Determinants of slash and burn:

The case of chitemene farming system in Zambia

by

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DEDICATION

This thesis is dedicated to my father (1935- 2000) who was an inspiration to me

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Abstract

Slash and burn shifting (*Chitemene*) cultivation has been the dominant traditional land use system in the *Miombo* woodlands of Northern Zambia. The land use system adopted by farmers depends on the interaction between biophysical and socio- cultural and economical resources available to them. Socio economic resources also include policies, which influence the farmers' decisions. Despite the so many interventions that have been done and condemnation of this system, this practice of cultivation still persist up to today. It is estimated that Northern Province has lost 35% of its biomass, representing about 43000 km^2 of forests land over the past 40 years. The continuation of *Chitemene* system is in the long term unsustainable. This is because if the rural population continues to grow and if the current trend in *Chitemene* continues, complete deforestation may occur in a few decades. This study tried to investigate the factors that determine this practice in Zambia. The study employed a binomial logit model in order to identify the factors that influence the farmers' decision to practice *chitemene* and to quantify the relative importance of these factors. This was employed on data collected from a survey of 90 farmers from Kasama district in the Northern Province of Zambia.

It was hypothesized that the farmers' behavior is influenced by a complex set of socio economic, demographic, technical, institutional and biophysical factors. Some of the determinants of slash and burn practice found in studies done are structural adjustment programme in Zambia, population growth land tenure system, infrastructure, necessary support services, number of household members, age, gender, education level and amount of available land. It was also hypothesized that the traditional way of life of the people has more influence on the farmers' decision to practice slash and burn than other factors such as land tenure and even availability of agricultural inputs. This is because despite the so many interventions the practice has continued. Also the older the farmer is in his farming practice and age the more likely he is to practice *chitemene*. The reason is that farmers usually base their practice on experience and older farmers are a bit conservative and often tend to perpetuate the practice. The other one was that farmers with bigger land area are more likely to practice chitemene than those with less total land area. Farmers with bigger land area have more woodland and therefore more likely to practice.

The study revealed from the bivariate analysis results that availability of land increases the chances of the farmer practicing *chitemene*. It was also shown that non-availability of credit influences farmers' decision to practice *chitemene* positively. Lack of money to acquire inputs contributed more to farmers' decision to practice *chitemene*. In the econometric analysis, age of the farmer, effect of non-availability of credit facility, effect of household size and influence of tradition had a significant influence on *chitemene* practice. It was found that the main reason for *chitemene* practice is lack of money for acquisition of inputs. Policies that facilitate provision of credit and infrastructure development like roads are necessary if slash and burn is to be reduced. This study identified some entry points for policy. Poverty may prevent poor farmers from investing in land conservation due to imperfections in credit markets and high subsistence requirements. So unless the government employs policies that target these factors, there is every reason for the farmers to continue the practice of slash and burn.

This study brings to light that practicing of *Chitemene* depends upon a number of factors that dictate its continued practice. It is imperative that the policy makers and all those involved in agricultural development and policy formulation understand these factors and their relative importance in order to have targeted policies. Moreover although a number of studies have been done on slash and burn and its effects in Zambia, these studies have not analysed the significance of these factors. This study has considered this. Apart from this, it has also contributed to the bulk of research literature on chitemene that might be relevant for future research.

Table of Contents

<u>List of tables</u>

List of figures

List of Acronyms and Abbreviations

SPRP	-	Soil Productivity Research Programme
ECZ	-	Environmental Council of Zambia
FAO	-	Food and Agricultural Organization
UNEP	-	United Nations Environmental Programme
SAP	-	Structural Adjustment Programme
MAFF	-	Ministry of Agricultural, Food and Fisheries
CSO	-	Central Statistics Office
NORAD	-	Norwegian Agency for Development Cooperation
SPSS	-	Statistical Package for Social Scientists
OLS	-	Ordinary Least Squares
ASP	-	Agricultural Support Programme
GRZ	-	Government Republic of Zambia
NGO	-	Non-Governmental Organization
JICA	-	Japan International cooperation Agency
JFM	-	Joint Forestry Management
PAM	-	Programme Against Malnutrition
MENR	-	Ministry of Environment and Natural Resources
IFPRI	-	International Food Policy Research Institute
PASViD	-	Participatory Approach to Sustainable Village Development

CHAPTER 1
INTRODUCTION

1.1 Introduction

Although Africa has more than 17 percent of the world forests (United Nations Environmental Programme (UNEP), 2000), it has the second largest annual deforestation in the world (FAO, 1997). These forests are concentrated around the tropical zones of western, central, eastern and southern Africa. The focus of this study is on Zambia, which falls within this region and where deforestation has been a persistent problem especially in the Northern part of Zambia where *chitemene* farming system (a form of slash and burn[1]) is practiced. This study focuses on the main factors that determine this type of farming system. What main factors have made this practice to continue over time? What are the alternative land use systems to slash and burn that will reduce deforestation? How can these alternative systems be promoted? What policies should government embark on that can help control this indiscriminate cutting of trees or manage the forest in such a manner that future generations are not affected? How can government policies help mitigate the effect of this system? In this introductory chapter a background to the study is given so as to put the study in context. It then goes on to discuss the problem statement, study objectives, hypothesis, scope and organization of the rest of the study.

1.2 Background to the study

Zambia's vegetation is divided into four categories namely closed forests, open forests, terminaria and grasslands (Environmental Council of Zambia, 2001 cited from Storrs, 1995). The open forests (also known as woodlands) are the dominant vegetation type covering 75 percent of land in Zambia. There are four types of woodlands. The most extensive is the *miombo* woodland, which covers about 42 percent of the country (Environmental Council of Zambia, 2001). Other literature however, says it covers about 45 percent of Zambia's land area (Reed, 1996). *Miombo* woodland is characterized by *Brachystegia, Julbernadia and Isoberlinia* species. During the 1980s alone *Miombo*

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[1] In later texts slash & burn and *chitemene* will be used interchangeably

woodland area was being lost at the rate of 900,000 hectares per year (Chidumayo, 1996). The pre 1980 rate was 680,000 hectares per year (Reed, 1996) indicating that the rate of deforestation has increased over the years. Over 90 percent of deforestation is as a result of land clearing for agriculture of which *chitemene* contributes half of the loss of woodland (Reed, 1996).

In the Northern Province of Zambia (Appendix 2), the *Miombo* woodland is the most predominant forest type. It is estimated that Northern Province has lost 35% of its biomass, representing about 43,000 km^2 of forestland over the past 40 years (SPRP, 1994; Misamfu, 1999). This has mainly been through slash and burn system of cultivation called *Chitemene* (Reed, 1996). Other adverse effects of slash and burn include loss of biological diversity within the forests (Goma et al., 2003), increased water runoff and erosion, soil fertility depletion due to leaching of nutrients (Goma et al., 2003; Rasul and Thapa, 2003). From an energy point of view, it is an extremely destructive system as it capitalizes large quantities of biomass (Holden, 1993). FAO (2004) reports that apart from depletion of wildlife, soil erosion and a settlement problem, deforestation is one of the major environmental problems. The report goes on to say that this deforestation is caused mainly by *Chitemene* cultivation practiced in this part of the country. However this system of slash and burn or burning of trees contributes to soil fertility in the form of ash, a method that is different from inorganic fertilizers, which are purchased. Therefore it is considered to be of low external input system with high efficiency in terms of crop yield improvement (Holden, 1993) and therefore more economical from the small-scale farmer point of view.

Slash and burn shifting cultivation[2] has been the dominant traditional land use system in the Miombo woodlands of Northern Zambia (Davies, 2000; FAO, 2004; Holden 1993; Schultz, 1976; Chidumayo1987, 1996; Moore and Vaughan, 1994). The word '*Chitemene*' is a local language word, which means to cut. This shifting type of cultivation method is characterized by short cropping period of two to six years that are

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[2] Shifting Cultivation is a term used to describe agricultural systems that involve an alternation between cropping for a few years on selected and cleared plots, by means of slash and burn and mainly by use of hoe and axe and a lengthy period when the soil is rested

followed by long fallow periods of ten to twenty years (Mansfield, 1975; Chidumayo 1996) or in some cases 22 to 25 years (Allan, 1967). Trees are cut or lopped in a large area, six to ten times larger than the area where they are piled and burnt. Then crops like finger millet, pumpkins, groundnuts and beans are grown in the ash garden (infield) for a few years, which range from 2 to 6 years (Schultz, 1976; Holden et al., 1998). The materials to be burned usually comprise branches, which have been looped from trees in the surrounding area (outfield). The carrying capacity of this system has been very low ranging from two to about five people per square kilometer (Chidumayo, 1987; Holden et al., 1998). However, due to population increase, the carrying capacity has increased and the fallow period has decreased from the range of 10 to 20 years to about 3 to 4 years (Moore & Vaughan, 1994; Holden et al, 1998). This regeneration period is not enough. According to Stromgald (1991), soil fertility declines by eighty (80) percent in 3 years and fallowing is used to regenerate soil fertility. Despite all this *chitemene* practice has however, continued (FAO, 2004; Agriculture Support Programme, 2004; Goma et al., 2003; Davies 2002). This is because the land use system adopted by farmers depend on the interaction between biophysical and socio economical resources available to them (Goma et al., 2003). Socio economic resources also include policies, which influence the farmers' decisions (Palm et al 1995) to either stop or continue the practice.

The economic policies by the previous government (Kaunda Administration) before 1991 were that of an interventionist strategy in managing the agricultural sector (Holden, 1998; MAFF, 1992). These included regulated markets, price controls, credit provision and input subsidies. This strategy helped farmers' to have access to inputs at subsidized prices and access to affordable loans. In turn the farmers had access to permanent fields and therefore there was no need to practice *Chitemene* or it was less practiced (MAFF, 1992). The main crop planted on these permanent fields was maize. However despite all these interventionist policies, slash and burn type of farming still persisted (Holden 1993, Holden, 1998).

