to the built-up area, the squatter settlements also have a higher concentration of peri-urban cultivation. As a result, the areas that experience extreme pressure as far as the shortage of woodland is concerned correspond with these areas, which are mostly in the southern part of the study area.

## 5.2 Human activities which have fostered deforestation

The respondents were asked to name which of the three human activities, settlement, peri-urban cultivation or woodfuel production they thought had the strongest impact on the removal of vegetation in Kasama. The responses are summarised in Table 5.2

**Table 5.2 Human activities which foster deforestation in Kasama**

| Activity | Number of respondents | Percentage of sample |
|---|---|---|
| Woodfuel | 31 | 51.7 |
| Cultivation | 18 | 30.0 |
| Settlement | 11 | 18.3 |
| Total | 60 | 100 |

Source: field data.

Ostensibly, most of the respondents attributed deforestation in Kasama to woodfuel production, peri-urban cultivation and the expansion of the built-up area, in that order. The prominence of woodfuel production as the human activity that contributes most to deforestation in the area is probably due to the fact that, in as far as the clearing of vegetation in the peri-urban areas of Zambia is concerned, woodfuel production seems to precede the other activities. For example, van den Berg (1984) notes that during the deforestation of Lusaka South Forest Reserve, charcoal burners initiated the clearing; peri-urban cultivation and building moved in later, making it difficult for regeneration to take place. The harvesting of the indigenous forest for woodfuel leaves behind a very thin cover of small trees, which makes it easier to clear further for cultivation and building. The conversion of a woodland area into an urban area would, therefore, follow the stages shown in Figure 5.7.

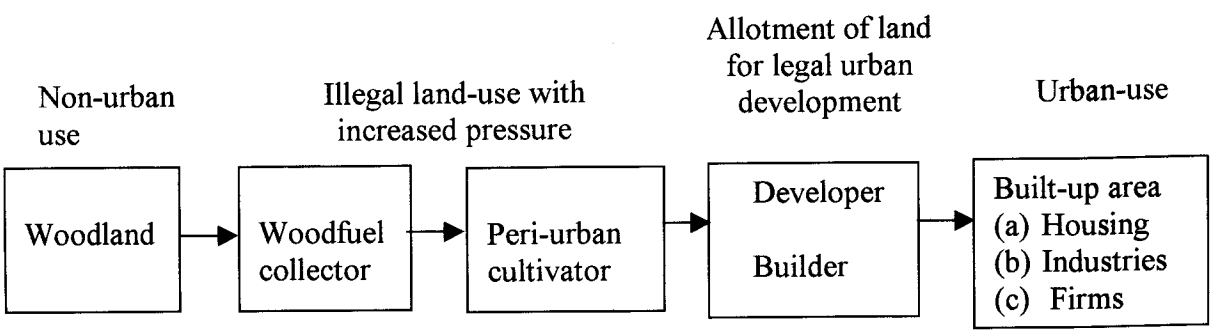



**Figure 5.7 Stages in the conversion of a woodland area into an urban area.**

Source: Modified from Bryant, Russwurm and McLellan, (1982: 56).

**Plate 2: Charcoal production in the peri-urban areas of Kasama.**

### 5.2.1 Woodfuel production

The production of charcoal is one of the main human activities in the peri-urban areas of Kasama (Plate 2).

Table 5.3 shows the contribution of charcoal production to deforestation in Kasama.

**Table 5. 3 Estimated deforestation as a result of charcoal production.**

| Year | Charcoal consumed (kg) | Wood used (kg) | Estimated deforestation (ha) | Actual increase (ha) |
|---|---|---|---|---|
| 1963 | 1,557,058 | 6,979,189 | 94.3 | - |
| 1974 | 3,694,952 | 16,561,865 | 223.8 | 129.5 |
| 1982 | 6,373,790 | 28,569,206 | 386.1 | 162.3 |
| 1991 | 8,128,602 | 36,434,790 | 492.4 | 106.2 |

Source: Calculated from field data and census data.

The estimated total area of woodland cleared as a result of charcoal production increased from 94.3 hectares in 1963 to 492.4 hectares in 1991. However, the actual area of deforestation varied from period to period. There was a steady increase between 1963 and 1982 but the period between 1982 and 1991 shows a decline in the area. The decline is related to the rate of deforestation which is discussed under Section 5.1 above.

Although the harvesting of woodlands for woodfuel plays a leading role in the clearing of indigenous forests, its total contribution to deforestation in the area is the least understood. There are inherent problems in trying to estimate the area of deforestation caused by woodfuel production. To begin with, woodlands are not clear-felled for woodfuel production. This means that the areas affected by woodfuel production are not distinct on air photographs and cannot be delimited on the maps showing the changes in land cover from 1963 to 1991. Consequently, the area cleared for woodfuel production cannot be estimated from the air photographs. The area was for this reason, estimated by using the respondents' woodfuel consumption, using the formulas in

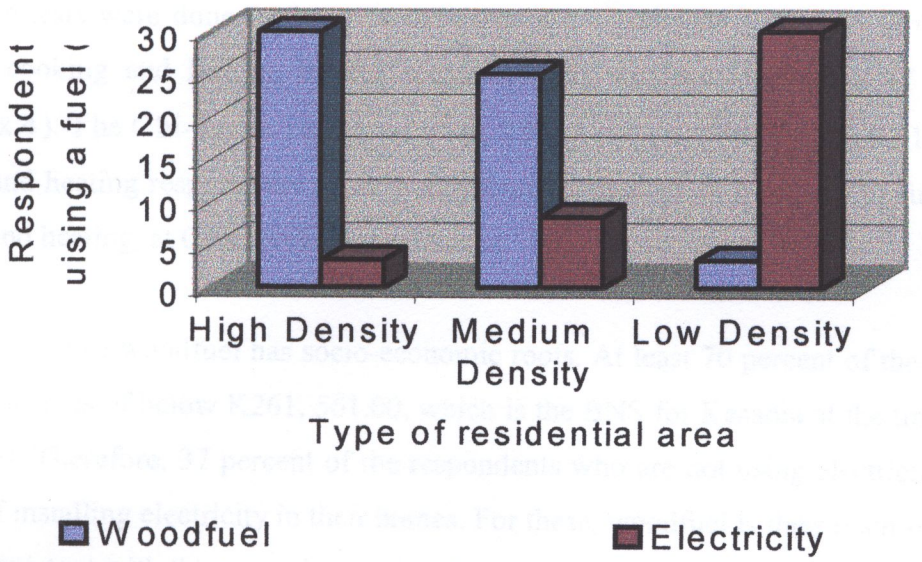
Appendix 7. It must be noted, however, that some of the woodfuel consumed in the study area is brought in from outside. This means that the actual area of woodland cleared for the production of woodfuel within the study area should be smaller than the estimated one.

