

THE UNIVERSITY OF ZAMBIA

SCHOOL OF NATURAL SCIENCES

GEOGRAPHY DEPARTMENT

THE IMPACT OF SMALL - SCALE FARMING ON THE AGRICULTURAL LAND RESOURCES IN MAGOYE WEST

BY

MWEEMBA LIBERTY

THESIS
M.Sc.
MAGYE
2003
LIB

Project report submitted to the Department of Geography at the University of Zambia in partial fulfillment of the requirements for the degree of **Master of Science (M.Sc.)** in Geography.



APPROVAL

THIS DISSERTATION BY MR. LIBERTY MWEEMBA ENTITLED: "THE IMPACT OF SMALL SCALE FARMING ON THE AGRICULTURAL LAND RESOURCES IN MAGOYE WEST" IS APPROVED AS FULFILLING THE REQUIREMENT FOR THE AWARD OF THE DEGREE OF MASTER OF SCIENCE IN GEOGRAPHY BY UNIVERSITY OF ZAMBIA.


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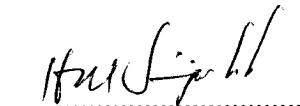
.....
External Examiner


.....


DR. C.P.A. BANDA
Supervisor and Internal Examiner


.....
14/11/03

DR. HENRY M. SICHINGABULA
Internal Examiner



.....
14/11/2003


.....
R.Y. SINGH
Dissertation Chairperson


.....
14/11/2003

Declaration

I, Mweemba Liberty, declare that this project has been composed by me and the work recorded is my own. All maps and diagrams were drawn by me, and all quotations have been distinguished by quotation marks. The sources of all materials have specifically been acknowledged and the project has not been previously submitted for any academic award.

Signature 

Date 10-11-03

Dedication

I dedicate this work to all those who have encouraged and inspired me in life especially my parents, brothers and sisters for their immeasurable material and financial support without which I would not have reached this far. I also dedicate this work to my wife Noreen and my daughters Chileleko and Mwenzi.

ACKNOWLEDGEMENTS

Those who are owed acknowledgements for providing the stimuli, the education, and the means that culminated in the writing of this report are many. Some were involved in its immediate preparation, some played a part far distance in time and were unaware of the active role they played as invisible but ever present and scrutinizing guides. Although this work is a modest one, my debts are great and I shall take this opportunity to express my gratitude.

The central material of which this work is based derives from interviews with fifty small-scale farmers in Magoye West. I am deeply grateful to these farmers for sharing their thoughts with me.

My sincere gratitude to all members of staff in Geography department, especially Professor Singh and Mr. Kajoba for coordinating the course and Dr. Munyati for Computer lessons.

Special thanks go to my course mates namely, Mr. Mankapi L., Mr. Chileshe B., Mrs. Chinyama M., Mrs. Zyambo A., Mrs Bwalya M., Mr. Chinoya, Mr. Mwenda, Mr. Kangwa and Sister Christine who through words and actions gave me so much encouragement.

I extend my sincere gratitude to Mrs. Sambo for her secretarial work.

Finally, and most important of all, my debt is acknowledged to Dr. G.P.A. Banda my professional spirited Supervisor, for the fatherly attention and advice without which I would not have managed to produce this report in the manner I have done.

ABSTRACT

The Magoye West forest Reserve number 50 was not occupied by small-scale farmers before 1980. However, after this period, farmers from surrounding areas started moving in the forest reserve to settle illegally. As the population kept on growing in this area, there was an indiscriminate cutting down of trees for various purposes such as charcoal, timber as well as land expansion for cultivation.

The aim of this report is to discuss the impact of small-scale farming on the agricultural Land Resources in Magoye West forest reserve in Southern Province of Zambia.

Firstly, forest degradation is stimulated by rapid population growth combined with shifting cultivation (people moving into forest to farm), poorly regulated logging and 'open access' land tenure. Open-access occurs when there is no effective regulation of land use. This allows farmers and other land users to exploit the land, and the resources on it, in an unsustainable manner. Open-access in this area also reduces the motivation for farmers to conserve the land resources since it is not theirs.

Secondly, the use of modern farm inputs such as fertilizer was found to be negatively related to the rate of deforestation, suggesting that intensifying agriculture by applying more fertilizer would slow down the rate of deforestation.

Thirdly, the average level of education of small-scale farmers in Magoye West is very low. There is a close relationship between education and extension training as well as obtaining loans. Education is significantly variable since more literate and knowledgeable people make better farmers because they are able to invest on the land by conserving soils and

forests. Since the sample was largely composed of illiterate people, natural resource conservation is limited in this area.

Lastly, fuel wood prices are low in Magoye West because it can be mined, nearly freely, from open-access areas. Where there is open-access, trees can be cleared from forests by migrant farmers. This results in women's time being increasingly constrained in rural areas as fuel wood become scarce, due to rapid deforestation, and women have to walk farther for fuel wood collection.

All in all, as the population keeps on growing in Magoye West, there is indiscriminate cutting down of trees for various purposes such as charcoal, timber and land expansion for cultivation. Rapid population growth has put increasing pressure on cultivable land leading to deforestation, soil erosion and loss of biodiversity. Furthermore, land occupation and use in this area is temporal since the farmers are illegally there, and there is no motivation for the farmers to invest in farm intensification and land resource conservation since they do not own that land.

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CHAPTER ONE

INTRODUCTION

1.1 **General Background to the Study (The Main Linkages)**

The Magoye West Forest Reserve was unoccupied before 1980. After 1980, illegal farmers settled in the area. As the population kept on growing there was an indiscriminate cutting down of trees.

As the world population keeps growing, the signs of environmental degradation proliferate. The cause of this phenomenon, according to the Union for African Population Studies (UAPS) (1997), lies in the wealth and poverty of Nations. While the demographic factor is of little impact on environmental degradation in the industrialized countries, it is the potential cause of that deterioration in the Third World Countries. In fact, in wealthy countries, consumers destroy the environment by their very capacity to consume resources and to produce large quantities of waste. In poor countries, according to UAPS (1997), demographic pressure and inappropriate farming practices contribute to soil impoverishment, erosion, poor yields and deforestation.

As implied above, rapid population growth, environmental degradation and slow agricultural growth are closely linked. The principle problem is that the technologies applied in shifting cultivation and transhumant pastoralist system, appropriate under conditions of low population density on Zambia's fragile natural resources base, are environmentally damaging when practiced by rapidly increasing populations. When population densities increase and shifting around

on the land becomes impossible but farming practices do not change, soil degrades and forests are destroyed (World Bank, 1994; Bromley, 1989).

The rural livelihood system in Zambia is essentially agricultural, and agriculture is the main link between people and their environment (agricultural land resources). Through agricultural activities people seek to husband the available soil, water and biological resources so as to 'harvest' a livelihood for themselves. However, population growth has surpassed soil productivity such that there is no dynamic equilibrium between the stock of land resources and the human population depending on it for survival.

1.2 **Theoretical Framework**

The Magoye West Forest Reserve number 50 was not occupied by small scale farmers before 1980. However, after this period, people from surrounding areas started moving in the forest reserve to settle illegally. As the population kept on growing in this area, there was an indiscriminate cutting down of trees for various purposes such as charcoal, timber as well as land expansion for cultivation. Rapid population growth has put increasing pressure on cultivatable land under different systems of land tenure and modes of agricultural production, leading to excessive deforestation, soil erosion and loss of biodiversity. The ability to shift around on virgin land is eliminated by population pressure. In this area, the traditional land tenure system constrains agricultural productivity and causes environmental degradation because land resources are not privately owned, but are either

common property of a community or are open access resources owned by no one. The users of such resources have no motivation to limit their consumption thereof because they cannot be certain that other users will similarly limit theirs because they are illegal settlers. With this open access to land resources, land occupation and use is temporal and there is no motivation for the farmers to invest in farm intensification and land resource conservation since they do not own the land.

This study was aimed at assessing the impact of Small- Scale farming on the agricultural Land Resources in Magoye West forest reserve area. Although the concern of the study was to assess the impact of the activities of a community of people on its environment, information relating to the families and to their involvement in the wider community activities was also sought.

1.3 **Statement of Problem**

In 1964, Zambia attained its independence with greater expectations of reaching the 'Promised Land' of prosperity and happiness. However, the development strategy followed by Zambia after independence was biased against agriculture and rural development and failed to generate significant employment and income growth. At independence, Zambia inherited a mono-economy from the British Colonialists, which was heavily dependent on copper mining for export. Although other sectors of the economy were being developed, principally agriculture and manufacturing, copper mining has continued to be the main stay of the Zambian economy; hence there has been more attention and investment in

this sector compared to other sectors of the economy. The biasness against agriculture meant that Zambia's potential for small holder agriculture was neglected, and the sector was never able to play a major role in poverty reduction and minimization of agricultural land degradation (World Bank, 1994).

Building on renewed adjustment efforts started in the late eighties by the former government, the current government has been pursuing a more aggressive and comprehensive Structural Adjustment Programmes (SAPs). But, as with the crisis, which led to them, SAPs eventually took a long-term perspective. And above all, these programmes produced undesirable side effects, which (already difficult to accept in the short-term) became intolerable in the long run. Finally, the new rules of the game established by the SAPs (reduction of the State's role, generalization of economic liberalism) resulted in the exacerbation of inequalities and poverty, which, in turn, contribute to environmental degradation (World Bank, 1994; UNDP, 1997).

Much of Africa's natural resource base and ecological environment is deteriorating. According to the United Nations [UN], (1997), if present trends continue, this deterioration will accelerate. The most pressing problem is the high rate of loss of vegetative cover which is mainly the result of deforestation and the conversion of Savannah to cropland, which in turn leads to soil erosion and loss of soil fertility. Rapid population growth had put increasing pressure on cultivatable

land under different systems of land tenure and modes of agricultural production, leading to deforestation, soil erosion and loss of biodiversity.

Traditional African Crop-livestock production methods, modes of obtaining wood fuel and building materials, land tenure systems and land use arrangement, and gender roles in rural production and household maintenance systems were well suited to survival needs on a fragile environmental resource endowment when population densities were low and populations were growing slowly. But the persistence of these traditional arrangements and practices, under severe stress from rapid population growth is causing severe degradation of natural resources which, in turn, contributes further to agricultural stagnation (Cleaver and Schreiber, 1994).

In Magoye West, usufruct rights are acquired simply by clearing of land without necessarily planting anything. The motivation has been strong for settlers to move into previously uncultivated forest and clear the land quickly in order to strengthen their claims and weaken those of others. Farmers clear and plough far more land than they actually intend to crop in order to establish more land.

The degradation of agricultural land and pasture can itself bring increasing risks to poor farmers reliant on these resources. Farmers face a critical dilemma; a central element of their traditional farming system – the ability to shift around on the land is being eliminated by population pressure, yet they continue to use the

other elements of their customary production systems. The problem is that where fallow periods are short, or non-existent, and where traditional cultivation techniques continue to be used, soil fertility deteriorates and soils are not conserved. As a result, crop yields decline, forcing farmers to expand production along the already receding land frontier. Poor farming households, who risk falling below subsistence level of consumption, will treat available natural resources as an asset to be drawn down in times of emergency. For poor households, options for managing natural resources for future use are often limited or unavailable. Their assets and agricultural stores are minimal and quickly depleted.

1.4 **Focus of the study**

As mentioned in the introductory part, this study was aimed at assessing the impact of small- scale farming on the agricultural Land Resources. Although the concern of the study was to assess the impact of the activities of a community of people on its environment, information relating to the family and to their involvement in the wider community activities was also sought.

1.5 **Study objectives**

This study is basically exploratory in nature and its aim is to assess the impact of small- scale farming on the agricultural Land Resources in Magoye West Agricultural Settlement. Related to this broad aim, the study had the following specific objectives:

- i) To determine how small-scale farming contributes to soil degradation;
- ii) To assess how small-scale farming contributes to forest degradation;
- iii) To assess measures taken by small-scale farmers to conserve soils;
- iv) To assess measures taken by small-scale farmers to conserve forests; and
- v) To determine how different levels of education of small-scale farmers enhance knowledge of conserving agricultural land resources.

1.6 Hypotheses

The presumed assumptions of the study which are linked to the specific objectives were:

- i) Increase in population limits small-scale farmers to acting in ways that are not damaging to the soils;
- ii) Increase in population limits small-scale farmers to acting in ways that are not damaging to the forests;
- iii) Small-scale farmers do not take appropriate measures to conserve soils;
- iv) Small-scale farmers do not take appropriate measures to conserve forests;
- v) The high levels of education of the small-scale farmers enhance knowledge of conserving agricultural land resources.

1.7 Significance of the study

This study is significant because in a country like Zambia, that is now struggling to re-build its economy, there is need for concerted efforts to broaden the economic base with agricultural production by way of encouraging small scale

farmers to conserve their agricultural land resources to enhance agricultural production.

Rapid population growth, environmental degradation and slow agricultural growth are closely linked. The principle problems is that the technologies applied in shifting cultivation and transhumance pastoralist system, appropriate under conditions of low population density on Zambia's fragile natural resource base, are environmentally damaging when practiced by rapid increasing population. When population densities increase and shifting around on the land becomes impossible, but farming practices do not change, soil degrades and forests are destroyed. Soil degradation and deforestation constrain agricultural growth (World Bank, 1994; Bromley, 1989).

The production of food is of great importance in Zambia and any effort directed at monitoring or enhancing its development should be greatly appreciated by the government. By selecting some of the main themes common to the literature on the topic of agriculture and the environment and talking about them with small scale farmers, we should be able to provide information and insights which could be of interest to planners and policy makers in Zambia. It will also help planners draw careful agricultural plans aimed at preventing agricultural land resource degradation. Furthermore, most research works available do not give a clear statistical relationship between population activities and the environment. This study fills in some of these gaps.

It is hoped that findings and generalizations drawn from a local region could be used to other regions where people have the same plight. Furthermore, it is hoped that recommendations suggested will be of value to authorities involved in formulating agricultural and environmental policies in Zambia.

1.8 **Organization of the dissertation**

This dissertation has six chapters. Chapter Two reviews literature on small-scale farming and the environment. Chapter Three looks at the location and description of study area. Chapter Four looks at the methodology which indicates sources of data, sampling procedures, sample size and the characteristics of the respondents. In the same chapter, the organization of fieldwork and limitations of this study are included. Chapter Five is based on the analysis and discussion of issues pertaining to the impact of the human community on its environment. An attempt is made to translate the amount of woodland cleared during this period into crude biomass terms. Another attempt is also made to determine how the lost biomass would represent a substantial opportunity cost if it were to be translated into timber or fuel wood terms. Soil pH and nutrient content were used to determine soil fertility before and after human settlements. Furthermore, determinants of the rate of deforestation and the average crop yields are interpreted statistically. Finally, Chapter Six focuses on conclusions and recommendations.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

The continent of Africa faces three important challenges:

1. reducing the rate of population growth;
2. safeguarding their natural resource base, and
3. making agriculture, as quickly as possible, sufficiently productive to ensure rising standards of living for the rapidly increasing population without further endangering the resource base available for this purpose (UN, 1997).

According to Lele and Stone (1989), much of Sub-Saharan Africa is highly vulnerable to soil degradation and erosion. Such land degradation is often more dramatically, but somewhat loosely referred to as “desertification”: the process of sustained deterioration of the biological productivity of land. It is manifested in such phenomena as soil erosion, soil structure deterioration, reduction in organic matter and nutrient content, and salinization. The vulnerability of Africa to land degradation is due to factors such as soil characteristics, intense soil drying in the dry season, severely erosive seasonal rainfall in many areas, wind erosion in drier areas and low-resource farming with inadequate soil conservation measures (World Bank, 1994). According to Bromley (1989),

sizeable areas used for cropping in low rainfall regions are subjected to soil degradation and soil fertility loss. Top soil losses, even on gently sloping cropland, have been reported to range from 25 tons to 250 tons per hectare annually. These rates translate into losses of between two millimeters to two centimeters of top soil annually.

The United Nations Environmental Programme [UNEP], (1988), in its study 'environmental perspective to the year 2000 and beyond', states that in a number of countries the momentum of population growth, coupled with poverty, environmental degradation and unfavorable economic conditions, had created serious imbalances between population and the environment. The report asserts that rapid population growth has put increasing pressure on cultivable land under different systems of land tenure and modes of agriculture production, leading to deforestation, soil erosion and loss of biodiversity.

The report on the Food and Agricultural Organization (FAO)/Netherlands conference on Agriculture and the Environment, (FAO, 1995; p. 11) asserts that;

With the acceleration of demand to population growth, technological change as well as lack of alternative employment opportunities in rural areas, the conflict between agriculture and the environment has grown. This has led to accelerated natural resource degradation, including loss of soil fertility and deforestation.