The government strategy of subsidizing inputs collapsed due to lack of resources to sustain it. With the support of the World Bank and International Monetary Fund, the

country embarked on the Structural Adjustment Programme (SAP) in 1991 (MAFF, 1992). A number of measures were taken to implement the programme. Some of these measures included Price deregulation, liberalization of agricultural marketing, large cuts in government expenditure through the removal of subsidies on fertilizers and other agricultural Inputs (MAFF, 1992). Prior to the SAP, the government policies at the time provided subsidies for inputs and even facilitated and provided the market for the produce (MAFF, 1992). These enabled farmers to meet their food security requirement and were also able to sell their surplus.

Economy wide government policies (e.g. price liberalization, removal of fertilizer subsidies) alter economic price structures, which in turn affect the smaller units at household level (Holden, 1998). These government policies also referred to as outside pressure over time by Goma et al. (2003) present external shocks, which affect households both directly and indirectly. Households' responses to external shocks like these are sensitive to the effectiveness of the markets linking households to a larger economy (De Janvry et al., 1991). This is because in Zambia, small-scale farmers have the natural resource base as an input in their production system (Holden, 1993). They are biomass based subsistence farmers (Dasgupta 1993). These have a link to the general economy as they form the majority of the rural population (Davies 2000).

These measures under the structural adjustment programme had serious economic hardships on the small-scale farmers who are resource poor and relied much on subsidies. They have over the years made most of the people who had reduced on this practice to increase slash and burn type of farming, which does not require any purchased inputs (Holden et al 1998). With or without these measures mentioned above, *Chitemene* was and still continues to be practiced before, during and after the interventionist period (Chidumayo, 1987; Holden, 1993, 1998; Kasama District, 2002; Davies, 2000, Agriculture Support Programme, 2003, FAO, 2004). Studies that were undertaken in 2000, 2003 and 2004 still found *chitemene* farming system still the most widely practiced in the area (Davies, 2000, FAO, 2004) despite the government discouraging it through extension education.

1.3 Specific Problem

The continuation of *Chitemene* or slash and burn system is in the long term unsustainable (SPRP, 1994; Thomas et al., 1987, Rasul and Thapa, 2003). Chidumayo (1987) reports that the sustainability of shifting cultivation system hinges on the balance between the population of cultivators and the availability of suitable woodland. He further suggests that increasing population in these areas results in either adopting less wood-dependant agricultural practices, or a reduction in the fallow period required for the regeneration of natural woodland. There is already evidence of the shortening of fallow period between cuttings (Moore & Vaughan, 1994; Holden et al., 1998). If the rural population continues to grow and the current trend in *Chitemene* continues, complete deforestation may occur in a few decades (Thomas et al., 1987).

Farmers' behavior is influenced by a complex set of socio economic, demographic, technical, institutional and biophysical factors (Feder et al., 1985). Practicing of *Chitemene* therefore, depends upon a number of these factors that dictate its continued practice. It is imperative that the policy makers and all those involved in agricultural development and policy formulation understand these factors and their relative importance in order to have targeted policies. Although a number of studies have been done on slash and burn and its effects in Zambia (Moore and Vaughan, 1994; Holden, 1991, 1998), these studies have not analysed the significance of these factors.

The study by Holden (1998) showed the effect of SAP on *chitemene* which is just one of the determinants. Some of the determinants of slash and burn practice found in studies done elsewhere are population growth (FAO, 1984), land tenure system, infrastructure, necessary support services (Rasul and Thapa, 2003) like access to extension, training attained on farming, credit facilities and subsidies. Others include infrastructure development such as roads, market accessibility, number of household members (labour availability), age, gender, education level and amount of available land (Vosti and Witcover, 1996). This study tries to investigate the factors that determine this practice in Zambia. The study will employ a binomial logit model in order to identify the economic,

5

social, institutional, cultural and technical factors that dictate the farmers' decision to practice *chitemene* and to quantify the relative importance of these factors. Since the decision whether to practice *chitemene* or not is a qualitative one, the estimation of the coefficients entails the use of qualitative response models. Logit was chosen because of its mathematical simplicity and wider use.

1.4 Objectives of the study

1.4.1 General Objective

The overall objective is to investigate the determinants of *chitemene* type of farming system in Northern Zambia. This is then used to identify the most effective policy responses and relate this to policy formulation.

1.4.2 Specific objectives

The specific objectives of this study are

1) to identify the major factors that determine farmers' decision to practice *chitemene*

2) to quantify the relative importance of these factors that determines the continued practice of *chitemene* and

3) based on research findings to identify and recommend possible policy solutions that could help control *chitemene*

1.5 Statement of Hypothesis

The various studies that have been done have identified a number of factors that influences the farmers' decision to continue or even start practicing slash and burn. There are some critical factors compared to others that influence the farmers' decision to start or continue practicing *chitemene*. Measures to correct this environmentally unfriendly (ECZ, 2001; MENR, 1994) practice can only be judiciously done if there is a way of determining the critical factors of slash and burn. It would then be possible to formulate targeted policies aimed at addressing these factors. Based on the factors identified from literature the following hypotheses emerge;

1. Land tenure has a significant effect on the practice of *chitemene*. A farmer without title deeds is more likely to practice *chitemene* than one with title deeds.

2. The traditional way of life of the people has more influence on the farmers' decision to practice slash and burn than other factors such as land tenure and even availability of agricultural inputs.

3. The older the farmer is in his farming practice the more likely he is to practice *chitemene*

4. Farmers with bigger land area are more likely to practice *chitemene* than those with less total land area

5. Farmers who do not receive any form support like credit facilities and subsidies are more likely to practice *chitemene* that those with access to support services.

6. There is a significant relationship between household size and *chitemene* practice. Household with more members are more likely to practice *chitemene* than those with less members.

7. Older farmers in terms of age are more likely to practice *chitemene* than younger farmers

8. The older the farmer is in his farming practice the more likely he is to practice *chitemene*

9. Farmers with increased educational level are less likely to practice *chitemene* than those less education.

1.6 Scope and organization of the study

A larger part of Northern Province of Zambia has lost its forest through slash and burn cultivation. Due to financial and time constraints the study was only conducted in one district. However the results obtained are expected to be reasonably representative of the province as it has similar geographical and ecological characteristics. Other similarities include socio-economic characteristics in terms of input and output marketing systems, similar technologies used and land ownership policies and even same tribe across the districts where the system is practiced. *Chitemene* cultivation system has been the main survival strategy of the rural people in this province (Moore and Vaughan, 1994). This system has however, not been able to meet farmers food requirements and is also not sustainable.

The study is organized in six chapters. The first chapter gives a brief background to the study narrowing down to the problem statement, objectives and hypothesis. The second chapter gives an overview of Zambian agriculture and its contribution to the economy. The third chapter reviews some literature on studies that have been done on determinants of slash and burn and how it links up with deforestation, although the two are not always the same as seen in literature review. The fourth chapter is on methods and procedures used in the study with description of the study area, sampling and data collection methods used. It then describes the analytical and empirical model used in the study. The variables are also specified. The fifth chapter reports on the results and discussion of the field survey with a descriptive analysis of the sampled households and a bi-variate analysis of the factors that contribute to *chitemene* practice. Econometric estimation of the determinants of slash burn is also done, analysed and discussed. Chapter six gives the summary of the study, policy discussion and limitation of the study and possible areas of future research.

CHAPTER 2

BACKGROUND TO AGRICULTURE AND FARMING SYSTEMS IN ZAMBIA

2.1 Introduction

This chapter gives a brief overview of the country starting with where it is situated in Africa and its neighbours. It then gives physical and economic characteristics, which includes a brief background of the Zambian economy narrowing down to agriculture, its importance and how it fits in the economy. The chapter then concludes by highlighting environmental issues as they relate to agriculture.

2.2 Location

Zambia is a landlocked country in the southern part of Africa covering an area of 752,612 square kilometers located between latitudes 8 and 18 degrees South of the equator and between longitudes 22 and 36 degrees East. The country shares a boundary with eight countries namely Angola, Namibia, Botswana, Zimbabwe, Mozambique, Malawi, Tanzania and Democratic Republic of Congo (ECZ, 2001).

2.3 Climate, physical features and agro ecological zones

The country has a tropical climate characterized by three distinct seasons. These seasons include cool dry season from May to August, hot dry season from August to November, and lastly the warm wet season from November to April. However though the country has a tropical climate, temperatures are modified by altitude. A large part of the country is on the central African plateau between 1000 and 1600 meters above sea level. The natural vegetation is that of savannah woodland dominated by *miombo* woodlands, which cover about 50% of the country. *Mopane* and *munga* woodlands cover much of the hot and dry southern valleys of the country (MENR, 1994)

Zambia is divided into three major agro-ecological zones namely zone I, II and III. Zone I receives rainfall below 800 millimeters; Zone II receives rainfall between 800 and 1000 millimeters whilst Zone III receives rainfall above 1000 millimeters and is the largest

(Appendix 3). The vegetation of the country is mainly savannah woodlands in high rainfall regions of the country and tropical grassland in low rainfall regions.

2.4 The Zambian Economy

Copper mining has been the backbone of the economy since independence. The copper prices started dropping in the mid 1970s and have remained relatively low. Since then Zambia has been experiencing sluggish economic growth, making it difficult for the country to cover its budget deficits. The recent closures of most of the manufacturing industries, the poor operational state of the mines and the escalating inflation rate have reduced the country to one of the poorest countries in the world (Chomba, 2004). Poverty levels have increased to about 70% of the total population (Saasa, 2003). These levels are high in the rural areas where they go as high as 83.3 percent as compared to urban areas with 56 per cent (CSO, 2003).