In Kasama, woodfuel is used as household energy for heating and cooking. Table 5.4 shows the use of woodfuel and electricity among the respondents. The study found that 58.3 percent of all the respondents use woodfuel in their homes for cooking while 61.7 percent use it for heating. This is graphically presented in Figure 5.8. The dominance of woodfuel as a source of energy in the high and medium density residential areas is most definite. On the other hand, charcoal and firewood are marginally used in the low-density residential areas; the dominance of electricity here is more explicit. This proves Cheatle and Cheatle's (1979) assertion that charcoal is the most commonly used fuel for the lower income groups while the predominant fuel for the high-income urban dwellers is electricity.

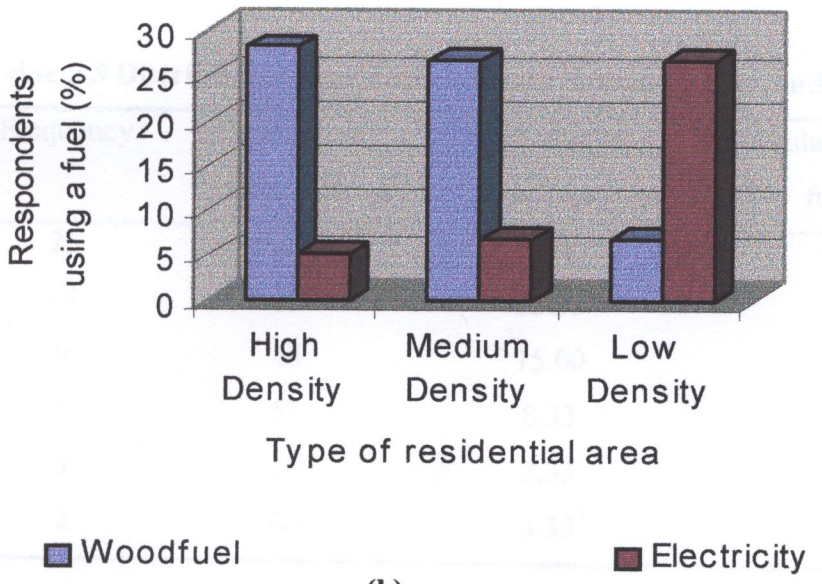
**Table 5.4 The actual use of selected fuels among respondents in different residential area categories for cooking and heating.**

| Activity | Energy source | Category of residential area | | | | |
|---|---|---|---|---|---|---|
| | | High density % | Medium density % | Low density % | Total % | |
| Heating | Charcoal | 15.5 | 15.0 | 5.0 | 35.0 | 61.7 |
| | Firewood | 13.3 | 11.7 | 1.7 | 26.7 | |
| | Electricity | 5.0 | 6.7 | 26.7 | 38.4 | |
| Cooking | Charcoal | 21.7 | 21.7 | 3.3 | 46.7 | 58.3 |
| | Firewood | 8.3 | 3.3 | 0.0 | 11.6 | |
| | Electricity | 3.3 | 8.3 | 30.0 | 41.6 | |

Source: Field data.




(a)




(b)

**Figure 5.8 The actual use of selected fuels among respondents for (a) cooking and (b) heating.**

Source: Field data

Chi-square tests were done to determine if there is a significant difference in the types of fuel used for cooking and heating by the respondents in different categories of residential area (Appendix 4). The Chi-square results of $\chi^2_{obs}$ 29.7 > $\chi^2_{crit}$ 5.99 and $\chi^2_{obs}$ 22.1> $\chi^2_{crit}$ 5.99 for cooking and heating respectively show a significant difference in the types of fuel used for both cooking and heating, at 0.05 level of significance.

The importance of woodfuel has socio-economic roots. At least 70 percent of the respondents get monthly incomes of below K261, 561.00, which is the BNS for Kasama at the time of the survey (Table 5.5). Therefore, 37 percent of the respondents who are not using electricity cannot afford the cost of installing electricity in their homes. For these, woodfuel is their main source of energy. This is consistent with the report by the SARDC/IUCN/SADC (1994) that woodfuel continues to be the cheapest domestic fuel available compared to electricity, paraffin (kerosene), solar energy and biogas. Most of those who cannot afford are in the low-income group. The result of a t-test, $t_{obs}$ 2.99 > $t_{crit}$ 2.03 shows that there is a significant difference in the incomes of those using woodfuel and those using electricity at 0.05 level of significance (Appendix 6).

**Table 5.5 Distribution of monthly incomes among the respondents**

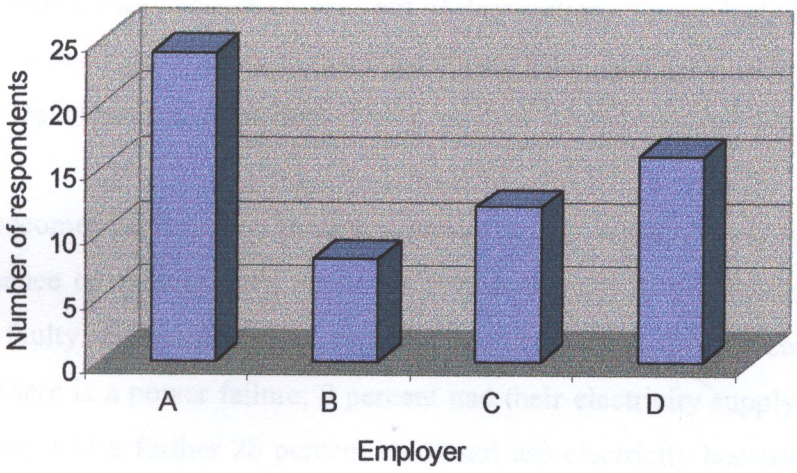
| Class (K'000) | Frequency | Cumulative frequency | Percentage frequency | Cumulative percentage frequency |
|---|---|---|---|---|
| > 101 | 25 | 25 | 41.67 | 41.67 |
| 101 – 200 | 14 | 39 | 23.33 | 65.00 |
| 201 – 300 | 9 | 48 | 15.00 | 80.00 |
| 301 – 400 | 5 | 53 | 8.33 | 88.33 |
| 401 - 500 | 5 | 58 | 8.33 | 96.67 |
| > 500 | 2 | 60 | 3.33 | 100.00 |

Source: field data

Between the woodfuel types, charcoal is more favoured because it has almost twice the heat content per unit weight of dry wood and burns well (SARDC/IUCN/SADC, 1994). However, for the purpose of heating, 19 percent of the households solely use firewood, even in the low-density

areas, because it is cheaper and can easily be collected from nearby bushes or brought back from the fields.