Soil degradation and deforestation constrain agricultural growth. Lagging agricultural growth perpetuates rural poverty and food insecurity, which in turn impedes the onset of the demographic transition to lower human fertility rates.

Environmental integrity and resource conservation is critical for sustainable long-term growth of agriculture, and of the economy. But this will be very difficult to achieve if present rates of population growth persist. Population growth is unlikely to decelerate unless there is more vigorous growth of agriculture, and the economies dependant on agriculture. At the same time, agricultural growth based on traditional patterns of resource use and production technologies will be increasingly constrained by rapid population growth and the degradation of the environmental resource base (Marquette, 1997).

According to Kendall (1995), human activities have altered between one-third and one-half of the earth's ice free surface. Cropland and rangeland are under heavy pressure worldwide and are increasingly suffering from wide spread injurious practices: erosion, over cultivation, over grazing and salinization. Much cropland is losing its' fertility, and there is extensive land abandonment. Injury and loss of arable land is one of the world's most critical environmental problems, and also one of the least appreciated, and it carries heavy consequences.

2.2 **Cultivation**

The outright clearance of woodland to produce extra cropland is one of the major causes of woodland loss. Dorst (1990), writes that in Ghana, 74,925 hectares of land are cleared every year for Cocoa plantations and that only 15% of the country is covered with vegetation.

A similar situation occurs in Nigeria where 249,885 hectares of woodland are being cleared each year for cultivation. Dorst (1990), also notes that both Kenya and Tanzania have only two percent of exploitable forests remaining. Grainger's (1990) findings show that about 70,000 hectares of woodlands are cleared for tobacco cultivation in Zimbabwe each year. He also notes that in Burkina Faso, about 50,000 hectares of woodland are cleared for agricultural expansion every year.

The tropical world is dominated by shifting cultivation; 'an agricultural system which is characterized by rotation of fields rather than crops', (Mulenga, 1982:82). "This system", argues Eckholm (1986:42), "accounts for more failed trees than permanent agriculture". He sights an example where FAO estimates that 8.5 and 10 million hectares of forests are cleared annually for agriculture in Asia and Latin America respectively (Eckholm, 1986).

2.3 **Pastoralism: Rangeland degradation**

About 25 million of the world's estimated 40 million nomadic and transhumant pastoralists live in Africa (Barnes, 1990). Between 1986 and 1995 (according to FAO [1996], the number of cattle increased by 74 percent in Sudano-Sahelian Africa, and by 65 percent in humid and Sub humid West Africa, and by 61 percent in Southern Central Africa. At the same time, the extent and quality of the rangeland declined. Cultivators move into the best grazing areas and convert them to cropland; the traditional use rights of pastoralists, and particularly of

transhumant herders, are ignored or overridden, and their herds are increasingly forced to more marginal land, which is rapidly degraded by over grazing.

Long periods of below – normal rainfall and severe droughts have accelerated the degradation of rangelands, and past efforts to address the problem of water supplies for pastoralist have often compounded, rather than ameliorated the problems. Deep wells have been sunk to ensure water supplies during the dry season, but with free access to these wells, the number of animals congregating around them far exceeds the carrying capacity of the surrounding rangeland, causing rapid deterioration. Desertification has tended to spread outward from these areas of excessive and prolonged animal concentration (Cleaner and Schrieber, 1994).

In Zambia, the Ministry of Agriculture (MA) (1992) carried out a survey on the grazing situations in Southern Province. It was reported that as the animal population increased, there was pressure on the grazing land, accelerated by conversion of some of grazing areas into arable land.

Mulenga (1982), also observed that grazing and browsing of domesticated animals is one of the activities that have led to a gradual transformation of the indigenous vegetation in some parts of the Luangwa District.

Livestock concentration on the nearby rangeland can be detrimental as livestock tend to overgraze that land while the more remote areas may be under grazed (Margquette, 1997; Kendall, 1995; Gondie, 1986). Grainger (1990) notes that an absolute decrease in the amount of plant cover leaves the soil less protected from the impact of livestock hooves. The continued overgrazing and trampling leads to increased run off, accelerated soil erosion and decrease in the plant production (Gondie, 1986; Grainger 1990; Mulenga, 1982).

2.4 Traditional crop cultivation, Livestock husbandry methods and the environment

For centuries, shifting cultivation and transhumant pastoralism have been, under the prevailing agroecological conditions and factor endowments, appropriate systems for people throughout most of Sub-Saharan Africa to derive their livelihood in a sustainable manner, from the natural resource endowment of their environment. The ecological and economic systems were in equilibrium. The key to maintaining this equilibrium was mobility. People shifted to different locations when soil fertility declined or forage was depleted, allowing the fertility of the land to be reconstituted through the natural processes of vegetative growth and decay (Cleaner and Schreiber, 1994).

Cleaner and Schreiber (1994), have further argued that these mobile systems of shifting and long-fallow cultivation and pastoral transhumance were suitable because of low population densities, abundant land, and limited capital and technological, and often difficult agro-climatic conditions. In the absence of

sufficient rapid and widespread technological change, population growth has led to the expansion of the area under cultivation. This has involved mainly the conversion of large areas of forests, wetlands, river valley bottoms and grassland Savannah to cropland. Since 1965, the area farmed in Africa has increased by over 21 million hectares. Much of this has taken place on ecologically fragile and agriculturally marginal land, which is not suitable for sustained farming and eventually, abandoned in an advanced state of degradation. Forested land has declined by about 6.5 million hectares since 1965, but land available to expand cultivation has become increasingly scarce in most parts of Africa, drastically narrowing the scope for further expansion (Cleaner and Schrieber, 1994).

According to FAO (1998), over the past thirty years, crop acreage has expanded by only 0.7 percent annually, and the population pressure on cropped land has increased sharply. On average, per capital available land in Africa declined from 0.5 hectares per person in 1965 to 0.4 hectares per person in the 1980s and less than 0.3 hectares per person in the 1990s. Because of agroclimatic and soil characteristics, the potential productive land endowment per capita in most Sub-Saharan Africa is even poorer than these simple acreage-statistics suggest. Zambia, for example, is more densely populated than India or Bangladesh if account is taken of the extremely poor quality of its agricultural resource endowment. Nigeria and Senegal are more densely populated than the Philippines. Mali, Burkina Faso, and Gambia are twice as densely populated as Indonesia (Pingili, 1997; FAO, 1998).

2.5 **Fallow periods**

There is considerable diversity among countries, but everywhere fallow periods are shortening as populations increase and the land frontier recedes. In many areas, from Mauritania to Lesotho, fallow periods are not sufficiently long any more to restore soil fertility. Increasingly, farmers are compelled to remain on the same parcel of land yet they change their farming methods only very slowly. These farmers face a critical dilemma, a central element of their traditional farming system – the ability to shift around on the land is being eliminated by population pressure, yet they continue to use the other elements of their customary production systems. Where fallow periods are too short, or non-existent, and where traditional cultivation techniques continue to be used, soil fertility deteriorates and soils are not conserved. Wind and water erosion, soil nutrient depletion, acidity, and deteriorating soil structure become common and increasingly severe. As a result, crop yields decline, forcing farmers to expand production along the already receding land frontier (Daly, 1989; Netting, 1993)

2.6 **Poverty imposes short-time horizon for small-scale farmers**

The very poor small-scale farmers who are struggling at the edge of subsistence levels of consumption are preoccupied with survival on a day-to-day basis. The ability to plan ahead is often restricted to a critically short-time horizon, measured in days or weeks. But these short-time horizons should not be viewed as innate characteristics of the poor, but rather the consequence of complex interactions among policy, institutional and social failures.

Simplifying the relationship of poverty and the environment to a single concept of short-time horizons, while useful as a heuristic device, does not capture all-important elements of the relationship. According to Mink (1993), there are revealing example of poor farmers or herders who demonstrate long time horizons, although they may be constrained in pursuing them. Such examples are usually of cohesive communities, with strong cultural or religious values that may define obligations of stewardship in managing natural resources in honor of ancestry. Communities often have social welfare arrangements that support families in times of crisis, thus reducing certain kinds of risks. Traditional cultivation of perennial crops, such as cocoa in West Africa, demonstrates the existence of conditions that provide poor farmers with incentives to make investments that may only begin to bear fruit in five to eight years.

Poor farmers' horizons are short partly as a result of their having, in economic terms, a high rate of pure time preference (Williamson, 1991). This lowers the ability to forego consumption today by using savings previously put aside for later consumption purposes. In terms of natural resources, the implication of a high subjective discount rate are rapid resource extractions to meet present income or consumption needs, and low investment in natural resources to improve future returns. Given the greater value placed on the present consumption, resources are mined at a more rapid rate. For example, with high discount rates, rural inhabitants with rights to tree resources are more likely to harvest them at a faster

rate. Similarly, short-term production strategies that raise current income at the cost of future production, overgrazing pasture or shortening fallow time, may be pursued.

Similarly, poor farmers are unlikely to make natural resource investments that only give positive returns after a number of years. Thus, efforts to introduce soil conservation and water harvesting techniques in the Yatenga area of Burkina Faso found only those that delivered an increase in yield within a year or two were likely to be adopted by farmers. Schemes designed to get rural communities and farmers to plant wood lots typically fail where no products are to be harvested as logs, but succeed where products such as building poles and fodder can be harvested more quickly (Barnes, 1990).

2.7 Agricultural land degradation in Zambia

2.7.1 Background of Zambia's Socio- Economic condition

According to Mwanza (1992), Zambia's economic structure has evolved since the late 1890's which made Zambia very dependent on a single export commodity (copper) whose earnings were characterized by a high degree of instability. During the immediate post World War II era, copper mining transformed the country into a rapidly growing economy (Baldwin, 1966). During that period the international copper price rose and reached the highest levels in 1955. In 1953, the central African Federation (Southern Rhodesia, Northern Rhodesia and Nyansaland) was formed. The foundation of this Federation was opposed by

nationalists in Northern Rhodesia since it was mainly designed to benefit southern Rhodesia and South Africa. Furthermore, industrial and infrastructural development was concentrated in Southern Rhodesia with the North serving as a market (ILO, 1982; Mwanza, 1992;).

By the end of the colonial era, the basic structure of the Zambian economy had been established. On one hand, there was a thriving export enclave based on the exploitation and export of copper. This sector was served by a well developed infrastructure. The development of mining also spearheaded the development of a small, but vigorous manufacturing sector. In the rural areas, there were a lot of contrasts. The line of rail regions were lost to a thriving agrarian capitalist sector based on the production and export of a few crops. Alongside these farmers was an undeveloped peasant sector which served mainly as a reservoir.

The early 1970s were characterized by de-accumulation of government revenue mainly due to a decline in copper prices. It must be pointed out that during the boom period, the agricultural sector was relatively neglected. For instance, there was no major shift in agricultural policy and little attempts were made to integrate the development of agriculture with that of manufacturing. To this day, the nature of agricultural pricing policy and land tenure system still bears the marks of the colonial era which were designed to benefit European settlers (Good, 1976).

The post 1975 period has been characterized by a massive contraction of the Zambian economy brought about by, mainly, the effects of the World recession after the 1973 energy crisis. This recession led, in part, to reduced demand for industrial and constructional inputs, such as copper. Furthermore, falling export prices and rising import prices and the resultant high deficits in Zambia's balance payment and the government's budget exacerbated the economic crisis. According to Sichingabula (2000), the import substitution programme cost the country a lot of money which was never recovered. Conditions worsened after the 1973-74 oil crisis, but country continued with this programme, exacerbating the problem of the balance of payment. By the end of 1970s Zambia's economy was under pressure from a low trade balance, increasing debt to the International Monetary Fund and World Bank under the SAP started in 1978 (Young 1988, Loxley and Young, 1990) increasing debt service payment and falling copper prices.

In order to redress the colonial neglect, Zambia's First National Development Plan (FNDP)[1966-70] called for the diversification of the economy and reduction of dependence on the mining and export of unprocessed copper. The launching of the Second National Development Plan (SNDP)[1972-76] was mainly for expansion of agricultural production, transformation of subsistence agriculture, industrial expansion, reduction of regional inequalities and development of tourism. Unfortunately, most of these objectives were not achieved. The Third National Development Plan (TNDP)[1979-83] was designed to overcome the

causes of failure of the SNDP. It marked the beginning of the Structural Adjustment Programme (SAP) (Mwanza, 1992; Daniel, 1995).

But, as with the crisis, which led to then, SAPs eventually took a long term perspective. And above all, these programmes produced undesirable side effects, which (already difficult to accept in the short term) become intolerable in the long run. Finally, the new rules of the game established by the SAPs (reduction of the State's role, generalization of economic liberalism) resulted in the exacerbation of inequalities and poverty, which, in turn, contribute to low agricultural production due to environmental degradation in rural areas (World Bank, 1994; UNDP, 1997). The Zambian government policy neglected the agricultural sector in terms of financial resource allocation. This is despite the reality that the majority of the people depend on agriculture for their livelihood. In 1991 under a new government and enhanced SAP, there was an attempt to reform agricultural policies. However, the country's policy of price interventions worked against the necessary incentives to increase agricultural output (Saasa, and Carlsson, 2002).

Agriculture is the main economic activity in rural Zambia, and virtually all poor rural households are headed by a person whose primary source of employment is agriculture. Although off-farm and farm product processing income is often critical to the survival of these households, their main source of income is agricultural production activities. Agriculture, because it is the main source of income and sustenance among small-scale farmers, and because it can provide an

overwhelmingly positive contribution to national development, should be the main sector of focus for any rural poverty reduction programme. Programmes designed to provide off farm income – generating activities or services should be linked closely to agriculture (Word Bank, 1994).

The need for agricultural development in Zambia can be attributed to many factors; the major one being the intensification of crop production due to escalating requirements for food arising from population growth and high consumption levels. However, according to McGiven (1992), there is very poor soil management in Zambia. There is overgrazing of lands and poor agricultural practices, which have contributed to soil degradation. Misuses of the soil pose a serious and growing threat to sustainable development and protection of the environment. McGiven (1992), continues to say that apart from Luapula and Northern provinces, all the other provinces have serious problems of soil erosion caused by running water largely due to poor farming practices. Such poor farming practices have contributed to the development of gully erosion in such areas as Mundombotoka, Mumbi, Chikambo, and Kasengo gullies in Lundazi district, Petauke, Sinazongwe and Mazabuka respectively. All these have largely been caused by poor soil management, which is related to the production of more food to meet the demand of a growing population.

2.8 **Open access resources**

Traditional tenure systems in Zambia constrain agricultural productivity and cause environmental degradation because land resources are not privately owned, but are either common property of the community clan or ethnic group or are open-access resources owned by no one. According to FAO (1998), users of such resources have no incentive to limit their consumption thereof because they cannot be certain that other users will similarly limit theirs. Since they lack secure property rights, individuals are dissuaded from adopting long-term conservation investment and production strategies. Open-access systems are not conducive to resource conservation or to investment in land. Open-access resources are at great risk of over-exploitation, since they lack clearly defined ownership and use rights assignments as well as effective management. This problem was resolved in Europe largely by the allocation of land to individual owners who then had an incentive to invest in it, develop it, and conserve it.

2.9 **Reducing productivity of the poor farmer's natural resources**

Environmental degradation reduces the productivity of natural resources managed by the poor small-scale farmers, thereby perpetuating impoverishment. Where the poor farmers depend on biomass fuel and confront increasing fuel wood scarcity, they often shift to animal dung, fodder, and crop residues for fuel. Because reduced quantities of these resources or materials are therefore returned to the soil, its fertility declines. Where rural population growth is putting pressure on land resources such that fallow periods are shortened, poverty may constrain

farmers' ability to maintain soil productivity through more intense application of variable inputs (UNDP, UNEP and World Bank, 1994).

Environmental degradation can lower the labor productivity of the small-scale farmer, even when they are healthy. For example, as fuel wood becomes scarce, due to deforestation, poor households must spend an increasing amount of time collecting it. Where family labour is not abundant, greater time spent on fuel wood collections takes away from others productive activities, and can result in lower incomes (Mink, 1993).

Until the identified negative and limiting factors in the literature review namely; soil degradation, deforestation, short fallow periods, lack of soil conservation measures, population increase and open-access resources; are correctly addressed, agricultural development in Zambia in general and Magoye area in particular will remain a myth.

This study will attempt to fill in these gaps that are found in the literature and address the above mentioned problems or limiting factors to agricultural development in Magoye. Statistical tests will be applied where possible to explain relationships that exist among population growth, natural resource degradation and slow agriculture growth.