This present state of the country's economy, high poverty incidence and many existing agricultural constraints can be traced to the development strategies pursued by the government over the past years. The country's economic performance can be divided into four periods (ECZ, 2001). The first period is between 1964 and 1974. At independence in 1964, Zambia had a relatively prosperous economy with high revenues from copper export earnings. During that time its per capita gross domestic product (GDP) was over $500 and inflation rate was less than 5 per cent (JICA, 2000). After independence the country adopted socialist orientated development strategies that involved government controlled agricultural marketing and pricing and provided consumer subsidies (JICA, 2000; Holden, 1998). In short the government rather than the private sector was the key player in economic development. During this period the government promoted maize production to secure food for the urban population. This was done through investment in agricultural research, extension and establishment of parastatal cooperatives to provide credits, fertilizer and seeds to farmers. They even collected maize output and even built storage facilities and organized maize transportation and controlled pricing for inputs and outputs (Holden, 1998). During this period, dependence on the government by the rural population was strong. During the second period 1975 to 1982, revenues from mineral

10

exports started declining and oil prices started rising making it difficult for the government to finance the economy (ECZ, 2001; JICA, 2000). However the government did not adjust it's spending but increased its administrative controls and this led to the second period 1983 to 1991. During this period the government's capacity to finance the economy deteriorated greatly and the terms of trade turned against rural areas as government tried to mitigate the effects of these external shocks (fall of copper prices and increased oil prices) by subsidizing urban consumption (JICA, 2000). In an attempt to address this problem the government adopted the economic structural adjustment programme in the 1980s but was suspended after protests and riots for food in the late 1980s. The SAP was later introduced by the new government in 1991, and has been aggressively pursued since then. The post 1991 era is the fourth period. The radical reform measures under SAP mentioned in the background to the study were implemented during this period. Impacts of these adjustment policies on small-scale farmers and the environment became policy issues in the 1990s not only in Zambia but also in many developing countries in sub-Saharan Africa as rural farmers make up the majority of the population (Holden 1998). With the above economic difficulties the government has been looking for a better alternative to mining, which can sustain the economy.

2.5 Importance of agriculture in Zambia

The government views agriculture as the best alternative to mining due to its contribution to GDP. Beintema et al. (2004) shows that Zambia at the moment relies heavily on the agriculture sector, which contributed 69 percent of the total employment and 22 percent of GDP in 2000. Other literature however, has shown a contribution of 17.2 per cent of GDP during the same period (BOZ, 2003).

Agriculture is very important in Zambia because it employs most of the rural households and it is the primary source of food for half the population (Chomba, 2004; CSO, 2003). It is a potential source of foreign exchange for the country as now indicated by the rise in GDP. There are approximately one million farmers (MAFF[3], 1999/2000) in Zambia who are grouped into three main categories. These are large-scale farmers, medium-scale

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[3] MAFF has since changed its name to MACO, Ministry of Agriculture and Cooperatives

farmers and small-scale farmers. According to the classification of the Ministry of Agriculture and Co-operatives (MAFF, 1999/2000) large-scale farmers comprising about 2% of the farmer population cultivate more than 20 hectares and are generally characterized by high mechanization and a well-organized farmer network, which facilitates the acquisition of inputs. Medium-scale farmers make up about 13% of the farmer population and by definition cultivate a land area between 5 and 20 hectares. In the case of small-scale farmers (85% of farmer population), they cultivate a land area that is less than 2 hectares but can go up to 5 hectares. The major crops grown in Zambia are maize, groundnuts, cassava, Sorghum, millet, rice, beans, cotton, soyabeans, wheat, sunflower, sugarcane and tobacco (ECZ, 2001; MAFF, 1999/2000).

2.6 Farming Systems in Zambia

There are five major farming systems that have been identified in Zambia though we still can further divide the provinces into smaller farming systems as has been done for the Northern Province. These are shifting cultivation, semi-permanent hoe system, semi permanent hoe and ox plough system, semi commercial cultivation and commercial systems (Saasa 2003). While the large-scale farmers are largely associated with the latter farming system, the smallholder households are mainly associated with the first four farming systems.

The first system is shifting cultivation faming System. This system has traditionally been practiced in Zone III where slash and burn (*chitemene)* system is practiced. The dominant crops grown here are maize, cassava, millet, groundnuts and beans. This system is unsuitable in the long run because of inadequate land to allow long fallow periods but the practice has continued as has been mentioned.

The second is the traditional farming system. This system is mainly practiced in the lowest rainfall (less than 800 millimeters) bracket of the country known as Zone I. The harshest conditions are found in this zone. The weather is generally unsuitable for crop production and it is prone to droughts or spurts of rainfall that cause floods and crop destruction. The main crops grown are sorghum and maize but the crop output in this

region in most cases is low. It has a very short growing season. This system however, is also practiced in other zones especially areas where *chitemene* is not practiced.

The semi-permanent hoe and ox plough farming system is the third one and this is prevalent in Zone II characterized by annual rainfall ranging from 800mm to 1000 mm (Appendix 3). The main crops grown are finger millets, maize, cassava, groundnuts and beans. Livestock has been the major source of draught power though this has recently declined due to disease and droughts.

The fourth system is the semi-commercial hoe and ox plough farming system. This category of farmers is mainly found in region II (Appendix 3). The main crops grown are maize, groundnuts, cotton and beans. Livestock is the major asset for the farming activities and the farmers have equally been affected by the pestilence that attacked the animals. The farmers in this category are mainly dependent on fertilizer and kraal manure as a way of improving soil fertility.

The last one is the commercial farming system. This is characterized by well-developed agronomic management practices and intensive usage of mechanized farm equipment. Most of these farmers are found in Zone II. They are characterized by better infrastructure and services and a good number of crops grown are improved varieties (ECZ, 2001)

2.7 Environmental issues in Agriculture

The link between poverty and environmental degradation cannot be over emphasized. The MENR (1994) report outlines five main areas of environmental concerns namely deforestation, wildlife, land degradation, air and water pollution. Clearing land for agriculture is the major cause of deforestation. In Northern province it is as a result of *chitemene*, which, as earlier mentioned is unsustainable. Since *chitemene* is practiced by small-scale farmers who constitute the majority of farmers in the country (CSO, 2003), the impact that this would have on the environment is big. CSO (2003) actually indicates that Eastern and Northern Province accounts for most of this rural population.

The above sections have looked at the Zambian economy as it relates to agriculture and the environment. Zambia has identified agriculture as the best alternative to mining in contributing to the growth of the economy and that the sector can contribute to poverty reduction since it is the primary source of food for half the population. It has also been found that the majority of the farmers are small-scale who live in rural areas where their farming depends mainly on the environment or natural resources for their livelihood and survival. This means addressing issues of poverty in rural areas is a matter of improving people's ability to derive sustenance and income from productively and sustainably managed natural resources. Once this is done, it will have a direct bearing on the economy since more than half the population lives in rural areas (ECZ, 2001). Bearing in mind that agricultural production in rural areas is natural resource based it is therefore important to understand the role that household decisions play and the factors that lead to these decisions in determining the use of natural resources especially land use. In line with this, the present study looks at the factors that influence farmers' decision to resort to *chitemene* practice in Northern Province.

CHAPTER 3
LITERATURE REVIEW

3.1 Introduction

Understanding the determinants of land use in developing countries has become a priority for researchers and policy makers with a wide range of interests (Nelson et al, 2002). Understanding the underlying factors that make farmers (who Scriecui (2001) refers to as the agents of deforestation) decide on how to use their land especially as pertains to slash and burn will help in coming up with policies or measures that would help mitigate this practice of slash and burn.

The main objective of this chapter is to review studies that have been done on slash and burn or deforestation with a view to identify and analyse the most important factors that influence the farmers decision to practice slash and burn. The review helps in the development of the questionnaire and analysis of some policy issues. The first section highlights the underlying factors that determine slash and burn. The factors are broken down into internal and external factors. The section concludes by giving the Asian experience of slash and burn (which is similar to the Zambian one) with a view of identifying the determinants of this system. The second section present examples of studies that have used logit model approach and how it has been used to determine these factors that influence farmers decisions to adopt certain practices like slash and burn.

3.2 Underlying Factors determining slash and burn.

Determinants of rural household behaviour and the way decisions are made is based on certain critical assumptions especially on the households' primary objective. This objective is assumed to be household[4] food security (Vosti and Witcover, 1996; Chomba, 2004). Scrieciu (2001) explains it in a deeper sense by saying that the subsistence approach assumes an extreme case, that no markets exist, therefore the theoretical approach begins with the assumption that a person's objective is to satisfy this

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[4] A household is a group of persons who normally live and eat together. These people may or may not be related by blood, but make common provision for food or other essentials and have only one person who they regard as the head of the household (CSO, 2003)

subsistence requirement. This primary objective forms the basis under which the other factors are affected.

According to Vosti and Witcover, (1996) household decision sequence, starts when the farmer first sets his household objectives for a given period of time shown in figure 1. Then the farmer assesses the resources available to achieve the above objective. These resources will be referred to as internal factors. These factors can be human, financial or natural. Human factors include household size, age, gender, educational level, farming experience, income level, other sources of income etc (Vosti and Witcover, 1996; Shuck et al., 2002); financial factors include assets (Vosti and Witcover, 1996) and access to financial capital. Natural factors include location of area, soil quality and water sources (Vosti, 1993; Shuck et al., 2002). After assessing the internal factors the farmer then looks at the external factors which, are also referred to as macro level causes of deforestation (Scrieciu, 2001) and are there to condition the farmers' use of the resources. These external factors can be government policy, institutional arrangements, infrastructure, technologies (Vosti and Witcover, 1996; Scrieciu, 2001), population pressure, input and output prices, market access, land tenure and political instability (Barbier et al., 2001). After considering the above, the farmer will then choose production activities that will meet his objectives. This decision sequence shown in fig 1 is used in the literature search to guide in the identification of the factors that have been found in various research done on slash and burn and how they are related to this study.