Charcoal burning is also important in Kasama because it provides a means of earning a livelihood for some families in the peri-urban areas of the town. This dependence on woodfuel can be attributed to non-availability of job opportunities in Kasama, the result of lack of industrial development and the closure of the few industries which had emerged. Figure 5.9 shows that 28 (or 46.7 percent) of the respondents are either 'self employed' or not in employment at all. Nevertheless, these people have to earn a living. As a result, even where the respondents are aware of the consequences of cutting trees for woodfuel, they feel that the practice is inevitable (Table 5.6).




A) Government (B) Company (C) Self (D) Unemployed

**Figure 5.9 Respondents' sector of employment**

Source: Field data.

**Table 5.6 Awareness of the consequence of cutting trees for woodfuel.**

| Response | Number of respondents | Percentage of total sample |
|---|---|---|
| Not aware | 6 | 10 |
| Thought there was no problem | 8 | 13.3 |
| Aware of problem | 46 | 76.7 |
| Total | 60 | 100.0 |

Source: field data.

Table 5.6 shows that twenty-three percent of the respondents are either oblivious of the problems caused by woodfuel production or they feel that the activity causes no problem. The main reason advanced by the latter group of respondents is that woodfuel producers cannot stop producing woodfuel because it is the mainstay of their livelihoods. This claim confirms the assertion that most people in Africa make selfish choices out of desperation. "Individuals have little choice but to exploit the resource base in order to meet their immediate need for survival" (SARA/Academy for Educational Development, 1994:66).

Charcoal also becomes handy when there is a power failure, when electricity supply is disrupted during maintenance or disconnected when the consumers fail to settle bills or when electrical appliances are faulty. Fifty-six percent of the respondents who have access to electricity use charcoal when there is a power failure; 8 percent had their electricity supply disconnected at the time of the survey and a further 28 percent could not use electricity because of faulty electrical appliances. In order to cut down on electricity bills, some households use charcoal for long-cooking foodstuffs like beans, maize, fish and pumpkins.

The dependence on woodfuel by the respondents will continue to enhance deforestation in the vicinity of the town unless some conservation measures are taken.

### 5.2.2 Peri-urban cultivation

Peri-urban cultivation covers the largest area and has expanded the most between 1963 and 1991, having expanded from 918 hectares to 4 014 hectares during the period under consideration. The

largest increase of 1 369 hectares was recorded between 1963 and 1974 due to the establishment of a plantation of gmelina, tropical pine and eucalyptus along the Mbala road and a coffee plantation at Misamfu. Similarly, the period between 1982 and 1991 recorded a higher increase in the area under cultivation than the period 1974 to 1982 due to the extension of the exotic tree plantation.

Peri-urban cultivation has also expanded into some dambo areas and the valleys of the Mulilansolo, Lualuo and Lukashya where vegetables like tomatoes, cabbages and rape are being grown. It is, however, difficult to show this on the land-cover maps because the scale of the maps is small. Table 5.7 shows the spatial extent of peri-urban cultivation over time.

**Table 5.7 Area under peri-urban cultivation**

| Year | Area under cultivation (ha) | Actual increase (ha) | Percentage of total area |
|---|---|---|---|
| 1963 | 918 | - | 6.9 |
| 1974 | 2287 | 1369 | 14.3 |
| 1982 | 3140 | 853 | 21.2 |
| 1991 | 4014 | 874 | 27.1 |

Source: Air photographs.

It is difficult to link the area under peri-urban cultivation to deforestation because, more often than not, the activity takes place on land already cleared for other purposes. For instance, Oyelese (1971) found that in Ibadan, peri-urban cultivation took place on land which had been cleared for residential plots but which had not been immediately developed. In Kasama, peri-urban cultivation is done on idle land within the town and on the outskirts of the town (Plate 3).

Nevertheless, it is evident that as soon as the land is taken up for the more viable land-uses, peri-urban cultivation has to shift to other areas. Therefore, one phenomenon that has contributed to the widening frontier of peri-urban cultivation is the relocation of peri-urban fields. Since peri-urban cultivation is mainly an illegal activity, many cultivators who previously possessed fields have had them repossessed by the legal owners and the more legitimate land-uses as the town

**Plate 3: Maize growing in the peri-urban areas of Kasama.**

continues to expand. This has in turn led to an outward movement of the peri-urban fields into areas not immediately needed for legal urban land-uses. Forty-four percent of those who have fields said they would find alternative land elsewhere, either within the study area or beyond. The destination areas include the surrounding woodlands. This point is further strengthened by the fact that 29 percent of the respondents who have fields said they had started their fields on virgin land; an additional 9 percent said they have extended their fields into virgin land. This has certainly put pressure on the indigenous woodlands around the town.

The most important repercussion of field relocation as the urban area grows, therefore, is the removal of indigenous woody vegetation in the peri-urban area as the cultivators clear new land for their fields. In Kasama, the opening of new fields in the woodlands around the settlements of Mwika, Kasama Village, Mutale and Ntema in recent years is very evident in Figure 5.4 and attests to this assertion.

To find out the importance of peri-urban cultivation, the respondents were asked to indicate whether they had a field or not. Thirty-four (or 56.6 percent) of the respondents said they owned fields while 26 (or 34.4 percent) said they had no fields. The respondents were further asked to state the reasons why they participated or did not participate in peri-urban cultivation. Those not engaged in peri-urban cultivation were further asked to state whether they had interest in the activity or not. The result is shown in Tables 5.8 and 5.9.