CHAPTER THREE
DESCRIPTION OF STUDY AREA

3.1 Introduction

This chapter provides some information on the physical characteristics of Magoye West forest reserve and the socio- economic condition of the local people.

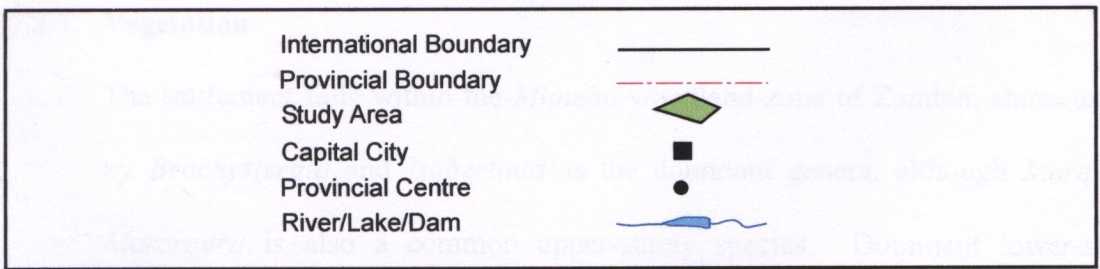
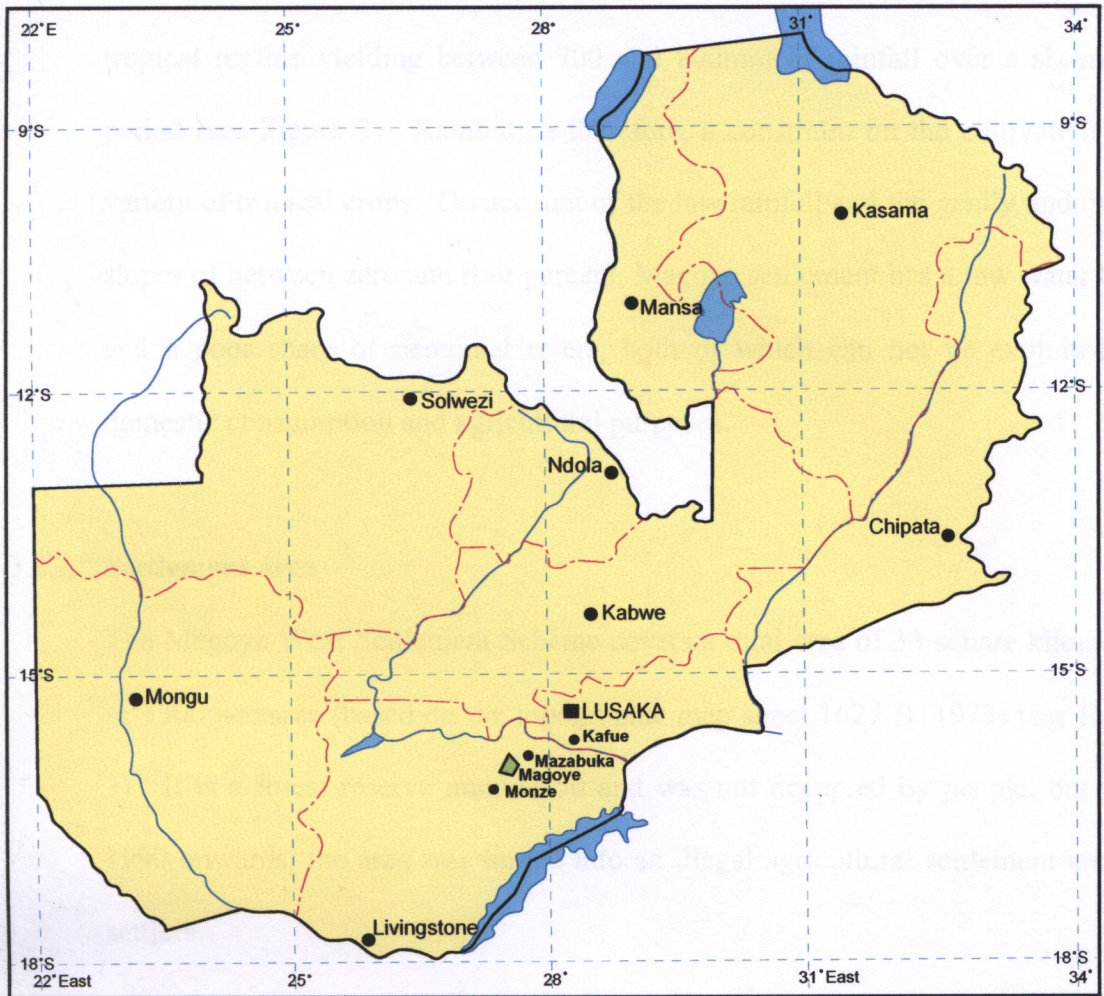
3.2 Location and description of study area

The study area is located between Monze and Mazabuka towns in the Southern Province of Zambia(see Figure 1). It is 20km away from Monze and 30km away from Mazabuka. It is located on the western side of Magoye town. In terms of longitudes and latitudes the area lies roughly between 25 degrees 50' and 25 degrees 55' East of Greenwich meridian and 17 degrees 05' and 17 degree 15' south of the equator.

3.2.1 Climatic characteristics

Just like the rest of Zambia, the study area experiences a tropical type of climate. Rainfall is seasonal and erratic. In July, which is the coldest month, mean temperatures range between 15 degrees and 17.5 degrees celsius, while those of October, which is the hottest month, range between 25 degrees and 27.5 degrees

Fig. 1: Location of Magoye West Forest Reserve, Southern Province, Zambia.



celsius (Chikumbi, Chileshe, Pungwe, 1991). The Magoye West Settlement Scheme lies in one part of Zambia with low rainfall, unreliable and seasonal tropical regime yielding between 700 and 800mm of rainfall over a six-month period (see Figure 2). Rainfall, is therefore, a constraint on the cultivation of a variety of tropical crops. On account of the low rainfall and the gently undulating slopes of between zero and four percent, Magoye settlement has a low water table and a poor share of perennial rivers, both of which can not be exploited for domestic consumption and agricultural purposes.

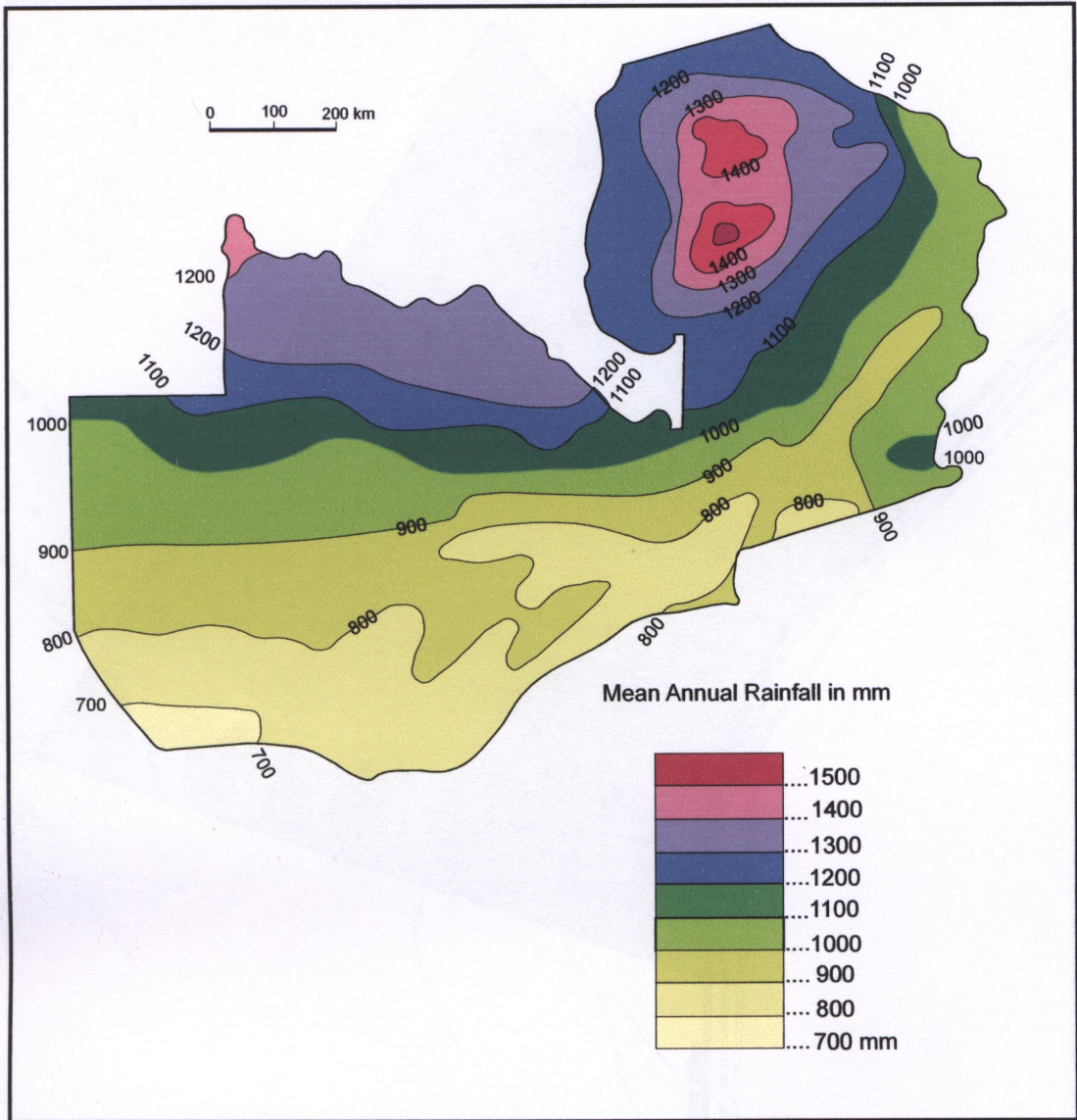
3.2.2. Settlement area

The Magoye West Settlement Scheme covers a total area of 33 square kilometers or 3300 hectares (based on the topographic map sheet 1627 B. 1973) (see Figure 3). It is a forest reserve number 50 and was not occupied by people, but from 1990 onwards, the area was turned into an illegal agricultural settlement area by settlers.

3.2.3. Vegetation

The settlement falls within the *Miombo* woodland zone of Zambia, characterized by *Brachystegia* and *Isoberlinia* as the dominant genera, although *Murquesia* *Marcroua* is also a common upper-storey species. Dominant lower-storey species include *Diplorlynchus* *Candylocarpen* and *Uapaca* *Spp.* Much of the settlement is not still covered by what appears to be virgin woodland. The plot for basal area measurements was demarcated in an area judged to be

Fig. 2: Mean Annual Rainfall (mm)



SOURCE: Atlas sheet 13.

Fig. 3: Magoye West Forest Reserve as at 1973



0 1 2 3 km

Forest Reserve Boundary.....	-----	Settlement.....	•
Main Road.....	—————	Land under Cultivation.....	Orange
Other Road.....	====	Grassland / Bareland.....	Yellow
Footpath.....	- - - - -	Open Bush and Tree grassland....	Light Green
Railway.....	- - - - -	Woodland.....	Dark Green
River/Stream.....	~~~~~	Dambo/Area liable to flooding.....	Light Blue

Source: Topographic map sheet 1627B1 (1973).

representative of a pre-settlement virgin and dense woodland forest. This point will be developed in the next chapter.

3.2.4 **Soil characteristics**

According to Brammer (1976), the Southern province soils between Mazabuka and Monze are dark brown on top overlying a strong to yellow red subsoil which becomes molten red and yellow one meter deep from the surface. There is a gradual increase in clay content with depth from loamy sand or sand loamy mixture in the topsoil to sandy clay below 30-50cm. Some areas have soils, which are acric ferrosols developed over basic parent materials.

CHAPTER FOUR

METHODOLOGY

4.1 Introduction

This chapter provides some insights into the way data concerning the impact of the activities of a community of people on its environment in Magoye West settlement in southern province was collected. The sampling procedures, characteristics of the sample, sources of errors, ways of analyzing data, and problems encountered during fieldwork are also described.

4.2 Pre-field work

Preparations were made before setting out for fieldwork. Secondary data was collected from:

- i) The University of Zambia Library; where data on the overview of agriculture, population and the environment were sort;
- ii) The Department of Agriculture; where data on inputs and credit facilities were obtained;
- iii) The Survey Department of the Ministry of Lands and Natural Resources where information on land use and rate of deforestation were obtained from a topographic map (1:50 000 Monze District map sheet number 1627 B1, 1982) (latest), and black and white Panchromatic Aerial photographs for the years 1980, 1990 and 1994 of the study area were used. These were the only photographs available at the time of study;

- iv) The Central Statistics Office (CSO); where data on Zambia's living conditions and population distribution was collected; and
- v) The Food and Agriculture Organization (FAO), where data on the dummy variables for "policy appropriateness" was sort (the value of one indicates conducive agricultural policy while the value of zero indicates inappropriate agricultural policies).

Other necessary pieces of equipment were also sourced such as measuring tapes (for measuring field sizes) soil auger (for soil sampling), a pair of compass clinometer (for measuring the slopes), and a pair of calipers (for measuring the tree girth). Interview schedules and questionnaires for collecting data were prepared.

Secondary data helped the researcher to know about the existing relevant literature on the problem under investigation while part of it enriched the section on the main findings of this study.

4.3. Field data (primary)

To collect the necessary information the following methods were used:

- i) Interview schedule with Households (See Appendix 1).

Although a classic type of study using written questionnaires was planned to be administered to the respondent within the setting of formal interviews, the questionnaire which was prepared could not be used by individual respondents because most of them were illiterate. Interviews

were, therefore, conducted with each individual and responses were written down. In this case wide – ranging discussions were held with small-scale farmers. Discussions conducted in such a manner helped to develop confidence and to make known the wishes and the ideals of small-scale farmers in the Magoye West Settlement. It was made clear at the beginning of every interview that the researcher was not a government officer and that the information was not being collected for government purposes, but for academic purposes.

The interviews covered a wide range of topics but focused mainly on agricultural land resources. Most interviews lasted about an hour, and sometimes questions not on the questionnaire were asked when it seemed appropriate. All the interviews were translated in *Chitonga*. Some questions were carefully explained and re-explained on request. The main impression the current researcher got was that the majority of the farmers were frank and open with their information.

The questionnaire was constructed in a way that it would seek to elicit information about small-scale farmers on the following:

- i) Fallow lengths;
- ii) Crop yields and fertilizer use;
- iii) Cultivated areas;
- iv) Ways of conserving soils and forests;

- v) Income;
- vi) Changes in food supply and land sufficiency; and
- vii) Access to extension services and agricultural loans.

Unstructured interviews, with agricultural extension workers and some members of the land use planning office in Monze, were also held. Questions were basically concerned with services they offer to farmers and problems they face in conducting their duties.

ii) Use of the three sets of panchromatic black and white aerial photographs for the years 1980, 1990 and 1994

Aerial photographs were used to assess the rate of deforestation in the study area. The base year for these aerial photographs was 1980. Before 1990, the area, Magoye West, was a forest reserve No. 50 as mentioned earlier.

Line transects were used concurrently with mapping from aerial photographs to determine the rate of deforestation and land use. Time series panchromatic aerial photographs of the study area were used to assess spatial trends in deforestation. Aerial photographs for the years 1980, 1990 and 1994 were obtained from the Survey Department, Ministry of Lands and Natural Resources (these were the only photos available for this area).

The 1980 aerial photograph was used as the starting point because in this year, there were no settlers in the area under study. The intervals between

photographs allowed for the study of changes in the vegetation cover of the area over time. For each year, the aerial photographs were demarcated into the categories; vegetation, bare land, dambo and cultivated areas.

The volume of vegetation removed for each photo was determined by multiplying the area of vegetation removed by 93t ha^{-1} , which is the standard volume of wet *Miombo* in Zambia (Chidumayo, 1997).

iii) Cadastral maps and Topographical maps

These were used to analyze aerial expansion of vegetation recession since 1980 (see section 4.6 for details).

4.4 Field observation

Observations were made in the field in order to ascertain:

- a) the various activities that farmers were involved in and their influence on soils and woody vegetation;
- b) The extent to which trees were cut in the area;
- c) A set of air photographs ZA 94/5 Southern Province 1:30 000 1994 was used as a way of ground *truthing*, that is, to relate what was on the photographs to the actual situation in the field.

4.5 Vegetation cover mapping

A preliminary analysis was done on the 1994 air photograph before going for fieldwork. This was done in order to obtain some information upon which field observations were to be based.