(1)
SET
HOUSEHOLD
OBJECTIVES

Household Food Security Objective in Period 1

(2)
ASSESS
RESOURCES
AVAILABLE
TO
HOUSEHOLD

Natural Resources and capital availability to meet Household Food Security
Security Objective in Period 1

| Natural Resources (Soil, Forest, Water, etc | Human Capital (Health, Educ..) | On- Farm Physical and Financial Capital | Off-farm Physical and Financial Capital | Community-Owned Resources | Political Capital |

(3)
CONDITIONING
FACTORS LARGELY
EXTERNAL
TO HOUSEHOLD

Conditioning factors: E.g., Policies, Technologies
Institutional Arrangements and community Assets

(4)
ENGAGE
HOUSEHOLD
PRODUCTION
ACTIVITIES

Household Multisectoral Production and Investment Activities

Agriculture

Non- Agriculture

Crops   Livestock   Extractive   Commerce, etc

(5)
ENVIRONMENTAL
CONSEQUENCES

Environmental Consequences of Household and Community Activities

E.g., Soil loss   E.g., Afforestation   E.g. Overgrazing   E.g., Improved Pastures   E.g., Sustainable Extraction

NEW STOCK OF
OF AVAILABLE
HOUSEHOLD RESOURCES

Natural Resources and Capital Available in Period 2

Fig 1 Household Decision Sequence in their use of resources
Source: Vosti and Witcover, 1996

It is important to mention that the situation mentioned above suits the Zambian situation very well. This is because most of the small-scale farmers are mainly subsistence farmers. This simply means these farmers grow crops first to satisfy their consumption needs before anything else. So their primary objective is household food security. If they happen to have a surplus then they can sell it to raise money for other household needs such as groceries, or school fees for their children. However if the conditions are not suitable for them to even meet their subsistence needs they would do what ever is necessary to guarantee survival. This survival strategy, according to Vosti and Witcover (1996), has often meant adoption of the inappropriate short cycle of slash and burn system of farming. This has been the case for Zambia where people have adopted the *chitemene* system whose fallow period as already mentioned has reduced from that of more than 20 years, which was sustainable to about 3 to 4 years.

3.2.1 Internal factors

A survey of the literature shows that factors associated with human resources include population, household size, age, gender, educational level, farming experience, income level and other sources of income (Vosti and Witcover, 1996; Shuck et al., 2002). Vosti and Witcover (1996) used an analytical (theoretical) approach to explore household perspectives on slash and burn by using a conceptual model of household decision-making process for the rural people. This study indicated that population increase in the absence of appropriate technology can force households to slash burn in order to meet the objective of food provision. This was confirmed by Benhin et al. (1999). Pressure from agriculture had been fueled by population growth combined with traditional practices such as shifting cultivation (Thomas et al., 1990). However, a research report on agricultural land expansion and deforestation in Malawi (Minde et al., 2002) presents a broader picture. The study finds that population growth alone cannot fully explain deforestation in Malawi. They found that government decisions to liberalize maize markets and other agricultural policies put additional pressure on forests. The report concludes that generalizations linking deforestation to population growth cannot be made

without taking into account other variables- internal and external, which may either increase or relieve pressure on forests. It is therefore important to be cautious when making conclusions on factors that affect deforestation.

Household size is closely related to population size. However the influences are somehow different. While population increase refers to increases in the number of people to feed, household size in this case refers to the labour availability to help in cutting down trees. Vosti and Witcover (1996) reports that timing and availability of labour, can make the difference between success and failure in meeting household objectives. This labour aspect is the one that has been used in this study. Population was not included in the model of the study. Holden (1993) found that in northern Zambia labour rich households, have not only higher incomes but also cause the most deforestation. The other factor that has been considered in the study is Educational level of the farmer. This factor is closely related to other factors like extension service.

Natural factors are the ones that are close to the rural poor. These include things like amount of land available, water and even the topography of land. All these coupled with other factors will influence the farmers' decision (Chomitz et al., 1996). Sometimes having too many trees has contributed to slash and burn. Vosti and Witcover (1996) argue that the environmental bi-products will affect the decisions made by the farmer who has to provide food for his household. This has been experienced in South America where construction of roads has led to more deforestation not only because of agricultural expansion but because the road has brought the market for timber closer to the farmers (Chomitz et al., 1996; Pfaff, 1996; Barbier, 1997). In Zambia however it is hypothesized that opening up of these rural areas will lead to a reduction in slash and burn. This has been confirmed by some studies (Gyawali et al., 2004). Gyawali et al. (2004) indicate that roads provide access to resources and allow transportation of agricultural goods, logs and farm inputs increasing opportunities for farmers to be involved in wider range of economic activities thus increasing their income which translates into food security.

Financial factors include things that farmers can use to support their farming practice like livestock, farming implements and land. Farmers should not only have assets but also liquidity of these assets matter (Vosti and Witcover, 1996). In most of these rural areas there are deficiencies in financial infrastructure like banking and credit institutions (Vosti and Witcover, 1996). In Zambia access to these financial institutions is hampered by poor road infrastructure (Davies, 2000) that leads to towns where these are. Because these are not nearby, it affects the farmers' access to credit and markets for inputs and for selling of their produce. Credit facilities used to be there when the government provided support in terms of subsidy and even transport for the farmers' inputs and produce (MAFF, 1994). These services were withdrawn after liberalisation of the economy. Lack of financial capital by the small-scale farmers has led to further marginalisation of the absolute poor who now have to find other means of providing food.

3.2.2 External factors

External factors are those factors that are outside the farmers influence. These factors include policies, technologies and institutional arrangements (Rasul and Thapa, 2003; Vosti and Witcover, 1996). Institutional arrangements include things like land tenure, property rights, availability of services like agricultural and forestry extension and support from social networks (Schuck et al., 2001; Rasul and Thapa, 2003,).

In their study Schuck et al. (2001) found that extension education can have a significant impact in moving farmers away from slash and burn towards other more profitable and sustainable production methods though this production does not go to higher levels of production. They also found that extension education would not be of much use on its own unless it is coupled with land tenure reforms that facilitate land ownership in ways that don't involve slash and burn agriculture. This paper has touched on some of the factors that have led to *chitemene* practic*e* either being perpetuated or increased. However it was not indicated in the article on how significant these factors are in determining slash and burn. The two factors, extension service (both agricultural and forestry) and land tenure system are critical factors that have been included in this study on determinants of slash and burn.

It is very evident that in Zambia and in most developing countries market and policy failures have contributed to deforestation (Saasa, 2003). Mainardi (1998) goes further to say that apart from these mentioned, demographic pressures and poverty are also responsible and he says most authors seem to agree on this. Holden et al (year unspecified) blames these policy failures for poverty, economic stagnation and decline. Depending on the type of deforestation being talked about these external factors can have either a positive or a negative influence on deforestation. For an area, which is being cleared for development, deforestation will occur and spread out from the road systems as they are constructed (Vosti and Witcover, 1996). However for a small-scale farmer, transportation constraint influences his land-patterns positively (Davies, 2000; Vosti and Witcover, 1996). Investment in infrastructure might help to reduce slash and burn as was found in a study done in Zambia (Davies, 2000).

In a transport and sustainable rural livelihood study in Zambia by Davies (2000) it was found that for the rural farmers, travel and transport constraints cannot be solved by roads alone. The study says it is a combination of inadequate infrastructure, poor public provision and exorbitant tariffs imposed by private transporters whose services are infrequent, which further impede the rural poor to generate a sustainable livelihood. This study found that in the three districts of Northern Province, the key livelihood constraint faced by rural communities was food insecurity. This is exacerbated by a number of factors such as financial and physical access to fertilizers (thus proliferating the use of *chitemene* farming system) and absence of an efficient marketing network, intensified by inferior road condition as mentioned. Further more, the size of the landholding for small-scale farmers is constrained by low labour inputs. Transportation constraints mentioned above influences the land use patterns. This is because these constraints will not only influence the timely arrival of inputs and products to local and regional markets but it will also influence the prices of these commodities.

The study finding indicates that because of the above factors, access to credit is extremely limited. There is late delivery of inputs like fertilisers, which if they arrive are

usually beyond the reach of these rural farmers who cannot afford them (IFPRI, 2003). Farmers may therefore respond with land use strategies that will border on a high environmental cost strategy just to guarantee household food security (Vosti and Witcover, 1996). Lack of Infrastructure therefore, is a policy issue, which is important to this study and will be one of the variables considered to contribute to deforestation. Another factor very closely related to infrastructure found from literature review was the market. A Market can mean the physical structure where the exchange of goods and services is done or it can be the process through which business transactions are done. Poor infrastructure results in these farmers having market imperfections (Holden and Binswanger, year unspecified). Some of the conditions that contribute to market imperfection are high transportation costs and dispersed low-density population (Holden and Binswanger, year unspecified).

3.2.2.1 Effect of Structural Adjustment Program (SAP) on deforestation

Policies can also have an effect on the farmer decision depending on how and where they are implemented. A case in point was SAP. SAP is a combination of policies that are implemented by government in order to achieve certain objectives. Depending on where these policies are implemented they can have different effects on the farmers.

Benhin and Barbier (2001) carried out a research relating to the structural adjustment program and its effect on deforestation in Ghana and Cameroon. The study examined how changes in cash crop land, food cropland and timber in the SAP period had directly influenced deforestation. This came from SAP's influence on input and output prices on cash crops, food crops and timber production. Result of this research shows that high output prices led to expansion in cropland and increased timber production, which resulted in increased deforestation. They also found that the proportionate increases in deforestation were not the same in the two countries and it depended on the crop considered. The influence of output prices of cocoa and timber were significant in Cameroon, while the impact of output prices of maize and timber were significant in Ghana. In Cameroon a 10 per cent increase in price of cocoa and timber led to 5.3 per cent increase in cocoa land and a 1.1 per cent increase in timber production in Cameroon respectively.   In Ghana, a 10 per cent increase in prices maize and the relative output and

input price of timber led to a 3.4 percent and a 3.2 per cent increase in maize land and timber production respectively. Therefore it follows that higher output prices led to greater forest loss. In their study however there was no strong evidence to show that removal of subsidies during SAP which led to increases in inputs prices such fertilisers also led to increased demand for crop land and therefore increases in deforestation. In their study they came up with some policy implications. One of them is that policy makers need to be aware that rising real crop prices could increase the incentive for forest conversion. On the other hand, it could also be an incentive for farmers to adopt land improvement techniques and therefore reduce deforestation. Thus complimentary public investments like research and extension are necessary as well as providing affordable credit for fertilisers and other inputs.

The situation in Ghana and Cameroon where SAP led to an increase in deforestation is similar to the Zambian situation where SAP also led to an increase in deforestation. However the circumstances are different. In both cases however it showed that SAP had a positive effect on deforestation. The Ghanaian/Cameroonian study however, concentrated on those areas whose forests are managed unlike the one considered in this study where forests are of the free access nature.