**Table 5.8 Reasons for owning peri-urban fields.**

| Reason | Number of respondents | Percentage of those with fields |
|---|---|---|
| Supplement food requirements | 25 | 73.5 |
| Cash | 1 | 2.9 |
| Food and cash | 8 | 23.5 |
| Hobby/pastime | 0 | 0.0 |
| Total | 34 | 100 |

Source: field data.

**Table 5.9 Reasons for not owning peri-urban fields.**

| Reason | Number of respondents | Percentage of those without fields |
|---|---|---|
| Lack of land | 8 | 30.7 |
| Lack of time for farming | 2 | 7.7 |
| Lack of agricultural inputs | 2 | 7.7 |
| Land repossessed | 9 | 34.6 |
| Gave up land upon retirement | 1 | 3.9 |
| Discouraged by thieves | 2 | 7.7 |
| Not yet settled | 2 | 7.7 |
| Total | 26 | 100 |

Source: Field data.

According to Jaeger and Huckabay (1986), peri-urban cultivation dates back to the early days of urban development in Zambia. At that time, the activity was mainly linked to the desire by the African workers to continue the rural life-style in towns than for economic proceeds. The scenario has since changed. It is evident from the results that the reasons for peri-urban cultivation in Kasama largely emanate from the increasing economic hardships that the people are going through. The majority of those who have fields (73.5 percent) engage in peri-urban cultivation to supplement domestic food requirements. A further 23.5 percent grow crops both for home consumption and for sale. The assertion by Munton (1974) and van den Berg (1984) that some urban folks, especially from the high-income group, engaged in agriculture as a hobby or pastime does not, therefore, seem to arise in Kasama. The intention to grow crops for food first and cash second is the overriding reason for both. This is consistent with what Skinner (1974) found in his study of Ouagadougou, where the peri-urban cultivators (mostly civil servants) regarded their peri-urban fields primarily as a source of basic staples for their families; the need to get an income out of the proceeds of the fields was secondary. The fact that most of the respondents in this study are civil servants or self-employed (Figure 5.9) getting meagre incomes explains why most of them grow crops for food and cash than for pastime.

The major distinction among the cultivators, however, is that while most of the low income cultivators confine themselves mostly to the empty land within the inner peri-urban area, the higher income cultivators are increasingly acquiring land in the settlement schemes in the outer peri-urban area. Such cultivators could be considered as small-holders.

The types of crops grown by most of the respondents further enhance the significance of the finding that peri-urban cultivation is done for food and cash. Most of the crops are mainly cereals yielding flour for the preparation of the local *nshima* and relish crops to accompany it. This practice is widespread since findings by Mortimore (1969), Bowa, *et al.* (1979), Mazambani, (1982) and Jaeger and Huckabay, (1986) all show that peri-urban cultivators grow crops which meet their immediate needs for food and that because of this, most of them are harvested before the main harvest period. Table 5.10 shows the types of crops grown.

The result also shows that although theft of crops is mentioned as one of the reasons why some respondents did not own peri-urban fields, it does not seem to discourage many of the respondents from cultivating their peri-urban plots. Scholars like Bowa, *et al.* (1979) and Mulenga (1995) made similar findings in their studies conducted in Lusaka. They concluded that when one cultivates in an urban area, one could not expect to eat alone. In fact, it is clear that many respondents would have owned peri-urban fields had it not been for scarcity of land in the area. Only one household has stated that they would give up their land, but this is only because the head of the household retired and the family will be moving out of Kasama.

**Table 5.10 Main crops grown in the peri-urban areas of Kasama.**

| Crop | % of respondents growing the crop |
|---|---|
| Maize | 97 |
| Potatoes | 50 |
| Groundnuts | 41 |
| Beans | 38 |
| Cassava | 21 |
| Sorghum | 21 |
| Millet | 15 |
| Pumpkin | 9 |
| Round nuts | 9 |

Source: Field data.

The establishment of plantations for exotic timber trees and coffee was done by government in a bid to take development to the rural areas in order to offset rural-urban migration and to produce softwood timber locally instead of importing it.

### 5.2.3 Physical expansion of the built-up area

The expansion of the physical built-up area of the town has been one of the major human activities in Kasama since 1963. The built-up area of Kasama expanded fastest after cultivation, from 556 hectares in 1963 to 1678 hectares in 1991 (Table 5.11). This was in response to the increasing population. Most of the expansion has been onto land which has already been cleared either for woodfuel production or peri-urban cultivation. Consequently, the figures for the built-up area only represent the potential woodland cover of the area occupied by the built-up area rather than the area of woodland actually removed by it.

**Table 5.11 Expansion of the built-up area between 1963 and 1991.**

| Year | Built-up area (ha) | Actual increase (ha) |
|---|---|---|
| 1963 | 556 | - |
| 1974 | 1229 | 673 |
| 1982 | 1290 | 61 |
| 1991 | 1678 | 388 |

Source: Air photographs

The expansion of the built-up area has been spasmodic. Table 5.11 shows that, although the built-up area has continued to increase, there have been periods of fast growth and those of slackened growth. Between 1963 and 1974, the built-up area expanded greatly but the period 1974 to 1982 was a period of relative dormancy. The period 1983 to 1991 saw a revival in the construction sector. The consequence of this type of expansion is that during the period of dormancy, peri-urban cultivation encroached upon most of the undeveloped empty land within and around the town. When the town begins to expand again, most of the peri-urban cultivators lose their fields and have to start new fields in the adjacent woodlands, thereby extending the frontiers of deforestation. This pattern is likely to continue until the urban fence is reached where no further expansion is possible.

The increasing population has necessitated the expansion of infrastructure, including housing. Potts (1989) has explained that because of the growth of the urban population, the major environmental problems associated with urban growth are largely confined to the provision of shelter in the broad sense.

The increase in the town's population is the result of the influx of people into the town. Figure 5.10 shows that most of the respondents came to Kasama in the last 20 years. This could be attributed to the completion of TAZARA, which has alleviated the town's transport problems, the general rapid growth of most Zambian towns after independence and the government's deliberate policy to decongest the large urban centres.