Data were divided into four categories of vegetation cover, bare land, dambo, cultivated areas, land use which include settlements and roads to mention but a few.

After the fieldwork, a detailed analysis was carried out manually, using a stereoscope, on all the three sets of air photographs. The different land cover types were traced on plastic overlays and later analyzed. The results were analyzed using a grid of squares so as to estimate the area covered by a category of each of the sets of air photos using the formula:

$$T = \frac{N \times (dxs)^2}{(100)m^2}$$

Where T = the total area,

N = the total number of squares,

d = the length of the side of a square and

s = the mean scale of the air photograph

Source: SADCC (1993) Environmental Monitoring System

Vol 2. P.66.

In this case, the length of the side of squares used was 2cm and the scale of photographs was 1:30 000. To assess the change in vegetation cover, areas of the succeeding photo were compared to that of the preceding one. For example; The areas covered with vegetation in 1994 and 1980 = the change in vegetation cover, that is, xha (1980) and xha (1994) vegetated. If the area in 1994 is larger than the area in 1980, then it means that vegetated area has increased and if the opposite occurs then deforestation was on the increase.

4.6 Sampling procedures and sample size

The domain of the study was rural and purposive sampling and simple random sampling methods were used.

4.6.1 Simple random sampling

The households were selected randomly to give each household equal opportunity to be included in the sample. The households were assigned a different number written on a piece of paper. The numbers which were drawn out of the box constituted the total sample. In 1996, the rural population in Southern Province was 988,000, whilst that of Magoye West was 2,900 (Central Statistics Office [CSO] (1996). When projected to the year 2000 population using the exponential projection method ($P_2 = p_1 \times e^{rt}$) the population will be 3,296. Such a population gives a total of 549 households, after this number has been divided by six, which is the average family size in Magoye (CSO, 1996). A sample of 50 households was, therefore, suitable for such a small population.

4.6.2 Purposive sampling

Purposive sampling was used in the case of Headmen, agricultural extension workers and members of the Land Use Planning Office to investigate possible ways through which small- scale farming contributed to soil and forest degradation. General questions concerning services they offer to people and some problems they face in conducting their duties were also used.

4.7 Characteristics of sample

The sample consisted of fifty (50) respondents. To the surprise of the researcher, it was discovered that, although some of the farmers did their activities in the settlement area (former forest reserve), they were actually staying outside the boundaries of the former forest reserve area. In this case, both people who settled in the study area and beyond the study area were interviewed. They were randomly selected from twelve villages, which were given numbers as shown in Table 4.1

Table 4.1: Listing of villages from which respondents were drawn

<u>Village No.</u>	<u>Number of respondents</u>	<u>Total number of People per Village</u>
1	4	19
2	6	30
3	5	28
4	5	24
5	3	15
6	3	16
7	4	17
8	5	23
9	3	16
10	6	33
11	2	14
12	4	18
Total	50	253

Thirty-five respondents (70 percent) were married, four (8 percent) were single, seven (14 percent) were widowed and four (8 percent) were divorced. Twenty six percent of the women were heads of their households while seventy four percent of heads of household were men.

4.8 Profile examination and soil sampling

4.8.1 Excavation of holes

In order to get a good view of each profile, a hole that was 180cm long, 60cm broad and 150cm deep was excavated when the conditions allowed it. Only in this way was it possible to get a good view of the horizontal development of the profile. This size of holes also made it possible to sample the soil without any trouble and risk of contamination. Only two holes per sample were excavated due to lack of resources and time. The soil samples were got from five areas, namely

A = Grazing land, B = Virgin forest soils, C = two year land fallow, D = Land under cultivation for more than two years, and E = Land under cultivation for more than three years continuously.

In some cases it was not possible to excavate the holes to the desired depth due, for example, to occurrence of parent rock at a more shallow depth, a plinthite horizon, or because iron concretions were so compact, that it was impenetrable in reasonable time by means of the resources of tools and labour available.

In some of the vertical soils high in clay holes were excavated to the depth of 90-100cm deep only because of lack of time, and the soil samples from the 90 to 150 cm depth were sampled by means of a soil auger having a diameter of ca. 4cm, if it was possible to penetrate the soil to the depth of 150cm by the help of that tool. But because most of the profile excavation were done during the dry season, the vertisol soils were so difficult to penetrate that often it was only possible to reach the depth of 50 – 60cm (see Appendix 3).

4.9 **Soil pH**

Soil pH and nutrient content was used to determine soil fertility. Two soil samples from five localities or land use were obtained and analyzed in the Laboratory. Soil samples were collected from grazing land, virgin forest, land under two years fallow, land under cultivation for two years and land under cultivation for more than three years (see analysis on page 80- 83).

4.10 Occupation

The chief occupation in the area is farming. Other income generating ventures include local beer brewing; charcoal burning and black smithing. In order to undertake these activities, a substantial amount of wood fuel is required. Other activities, particularly for women, are basket and clay pot making. Although all the families were rural they did not operate totally outside the cash economy.

4.11 Problem encountered in the study

Every research has its own problems and this one is not an exception. A number of problems which included the following were encountered:

- i) Data collection presented a problem because small-scale farmers were interviewed person to person, and this proved to be rather tiring and time consuming;
- ii) Counting of a sample of trees on the one-hectare study site selected for the study (a measure of standing wood stock before settlement) was tedious;
- iii) The researcher had to cycle long distances following the respondents since some of them were found far away from the study area, though they did their agricultural activities in the study area and,
- iv) Excavations of the holes was difficult because it was done during the dry season – the vertisol soils were difficult to penetrate.

12 **Possible sources of error in data collection**

Errors could emanate from estimates on sizes of cultivated fields, as some farmers were not very sure of the sizes of their fields. Where possible, measuring tapes were used to get correct sizes. Furthermore, estimates from aerial photographs could have generated some minor errors; but all in all, care was taken to minimize errors.

CHAPTER FIVE

DATA ANALYSIS AND DISCUSSION

5.1 Introduction

Small-scale farmers in Magoye West Settlement find themselves presiding over an agricultural system whose viability is increasingly problematic. The growing population has put increasing pressure on cultivable land under different systems of land tenure and modes of agricultural production, leading to deforestation and loss of soil fertility.

In this chapter, the following are considered: age structure, marital status, educational status, household size and headship, crude settlement population density of the small scale farmers and the pre-settlement and post settlement vegetation cover situation of Magoye west agricultural settlement. An attempt is made to translate the amount of woodland cleared during this period into crude biomass terms. pH and nutrient testing in areas judged to be representative of a pre-settlement virgin and woodland forests and those under cultivation were carried out. Other aspects considered under this chapter include: fallow lengths, ways which small-scale farmers use to conserve their soil and forest reserves, cultivated areas, crop yields, fertilizer use, changes in food supply, extension services and credit, land sufficiency, as well as sources of energy.

5.2 Demographic Characteristics of the people under study

The demographic characteristics of any area under study are important in understanding the living conditions of people through the impact they may have on the socio-economic situation. Furthermore, data on the demographic characteristics of the population provides background information necessary for the understanding of other aspects of the population, including economic activities.

5.2.1 Age structure

The average age of the small-scale farmers interviewed was 32.7 years. Only few farmers under the age of twenty were interviewed and a disproportionately high percentages of, 35.1 and 30.8, of the male and female farmers respectively were over fifty (see Table 5.1).

Table 5.1 Age and Sex Distribution of the farmers

Age (Years)	Number of respondents			
	Males	Percent	Females	Percent
Below 20	5	13.5	2	15.4
20 – 50	19	51.4	7	53.8
Over 50	13	35.1	4	30.8
Total	37	100.0	13	100.0

Age structure is very important, especially for those farmers under twenty, because it is these farmers, who are just beginning to set up independent households, who are most likely to find themselves victims of land pressure and other agricultural problems.

5.2.2 Marital status

The proportion of married persons, especially women, is an important proximate determinant of fertility because most births occur within marital unions. It also entails how demographic factors may directly or indirectly contribute to increasing pressure on the natural resources. Out of the fifty farmers interviewed, 70 percent were married, eight percent were single, fourteen percent were widowed and eight percent were divorced (see Table 5.2).

Table 5.2: Marital status of farmers in survey sample

Status	No. of respondents	Percent
Married	35	70.0
Single	4	8.0
Widowed	7	14.0
Divorced	4	8.0
Total	50	100.0

It is these farmers, especially women without husbands who experience serious difficulties in food production because they have no one to help them in cultivating and obtaining credits.

5.2.3 Household size and headship

In this study, 26 percent of the households were female headed as compared to 74 percent which were male headed. Male headed households had a higher average household size of 5.2 as compared to 3.9 for female headed households. The average household size for both female and male-headed households was 5.6.

5.2.4 Level of education

Thirty eight percent of the small-scale farmers interviewed had no education at all. Thirty six percent had attained primary schooling education, though none had completed their schooling even at this level. Of the thirteen (26 percent) who had secondary education, only eight managed to complete secondary school (see Table 5.3).

Table 5.3: Educational status of farmers under study

Level of Education	No. of respondents	Percent
Secondary	13	26.0
Primary	18	36.0
No Education	19	36.0
Total	50	100.0

The average number of years of school attendance among the respondents was 2.9. The level of education of small scale farmers in this area is thus very low, and of the farmers who had attended primary school very few would be literate. There is a close relationship between education and extension training as well as

obtaining loans. Since the sample comprised of people who were largely illiterate, agricultural training and credit offering to these farmers is very limited. Education, according to UNDP (1997), is a significant variable since more literate and knowledgeable people make better farmers because they are able to invest on the land by conserving soils and forests. Now that the sample was largely illiterate, natural resource conservation in this area was limited.

5.3 **Crude settlement population density**

Given a gross extent of 33 square kilometer and the year 2000 population, of which about 530 directly benefit from the settlement area, the settlement had a population density of about 16 persons per square kilometre in January 2000. This included people who settled in the former forest reserve and those who were settled outside but did their agricultural activities in the former forest reserve). This density is over four times that of Magoye constituency (4.5 persons per square kilometers).

However, when areas covered by water and those liable to flood (nine percent) are deducted from the total settlement area, a crude dry land density of about 18 persons per square kilometres is registered. The area covered by water and liable to floods (about three square kilometres) was measured from the black and white aerial photographs and topographic map sheet 1627 B1, 1973 published by the Survey department of the Ministry of Lands and Natural Resources. In a very general sense, this density could be regarded as the ratio of small-scale farmers to

arable land, although the inclusion of agriculturally valuable areas seasonally liable to floods would deflate the value somewhat.

5.4 **The environmental impact of small-scale farming**

The meaningful assessment of the impact of a community of people on its environment requires knowledge of the state of the environment before human settlement as well as its condition at some point during such settlement. A diachronic rather than a synchronic approach is therefore essential to community environmental impact analysis - an approach that monitors environmental change due to the dynamics in community variables with a direct or indirect bearing on the use of the environment. Demographic dynamics, for instance, can increase or decrease community demand on environmental resources. Similarly, a per capital increase in the demand for environmental resources over time due to commercial motives could accelerate environmental change.

Magoye West Settlement does not have such a time series data base, and the period of this research was inadequate for gauging environmental change as it relates to specific community variables. However, by using pre- and post-settlement aerial photographs, it was possible to measure the approximate extent of the obvious environmental impact – namely, deforestation, as earlier explained in methodology. Given the knowledge of the limitations of soils of the settlement vis-a-vis the kind of sedentary agriculture practiced in Magoye West, a relatively

plausible inference on the adaphic effect of permanent cultivation can be advanced using simple soil pH and nutrient testing.

5 **Pre-settlement impact on vegetation**

From the interpretation of a block of aerial photographs of the study area taken in 1980, it can be asserted that the settlement is on land that was virtually virgin. Only small patches of clearance close to the western boundary and along the Monze – Mazabuka road were evident. Small portions of agricultural activities were also evident on the northern boundary of the settlement (see Figure 4). Aerial measurements of these patches reveal that only about three square kilometres (nine percent) of pre-settlement Magoye West forest reserve were cleared. Thus about thirty (30) square kilometres of Magoye West forest reserve (91 percent) were in a virgin state in 1980. If the water covered and seasonally flooded areas were taken into account, pre-settlement Magoye West was covered by about twenty seven (27) (82 percent) square kilometres of the *Miombo* vegetation as mentioned earlier. This means that only about nine percent of the total settlement and wooded areas had been cleared for various purposes before the settlement was established.

It is evident that some areas of the forest reserve had their woody vegetation cleared before human settlement. This indicates that there was some encroachment on the woody vegetation by the surrounding villagers on the forest reserve area. Though nominally controlled, these “protected” or “reserved”

Fig. 4: Magoye West Forest Reserve as at Pre-Settlement, 1980.



Source: Aerial photographs July, 1980.

forests had become virtually open-access resources for large and small-scale exploitation, perhaps, because the responsible agencies were not able to provide effective management.

6 Post settlement impact on vegetation

At the time of the survey for this study, the latest post settlement aerial photography of Magoye West Settlement was for 1994. By using aerial photographs (1980, 1990, 1994), 1:50,000 topographic map (1986, latest) and some ground *truthing* of the area, an approximate picture of the impact of the population activities on woody vegetation can be sketched.

Table 5.4: Changes in Land Use and Vegetation Cover: 1980-94

YEAR	Woody Vegetation cover		Cultivated Land		Other Land Users		Total	
	ha	%	ha	%	ha	%	ha	%
1980	2700	90	100	3	200	6	3000	100
1990	1900	63	300	10	300	27	3000	100
1994	500	16	700	23	1800	60	3000	100

From Table 5.4, it can be deduced that the area under cultivation has been increasing since 1980 whilst the woody vegetated area has been decreasing. For instance in 1980, 2700 hectares (90 percent) of the study area was covered by woody vegetation while the cultivated area covered about 100 hectares (three percent) of the total area in the same year (see Figure 4). In 1990, 1900 hectares (63 percent) of the study area was covered by woody vegetation whilst the

cultivated area covered about 300 hectares (10 percent) of the total area (see also Figure 5). By 1994, only 500 hectares (16 percent) of study area was covered with woody vegetation whilst the cultivated area increased to 700 hectares (23 percent) (see also Figure 6). The area under other land uses increased from 200 hectares (six percent) in 1980 to 1800 hectares (60 percent) in 1994. Table 5.5 gives us the estimated rates of deforestation per annum between 1980 and 1994.

Table 5.5: Annum rate of deforestation (1980-94)

PERIOD	Approximated area Cleared		Deforestation rate per annum	
	Km ²	(ha)	Km ²	(ha)
1980 – 1990	8	800	0.8	80
1990 – 1994	14	1400	3.5	350
1980 – 1994	22	2200	1.6	160

It is estimated that about 22 square kilometres or 81 percent of the estimated 27 square kilometres of *Miombo* vegetation were cleared between 1980 and 1994. This represents an annual rate of woodland clearance of 1.6 square kilometres or 160 hectares (about three times the estimated annual rate of woodland loss of Zambia [0.5] (GRZ and IUCN, 1985). Given an approximated population of 530 small-scale farmers, a per capital cleared area of about 0.3 hectares is suggested. In per household terms, assuming an average family size of five members, each farming family can be said to have cleared about 1.5 hectares of woodland over this period. This value should, however, be scaled down to about 1.2 hectares if

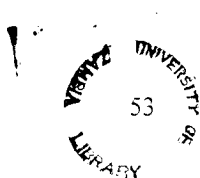


Fig. 5: Magoye West Forest Reserve as at 1990.