In their study Holden et al (1998), tried to show how village economies at household levels represent the link between the economy and the environment in sub-Saharan Africa. Like the Ghanaian/Cameroonian experience, he tried to show the link between Structural Adjustment Programme (SAP) and deforestation. A computable general equilibrium (CGE) model was used to show this link. In this model the conclusion was that SAP has led to an increase in deforestation. It has also led to a decrease in cash crop production, which is maize. Removal of subsidies on fertilizer, price deregulation, removal of credit facilities and other SAP policies led to a decrease in maize prices and farmers were not able to afford the fertilizers, which made them to increase their *chitemene* practice for them to be food secure.

In his earlier study Holden (1993) mentions that *chitemene* (slash and burn) had continued to be the dominant cropping system despite major changes to agricultural development in Zambia like the introduction of cassava, maize and fertilizer technologies. Cassava has had the most significant impact. However, introduction of cassava and improved technologies like hybrid maize and fertilizer have not been unable to replace *chitemene* completely. This was because the incentives to continue still exist as long as there is woodland. Holden mentions that the introduction of these incentives may have reduced *chitemene* but the continued incentives depended critically on government policy of equity pricing and input subsidization, which were in place at the time This could not however, be maintained due to lack of resources. With the introduction of SAP, farmers who could not afford the fertilizer had to go back to *chitemene.*

Holden echoes the same sentiment given by Vosti and Witcover (1996) that rural farmers are rational people, given their perception of the environment, opportunities and primary needs. Holden also mentions that the persistence of *chitemene* system is due to certain advantageous attributes of the system compared to the alternative systems.

3.3 Shifting cultivation practices: The Asian experience

The slash and burn system practiced in Asia is very similar to the one practiced in Zambia. It seems both systems have undergone similar evolution and lessons can be leant from this Asia experience. Some major similarities are that the farmers have reduced their fallow period from the 20 years and above to as low as 3 to 5 years of fallow. Both use very simple tools like the hoe and axe in their practice. The study by Rasul and Thapa (2003) start by tracing the evolution of slash and burn in the different countries and then analyses the factors that influenced and continues to influence the change. The first thing that the study has shown like others studies is that shifting cultivation is an environmentally and economically unsuitable practice. It suffices to mention though that shifting cultivation can be an environmentally suitable land use system where the fallow period is long enough to regenerate the soil capacity and vegetation cover (Rasul and Thapa, 2003). Rasul and Thapa's study is interesting in that it looked at the factors that

influences the change from shifting cultivation to permanent cultivation while this study looks at the factors that influences the farmer to practice shifting cultivation.

The study addressed the factors that facilitate or compels the farmer to change from shifting cultivation to more intensive permanent cropping system. In explaining this they cite a number of references with the basis being Boserup (1965) article. Boserup considered population growth to be the primary cause of change. Rasul and Thapa study tries to confirm what others have said, that Boserup theory was a simplistic explanation of land use but that land-use change is a complex process that involves a host of socio-economic, institutional and technological factors. Some of the major factors cited in their research from other researchers include Knowledge and technological development, combined influence of institutions and technology where institutions facilitates the introduction and use of new technology, population density, land availability, technology, market forces, economic and political structures. Others include public policy, which influences the availability and adoption of technology, prices of inputs and outputs, availability of resources (natural, human and technological) capital, constraints (biophysical and socio-economic) and policy environment which include land rights, land tenure, subsidies, taxes, commodity prices, transportation and marketing opportunities and lastly but not the least food and livelihood security of farm households (Vosti and Witcover, 1996)

Against this background, the study then analyses the changes that have been taking place in South and Southeast Asia. The study found that if population has been the only factor influencing shifting cultivation, the system would have disappeared by now looking at the rate at which population has been growing in the area. The research however, found that there are several socio-economic and institutional factors that contribute to this change in land use. Some of the factors they found were knowledge of terrace construction and plough cultivation (technological) which enabled the people to use land more intensively, enforcement of government laws and regulations like land tax and tenure systems; infrastructure development like roads and expansion of institutional support such as extension services, credit and marketing facilities. This study is an

interesting one in that it looks at factors that influence the change in land-use from shifting to permanent cultivation. This research however, is looking at the determinants of slash and burn in Zambia. It is these same factors mentioned above that influence farmers to change to other land use systems if they are addressed or to continue or change to the practice of slash and burn if they are not addressed.

This study shows not only that a number of factors determine slash and burn but also that mitigating this practice does not necessarily require one measure but might a require a number of them as was mentioned by Schuck et al. (2001). Since this system is similar to the Zambia system the factors that influences this change should also be similar to Zambia.

3.4 Empirical studies done on the determinants of deforestation (slash and burn)

There are various methods that could be used to understand land use determinants. However, in most of the methods, data restrictions impose constraints (Chomitz et al., 1996). A number of studies have been done on factors determining deforestation in other areas but not much has been done on Zambia. Most of the studies on determinants of adoption of technologies have used either the logit or the probit model. The most commonly used is logit model because of its comparatively mathematical simplicity (Gujarat, 2003). A lot of inconsistencies have been there in these studies. However these have been largely dependant on the area under study in terms of location and kind of agricultural method practiced. In this section a review of some studies that have used logit models is done.

Chomitz et al. (1996) used the logit econometric model to identify the determinants of forest loss in Southern Belize. New roads offer market access for timber and agricultural products from previously remote areas. They also lower costs of migration, land access and land clearing for subsistence agriculture. The study used geographical data to distinguish the effects of roads from other determinants of forest loss. The authors found that market distance; land quality and tenure had strong interaction effects on the likelihood and type of cultivation. They also found that in a region with geophysical

characteristics was favorable for commercial agriculture, a location near the market had a 34% chance of being converted to commercial agriculture but only 1.4% chance of being converted to semi subsistence agriculture (synonymous with slash and burn). As distance to the market increases, the probability that a piece of land would be converted to either semi-subsistence or commercial agriculture drops but it drops more rapidly for commercial agriculture. In these studies the models predictive abilities were assessed by its translation of predicted land use probabilities into land use category predictions. With the conventional being to choose the category with the highest predicted probabilities.

Cropper et al. (1999) uses the same econometric model to determine what factors affect location of deforestation in Northern Thailand. He examines the effect that two government policies, road construction and establishment of protected areas would have. The authors used binary probit (deforestation/no deforestation). The results are similar to Chomitz et al. (1996). They found that the effect of roads on land use is determined by geographical and socioeconomic variables.

Gyawali et al. (2004) used binary logit models to predict the probability of a census block group (CBG) being covered by forest cover or alternative covers as a function of the urban and rural census block group's biophysical and socio-economic characteristics. The alternative to being covered is not being covered which is synonymous with deforestation. They used the logit model as presented by Gujarati (2003). Some of the socioeconomic factors considered were population and education. Their results showed that lower population density increases the probability of increased forestland in a CBG. The odds ratio shows that a unit decrease in population density causes the odds of forestland increase by a factor of .47. The results did not however, indicate any significant relationship between forest cover and education and employment variables. Among the biophysical variables used, road density, stream density, and elevation have positive coefficients indicating that it is less likely to have forest cover with increasing road and stream density and elevation. This study agrees with what Chomitz et al. found concerning the effect of roads on deforestation. Gywali's study also considered biophysical factors like soils, which have not been considered in this research. However,

in case of soil, the coefficient is positive suggesting that a high loam content soil increases the probability of forest cover. Northern Province has been known to have soils which are inherently poor in fertility (Goma et al., 2003) and this might be another factor that can be included in future research.

Other studies have used logit models by looking at slash and burn from an adoption point of view (Schuck et al., 2002). The study reviews the role of land tenure and extension education in the adoption of slash and burn. The study uses survey data collected from the West African nation of Cameroon. They used logit model to calculate probability of the farmer adopting slash and burn or another production method. Using maximum likelihood they estimated the coefficients. They evaluated the fit of the model using goodness of fit like McFadden R^2, the log likelihood ratio test and the percentage of correct predictions. The results of this study are as earlier explained.

Since chitemene is a production system, it can be adopted as mentioned by Schuck et al. (2002). Many adoption studies have used logit models in determining factors that influence farmers' decisions to adopt technologies or certain practices. Enki et al. (2001) used the logit model to explain the underlying relationships between adoption decision and factors influencing it. The researcher used this to quantify the determinants of physical soil conservation measures in the Central highlands of Ethiopia. He collected data from 116 farmers using a structured questionnaire. Using the logit model, he was able to quantify that security of land ownership, technological traits, farm size, level of formal schooling, wealth status, off-farm income and assistance provided to the farmer are important factors determining adoption.

Adesina et al. (2000) used the logit econometric model to evaluate the factors determining farmers' adoption and use of alley cropping as opposed to slash and burn in Cameroon. He quantified the various factors determining farmers adoption based on a survey conducted in 11 villages in the region. Using the model by analyzing the significant levels and coefficient of these, the logit econometric model showed that male farmers are more likely to adopt than female farmers, adoption was higher for farmers

having contacts with extension agencies working on agro forestry technologies. Adoption was also higher for farmers belonging to farmer groups. But adoption was lower for farmers in areas with very high population due to tree competition and the last one being adoption was higher for farmers in areas facing fuel wood scarcity. In his study he showed that logit econometric modeling using farmer and village characteristics, socio economic and institutional variables can be used to more effectively target farmers and even locations where higher adoption rates may occur.

3.5 Summary

The chapter has attempted to review literature on factors that contribute to decision making of households as pertains to land use. It has looked at the underlying factors that determine slash and burn with references to studies that have been done. The factors have been divided into internal and external ones though from literature search it is quite difficult to divide them into these categories as their effects overlap and are often linked. Some studies from the above literature, where empirical analysis has been done, have shown that explanatory variables do not have the same impact on the decision of the farmer. It is these differences that this study wants to look at. Apart from the study done by Holden(1998), most studies done in Zambia have not used econometric models that can be used to quantify these factors based on farmers' perceptions or decision-making process.