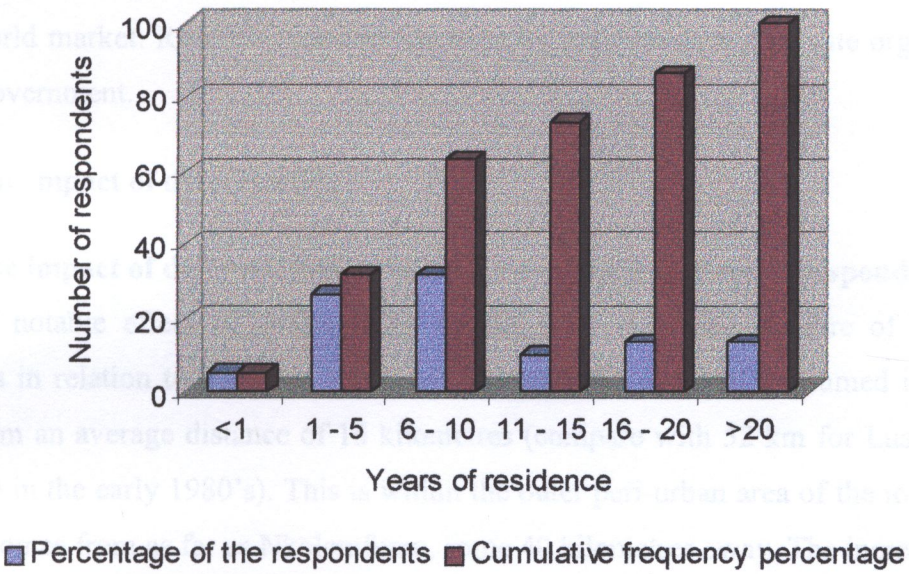



**Figure 5.10 Respondents' length of residence in Kasama**

Source: Field data

GRZ (1992:35) has clearly explained this phenomenon:

> *The explosive growth of urban population is a recent phenomenon which occurred during the post Independence period... At independence in 1964, several colonial policies and legislation which tended to restrict or inhibit migration to towns and permanent residence or employment in urban areas were removed.*

*A massive rural-urban migration contributed to the rapid urbanization... Government effort to create growth centres in rural areas has accelerated migration to small towns... The rapidly growing areas are the provincial administrative centres of Kasama, Mongu and Chipata.*

Rapid growth soon after Independence was helped by the country's economy that was still sound. The government had embarked on an ambitious programme to build houses, schools and hospitals. Consequently, for the period soon after Independence up to1974, the built-up area expanded by an impressive 121 percent. The period 1974 to 1982 shows a decline in the expansion of the built-up area. This period coincides with the period when Zambia's economy began to slip as the price of copper, which was Zambia's main revenue earner, continued to fall on the world market. Recent expansion has been by individuals and private organisations rather than by government.

## 5.3 The impact of deforestation

### 5.3.1 The impact of deforestation on the socio-economic welfare of respondents

The most notable effect of deforestation on the socio-economic welfare of the residents of Kasama is in relation to the price levels of charcoal. The charcoal consumed in Kasama today comes from an average distance of 16 kilometres (compare with 52 km for Lusaka and 200 km for Harare in the early 1980's). This is within the outer peri-urban area of the town though some charcoal comes from as far as Nkolemfumu, some 40 kilometres away. The increasing distance to the charcoal producing points shows the continuing recession of the forests around the town. Apart from the general decline in the Zambian economy, this has contributed to the escalating prices of charcoal. The increasing distance of charcoal producing points can also be attributed to the realisation by local people in those areas that they could make some money out of charcoal production. In any case, the possibility of evading the levy is higher further away from town.

Figure 5.11 shows the trend in the price of charcoal in Kasama between 1984 and 1996. The prices have been adjusted to the American dollar equivalent to cater for the devaluation of the Kwacha over the period of time. Although the graph shows fluctuations in the price of charcoal over the years, the general trend shows an increase in the prices of charcoal.

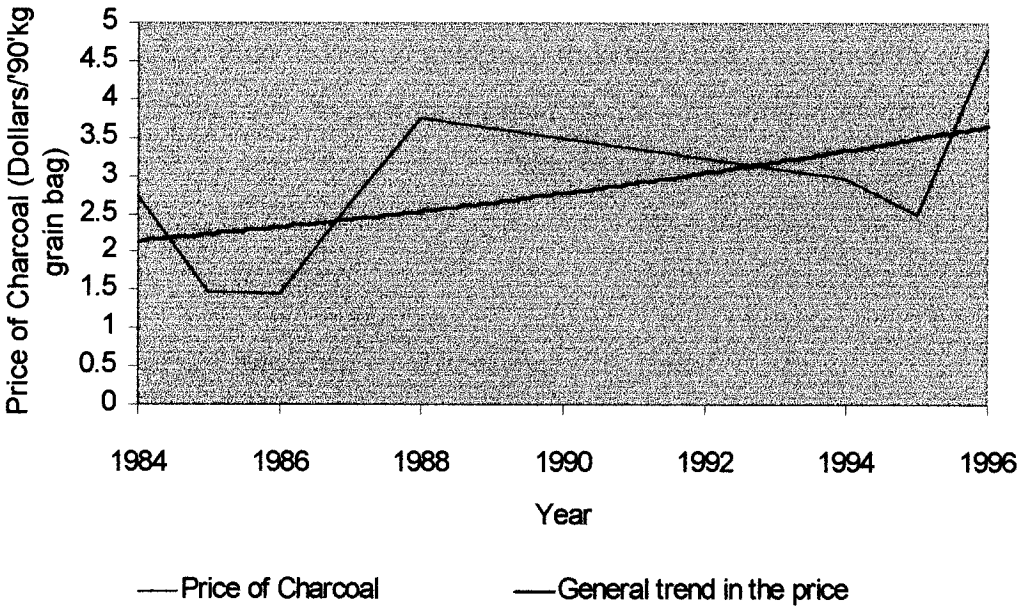



**Figure 5.11 The trend in the price of charcoal in Kasama between 1984 and 1996.**
Source: GRZ (1998:18)

The increasing price of charcoal brings two foreseeable problems for the people of Kasama. Firstly, given the low incomes that most of them get, a large portion of their incomes has to be spent on meeting their needs for domestic fuel. On average, the respondents spend K52 284.00 on domestic fuel per month (this including electricity and kerosene/candle). This represents 26 percent of their meagre monthly household income. This result compares with Allen's (1980) 25 percent of the household budget, but it is higher than Chidumayo's (1979) 17 percent spent on woodfuel alone.