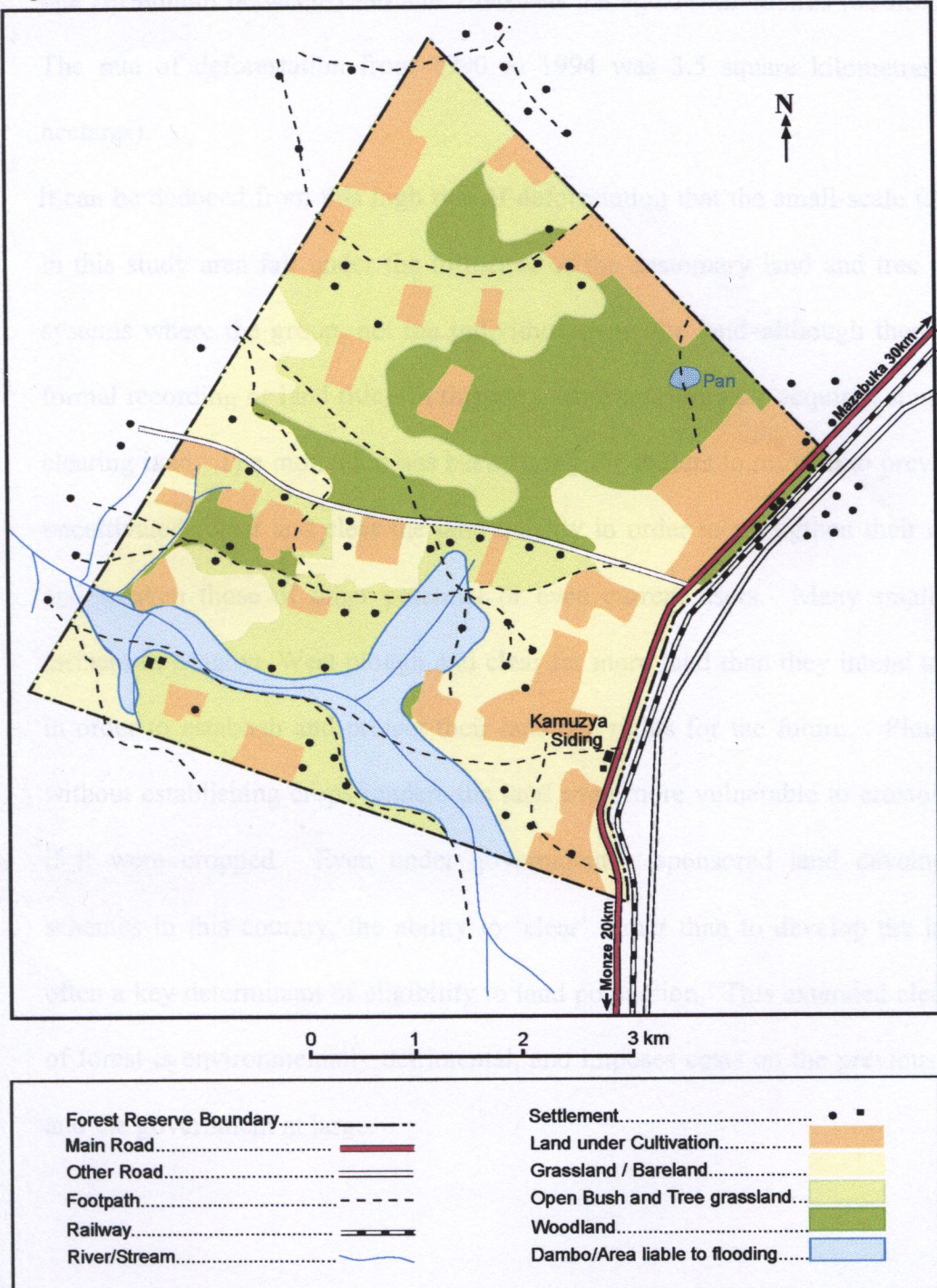


Source: Aerial photographs, June, 1990.

0 1 2 3 km

Forest Reserve Boundary	-----	Village/Other settlement	• ■ •
Main Road	=====	Land under Cultivation	Orange
Other Road	====	Grassland / Bareland	Light Yellow
Footpath	- - - -	Open Bush and Tree grassland	Yellow-Green
Railway	— + — + — + — +	Woodland	Green
River/Stream	~~~~~	Dambo/Area liable to flooding	Blue

Fig. 6: Magoye West Forest Reserve as at 1994



Source: Aerial photographs, July, 1994.

land cleared for infrastructural purposes is taken into account. The deforestation rate per annum between 1980 and 1990 was 0.8 square kilometres (80 hectares). The rate of deforestation from 1990 to 1994 was 3.5 square kilometres (350 hectares).

It can be deduced from this high rate of deforestation that the small-scale farmers in this study area fall under the influence of the customary land and tree tenure systems where the group, not the individual owns the land—although there is no formal recording or land title. In this area, usufruct rights are acquired simply by clearing land. The motivation has been strong for settlers to move into previously uncultivated forest and clear the land quickly in order to strengthen their claims and weaken those of other potential or even current users. Many small-scale farmers in Magoye West plough and clear far more land than they intend to crop in order to establish and protect their land use rights for the future. Ploughing without establishing crops renders the land even more vulnerable to erosion than if it were cropped. Even under government – sponsored land development schemes in this country, the ability to ‘clear’ rather than to develop the land is often a key determinant of eligibility to land possession. This extended clearance of forest is environmentally detrimental, and imposes costs on the previous users and the government at large.

7 Opportunity cost for lost biomass

An attempt was also made to translate the amount of woodland cleared during this period into crude biomass terms. The basal area method was used for this purpose by employing the following formula:

$BA = n(g)/12.57$, where:

BA is the basal area (a measure of standing wood stock)

N is the number of tree stems

G is tree girth at breast height and;

12.57 is an empirical constant for *miombo* vegetation

Through counting of a sample of trees on the one-hectare study site selected for the study, it was established that trees with girth of less than 0.4 metres (minimum standard) did not qualify to be counted. The basal area measurements were done in an area of Magoye West Settlement still representative of the virgin condition. The selection and demarcations were done with the help of two knowledgeable members of staff of the Land Use Planning Office in Monze.

Having the count of 295 and an average tree girth of 0.5 metres, the calculated basal area was 11.7 square metres per hectare. Therefore, Pre-settlement Magoye West had a standing wood block of about 4541 square metres. Of this basal area, about 291 square metres, or 83 percent had been cleared by 530 small-scale farmers. Indeed, the lost biomass would represent a substantial opportunity cost if it were to be translated into timber or fuel wood terms. For instance, in

undisturbed *miombo*, of the above wood biomass, it is estimated at 180 cubic metres per hectare, or ninety-nine metric tones bone-dry weight. It is further estimated that a tonne of bone-dry wood could produce about 6.2 standard bags of charcoal weighing forty kilogrammes. At the current price of a bag of charcoal of ZK20,000 and a market exchange rate of about ZK 4200 to US\$1, the cleared woody vegetation would be worth ZK24,861,580,000 or US\$8,252,757 on the open market.

8 **Statistical analysis to explain variation in the rate of deforestation**

Many of the relationships hypothesized and discussed in this study cannot be investigated statistically using aggregated data. However, limited testing may establish the plausibility of several of the hypotheses. The analysis in this chapter or section suggests that deforestation is related positively to population pressure on cultivated land (the smaller the cultivated area per person, the higher the rate of deforestation), the rate of population growth (the higher the population growth rate, the higher the rate of deforestation due to land clearing and fuel wood provision), and policies favourable to agriculture (the more profitable agriculture and logging, the more rapid the clearing of forests). Deforestation is negatively related to the use of modern farm inputs such as fertilizer (the greater the use of modern inputs the lower the need to clear more land for farming). Open – access land tenure situations were found to stimulate deforestation, but this could not be quantified because farmers were not able to provide measurable data.

Fig.7: Relationship between area cultivated and rate of deforestation

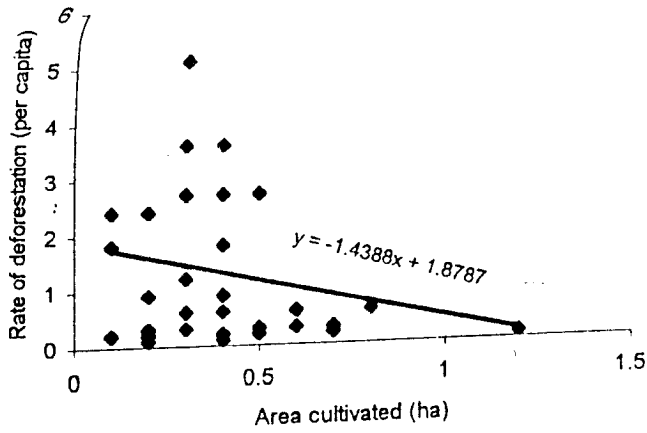


Fig. 8: Relationship between rate of deforestation and fertilizer use

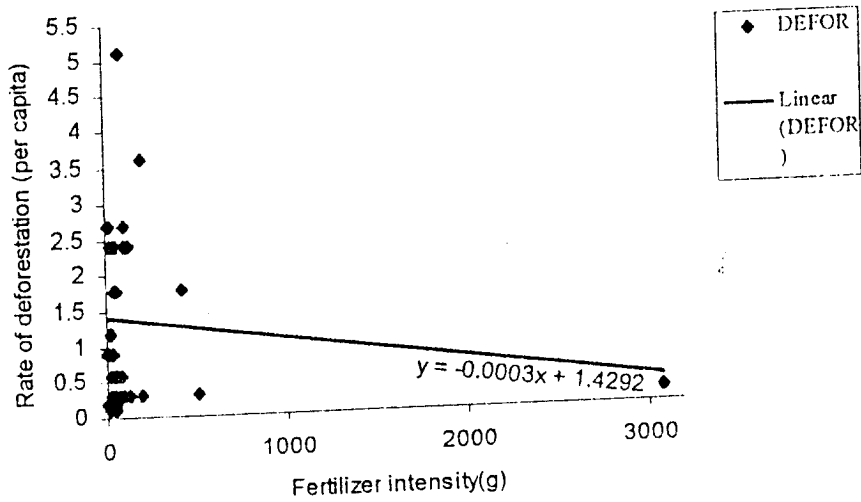


Fig. 9: Relationship between deforestation and agriculture policy

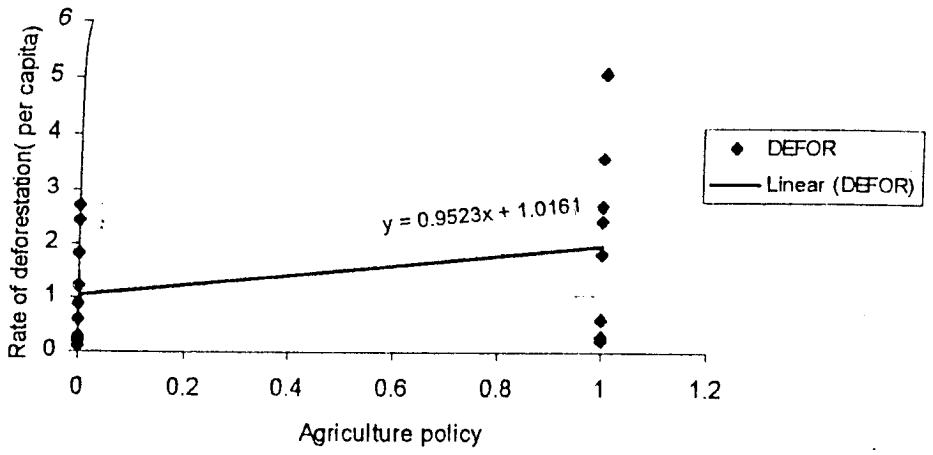
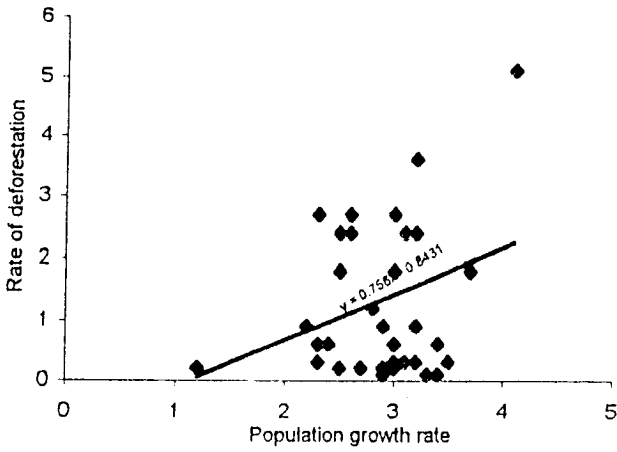


Fig. 10: Relationship between population growth rate and rate of deforestation



5.9 Determinants of the rate of deforestation

A statistical relationship was carried out with the rate of deforestation (1980-94) the dependent variable, and cultivated area (ha) per person, fertilizer use per hectare, population growth rate and agricultural policy dummy as independent variables. The values for each variable were converted to their natural logarithm and a regression equation was applied to these data. The coefficients reported below, therefore, represent elasticities. Policy appropriateness is represented by a dummy variable having the value '1' for farmers where policies were judged to have been conducive to profitable agriculture and '0' where it was judged to have been inappropriate. Of the fifty farmers interviewed, thirty-five (seventy percent) judged policies to have been inappropriate, nine (eighteen percent) appropriate and six (twelve percent) were not sure. However, these judgements were highly subjective. The model that was used is presented below.

$$\text{DEF AREA} = \beta_1 + \beta_2 * \text{LAC} + \beta_3 * \text{FERT} + \beta_4 * \text{POP} + \beta_5 * \text{POL} \\ + \text{ERROR TERM}$$

Dependent variable: Rate of Deforestation

Independent variables: Cultivated Area, (LAC) Fertilizer use (FERT), population growth rate (POP), and Agricultural policy (POL).

Table 5.6: Coefficients of the Determinants of the rate of deforestation

Dependent variable	Independent variables				Adjusted r ²
Date of Deforestation	Agricultural Policy POL	Cultivated Area LAC	Population Growth rate POP	Fertilizer use intensity FERT	
Coefficients T-Static	0.19523 0.97	-1.4388 -0.31	0.756 2.43	-0.003 -3.50	0.86

Displayed in Table 5.6 are the values of the coefficients, which represent elasticity. Only the coefficients of the relationship between rate of deforestation and the population growth rate as well as agricultural policy were significant at 0.05 level of significance. The relationships are explained in the sections that follow.

5.9.1 Cultivated area

The hypothesis that population pressure on cultivated area increases the rate of deforestation was confirmed. The variable in Table 5.6 had the expected negative coefficient (-0.439) which means that the smaller the cultivated area per person the higher the rate of deforestation. For every unit decrease in cultivated area, there is an increase of 1.439 square kilometers in the rate of deforestation (see Figure 7).

As mentioned earlier, in the Magoye area, usufruct rights are acquired simply by clearing land without necessarily planting anything. The motivation has been

strong for settlers to move into previously uncultivated forest areas and clear the land quickly in order to strengthen their claims and weaken those of other users. It was found that many small-scale farmers in this area clear and plough far more land than they actually intend to crop in order to establish and protect their land use right for the future. Clearing and ploughing without establishing crops may render the land even more vulnerable to erosion.

9.2 Fertilizer use

The use of modern farm inputs such as fertilizer as shown in Table 5.6 is negatively related to the rate of deforestation thereby suggesting that intensifying agriculture by applying more fertilizer would slow down the rate of deforestation. A unit increase in the amount of fertilizer used per hectare leads to a 0.003 square kilometers decrease in the rate of deforestation (see Figure 8). From this equation, it can be deduced that the application of more fertilizer per hectare through agricultural intensification is likely to be the most important policy available to deal with the problem of deforestation.

It was well established that fertilizer use is extremely low in this area averaging 83 grammes per hectare in the 1999/2000 agricultural season compared to China, for example, where it is 2,860 g/ha, and there is vast scope for increasing its use (Yongyuth, 1997). Poor households face higher levels of risk from various sources than better – off households do. Some of these risks are attributed to poorly conceived or implemented policies. Where the government is ineffectively

intervening in input supply markets, inputs used in production may be unavailable when needed or available only at high prices making it impossible for farmers to apply large quantities.

9.3 Agricultural policy

The dummy variable distinguishing farmers judging about the government agricultural policy range from One for those who consider policies as good, and Zero for those who consider policies to be poor is positive (0.952) as shown in Table 5.6. The result is therefore ambiguous. Even if poor agricultural policy were to reduce the rate of conversion of forest to crop land, it would not be appropriate to pursue poor agricultural policies to conserve forest resources, because the objective of accelerating agricultural growth will override that of reducing the rate of deforestation. However, this finding calls for mitigating actions to retard deforestation when agricultural policies are good. Land use planning will be important in this context.

A unit increase in agricultural policy application is associated with an increase of 0.952 square kilometers in the rate of deforestation (see Figure 9). This does not necessarily imply that agricultural policy does not influence reduction in deforestation. It might be due either to the poor quality of the data on agricultural policy or to the fact that the agriculture policy is not good enough to capture the many complex and important impacts of agricultural policy.

9.4 Impact of population growth on vegetation

The per capita change in population growth rate was tested for its impact on the vegetation cleared (deforestation) and was found to be significant at 0.05 level of significance. As shown in Table 5.6, a unit increase in the number of people per household leads to a 0.756 square kilometers increase in the land cleared per capita (see Figure 10).