CHAPTER 4
METHODOLOGY

4.1 Introduction

This chapter gives an overview of the methods used for data collection and analysis. The chapter commences by describing the area where the study was conducted. The location, physical features and farming systems are explained in this section. The sampled areas are also shown. The proceeding section explains the sampling procedure, data collection and questionnaire development. The chapter closes by describing the analytical and empirical model used with variable definitions and specifications. Limitation of the study and possible future research are also mentioned at the end of the chapter.

4.2 Brief description of the study area

The study was conducted in the Northern part of Zambia in Kasama district during the period June and July 2004. The study areas are homogeneous in that they have a similar farming system, similar rainfall distribution and cropping system.
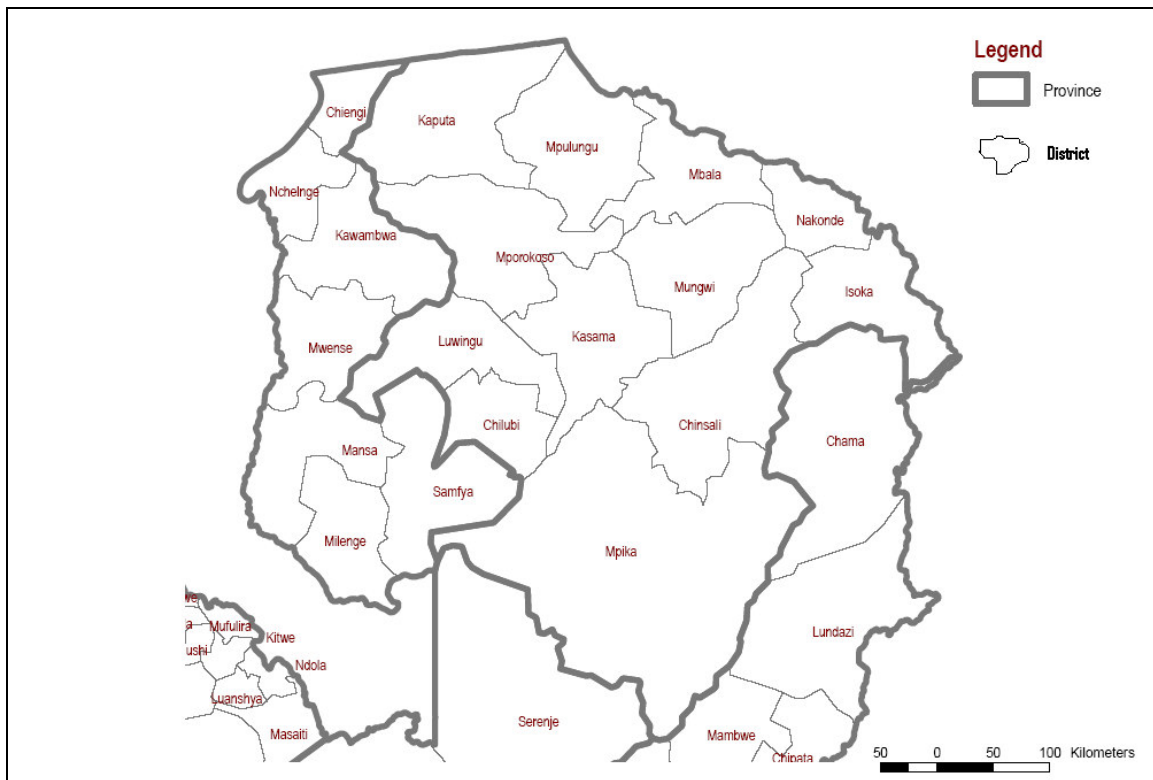
Fig 2: Map Showing Northern Province – Location of Kasama

Source –Humanitarian Activities in Zambia National report, 2004

The Province is situated in the northeastern part of Zambia bordering Luapula, Central and Eastern Provinces as well as the countries of the Democratic Republic of Congo, Tanzania and Malawi. It is the largest of the nine provinces in Zambia covering an area of 147,825 square kilometers representing about one fifth of the total land area of Zambia (CSO, 1990). Administratively it is divided into 12 districts of which Kasama is the provincial headquarters. According to Central Statistics Office [(CSO) (2003)] the province has a population of 1, 258 696 with an annual growth rate of 3.1%. 86% of the populations live in rural areas (Davies, 2000). Rural population density is 5.8 persons/km^2 (CSO, 2003). Northern Province had a negative population growth in the period 1963 to 1969 mainly due to high labour migration to the Copperbelt and Lusaka. This trend changed to a growth rate of 2.0% in the period 1970 to 1980 and was further increased to 2.4% in 1990(CSO, 1990).

The Province has the second highest number of children less than five years classified as malnourished after Luapula province (MAFF, 1997). The susceptibility of children to diseases and untimely death is very much influenced by their nutritional status. The poverty levels are highest among the small-scale farmers, with about 85 % of the farming households regarded as poor. Out of these poor farming households, the most prominent are among female headed households with 75% and 70% such households classified as poor and extremely poor respectively, compared to 65% and 55% for male households respectively (MAFF, 1997).

The major economic activity in the province is farming followed by fishing (MAFF, 1999/2000; CSO, 1990). The main crops grown are maize, millet, cassava, beans, and groundnuts and sweat potatoes.

Table 1; Crop growing households by type of crop as percentage of all agricultural crops in the province, 2000*

Crop	Percentage
Maize	64.7
Sorghum	35.9
Millet	63.1
Rice	7.8
Cassava	87.8
Sweat potatoes	73.6
Groundnuts	71.2
Mixed Beans	63.4
Cow peas	21.0

Source: CSO, 2003

*Note that the base of the percentage is the total number of agricultural households within the province

4.2.1 Physical environment

The main vegetation types are *Miombo* (95,240 km sq.), *Chipya* (7300 km sq.) and Mateshi (1430km sq.) with the *Miombo* being the most extensive woodland extending over the greater part of the area. The *Miombo* is dominated by *Brachystegia-Jubernardia* and *Isoberlinia* woodland (Goma et al., 2003), so called after the two dominating tree genera, which are both leguminous and fire resistant. The grasslands are dominated by *Hyparrhenia* and *Digiteria* species (22,830 km sq.). Destruction of this woodland would eventually result into grassland type of vegetation normally called Chipya dominated by fire hardy trees. *Chipya* is evergreen forest comprising open woodland with perennial grasses common in lake basins and along riverbanks. Species found under *Chipya* vegetation are fire-hardy and intolerant to shade. Common species are *Pterocarpis anolensis*, *Erythrophleum africanum* and *Parinari curatellifolia*.

The Province has a dominantly uniform, very gently undulating Central African Plateau, which is broken by major river systems, and quartzite hilly ridges which are resistant to weathering. The Chambeshi and Luangwa rivers, with catchment areas of 88,500 and

28,400 km sq respectively, also drain the province. The province has lakes Bangweulu (7500 km sq.), Mweru-wa-Ntipa (1600 km sq.) and Lake Tanganyika (2000 km sq.) with *Sarotherodon macrchir, Synodontis nigromaculatus, Alestes macropthalmus, Limnothrissa miodon* and *Stolothrissa tanganicae* as major fish species.

The province falls under the country's agro ecological zone III. It is a high rainfall area that experiences a unimodal type of rainfall with annual cumulative average of 1200mm, with a growing season of about 120 to 150 days. The soils in the wet *Miombo* woodland are generally low in fertility, shallow and slightly acidic (Goma et al., 2003). In the flood plains and lake basins (Bangweulu and Chambeshi), the soils are poorly drained. Similar soils are also found in river valleys, lake regions and shallow depressions on the upland called dambos.

Traditional farming systems and practices are prevalent in Northern Province. These farming systems are a product of the natural resource base and the prevailing socio-economic conditions over time. The lack of means of production forces farmers to adopt the only production technology within the reach of their possibilities (Loza, 2004) The available resources have made local farmers in Northern Zambia to adjust their farming systems accordingly. There are five traditional farming systems practiced in the province (LIMA Crop Recommendation Memo, 1991) and these are:

- Lake depression – Cassava fish farming system;
- Central Plateau, -a traditional *Chitemene*-based finger millet, cassava, groundnut and bean system. It contains approximately 60% of the province's suitable agricultural land (FAO, 2004)
- North Eastern Plateau - a traditional Fundikila-based finger millet, cassava and bean system. Cattle keeping is common;
- Chambeshi/Bangweulu system; predominantly a cassava/fish system with rice becoming an important cash crop;
- Luangwa valley; a sorghum-based system in close proximity to Game Park and game management areas.

The Central and Northeastern plateau are important maize producing areas but their productivity has declined over the years (Kapekele and Yamanda, 2002) (Table 3). The Fundikila[5] is practiced in almost in all areas of the plateau (Holden, 1993). It was originally practiced by the Mambwe tribe but has spread to many other places. In this system fallow or virgin land is tilled in the early dry season. The grass is either put in circular mounds or buried in long ridges and covered with soil. Beans, sweet potatoes and cassava are planted on the ridges or mounds. In the following rainy season the land is weeded and leveled. Decomposed organic matter is spread and finger millet is broadcasted.

Table 2: Average Crop Area Planted in Limas by District in 1997/98 and 2001/02 Seasons

Crop	Average Area Planted in Limas*	
	1997/1998	2001/2002
Maize	11.2	7.9
Sorghum	4.4	3.0
F/Millet	4.2	5.0
Groundnuts	3.7	3.7
Cowpeas	1.5	0.6
Beans	3.6	3.4
Cassava	4.9	5.0
S/Potatoes	2.5	2.5
Total	36	31.1

Source; MDSP Diagnostic Study for Northern Province (Kapekele and Yamanda, 2002)

*A lima is 0.25 of a hectare

4.2.2 Kasama district – Brief description
Kasama district is situated 852 kilometers from Lusaka the capital city of Zambia (Kasama District, 2002). It is located in the central plateau which is a traditionally

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[5] Bemba name for the method of cultivation, also called the Northern grass mound system described by Shultz, (1976) and others as the Mambwe mound system.