Secondly, the increased price means that some households cannot afford to buy charcoal and have to depend on firewood much of which they have to scrounge for. The women have to leave very early in the morning to collect firewood from the protected forest or the plantation. They have to come back before 07 00 hours when the forest guards begin their patrols or else the women will get arrested. This situation is similar to that described for many other Third World countries. In Niamey (Niger) and Ougadougou (Burkina Faso) in West Africa, for instance, Eckholm (1975) reports that women who could not afford to buy woodfuel had to depend on the surrounding countryside if the trees were within walking distance, otherwise they had to scrounge for twigs,

garbage or anything burnable about town. In Pakistani towns, people had to strip bark off the trees that line the streets. This is how desperate the domestic fuel energy crisis can be for most people in the high-density, low-income residential areas. In this vein, Eckholm (1975) has said, "for more than a third of the world's people, the real energy crisis is a daily scramble to find the wood they need to cook dinner; their search for wood, once a simple chore and now as forests recede, a day's labour in some places."

### 5.3.2 The impact of deforestation on the ecology of the area

The most obvious impact of deforestation in Kasama is the development of a stark, treeless landscape and the replacement of the natural landscape with a cultural landscape dominated by cultivation and built-up area. The implication of this trend, therefore, is that the ecological balance of the area has been disturbed. Evident from this study is that deforestation as well as cultivating on steep slopes and river valleys has led to erosion of varying degrees. At least 20.6 percent of the peri-urban cultivators have their fields either on steeply sloping land or on river banks. As a result, 41.2 percent of them experienced varying degrees of erosion: 7.1 percent had very severe erosion, 21.4 percent severe erosion and 71.4 percent had moderate erosion. Future studies could by the use of transects measure the extent of this impact.

## 5.4 Conclusion

The growth of the urban area of Kasama has certainly resulted in the removal of indigenous woody vegetation in the peri-urban areas of the town. The problem, however, is to ascertain how much deforestation is due to each one of woodfuel production, peri-urban cultivation and settlement. This is because these activities occur side by side (that is, they are not completely mutually exclusive). At times one precedes so that the others follow in its wake. Nevertheless, there is evidence that these human activities have worked together to contribute to the removal of indigenous woody vegetation in the area.

# CHAPTER SIX

## CONCLUSIONS AND RECOMMENDATIONS

### 6.1 Conclusions

This study has established that deforestation in the peri-urban area of Kasama is rampant and is a source of concern for the Forestry Department in the province. Much of the original wet miombo woodland has been cleared since 1963. The conclusion, therefore, is that the problem of woodland loss is not unique to the large towns alone. On the contrary, it is also present in the smaller towns and is just as inimical. The concerns raised about the impact of urban growth in the larger towns should also be directed at the smaller towns.

In Kasama, the primary cause of deforestation is the increasing population pressure on the land resources by the expanding population. The decision by the government to offload some population pressure from the large metropolitan centres on the Copperbelt, Kabwe and Lusaka by creating growth centres in rural areas has been one of the reasons for the accelerated increase in Kasama's population.

The agglomeration of people in the area has in turn led to mounting pressure on the land resources in general and indigenous woodlands in particular. The use of local resources for food production and woodfuel and the quest to provide housing both by government and private entities are the major causes of deforestation in the area.

The sentiments expressed by Potts (1989) that peri-urban cultivation and deforestation are forced upon the poor by low incomes and lack of alternatives are supported by the findings of this study. The majority of the population depends upon woodfuel to meet their domestic fuel needs because they cannot meet the cost of electricity. Similarly, many respondents engage in peri-urban cultivation to supplement their domestic food requirements at home.

Today, the area of forest cleared in the peri-urban areas of Kasama has declined to 20 hectares per annum because most of the open indigenous woodlands have already been cleared. Most of the remaining woodlands are in the gazetted national forest areas. However, there is mounting pressure from local politicians, institutions, individuals and civic leaders that these areas be degazetted. Other areas of bush are less attractive for settlement and cultivation but even here the bigger trees have been cut for woodfuel and construction poles.

Deforestation has had some implications on both the physical landscape of the peri-urban area and the socio-economic welfare of the residents, particularly the urban poor. One impact has been that buildings, roads, human-induced vegetation and cultivation have replaced 68 percent of the 1963 indigenous woodlands. The socio-economic consequences of deforestation have been that the price of charcoal has gone up as the distance to charcoal production points increases. This means that a large proportion of the meagre incomes has to be spent on domestic fuel instead of food, clothing, education and other necessities of life. Furthermore, women and children have to walk long distances to the National Forest to fetch firewood, risking to be arrested. This leaves them with little time to attend to other important chores.

The problem of meeting the demand for land for the various urban and peri-urban uses therefore is a mammoth one. The enigma is that urban and peri-urban residents require these resources and it would be difficult to altogether stop them from continuing to use them without providing alternatives. Therefore, the desire to maintain the natural environments around urban areas leads to conflict with the needs of urban users, especially the majority low-income populations. In effect, the remedy should be one that harmonises the provision of the needs of the people concerned and the protection of the natural environment. This calls for a more integrated and comprehensive form of management and control. In order to achieve this, certain obstacles, which hinder effective management of natural resources, have to be overcome. SARA/Academy for Educational Development (1994) have outlined the obstacles as follows:

1. Lack of awareness of the benefits of conservation by politicians, decision makers and the general public.

2. Harmful decisions, whether by individuals or governments, which place emphasis on narrow and short-term interests rather than long-term goals.
3. Lack of adequate environmental policies, regulations and legislation.
4. Lack of support from the local people who do not see the long-term benefits of conservation.
5. No concerted effort among politicians and decision makers to implement conservation-oriented economic development.
6. Financial limitations and inadequate trained manpower.

## 6.2 Recommendations

The following recommendations are made to reconcile the need for resource use and resource conservation:

1. The most feasible way of dealing with the problem of urban domestic fuel requirement at the moment seems to be through the establishment of woodfuel plantations in areas where the wood would be accessible to those who cannot afford modern sources of energy because of squalor and poverty. This can be done either by the Local Government authorities or communities.

2. Local Government authorities should devise a way of controlling the manner in which peri-urban cultivation is carried out. Areas that are environmentally stable and where the cultivators could work for a long time without being displaced should be allocated for the purpose. The cultivators could then be monitored and given expert advice by extension services workers so that they do not damage the environment and to enable them produce enough crops to sustain themselves.