As mentioned earlier, the area under study was a forest reserve and the 'new' occupants of this area came from other areas or places where agricultural land was in abundance. In these areas with abundant land, farmers were unlikely to have an incentive to intensify their agricultural production (i.e. to generate more crop output per unit land area) because there was no constraint on land. If there is no land constraint, and land is free or very cheap, it makes sense from the farmers' perspective to extend the use of land and minimize the use of other inputs, including capital and labour. When soils became poor, these farmers moved to the forest reserve (study area). When they first settled these migrants brought with them the techniques of shifting from one field to another, charcoal burning and fuel wood collection, and more land cleared than cropped which they practiced in the areas they abandoned. These techniques are often detrimental to their new environment. Although they soon begin to experiment with simple modifications in farming techniques, this indigenous adjustment has been too slow to keep pace with population growth, leading to deforestation.

The coefficient of determination of r^2 (0.86) found in Table 5.6 indicates that deforestation is not influenced only by four factors advanced in this study, namely; cultivated area, fertilizer use per hectare, population growth rate and agricultural policy. Other factors such as open-access land tenure, cutting down trees for charcoal, firewood and timber, poverty, to mention but a few; account for 14 percent of the rate of deforestation.

.10 **Land and tree tenure system**

Open access land tenure situations can stimulate deforestation but this could not be assessed in a rigorous quantitative sense because farmers interviewed could not give measurable information. A qualitative judgement was, therefore, made.

The traditional land tenure system in this area constrains agricultural productivity and causes environmental degradation because land resources are not privately owned, but are either common property of a community, clan, or ethnic group or are open access resources owned by no one. The users (farmers) of such resources have no motivation to limit their consumption thereof because they cannot be certain that other users will similarly limit theirs. Households will treat available natural resources as an asset to be drawn in times of emergency. Lacking secure property rights, individuals are dissuaded from adopting long-term conservation, investment and production strategies.

There are two possible solutions to this problem:

- i) establishing firm rules with enforceable sanctions, which could limit individual use of the resource for the common good; or
- ii) individualization/privatization of resource ownership and tenure, and registration of individual titles.

However, these solutions should be taken with caution, because in other regions, tenure individualization had negative impact on land distribution and social equity. For example, evaluations of tenure reforms in Kenya and Botswana by Lele and Stone (1998), are cited as showing that individualization of land tenure has led to land grabbing, concentration of land ownership, de facto expropriation of women, landlessness, and increasing marginalization.

The customary tenure system in Magoye West involves important intricacies; ownership, management responsibility and use right are often not identical. Use rights to different products from the same piece of land may be vested with different individuals or groups. Pastoralists and sedentary farmers may co-exist on the same land, with farmers having cultivation rights and pastoralists grazing rights after crops are harvested. On the same plot of land, the right to the products (e.g. logs) of trees and the right to plant annual crops may be quite distinct and vested in different individuals or groups. Understanding the complexities of local tenure system is especially important for comprehending the incentive system that applies to agroforestry activities. It also often helps explain deforestation. In

Magoye West, tree tenure is distinctly different from land tenure. One person or groups of persons may have rights to the land, while others have rights to the trees on it, or certain products from certain trees at certain times, and this results in deforestation. In addition, tree clearing in Magoye West has been the only way to establish uncontested usufruct rights for cultivation, and this has led to massive deforestation.

1 **Tenurial security**

Land in Zambia has been nationalized, though the government has allowed customary law to guide the use of some land while allocating other pieces of land to private investors, political elites and public projects. This has reduced and not increased tenurial security in this area. Investing in the land becomes risky for farmers, since the government can and do re-allocate land for “national purposes”. In many cases this accelerates the breakdown of customary land management systems and the emergence of open-access conditions in which exploitation by anyone is permitted. Settlers in Magoye West are not subjected to any land use guidelines. Perhaps, legal incentives through title deeds would help by offering land rights in exchange for management responsibilities.

2 **Labour stimulates fertility**

In Magoye West access to non-family labour is limited. Hiring wage labour is rarely an option, simply because there is, as yet, no class of landless labourers. More common, in this area, is the pooling of labour for certain tasks, sometimes

among gender and age mates within a village, more often among members of a larger kinship group. Land allocation for farming to members of a community on the basis of their ability to cultivate it may, therefore, be a disincentive to control human fertility, because the ability to cultivate land is generally determined by the ability to mobilize family labour. This is an important motivation to increase family size through polygamy and pressure on women to bear many children, which eventually can lead to deforestation due to growing population.

Fuel wood and deforestation

Wood fuels are the staple sources of household energy, with 100 percent of all households in Magoye West using them for cooking. Some agroprocessing and rural artisanal and semi-industrial activities (such as fish smoking, tobacco curing, pottery, brick making, smithies, beer brewing) also use considerable quantities of wood fuels. The need for wood fuel is one of the major causes of the reduced tree cover. Excessive lopping and felling, combined with poor regeneration capability of trees, have set in motion a down ward trend that has been sharply accelerated by prolonged periods of drought and by increasing livestock pressure on young re-growth (see land use changes in figures 3,4,5 and 6). Since a significant switch to other fuels is not likely or possible in the short to medium terms in Magoye West, population growth translates almost directly into a growth in demand for wood fuel, yet continued reliance on wood fuels is clearly threatened by unsustainable exploitation.

Commercialization of fuel wood

The commercialization of the fuel wood and the charcoal economy has increased the utility of rural fuel wood sources. Under subsistence conditions, local fuel wood resources were used only to meet local demand, but these resources can now also be exploited for sale outside. Limited and inelastic subsistence demand is replaced by limitless and 'elastic export' demand (from the standpoint of the local economy), leading to much more rapid rates of exploitation than would be implied by local population growth alone. The collection of fuel wood and its sale in urban/peri-urban areas like Magoye town, by poor rural women, on their own account or under contract to commercial traders, is an obvious example.

Diverting labour

Environmental degradation lowers the labour productivity of the farmers. For example, as fuel wood becomes scarce, poor households must spend an increasing amount of time collecting it. Where family labour is not abundant, greater time spent on fuel wood collection takes away from other productive activities, and can result in lower incomes. Considering the collection time for other forest products, the total effect loss on labour available for agriculture in Magoye West was estimated to be one-and-a-quarter hours a day. This result is within the range established by a similar study of household time use in Nepal. Kumar and Hutchkiss (1988), observed that the total effect on labour available for agriculture was estimated to be one-and-a-half hours a day lost to fuelwood collection

activities. With labour relatively scarce, the potential loss of household labour from agricultural activities was 22 percent. Further, it was shown that families were not able to compensate for this diversion of labour resulting in a reduction in household income from agriculture.

The brunt of the fuel wood crisis falls on women: They must manage household energy needs through fuel collection, preparation and use. Men in Magoye West do not usually involve themselves in fuel provision for the household under subsistence conditions, but there are exceptions; they usually take over only when the fuel economy becomes commercialized. Children increasingly have to help their mothers with this task. Girls, in particular, have to help in fuel wood fetching, fuel preparation, cooking, and tending the fire. Women and children have to walk increasingly longer distances than would be normal and take more time to collect fuel wood.

When fuel wood sources were more abundant, fuel gathering could often be combined with other activities, such as walking from the field. With increasing scarcity, fewer sources, and longer distances, the loads carried become larger and heavier, more time is required, and the opportunity to combine wood fetching with other tasks is reduced.

With respect to fuel wood, the survey reviewed the collection and consumption pattern as illustrated in Table 5.7.

Table 5.7: Fuel wood collection and consumption/week

% of total No. of households	No. of trips per week	Average amount of firewood per trip (kg)	Amount consumed/ household/week (kg)
6	1	29.0	29.0
31	2	22.4	44.8
43	3	20.6	41.2
9	4 and above	18.0	72.0
89			187.0

Table 5.7 shows that there was a shortfall of 11 percent in the total number of households because four households did not collect firewood on a weekly basis. They collect firewood using ox-carts or a slage at least once in two weeks. The average amount of firewood collected per trip by 74 percent of the households was 43Kg. Nine percent of the households collected about 18Kg of firewood per trip, four times per week. Wood fuel consumed per household per week depends on the number of trips and the amount of firewood per trip. Women with less trips carried more firewood than those with more trips. For example, those with one trip per week carried an average amount of firewood of 29Kgs per trip whilst those with four trips and more per week carried an average amount of firewood of 18Kg per trip. The size of an individual household also determined the amount of wood fuel consumed within a given period of time. Larger households could consume more fuel than smaller households because in the former more food would need to be cooked than in the later (for the purpose of this study larger households refers to a family with more than six adult members). The amount of

wood fuel consumed at a time is also determined by the type of food to be cooked; for instance, beans would need more wood fuel than cabbage.

Women very rarely have access to any labour-saving technology for their task-transport aids or efficient tools for cutting or felling trees. They carry heavy loads to reduce the number of trips required to provide fuel for their households. They may load on their heads as much as 30Kgs of wood over a distance of six kilometres often over difficult terrain.

6 **Distance covered to sources of fuel wood**

It was well established that fuel wood was usually gathered by women and children, and the additional collection burden resulting from forest cover degradation falls most directly on them. Amounts of time devoted and distances traveled for collection vary widely, but in many places distances traveled are already substantial, often ranging up to 1 – 3 hours/day and in exceptional cases as much as six kilometres.

Table 5.8: Distance covered to sources of firewood

Distance covered (km)	Number of Respondents	Percent
Less than 1	8	16
1 – 2	12	24
3 – 4	21	42
More than 4	9	18
Total	50	100

From Table 5.8 it can be deduced that eight (sixteen percent) of the respondents covered less than one kilometer from their homes to sources of firewood while a disproportionately high number, twenty one (42 percent) of the farmers interviewed covered between three to four kilometres.

There are many causes for the fuel wood problem, including the traditions of its use and the absence of alternative fuels. The major reason for lack of success in introducing alternative fuels in this area is that wood has been regarded as a free commodity taken largely from land to which everyone has the right to access.

7.7 Statistical analysis to explain variations in crop yields

Farmers experiencing a more rapid degradation of their natural resources endowment, as reflected in higher deforestation rates per capital and soil low fertility, are likely to have lower crop yields. Schooling, especially basic education level or better, of both males and females should facilitate the adoption of intensive farming techniques, natural resource conservation techniques and

should therefore be associated with higher crop yields. More literate and knowledgeable people make better farmers because they are able to invest on the land by conserving their soils as stressed earlier. Efforts to stimulate agricultural intensification (by promoting fertilizer use, for example) will significantly accelerate the increase in crop yields. Crop yields should be higher for farmers with large households relative to cultivated land, hence, statistical analysis should show an inverse relationship between area cultivated per person and crop yields (other things being equal). Farmers who consider agricultural policies (marketing, credit, extension) favourable will have high yields (see detailed analysis in the sections that follow).

Determinants of average crop yields

A statistical relationship analysis was done using crop yields, namely, maize, cassava, groundnuts and cotton, as the dependent variables. On the other hand cultivated areas (ha) per person, fertilizer use per person (g), education, deforestation rate and agricultural policy dummy were used as independent variables.

The values for each variable were converted to their natural logarithm, and a regression equation was applied to these data. The coefficients reported below, therefore, represent elasticities. As mentioned earlier, policy appropriateness is represented by a dummy variable having the value '1' for farmers where

agricultural policies were judged to have been conducive to profitable agriculture and O where it was judged to have been inappropriate.

Model: $\text{Yield} = \beta_1 + \beta_2 * \text{POL} + \beta_3 * \text{BSC} + \beta_4 * \text{LAC} + \beta_5 * \text{FERT} + \beta_6 * \text{DEF} + \text{ERROR TERM}$

Dependent variable: Crop yields (maize, cassava, groundnuts and cotton)

Independent variable: Cultivated Area, Fertilizer use, Deforestation rate, basic education and agricultural policy.

Table 5.9: Coefficients of the determinants of average crop yields in Magoye

Dependent variable	Independent variables				Adjusted r ²
	Agricultural Policy POL	Basic Education BSC	Cultivated Area LAC	Fertilizer use Intensity FERT.	
Cotton					
Coefficients	0.18	1.26	-0.34	0.07	0.83
T-static	1.27	0.19	-0.01	-7.01	
Groundnuts					
Coefficients	0.45	0.05	-1.17	-0.01	0.63
T-static	0.39	2.98	-1.33	0.14	
Cassava					
Coefficients	-0.33	-0.78	0.06	0.05	0.84
T-static	-0.36	-0.05	0.11	0.13	
Maize					
Coefficients	0.17	-0.03	-0.89	0.86	0.81
T-static	1.44	0.13	-2.38	3.11	

8.1 Agricultural policy

Conducive agricultural policy, represented by the proxy nominal Protection Coefficient, shows a negative effect on agricultural yields (except for cassava).

The relationship is significant in the case of cotton and maize. Farmers respond to incentives, largely by using more inputs. Conversely, “taxing” producers

through a poor policy environment for farming hinders agricultural growth. Taking the case of cotton, the coefficient suggests that a unit increase in the Nominal Protection Coefficient is associated with a 0.18kg increase in cotton yields. Given the poor quality of the data, this should only be interpreted as an indicative relationship, especially in view of tenuous implicit assumption that the elasticity is constant along the entire production function.

18.2 Cultivated area

Area cultivated per person and crop yields are found to be inversely related (excluding the special case of cassava). However, this relationship is only significant for groundnuts and maize. It is note worthy that in the case of groundnuts the inverse relationship entails that a decrease in the area cultivated per person is more than offset by an increase in yields. A unit decrease in the cultivated area leads to a 1.17kgs increase in yields.

18.3 Education

Basic education was found to enhance agricultural productivity. The effect of education on crop yields is likely to be attributed to the impact of rural people being familiar and comfortable with formal learning as such and being receptive to new farming techniques and opportunities. The interpretation of the results taking the case of cotton as an example is that a unit increase in basic gross education enrollment leads to 1.26kgs increase in cotton yields.

8.4 Environmental degradation

The percentage change in per capita forest area was tested for its impact on yields, and was found to be insignificant. This does not necessarily imply that environmental degradation does not influence crop yields. It might be due either to the poor quality of the data on deforestation or to the fact that deforestation is not good enough to proxy to capture the many complex and important impacts of environmental degradation.

8.5 Fertilizer use

The intensity of fertilizer use was found to enhance agricultural productivity. Taking the case of maize, a unit increase in fertilizer use is associated with 0.86kgs increase in maize yields. The Coefficient is statistically significant. Fertilizer use is extremely low in Magoye West as mentioned earlier – averaging 83 grams per hectare in 1999/2000 growing season, as compared to China, for example, where it is 2,860g/ha (Yongyuth, 1997). This is also true for other modern tools and inputs (such as seeds of higher-yielding varieties, and insecticides, with which fertilizer use is highly correlated. Fertilizer use can, therefore, be considered a proxy for the adoption of ‘modern’ farming technology, and the coefficient linking fertilizer use to crop yields picks up the effect of the use of other modern inputs as well. Growth rates of fertilizer use and other modern inputs of 8.6-12.8% per year during the next decade are feasible. This would stimulate growth of maize yields, according to this equation, by between 0.86 and 1.3 percent per year.

The results of cassava differ strikingly, from all others. Neither the nominal protection coefficient, nor fertilizer, nor basic education, nor per capita arable land seems to affect cassava yields. This may be explained by some of the special features of cassava; it can be left in the ground for up to two years; is harvested only immediately before consumption/marketing; is often the food crop of last resort in this area, and is rarely traded internationally from year to year and therefore is an inadequate measure of actual production.

Extent of cultivated area in relation to crop yield

Table 5.10 shows the extent of maize cultivated areas and yields for the market during the 1999/2000 farming season. Maize was picked as an example because it is the main crop grown by all the households under study.

Table 5.10: Maize Cultivated Areas and Yields 1999/2000 in Magoye West

Percentage of total Number of households	Average Area Cultivated (ha)	Average yields per area (number of 90kg bags)
63	2.5	19
31	3.5	28
6	5.5	115
100	11.5	162

It can be deduced that most of the people in the study area are small-scale farmers who cultivate extensive areas with low yields. Sixty three percent of the

households harvested an average of 20 x 90kg bags of maize on a 2.5 hectare piece of land during the previous agricultural season. Six percent of the households harvested an average of 20 x 90kg bags of maize on a six-hectare piece of land. The reasons put forwards for the poor yields by most farmers were that of lack of farming equipment and inputs. Inputs such as fertilizer are always delivered late or are only available at high costs.