Chitemene based farming system. The majority of land users are subsistence farmers. The average annual rainfall is 1200mm. The district has the highest share of the population in the province estimated at 13.6 percent (out of the total of 1,258,696) with an annual growth rate of 3.1 %(CSO, 2003)
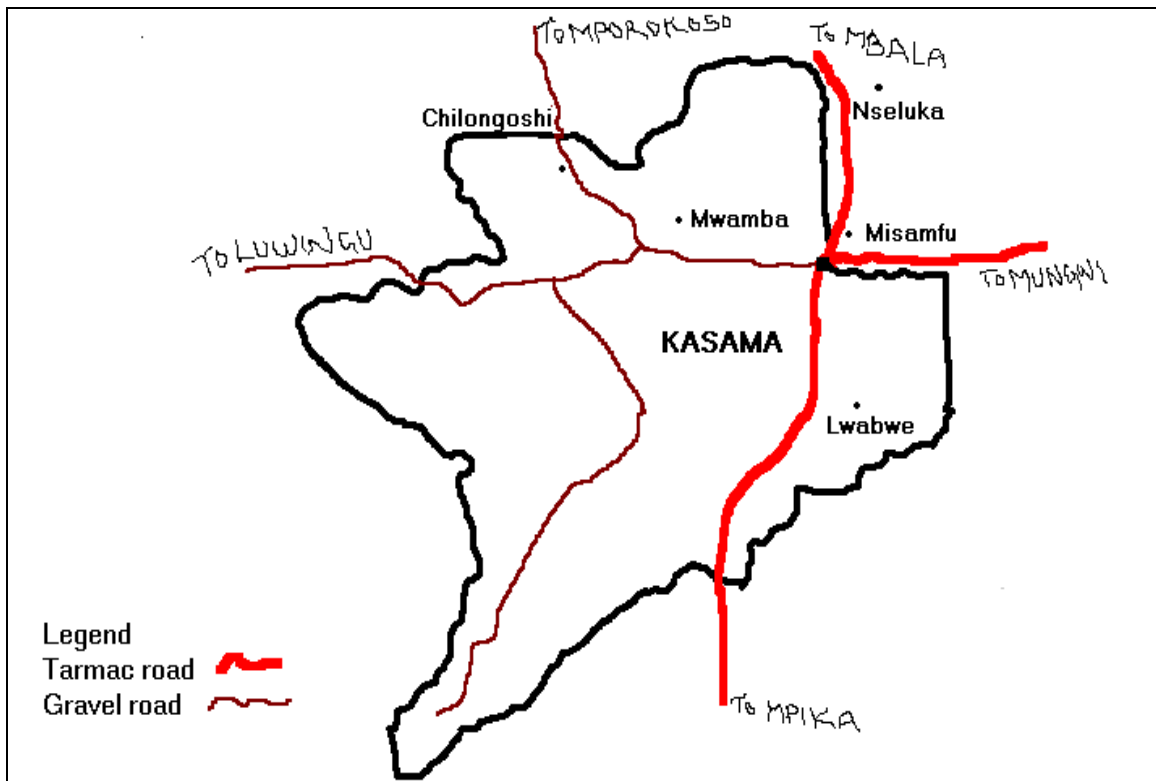
Fig 3: Map of Kasama District showing location of study areas
Source; Dept of Agriculture, Kasama

The district has two major ethnic groups namely Bemba and Lungu the latter being concentrated in the northern part bordering Mporokoso district. The tradition and customs of these groups are very similar and their main source of livelihood is subsistence farming (Kasama District, 2002). The study focused on five camps[6] in Kasama district namely Misamfu, Mwamba, Chilongoshi, Lwabwe and Nseluka.

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[6] A camp is the lowest agricultural administrative unit

4.3 Sampling and data collection

A multistage sampling procedure was used where in the first stage a province where *chitemene* is practiced was selected. Then Kasama district was picked from the twelve districts. *Chitemene* is mainly practiced in five districts namely Kasama, Luwingu, Mporokoso, Mpika and Chinsali. Kasama was picked because the provincial agricultural office and the regional agricultural research center are based here. More over, the dominant group that practices *chitemene* is here. So from the technical, financial and time constraint point of view, Kasama seemed a better choice than the other districts. Then from Kasama four camps were selected in consultation with the district agricultural office. In the second stage farmers practicing *Chitemene* were randomly selected. In all the camps that visited, there were scanty records of number of farmers per camp. So instead of following the list of farmers, the camp extension officers in conjunction with village headmen called up meetings where sampling was done. The total number of farmers in Kasama is 3258(District Situation Analysis) broken down as shown in Table 3

Table 3: Farmer Type and their total number and hectarage under cultivation in Kasama district

Type of farmer	Total Number	Hectarage under cultivation
Large-scale	8	600
Medium-scale	250	3250
Small-scale	3000	6000
Total	3258	9850

Source; Kasama District Situation Analysis, 2002

Large-scale farmers are those who cultivate more than 10 hectares while medium scale are those who cultivate between 2 to 9 hectares and lastly small-scale farmers who make up the majority are those who cultivate less than 2 hectares. From our sample there were no farmers falling in the large-scale category as defined for this study. The camps selected and the number of farmers sampled is shown in the table 4.

Table 4: Camp Selected and number of farmers sampled

Camp	Number of farmers
Mwamba A	15
Mwamba B	15
Misamfu	16
Chilongoshi	15
Lwabwe	17
Nseluka	12

Ninety(90) farmers were randomly sampled for interviews as shown in table 4 above. In cases where the farmer was not available at the time of the interview, another was then sampled from the village.

4.3.1 Method of data collection

Relevant data was collected from primary and secondary sources. Data from secondary sources included published and unpublished documents from the Ministry of Agriculture about the study area. Secondary data on policy measures governing agriculture, their implementation and effect and how they are combined were reviewed and analyzed. Primary data was key to this study and was collected from sample farmers in the study areas using a questionnaire.

4.3.2 Questionnaire development

The questionnaire used contained both open ended and close-ended questions. Things that are obvious and for which answers can easily be obtained like information on age of the farmer, educational level, household composition, sources of income, land ownership, cultivation method, whether extension visits the farmer and transport availability to the village comprised the close ended part of the questionnaire while questions on why the farmer is not satisfied with crop yields; major constraints in *chitemene* fields; why farmers may not practice *chitemene* and how lack of title deeds affect *chitemene* practice made up the open ended part of the questionnaire(Appendix 1).

The draft questionnaire was discussed with extension officers and enumerators. Enumerator training was done for two days where the questionnaire was discussed and necessary clarifications where made. The questionnaire was then pre-tested and necessary modifications were made. The pretest was done in Misamfu camp in a village called Chambeshi. Due to time constraint only ten (10) farmers were sampled for pretest. Each farmer was visited and questionnaire administered using a participatory rural appraisal techniques. Then the survey team convened afterwards to look at the gaps, duration, fluency, and easiness to understand and read and even to fill up the questionnaire. The necessary changes to the questionnaire were then made. Some questions were added for example the one asking whether the farmer practices chitemene or not. Initially this question was implied in one of the questions. Some questions that were not initially pre-coded were pre-coded to make the questionnaire simpler for data capture. Other parts that needed further clarification had further questions asked. Open-ended questions like 'if so how' were used. The questionnaire was then ready for administering and more copies were made. About 120 questionnaires were prepared to allow for replacement of those with mistakes or those filled wrongly.

4.4 Data Analysis

4.4.1 Descriptive analysis

Analysis of data involved data cleansing by checking filled questionnaires for errors, running frequencies and finally where possible modifications regarding collapse or creation of new variables. Frequency distributions were used to create tables, bar charts and graphs. Bar charts, pie charts and frequency table were used to explain for descriptive statistics. Bivariate correlation analysis was used to describe relationships between the factors. Using the reviewed literature and information from the questionnaire the appropriate variables were then used in further tests for their significance in influencing farmers' decisions. The results of this exercise are presented in the next chapter.

4.4.2 Analytical Model

As earlier mentioned in the hypothesis, farmers' adoption behaviour is influenced by a complex set of factors. In many instances factors that influence farmers' decision to choose a certain practice have been hard to predict due mainly to methodological limitations (Nakhumwa, 2004). One of these could be in the choice of the model used. A relevant model therefore offers a better explanation on the underlying relationships between adopting a certain practice and factors influencing it (Enki et al., 2001)

In this study the model used to analyse the factors, which determine chitemene practice, involves a mix of quantitative and qualitative data. In the beginning it was established that a farmer either practices *chitemene* or does not. The dependant variable therefore is dichotomous, meaning it can only take two values, one (if the event occurs) and zero (if the event does not occur) eliciting a yes or no answer respectively. The estimation of this type therefore entails the use of qualitative response models. There are a number of response models that can be used. These include linear probability model (LPM), logit, probit and tobit models. Ordinary least squares (OLS) can also be used. However, using OLS might result in estimates being inefficient and heteroscedastic if the dependant variable is binary as is the case in this study. This might lead to hypothesis testing being inaccurate and misleading (Gujarati, 2003). If LPM is used there might be several estimation problems such us non normality of the error term, heteroscedasticity and the possibility of dependant variable lying outside the 0-1 range which violates the basic tenets of probability (Gujarati, 2003). The remaining two, logit and probit model give similar results. However since logit model is widely used because of its simplicity it was picked. The Tobit model needs a lot of mathematical calculations. This requires a lot of data to be used and also needs a bigger sample. The sample in this study was small due to time and financial constraint. Some explanatory variables were solicited from the farmers. However some potential variables, which might be influencing continued practice of *chitemene* were got through literature review (Rasul and Thapa, 2003, Schuck et al., 2002, Holden 1993, 1998; Vosti et al, 1996, Moore et al, 1994). These included age, educational level of farmer, land tenure system, total land cultivated, access to extension, form of support received, labour availability, training attained on farming,

farming experience, availability of market, lack of inputs (fertilizer, manure), high inputs prices, lack of credit, cultural practices and beliefs (tradition)

Following Gujarati (1995) the cumulative logistic distribution function for factors determining *chitemene* is specified as

$$P(i) = \frac{1}{1 + e^{-z(i)}} \qquad (1)$$

Where P(i) is the probability of *chitemene* practice by the ith farmer and Z(i) is a function of m explanatory variables (Xi) and is expressed as

$$Z(i) = B_0 + B_1 X_1 + B_2 X_2 + B_3 X_3 + \ldots\ldots + B_m X_m \qquad (2)$$

Where B_0 is the intercept and B_i are the slope parameters in the model. The slope tells us how the log-odds in favour of the practice change as the independent variables change. Equation (2) represents the cumulative logistic distribution function.