3. Encouraging a shift from using woodfuel to modern sources of energy. According to UNDP (1999:4), "providing access to modern energy services is essential to any effective poverty eradication programme". Exploring the development of sustainable energy forms

like solar power, wind power and biomass from plantations is also vital (Cocklin, Lonergan and Clarke, 1985).

4. Community based natural resource management: the local people have vast knowledge of the forests adjacent to their localities, have sustainably managed these forests for a long time, have the biggest stake in their conservation and hence their cooperation holds the key to sustainable development (UNEP, 1995). They should, therefore, be involved in the conservation effort.

5. Although the physical expansion of the urban area cannot be stopped, development can be controlled so that, as much as possible, viable indigenous woodlands adjacent to the urban areas are only removed when there is no alternative.

## 6.3 Future research

Since this study has established that deforestation is prevalent in Kasama over time and space, one area into which future research could venture is the ecological impacts of deforestation in the area. Problems such as the magnitude of soil erosion, silting of streams, changes in mean stream flow and in the characteristics of the fauna of the area could be investigated.

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# APPENDIX 1

## QUESTIONNAIRE

Preamble:

The following questionnaire is to help the research student gather data on the impact of urban growth on indigenous vegetation in Kasama. The information is purely for academic purpose and will be treated as confidential.

RESPONDENT NO: _____ DATE: _____

### Section A: Location of respondent

1. Locality Name:_____

2. Approximate distance from town centre: _____

### Section B: Respondent's personal particulars

4. Age: _____ Sex :_____

   Marital Status:_____ Educational Attainment:_____

5. Are you employed: Yes [ ] No [ ] (please tick)

6. Who is your employer?:

   (a) self-employed (b) government
   (c) company (d) NGO
   (d) any other (state):_____

7. What is your occupation, if employed?_____

8. Total household income per month: K_____

9. Approximate total household expenditure per month: K _____

## Section C: Record of period of residence

10. For how long have you been living in Kasama?
_____ days _____weeks _____months _____years _____since birth

11. Where were you living before you came to Kasama?
_____ village _____town _____province _____ country

12. Why did you come to Kasama? (please tick)

(a) born here
(b) on transfer
(c) to look for job
(d) to stay with relatives
(e) to change place
(f) to live in town
(g) to come and start business
(h) upon retirement/retrenchment
(i) any other reason(s):_____
_____

## Section D: Involvement in peri-urban cultivation

13. Do you own a crop field(s) within or on the outskirts of the town? (backyard gardens excluded) Yes [ ] No [ ]

14. If you own a field(s), is it

(a) within the township (b) on the outskirts of Kasama (please tick)

15. If you do not own a field, what reasons can you give for that?

(a) Non-availability of land
(b) Lack of
  (i) interest in farming
  (ii) time for the activity
  (iii) money and resources to carry out farming
  (iv) do not need to do any farming
  (v) Any other reason:_____

If you own a field, answer the questions 16 to 29.

16. Why did you choose to own a field in the township/outskirts?

(a) as a pastime or hobby
(b) to raise money to meet other family requirements
(c) to supplement the food requirements at home
(d) Any other reason (please specify):_____
_____

17. When you started cultivating your field was it on:

(a) virgin or vegetated land (b) already cleared land (tick)

18. Assuming that land is available, do you hope to extend your field further?
Yes [ ] No [ ] (tick)

19. If Yes, to about how many hectares? _____hectares.

20. Will you have to extend on

(a) virgin or vegetated land (b) already cleared land

21. Do you have problems with the local authorities/forest officers?
Yes [ ] No [ ] (tick)

22. Specify the problem if your answer to question 21 was Yes

_____

23. What suggestion(s) would you have to eradicate the problem?
Explain_____

_____

24. Is your field on

(a) flat ground (b) gently sloping land (c) steeply sloping land
(d) on the river side (please tick).

25. Does your field have any problem of erosion? Yes [ ] No [ ]

26. If your answer to question 25 was Yes, would you say the erosion is

(a) very severe (b) severe (c) moderate (d) negligible

27. Do you have alternative areas where you can do cultivation?
Yes [ ] No [ ]

28. If Yes, where? Specify area:_____

29. What crops do you normally grow? _____

_____

## Section E: Energy requirements

30. What is your chief means of (a) heating:_____

(b) cooking :_____ (c) lighting:_____

31. Is your house connected to the electricity source? Yes [ ] No [ ]

32. If the answer to question 31 is No, why? _____
_____

33. If your house is connected to the electricity source but you do not use the electricity, explain why:_____
_____

If you use either firewood or charcoal or both answer questions 34 to 43.

34. How many '50' kg bags do you per month? _____

35. Who supplies you with the charcoal/firewood? (a) self (b) charcoal burners (c) market vendors (tick)

36. If you supply it yourself where to do you get it from?_____

37. If you get it from the vendors
(a) how far is the purchasing point from your home? _____km
(b) from how far do the vendors get the commodities? _____km

38. How much do you spend on domestic fuel per month?
(a) Electricity K _____
(b) Charcoal K _____
(c) Firewood K _____

39. If you burn the charcoal/collect the firewood yourself, do you have problems with the local authorities/forest officers?
Yes [ ] No [ ] (tick)

40. If your answer to question 39 was Yes, specify the problem:
_____

41. What problems do you think charcoal burning and firewood cutting could cause? Explain:_____

42. How could the problems you have mentioned in question 41 be solved?

43. Which one of the following activities do you think contributes most to deforestation around Kasama? (Please tick).

(a) Cultivation:___-(b) Charcoal burning: ____ (c) Peri-urban cultivation: ____

# APPENDIX 2

## INTERVIEW GUIDE FOR PFEO

1. What is the area of forest cleared in and around Kasama each year?

_____

2. Has there been an increase or decrease in the hectarage of forest cleared in Kasama each year?

_____

3. What are the main activities that lead to the clearance of vegetation, in their order of importance?

(a) _____
(b) _____
(c) _____
(d) _____
(e) _____

4. What is the Forestry Department doing to cut down on deforestation in the area?

_____
_____

5. If deforestation has been rampant in and around Kasama, what have been the direct and indirect impacts of deforestation?