5.20 Fallow periods

With respect to length of fallow periods, the survey generated the following results:

Table 5.11: Fallow lengths in the study area

Fallow lengths (years)	Number of respondents	Percent
0 – 1	39	78
2 – 3	11	22
Above 3	0	0
Total	50	100

Fallow periods in this area are short ranging from 0 to 3 years. In the study area, land for farming is assigned to eligible claimants on the basis of their ability to clear it and to establish field crops. Bush or forest fallows tend to revert to communal authority and can be reassigned to another claimant. The shortening of fallows may therefore also be the result of the cultivator's attempt to safe guard his or her rights to the plot. Because good land is becoming scarce, shortened

fallows are also caused by someone else moving in too soon after the previous cultivator has left the plot to natural regeneration.

5.21 **Impact on soils**

The study attempted to evaluate the impact of small-scale farming on soils in the study area. As seen from the map of Magoye West (Fig.11), a number of traverses were laid out in order to get as clear a picture as possible of the impact of small-scale farming on soils in this region. The researcher tried to indicate quite roughly on the map the places at which a profile or a group of profiles were examined.

As mentioned in the methodology, in some cases, it was not possible to excavate the hole(s) to the desired depth, due for example, to occurrence of parent rock at more shallow depth, a plinthite horizon, or because iron concretions became so compact, that it was impenetrable in reasonable time by means of the resources of tools and labour available. The soil samples were got from five areas, namely; A = grazing land, B = Virgin forest soils, C = two year land fallow, D = Land under cultivation for more than two years, and E = Land under cultivation for more than three years continuously. Results are shown in Table 5.12. Explanations of the abbreviations used in Table 5.12 are in appendix 3.

Fig. 11: Magoye West Forest Reserve Soil Sampling Sites.



0 1 2 3 km

Forest Reserve Boundary.....	Settlement.....	Site
Main Road.....	Land under Cultivation.....	A - in Grazing Land
Other Road.....	Grassland / Bareland.....	B - in virgin forest Soils
Footpath.....	Open Bush & Tree grassland.....	C - in Fallow for 2years
Railway.....	Woodland.....	D - in Area cultivated for 2 years
River/Stream.....	Dambo/Area liable to flooding.....	E - in cultivated Area for more than 3 years

Source: Aerial photographs, July, 1994.

Table 4.12: Soil Profile examination in five areas

Profile Designation	Soil Sample Points				
	A	B	C	D	E
Pre-History	Grazing land	Virgin forest Soils	Two years fallow	Land under cultivation For two years	Land under cultivation for more than three years
Soil order	Ferralsol/ Vertsols	Ferralsol	Ferralsol	Ferralsol	Ferralsol
Gradient	2 – 4%	3.5 – 4%	3.5 – 4%	3 – 4%	3.5 – 4%
Erosion	No	No	No	No	Sheet
Depth of Horison	Down to 70cm (average)	Down to 50cm	Down to 60cm	Down to 60cm	Down to 90cm
Texture	Loamy sand	Silty clay Loam	Silt loam to clay loam	Sand loamy	Sandy
Top	Loamy to clay Loamy	Silt clay	clay	loamy to clay	Sandy loamy to clay
Down					

5.22 Observations

When it comes to observations, it has been interesting to note, how, even in the last part of the dry season, the quite sandy ferralsol soil (the term sand refers here to the textural determination of the field) had a relative high content of moisture at once one reached the depth of 60 – 70 cm or more below the soil surface. This was most commonly seen in the soil samples obtained from the grazing land and virgin forest soils indicating that soils from these areas had a higher water retention capacity compared to those areas under cultivation.

The profiles examined in the flat areas revealed that solving the drainage problem only would not change these soils into high potential agricultural land as long as the present price level for agricultural products is not raised considerably and as long as the present form of agricultural technology has not been changed to a great extent. Most of the profiles examined, particularly cultivated areas revealed that they were either made up of extreme sandy lacustrine deposits, which are of very low agricultural value, if they are not fertilized heavily or they are made up of stiff clay soil which are difficult for the farmers to cultivate with the agricultural technology presently in use in the area currently under study.

Further more, the grading of the texture from a more sandy one at the top of the profile to a more clay one further downward, was also observed in the Ferralsol soils examined in this area. This can be seen when one compares the texture at top and down as described in Table 5.12.

5.23 **Nutrients status**

Nutrient status is gauged by conventional soil analytical data, which are somewhat arbitrarily divided into:

- a) indices indicating more labile or easily available forms of nutrients and
- b) indices indicating a less readily available or reserve category of nutrients.

As mentioned earlier, soil samples were obtained from five areas, namely:

A = Grazing land, B = Virgin forest soils, C = two years land fallow, D = land under cultivation for two years and, E = land under cultivation for more than three years continuously; and then nutrient testing was carried out, in spite of the briefness due to limited resources.

5.24 **Availability indices of nutrients**

5.24.1 **pH (water)**

pH (water) is the simplest soil measurement but as a single index, it probably has the most value as it gives an indication of the stage of soil weathering, availability of certain nutrients and the need for liming for certain crops.

Fig. 12: **pH Status of tested soils**

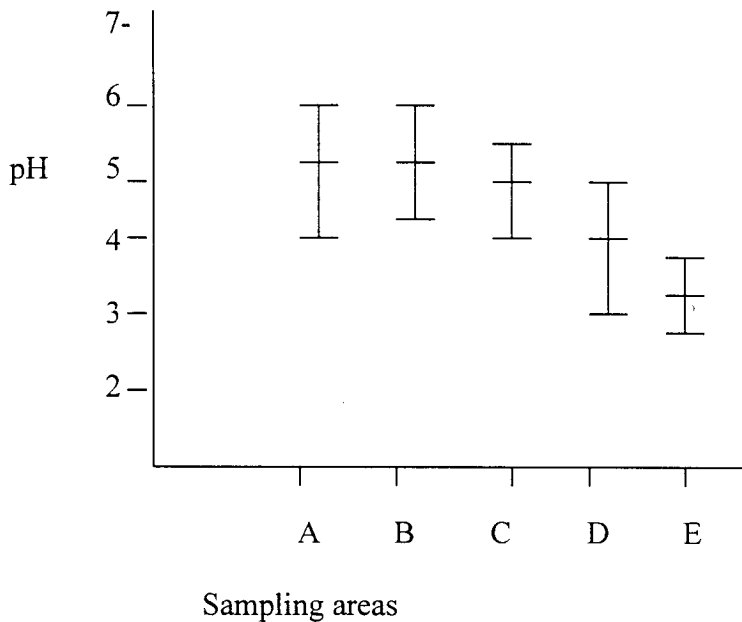


Figure 12 shows that all the soils are acidic, the majority being in the range 3.0 – 6.2. The grazing areas and the virgin forest soils have the lowest acid levels while the land under cultivation for more than three years had the highest acid levels.

5.24.2 Phosphate (NaOH Soluble inorganic)

Only the grazing and virgin forest soils had distinctly higher levels of phosphates, their mean levels being greater than the maximum values found for the other samples. In the two areas mentioned above, the level of phosphate range from 90 – 400 ppm. Areas under cultivation had mean levels below 60 ppm, an indication that such soils need phosphate application.

5.25 Reserve indices

5.25.1 Potassium

From Table 5.13, the potassium ranges show that the area which has been under cultivation for more than three years is poorest in potassium reserves while the areas under grazing and virgin forests tend to be richest. According to mean values, the land under cultivation for more than three years have less than 5m.e/100g. The land under grazing and virgin forest had potassium reserves of between 5 – 16 m.e/100g.

Table 5.13: Extractable potassium in Soil Sample groups M.e/100g

Soil Sample from:	Top Soil		Sub Soil	
	Range	Mean	Range	Mean
Grazing Land	0.80 – 12.5	3.57	0.64 – 13.6	5.22
Virgin Forest Soils	0.96 – 14.1	6.89	2.52 – 18.1	9.04
Two years fallow	0.57 – 9.83	2.83	0.81 – 10.8	3.28
Land under cultivation for 2 years	0.32 – 4.73	1.40	0.30 – 5.93	1.67
Land over cultivation for more than 3 years	0.37 – 1.97	0.93	0.32 – 1.69	0.84

Generally soils in Magoye West have a low Cation Exchange Capacity (CEC) ranging between 4 and 18-m.e/100g clay, indicating a very low nutrient retention capacity. Another common feature of these soils is their high aluminium content. Despite these nutrient deficiencies, the small-scale farmers do not take adequate measures to conserve their soil because they are on the government listed forest reserves. Where fertilizer is applied, it is done in smaller quantities. As mentioned earlier, fertilizer use is extremely low in Magoye West, averaging 83 grams per hectare compared to China for example, where it is 2,860g/hectare

(Yongyuth, 1997). Fertilizer in this area is usually not available or may be available at very high prices, which cannot be met by poor small-scale farmers. The successful development of the large reserves of virgin soils in Magoye West with agriculture depends, to a considerable extent, on the availability and relative cheapness of fertilizer inputs. Little can be relied upon the natural soil fertility to sustain large yields.

5.26 Food sufficiency

In this study, food essentially refers to maize, which is the staple crop in Magoye area. Forty-three percent of the small-scale farmers interviewed said they grew sufficient food. Fifty seven percent said they did not produce enough. Table 5.14 shows the months in which food supplies had run out for respondents in the previous year.

Table 5.14: Food sufficiency in Magoye West

Month	Number of households Running out of food	Percent	Cumulative %
May 'a'	0	0.0	0
June	0	0.0	0
July	1	2.0	1
August	2	4.0	3
September	3	6.0	6
October	4	8.0	10
November	7	14.0	17
December	10	20.0	27
January	14	28.0	37
February	7	14.0	41
March	2	4.0	48
April	0	0.0	50

Note: 'a' refers to first month of harvest.

By the sixth month after harvest, nearly 34 percent of the households had run out of food, and by the ninth month 96 percent were in a similar situation. It can be noticed that most small-scale farmers run short of food before the end of the year, most of which are female headed households. The other problem is that most of the farmers have few choices outside agricultural activities. Most of them derive their food supply directly from agriculture rather than non-agricultural ventures.

5.27 Changes in food supply

Twenty six percent of the farmers said that their food supply had increased in the most recent agricultural year, eighteen percent said it had remained about the same, fifty-six percent said it had decreased while the remaining fourteen percent were uncertain (see Table 5.15).

Table 5.15: Changes in food supply in Magoye West

Level of food supply	Number of Respondents	Percent
Increase in food supply	13	26
Decrease in food supply	28	56
Food supply remained same	9	18
Uncertain	7	14
Total	50	100

The small-scale farmers were asked to suggest reason for the increase in food supply. Thirty-one (62 percent), said that there was plenty of rainfall. Twenty-four (48 percent) said that they used fertilizer while nineteen (38 percent) planted earlier. Fifteen (30 percent) thought that it was God's will.

Decrease in food supply was explained by the following reasons: Thirty-nine (78 percent) said that they failed to use fertilizer or sufficient fertilizer because it was expensive. Thirty-six (72 percent) attributed low food supply to inappropriate husbandry, for example; late planting, late fertilizing and failure to weed sufficiently. Nineteen (38 percent) cited lack of adequate rainfall as the reason for the decrease in food supply, while twenty-four (48 percent) ate the new (green) maize too early. The 1998 season had been particularly bad because rainfall was scarce. In the following year, i.e. 1999, some households ran short of food because they had eaten the new (green) maize too early without early waiting for it to mature.

5.28 **Livestock ownership**

Livestock represents a source of food, wealth and security in Magoye West. It may complement or supplement crop production in terms of food supply and cash earnings. However, it may also compete with crop production for land. Table 5.16 shows livestock ownership for small-scale farmers under study.

Table 5.16: Livestock ownership in Magoye West

Type of Livestock	Number of Owners	No. of animals per capita (Approx.)
Cattle	29	232
Goats	10	50
Chickens	50	450
Pigeons	6	84
Ducks	4	16

It was observed that there were no specific grazing areas such that animals were confined to the stream valleys, fallow fields and spaces around cultivated fields and settlements. There is no seasonal movement of animals to different grazing places and this means that the available grazing spaces are utilized continuously throughout the year leading to soil and vegetation degradation. According to some farmers, there used to be a specific area for grazing, but this was converted to arable land.

The issue is not simply one of too many animals relative to available grazing areas. Long periods of below normal rainfall and severe drought have accelerated the degradation of range lands, and past efforts to address the problem of water supplies for pastoralists have often compounded, rather than ameliorated, the problem. Dams and wells have been sunk to ensure adequacy of water supplies during the dry season, but with free access to these wells, the number of animals congregating around them far exceeds the carrying capacity of the surrounding rangeland, causing rapid vegetation and soil deterioration.

5.29 **Credit for small-scale farmers**

The result of this study indicated that most small-scale farmers are being excluded from credit. Credit and insurance markets are frequently fragmented or non-existent. Formal credit markets do not serve poor farmers who are geographically isolated in marginal areas or who lack land title to offer as collateral. Informal credit markets may operate under such circumstances, but are characterized by rationing, high interest rates, and a predominance of short term lending. Empirical results in this study that compared squatters without title on state land (forest reserve) on Magoye West to titled farmers on Magoye East show that the latter had better access to credit, had higher investment levels and were more likely to make land improvements, use more inputs, and achieve higher land productivity.

It was observed that only 19 percent of the small-scale farmers received credit from the World Food Programme Agency in the study area. However, it should be made clear that forty-six percent of the small-scale farmers in the sample did not want credit. Thirty-five percent said they were uncertain whether they would be able to pay it back, or they were quite certain they would not be able to. Because credit and extension services are so tightly linked, this fear must pose a very basic stumbling block for extension services ever reaching the majority of the small-scale farmers.

5.30 **Natural reserve conservation**

It was observed that farmers in this study area do not take serious measures to conserve natural resources. Forty-one percent of the small-scale farmers in the sample feared that if they plant trees their land would revert to the state, because all forest land is owned by the state. Fifty-nine percent of those who responded have been unwilling to plant trees to conserve soils because they are on the forest department's protected list.

All in all, this study has reviewed that soil and forest degradation in Magoye West are stimulated by rapid population growth combined with shifting cultivation (people moving into forests to farm), poorly regulated logging, open access land tenure, short fallow lengths, low education levels and low farm inputs application.

Further more, poor farmers' horizons are short partly as a result of their having (in economic terms) a high rate of pure time preference. This lowers their ability to forego consumption today by using savings previously put aside for later consumption purposes. In terms of natural resources, the implications of a high subjective discount rate are rapid resource extraction to meet present income or consumption needs, and low investment in natural resources to improve future returns. Given the greater value placed on present consumption, resources are "mined" at a more rapid rate. For example, with high discount rates, rural inhabitants with rights to tree resources are more likely to harvest them at a faster rate. Similarly, short-term production strategies that raise current income at the

cost of future production (overgrazing pasture or shortening fallow time) may be pursued.

CHAPTER SIX

CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

The information presented in this dissertation gives us an overview of the impact of the activities of a community of people on agricultural land resources in Magoye West. Some of the significant features of Magoye West discussed in preceding chapters distinguish it, while others make it comparable to other parts of Zambia, Southern and Central Africa, or sub-Saharan Africa as a whole. Taken in combination, they help to portray the specific nature of small-scale farmers in the area such as; ages of small-scale farmers, their marital status, level of education, land use, food supply, livestock ownership, fallow lengths, crop yields, levels of fertilizer use, and ways of conserving soils as well as forests resources.

The responses recorded and discussed are to a large extent self-explanatory. Nevertheless, there is need to draw out and comment on some of the major issues, which emerge from the study.

In doing this, there are three audiences in mind: First, there are those who directly influence the design and implementation of policy in the Ministries of Agriculture and cooperatives as well as Tourism, Environment and Natural Resources in Zambia. The second audience is the broader one of scholars, observers, advisors and practitioners inside and outside Africa who have an interest in agriculture, population and the environment. The third audience is that of small-scale farmers

in Magoye West. It is felt that the divergent need of these three audiences may be met effectively if not perfectly by relating the most important findings of the study.

The study indicated that in Magoye West, usufruct rights are acquired simply by clearing of land without necessarily planting anything. The motivation has been strong for settlers to move into previously uncultivated forest and clear the land quickly in order to strengthen their claims and weaken those of other users. Many small-scale farmers clear and plough far more land than they actually intend to crop in order to establish and protect their land use rights for the future.

The use of modern farm inputs such as fertilizer was found to be negatively related to the rate of deforestation suggesting that intensifying agriculture by applying more fertilizer would slow down the rate of deforestation. However, fertilizer use is extremely low in Mogoye West – averaging 83 grammes per hectare in the 1999/2000 agricultural season compared to China, for example, where it is 2,860g/ha. Farming inputs are in most cases unavailable when needed or available only at high prices making it impossible for farmers in this area to apply large quantities.

The area under study was a forest reserve and the ‘new’ occupants came from places where agricultural land was in abundance. These migrants brought with them the techniques they practiced in the areas they abandoned, and these

techniques are often detrimental to their new environment. Although they soon begin to experiment with simple modifications in farming techniques, this indigenous adjustment has been too slow to keep pace with population growth, leading to deforestation and soil degradation.

The key conclusion of this study is that forest degradation is stimulated by rapid population growth combined with shifting cultivation (people moving into forests to farm), poorly regulated logging, and 'open-access' land tenure. Open-access occurs when there is no effective regulation of land use, either traditional or modern. This allows farmers and other users to exploit the land, and the resources on it, in an unsustainable manner. With open-access, land occupation and use is temporally and there is no motivation for the farmers to invest in farm intensification. Open – access also reduces the incentive for farmers to conserve the land since it is not theirs.

Fuel wood prices in Magoye West are low because it can be exploited, nearly freely, from open access areas. Where there is open-access, trees can be cleared from farmland by migrant farmers. This results in women's time being increasingly constrained in rural areas as fuel wood become scarce, and women have to walk farther for fuel wood. With less time available, women have difficulty in maintaining food output, and this contributes to food insecurity.

Diffusion of agricultural advice and credit to small-scale farmers is limited and this presents a big problem. However, it should be put clear that a few farmers did not want credit. They were scared of it because they were either uncertain whether they would be able to pay it back, or they were quite certain they would not be able to.

The level of education of small-scale farmers in Magoye West is very low. Education is a significant variable since more literate and knowledgeable people make better farmers because they are able to invest on the land by conserving soils and forests. Since the sample was largely illiterate, natural resource conservation is limited in this area.

A policy strategy is needed to break out of the low agricultural growth, rapid population growth and environmental degradation that reinforces poverty and degrades natural resources. To correct the current disastrous trends, a set of mutually reinforcing actions need to be undertaken by government and external aid agencies. The synergies inherent in this research project provide considerable potential for addressing these problems.

Until the identified positive and limiting factors in this research project are taken to remedy, this agricultural transformation and natural resource conservation will remain a myth.

6.2 Recommendations

The recommendations presented in this study are addressed mainly to government. However, international organizations and non-governmental organizations, local community (farmers) also have a wide responsibility in this area. It is hoped that findings and generalizations drawn from a local region could be used to other regions where people have the same plight. Furthermore, recommendations suggested below will be of value to authorities involved in formulating agricultural and environmental policies in Zambia.

1. Government should legalize the settlement because farmers will not be willing to practice conservation measures when they know that they are illegally settled in the area. Additionally, an appropriate macro economic stance should be adopted to enable growth in small-scale farmers' incomes. Macro economic policies that promote stable and broad based income growth are a longer term but essential components of improving the use of natural resources by the farmers. Higher incomes will result in lower pure time preference. They will allow them to consider longer-term resource use options that provide better returns.
2. Targeted government intervention can have an immediate impact in minimizing the extent to which rural households are forced to mine natural resources during crises that threaten to push them below subsistence levels of consumption. In times of flooding or drought, targeted interventions

such as food-for-work programmes can enable poor households to maintain minimum consumption levels without over exploiting the few natural resource assets to which they continue to have access. Temporal programs of this kind can be combined with natural resource management projects that will benefit the rural environment: up-grading rural road drainage to minimize erosion; planting wind breaks; and improving soil conservation and forest harvesting techniques on common property or public lands.

3. There is need to strengthen education and Public Health Programmes. More access to quality education can improve families' ability to use natural resources more productively and to diversify their income sources away from dependence on natural resources alone. Improving their income earning possibilities increases the opportunity costs of raising children and the incentives to have smaller families, while providing the means to improve the health and education prospects of children they do have. Both of these developments have clear environmental benefits.

4. Agricultural services and education must serve women as much as men to improve women's farming practices, raise their productivity and incomes, and reduce demand for children. Successful introduction of agro-forestation and fuel wood production on farms would significantly reduce women's work burden in fuel wood gathering. Introduction of appropriate transport such as ox-carts improvements and stoves that save both fuel and

time would also help. Success in these areas will free more women's time for agricultural production and other economic activities.

5. The rate of deforestation can be reduced by determined pursuit of agricultural intensification. This needs to be promoted through the use of large quantities of fertilizer, more effective regulation and taxation of logging as well as elimination of open - access land tenure situations.
6. Local communities need to be empowered to participate in issues concerning agricultural and demographic causes of environmental degradation in rural areas. Without participation, people will not demand smaller families, sustainable agricultural technologies and forest conservation. Participation is more likely to result in development initiatives that respond to felt needs rather than to short-term political imperatives and expediencies. In participation, land use plans should be developed with a spatial and regional focus. These should identify conservation areas, logging areas, farming areas, and locations for settlements and infrastructure development.
7. Multi-sectoral and cross-sectoral analysis is needed to resolve agricultural, population, settlement and environmental problems because of the important linkages and synergies among them. Environmental protection will be very difficult to achieve if present rates of population growth

continue. Population growth is unlikely to decelerate unless agriculture and the economies dependent on agriculture grow more rapidly.

8. The responsible authorities, should establish firm rules, with enforceable sanctions, which limit individual use of the resource for the common good. These rules should be implemented for them to be meaningful. Individualization/privatization of resource ownership and tenure, as well as registration of individual titles should be encouraged. Legal incentives would help by offering land rights in exchange for management responsibilities.

9. There is need to do a lot of research on the impact of human activities on agricultural land resources in Zambia. Furthermore, internal administrative changes, while potentially helpful, will not of themselves improve the lives of the small-scale farmers. And this is the real challenge. To improve their lives even in a limited way would involve a readiness both to find out more about the farmers and to re-assess long-standing assumptions and policies which have had an impact upon them. As a first step, it requires a willingness to get out and learn directly from the farmers themselves.

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APPENDIX 1
QUESTIONNAIRE

SERIAL NO. _____

Date of Interviews _____

I am a student at the University of Zambia carrying a research project on the impact of small Scale farming on the Agricultural Land Resource. The project is a partial fulfillment of the requirements for a degree of M.Sc. in Geography.

Your answers will be treated with strictest confidence and will be used for academic purposes only.

INSTRUCTIONS

1. Use a tick () to indicate your choice for multiple choice questions in the spaces provided.
2. Give brief but adequate information for descriptive questions.
3. Indicate N/A if not applicable.

SECTION A: IDENTIFICATION PARTICULARS

Fill in the spaces for your identification particulars:

1. Province: _____
2. District: _____

SECTION B: PERSONAL PARTICULARS

1. Sex (i) Male [] (ii) Female []
2. Age _____
3. Number of years spent in School _____
4. a) Household size _____
b) Head of Household _____

5. Children age:

AGE	NUMBER
0 – 6	
7 – 12	
13 – 18	
19 – 24	
25 and above	

6. Marital Status (i) Single [] (ii) Married []
 (iii) Divorced [] (iv) Separated []
 (v) Widowed []

SECTION C: ECONOMIC PARTICULARS

This section will ask you question about your economic activities.

1. Do you own any land? 1. Yes [] 2. No []

If your answer to question 1 is No proceed to question 7 and if Yes answer these questions:

4. How did you acquire land for farming? _____

5. Do you have problems with land acquisition? (Explain) _____

6. Does the land belong to the community or is it a personal property?

7. Do you have enough land for farming? _____

8. How many hectares of land do you use for crops?
 i) maize _____ (ha) ii) groundnuts _____ (ha)
 iii) cassava _____ (ha) iv) any other _____

9. How many bags (90kg) did you harvest this past season? _____

10. Which crops mentioned in question 7 do you sell?

11. How much did you receive from the sale of:
- i) maize _____(ZK)
 - ii) groundnuts _____(ZK)
 - iii) cassava _____(ZK)

10. Do you apply fertilizer to your crops? i) Yes [] ii) No []

If your answer to question 10 is Yes, answer question 11, if No to question 10, proceed to question 12.

11. How much per hectare?

- i) maize _____
- ii) groundnuts _____
- iii) cassava _____
- iv) others _____

12. Give reasons for not applying fertilizer _____

13. Do you have enough food throughout the year? Yes [] No []

If your answer to question 13 is no, answer question 14 and 15, if Yes, proceed to question 16.

14. Which months do you run short of food? _____

15. Give reasons for food shortages _____

16. Has there been any increase or decrease in food supply between 1990-99?

- i) increase []
- ii) decrease []
- iii) remain the same []

17. Give reasons for any changes in food supply: _____

18. How long are your fallow periods? i) Less than 2 years []
ii) 2 to 5 years [] iii) more than 5 years []

If your answer to 18 is (i), answer question 19 and if (iii), proceed to question 20.

19. Give reason for short fallowing _____

20. Give reasons for long fallowing _____

21. Do fallow periods have any implications on crop yields?

i) short fallow – implication _____

ii) long fallow – implication _____

22. Do you think there has been an increase or decrease in soil fertility in your field(s) in general?

i) increase [] ii) decrease []

iii) remain the same []

If your answer to question 22 is 'increase' or the same, answer question 23 and 24 and if it is 'decrease'. Proceed to question 25 and 26.

23. What measures are you taking to conserve your soils? _____

24. Do you plant trees/grass as a measure to conserve your soils? _____

25. What do you think has been the cause of this decrease? _____

26. Give reason for not conserving soils in your fields _____

27. How often do you expand your fields?

- i) never [] ii) every year []
iii) every after one year [] iv) after two years []

28. Give reasons why you expand your fields _____

29. Does the expansion of fields involve forest destruction? _____

30. Give reasons why you do not expand your fields? _____

31. How many live stocks do you have?

TYPE	NUMBER
Cattle	
Goats	
Sheep	
Others	

32. Do you have enough pasture for your animals?

- i) Yes [] ii) No []

If your answer to 32 is No, answer questions 33 and 34 and if Yes, proceed to question 35.

33. What could be the causes of the shortages of pasture? _____

34. What could be the implication of that shortfall? _____

35. Are the agricultural policies put up by government suitable?

- Marketing i) Yes [] ii) No []
Extension i) Yes [] ii) No []

36. Credit i) Yes [] ii) No []
Elaborate on your answer in question 35.

i) marketing _____

ii) extension _____

iii) credit _____

37. Have you ever been visited by an extension officer

i) Yes [] ii) No []

If your answer to 37 is Yes answer question 38 and if it is No proceed to question 30.

38. What sort of advice did he give? _____

SECTION D: SOURCES OF ENERGY

This section will ask you questions on the sources of energy.

39. What are the major sources of energy?

i) firewood [] ii) charcoal []

iv) others (specify) _____

40. How far are these sources of energy?

i) firewood a) less than 1km [] b) 1-3km []
c) more than 3km []

ii) charcoal a) less than 1km [] b) 1-3km []
c) more than 3km []

iii) others _____

41. If firewood is the main source of energy, how long does it take to fetch it?

i) 0 - 2km [] ii) 3 - 5km []

iii) more than 5 km []

42. Why do you think it takes all this long? _____

43. Why do you think it takes this short? _____

44. What other economic activities do you do apart from farming? _____

45. What general problems do you face as a farmer? (put in the order of significance)

1. _____
2. _____
3. _____
4. _____

APPENDIX 2

LAC: Land cultivated, ha/ person, 1998/99 season
 DEFOR: Deforestation, ha/ per capita
 GRTS: Groundnuts yields hundred, kg/ha, 1998/99
 MZY: Maize yields, hundred, kg/ha 1998/99
 CSY: Cassava yields, hundred, kg/ha 1998/99
 POPG: Per capita population growth rate
 BSC: Basic school enrollment
 FER: Fertilizer use, 100/ha

LAC98/99	GRTS	MZY	CSY	POPG	BSC	FERT	POL	DEFOR
0.4	7.2	11.6	53.3	2.5	22	57	0	1.8
0.6	5.8	4.6	45.8	2.3	43	17	0	0.6
0.3	6.6	6.9	56.5	4.1	65	90	1	5.1
0.2	14.2	11.5	50	2.2	30	6	0	0.9
0.1	9.8	18.8	95.4	3.7	75	421	1	1.8
0.2	5.4	9.6	80	3.1	38	94	1	2.4
0.3	31	16.2	31	3.2	99	505	1	0.3
0.4	6.7	11.9	21.3	3.2	55	203	1	3.6
0.1	7.6	6.6	40.3	2.5	33	55	0	2.4
0.5	3	16	76.4	3	20	8	0	2.7
0.2	5.3	10.4	40.7	2.9	13	40	0	0.1
0.2	8	16.9	70	3.2	92	125	0	0.3
0.4	6.8	2.9	38.4	2.7	66	29	0	0.2
0.4	7.9	9.5	83.2	3	49	49	1	1.8
1.2	4.1	3	60.2	3.3	90	7	0	0.1
0.4	7.2	11.6	53.3	2.5	22	52	0	1.8
0.3	12.4	11.2	114.5	2.6	47	20	1	2.7
0.7	11.1	10.3	32.9	2.5	51	4	0	0.2
0.6	11.9	10.2	25.5	3.1	70	71	1	0.3
0.6	5.8	4.6	45.8	2.3	43	17	0	0.6
0.3	5.7	9.1	72.6	3.2	94	25	0	0.3
0.3	6.6	6.9	56.5	4.1	65	90	1	5.1
0.3	11.5	17.8	30.3	3	24	39	0	0.3
0.4	7.4	17.1	61.1	3.4	30	46	0	0.1
0.2	10.4	13.8	30	3.1	48	40	1	2.4
0.2	8.6	13.2	80.2	2.9	70	38	0	0.9
0.2	14.2	11.5	50	2.2	30	6	0	0.9
0.4	5.8	8	55.4	2.3	43	6	0	2.7
0.1	9.8	18.8	95.4	3.7	75	421	1	1.8
0.2	5.6	7.5	40.3	2.6	94	125	0	2.4
0.2	5.4	9.6	80	3.1	38	94	1	2.4
0.3	6	10.6	66.5	2.8	93	21	0	1.2
0.3	6.7	11.9	21.3	3.2	55	203	1	3.6
0.3	9.4	12	91.3	2.4	23	59	0	0.6
0.1	7.6	6.6	40.3	2.5	33	55	0	2.4
0.1	6	36.7	15	1.2	90	3075	1	0.2
0.5	3	16	76.4	3	20	8	0	2.7
0.3	10.9	10.2	26.9	3	55	94	0	2.7
0.2	9.5	11.8	72	3.2	60	20	1	2.4
0.8	9.7	14.1	36.5	3	50	40	0	0.6
0.5	23.8	7.1	33.1	2.3	44	22	1	0.3

0.2	5.3	10.4	40.7	2.9	13	40	0	0.1
0.5	4	5.7	15	2.9	39	40	0	0.2
0.2	8	16.9	70	3.2	92	125	1	0.3
0.2	9.8	16	90	3.5	49	92	0	0.3
0.4	7.8	10.7	74.5	3.4	78	76	1	0.6
0.4	14.4	10	73.5	3.2	69	2	0	0.9
0.2	73.8	9	73.8	3	73	15	0	0.2
0.7	36	20.6	36	3.5	75	183	0	0.3
0.3	39	16.2	39	3.2	91	505	1	0.3

APPENDIX 3

THE PROFILE RECORDING SHEET

Soil profile number _____ Date of sampling _____

Vegetation:

- a) Dominant plant specie _____
- b) Associated plant specie _____
- c) Present land use _____

Relief:

- a) General pattern _____
- b) Gradient _____

Erosion pattern _____

The profile:

- a) Moisture condition of profile when sampled:
 - i) The A horizon (0r o – 15 cm) _____
 - ii) The B horizon (or 15 –60 cm) _____
 - iii) The C horizon (or 60 – 150 cm) _____

Depth: a) Of the profile _____

b) Of the horizon _____

Texture (field determination)

a) Of the A horizon _____

b) Of the B horizon _____

c) Of the C horizon _____

8. Drainage:

a) Run off _____

b) Permeability _____

9. Pre-history:

i) Grazing land []

ii) Virgin forest soil []

iii) Fallow (yrs) []

iv) Land under cultivation (yrs) []

10. Remarks _____

APPENDIX 4

Explanation of abbreviations used in Table 4.12

1. Pre- History: refers to the state of the land or the land use during the survey period.
2. Soil order (soil unit):
 - (a) Ferral soils: connotation of soils having a high content of iron and Sesquioxides in clay fraction.
 - (b) Vertisols: are dark soils having a high content of clay minerals which causes these soils to develop deep cracks during the dry season due to the swelling and shrinking property of that type of clay minerals .
3. Texture: refers to the finger feeling of soils. It refers also here to the upper 15cm of Layer between 60cm and 150cm.