_____
_____

6. What is the Department doing to ameliorate the impacts?

_____
_____
_____

7. What problems is the Department facing in combating deforestation in Kasama?

_____
_____

8. Do you face any interference from local politicians and traditional leaders in your execution of duty? (Please tick).

Yes: _____

No: _____

# APPENDIX 3

## Calculation of the rate of deforestation

To calculate the rate of deforestation, the following formula was used:

Rate of deforestation = $L/T$

Where $L$ = area deforested between $t_1$ and $t_2$.

$T$ = time (number of years between $t_1$ and $t_2$).

$t_1$ = time 1 (1963).

$t_2$ = time 2 (1991).

$$\text{Rate of deforestation} = \frac{10\,569 - 4\,124}{29}$$

$$= \frac{6445}{29}$$

$$= 222.2413793103$$

$$= \underline{222.2 \text{ hectares per year}}$$

# APPENDIX 4

## Difference in the types of fuel used by respondents for cooking.

The Chi-square $\chi^2$ test was used to test for the difference in the types of fuel used by respondent for cooking:

**Hypotheses:**

$H_o$: There is no significant difference in the type of fuel used among the different residential area category.

$H_1$: The fuel used for cooking differs from one type of residential area to another.

**Decision rules:**

(a) Degrees of freedom = $(3 - 1)(2 - 1) = 2$

(b) Level of significance, $\alpha = 0.05$

(c) If $\chi^2_{obs} > \chi^2_{crit}$, reject $H_o$.

| Type of fuel | Category of residential area | | | Total | % of total sample |
|---|---|---|---|---|---|
| | High density | Medium density | Low density | | |
| Woodfuel | 18 (11.7) | 15 (11.7 | 2 (11.7) | 35 | 58 |
| Electricity | 2 (8.3) | 5 (8.3) | 18 (8.3) | 25 | 42 |
| Total | 20 | 20 | 20 | 60 | 100 |

(Figures in brackets show expected values)

**Decision:**

$\chi^2_{obs} = 29.7$

$\chi^2_{crit} = 5.99$

Since $\chi^2_{obs}$ (29.7) > $\chi^2_{crit}$ (5.99), $H_o$ is rejected.

**Conclusion:** The fuel used for cooking differs from one residential area to another.

# APPENDIX 5

## Difference in the types of fuel used by respondents for heating

The Chi-square $\chi^2$ test was used to test for the difference in the types of fuel used by respondent for heating:

**Hypotheses:**

$H_o$: There is no significant difference in the type of fuel used among the different categories of residential area.
$H_1$: The fuel used for heating differs from one type of residential area to the other.

**Decision rules:**

(a) Degrees of freedom = (3 - 1)(2 - 1) = 2
(b) Level of significance, $\alpha = 0.05$.
(c) If $\chi^2_{obs} > \chi^2_{crit}$, reject $H_o$.

| Type of fuel | Category of residential | | | Total | % of total sample |
|---|---|---|---|---|---|
| | High Density | Medium Density | Low Density | | |
| Electricity | 3 (7.7) | 4 (7.7) | 16 (7.7) | 23 | 38 |
| Woodfuel | 17 (12.3) | 16 (12.3) | 4 (12.3) | 37 | 62 |
| Total | 20 | 20 | 20 | 60 | 100 |

(Figures in brackets show expected values)

**Decision:**

Since $\chi^2_{obs}$ (22.1) > $\chi^2_{crit}$, $H_o$ is rejected.

**Conclusion:** The type of fuel used for heating differs significantly from one type of residential area to the other.

# APPENDIX 6

## Comparison of monthly incomes

The t-test was used to determine if there is a significant difference in monthly incomes between households using charcoal and those using electricity for cooking.

**Hypotheses:**

$H_o$: There is no significant difference in incomes between electricity users and woodfuel users.

$H_1$: There is a significant difference in incomes.

**Decision rules:**

(a) Degrees of freedom, df = n - 1

(b) Level of significance, $\alpha = 0.05$

(c) Non-directional test, two-tailed.

(d) If $t_{obs} > t_{crit}$, reject $H_o$.

Summary Output-Test: Two-Sample Assuming Unequal Variances

| | Variable 1 | Variable 2 |
|---|---|---|
| Mean | 292.24 | 139.1857 |
| Variance | 53703.77 | 16722.62 |
| Observations | 25 | 35 |
| Hypothesized Mean Difference | 0 | |
| degrees of freedom | 35 | |
| t Stat | 2.986779 | |
| P(T<=t) one-tail | 0.002561 | |
| t Critical one-tail | 1.689573 | |
| P(T<=t) two-tail | 0.005122 | |
| t Critical two-tail | 2.03011 | |

Variable 1 Those using electricity
Variable 2 Those not using electricity

**Decision:** Since $t_{obs}$ 2.99 > $t_{crit}$ 2.03, $H_o$ is rejected.

**Conclusion:** There is a significant difference in the incomes of electricity users and charcoal users.

per
per
by

# APPENDIX 7

## Estimation of deforestation due to charcoal production

Total household charcoal consumption was estimated by multiplying the number of households by average annual consumption per household.

Since the household sector accounts for 96 percent of total charcoal consumption in Zambia, total charcoal consumption was estimated by dividing charcoal consumption in the household sector by 0.96.

The wood used in charcoal production was calculated by dividing charcoal produced by charcoal yield, where charcoal produced equals charcoal consumed divided by 0.97 and the yield rate is 0.23.

1. Total household charcoal consumption (ΣHc):

$$\Sigma Hc = Nh \times Ah$$

where ΣHc = total household charcoal consumption
*Nh* = number of households
*Ah* = average consumption per household per year * (975.6 kg for Kasama).

2. Wood used:

$$\text{Wood used} = \frac{\textit{Charcoal produced}}{\textit{Charcoal yield}}$$

Where charcoal produced equals charcoal consumed/0.97· and yield rate equals 0.23.

3. Deforestation through charcoal production:

$$De = \frac{\textit{Total wood used for charcoal production}}{\textit{Harvested cordwood per hectare}}$$

Where De = deforestation through charcoal production
Harvested cordwood per hectare = 74 tonnes in wet miombo.

---

* Bagged charcoal is estimated by multiplying the number of bags of charcoal by the average mass of charcoal per bag (41 kg for a '90' kg grain bag). The 60 respondents consumed 214 '50' kg grain bags per month or 975.6 kg per household per annum).

· On average, bagged charcoal is 97% of the charcoal produced. Charcoal produced is, therefore, estimated by dividing the weight of bagged charcoal by o.97.

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