From the above equation (1), we will have an estimation problem if we have to use OLS, because Pi is non-linear not only in X but in B's. But equation (1) is intrinsically linear. This can be shown by analyzing equation (1) further. If the probability of practicing chitemene is given as in equation (1) the probability of not practicing it is (1 – Pi) as shown below

$$1 - Pi = \frac{1}{1 - e^{zi}} \qquad (3)$$

The two equations can be written as

$$\frac{Pi}{1 - Pi} = \frac{1 + e^{zi}}{1 + e^{-zi}} = e^{zi} \qquad (4)$$

40

The conditional distribution of the outcome variable follows a binomial distribution with probability given by the conditional mean $P_{(i)}$. We rewrite the logistic model in terms of logs written as

$$\mathbf{Ln} \left[\frac{\mathbf{P\,i}}{\mathbf{1 - Pi}} \right] = \mathbf{Ln\,(e^{zi})} \; = \; \mathbf{Zi = B_0 + B_1\,X_1 + B_2\,X_2 + B_3\,X_3 + \dots + B_m\,X_m} \qquad (5)$$

The log of the odds ratio is not only linear in X but also linear in the Bi variable and as a result we can use OLS. Taking the stochastic term $\boldsymbol{\mu_i}$ into account, the logit econometric model to be used will be

$$\mathbf{Z(i) = B_0 + B_1\,X_1 + B_2\,X_2 + B_3\,X_3 + \dots + B_m\,X_m + \mu_i} \qquad (6)$$

This econometric model will be used and treated against the potential variables, which are assumed to affect the practice of *chitemene* farming system. It is assumed that the significant explanatory variables will not all have the same level of impact on the decision of the farmer to practice *chitemene* or not. The relative importance of each quantitative explanatory variable in the decision to slash and burn will be measured by examining the elasticities, defined as the percentage change in probabilities that would result from the percentage change in the value of these variables.

The strengths of the logit model are embedded in the special features that it has (Gujarati, 2003). Firstly although the probabilities lie between 0 and 1 the logits are not so bounded. As probability (P) goes from 0 to 1(i.e. as Z varies from $-\infty$ to $+\infty$), the logit L goes from $-\infty$ to $+\infty$ meaning the probabilities for the logit model are not linear, though L is linear in X. Secondly, it is possible from the model that given a variable Xi, we can directly estimate the probability of a farmer practicing chitemene or otherwise once the coefficients or parameters B_0 and B_1 or any number of coefficients have been found.

4.4.3 Empirical Model and Variable Specification

As has been mentioned, a dichotomous dependant variable for *chitemene* practice (Chiteprac) was defined as 1, indicating farmer practices *chitemene* and 0 otherwise. The explanatory (independent) variables of the study are those that are hypothesized to have association with the practice of *chitemene*. These explanatory variables include age, educational level of the farmer, farming experience, household size, total land area owned, access to extension, form of support received, distance from main road and influence of tradition on the *chitemene*.

The variable age measures the age of the household head in years. Young farmers are often expected to be more knowledgeable than older farmers and use more of new technologies (Adesina et al, 2000) while older farmers are a bit conservative and often tend to perpetuate the practice (Nakhumwa, 2004). Habtemariam (2004) agrees with this positive relationship by saying younger people are more open to new ideas than older ones and more likely to adopt new ideas. Since *chitemene* is a traditional practice younger farmers would be willing to adopt new technologies. This means therefore that the younger the farmer is the less *chitemene* he or she will practice. It is therefore hypothesized that age of the farmer and *chitemene* practice are positively related.

The other variable is educational level, which represents the level of formal schooling completed by household head. It is believed that schooling enhances farmers' perception, interpretation and response to innovations (Enki et al, 2001, Habtemariam (2004). Usually learned farmers are more risk lovers than those not learned. It is therefore hypothesized that those farmers with increased formal education practice less of *chitemene*.

The farming experience variable refers to the number of years that a farmer has been involved in farming. Depending on the interaction that the farmer has had in his/her farming life, it will determine whether he/she will settle for a certain type of farming. Most of the farmers interviewed have had interaction with parents and relatives and less with formal methods like extension officers. Also there have been a lot of policy changes

with the recent one being that of liberalization of agriculture (JICA, 2000). Most of the elderly farmers are risk averse. Literature indicates that the more years that the farmer has spent farming will increase his experimental base and should therefore assist him in making an adoption decision (Habtemariam, 2004). However Habtemariam (2004) also indicates that some other studies have found no relationship. However in this study the hypothesis is that as farmers get old they are more likely to practice *chitemene* as this is the system that assures them food in times of uncertainties (Moore and Vaughan, 1996). Farming experience is positively related to *chitemene* practice.

The other variable considered is household size. The hypothesis is that large household sizes are positively related to *chitemene* practice. *Chitemene* is a labour intensive practice, which need more labour (FAO, 2004). Household size also depends on the age and composition of the members. It is hypothesized that the larger the household the more likely that more *chitemene* will be practiced. This is with the assumption that other factors are constant.

The total land area owned refers to the total land owned by the respondent. This can be land given to him by the chief or inherited from parents. It is hypothesized that farmers with more land are able to practice more *chitemene* than farmers with smaller sizes. Land in the Northern Province at the moment is a not a limiting factor despite the population increase (FAO, 2004). It is hypothesized that land area is positively related to *chitemene* practice. The variable was given a 1 if the farmer owns more than five hectares and 0 if otherwise.

Agriculture extension is supposed to act as the channel for the dissemination of innovations. Contact with the extension service allows farmers to have access to information on new innovations or technologies (Adesina et al., 2000). It is measured by the frequency of extension visits to farmers. However, in this study since officers visited most of the farmers, access to extension in this case shall mean extension officers discussing *chitemene* with the farmers. The variable was given a 1 if extension officer discussed with the farmer and 0 if he/she did not. Access to extension is hypothesized to

be negatively related to *chitemene* practice. The other variable closely related to access to extension is the form of support received. Form of support received indicates the farmers' reaction to non-availability of credit. Non-availability of credit has made most farmers who at one time stopped or reduced on *chitemene* practice to revert back to the practice (Moore and Vaughan, 1994). Non- availability of credit is therefore positively related to *chitemene* practice. The variable was given 1 if it made the farmer to decide to continue practicing *chitemene* and 0 for otherwise.

The land ownership status commonly referred to as land title deeds is important when it comes to long-term investments. In the study area as earlier mentioned land is under communal ownership and is held in trust by traditional leaders who allocate to his subjects. In this area very few people have title deeds. The land tenure status of the farmer may influence his decisions to either practice *chitemene* or not. It was hypothesized that lack of title deeds is positively related to *chitemene* practice. The variable is given a value of 1 if the farmer's lack of title deeds contributes to chitemene practice and 0 if otherwise.

Traditional/ Cultural Practice refer to influence of tradition on *chitemene* practice. The hypothesis is that the farmers practice slash and burn because it has been their way of life for a long time (Moore and Vaughan, 1994). The hypothesis is that tradition is positively related to *chitemene* practice as opposed to other factors like lack of money.

Table 5: The definition of the variables and the units of measurement used in the logistic regression

Variables	Value	Minimum	Maximum	Expected Impact
Chiteprac	Dummy, Farmer Practices *Chitemene*	0	1	
Age	Age of the farmer	23	95	+
Edulevel	Dummy, Educational level of the farmer	0	1	-
Famexp	Farming experience of farmer	2	59	+
HHsize	Labour availability	1	16	+
TDAffechite	Dummy, Effect of not having title deeds on farmers decision	0	1	+
Crediteffect	Dummy, Influence of non availability of credit on farmers decision	0	1	+
Totalarea	Dummy, Total area of land owned by farmer	0	1	+
Whychite	Traditional and cultural practice	1	3	+

The **empirical model** to be used to analyze the farmers' decision regarding practice of chitemene is specified as;

$$\text{Chitprac} = \beta_0 + \beta_1\text{Age} + \beta_2\text{Edulevel} + \beta_3\text{Tland} + \beta_4\,\text{Crediteffect} + \beta_5\text{HHsize} + \beta_6\text{Famexp} + \beta_7\,\text{TDAffechite} + \beta_8\,\text{Whychite} + \mu_i \qquad (7)$$

μ_i is the error term, which represents other unobservable socioeconomic factors that also contribute to the farmers' decision to practice, slash and burn and are assumed to be independently distributed.

45

4.5 Limitations and areas of future study

One major constraint observed from the study was that the sample size and even area covered was small. This in a way affected the analysis. It is recommended that a bigger study should be done in all the districts where *chitemene* is practiced, in that case most of the major socio economic, institutional and technical factors like soil fertility mentioned by Goma et al. (2003) would come out strongly. This will help in better-targeted policies. However the results got from this study are a guide of the bigger picture of what is on the ground.

This research was done in order to fulfill the requirement for the attainment of the M.Sc degree. Though research was successfully conducted, one of the major constraints was financial constraint for the collection of data. This was further exacerbated by time as data was supposed to be collected within a given time due to academic pressure.

Most of the districts in the province practice *Chitemene*. However due to budgetary limitations only one district was sampled. Even within the district, some places, which the survey team would have loved to include, could not be included. This was further compounded by poor road infrastructure.

In this study the main target group was farmers who practice *chitemene*, but for the sake of comparison and also the analytical methodology used, non-*chitemene* practicing farmers were to be sampled also. It was however very difficult to find farmers who do not practice *chitemene* as most of them do practice. The research team would have loved to sample more than those sampled. Due to time and financial resource constraint a number of questions, which would have been included in the questionnaire were also omitted. These questions could be included in future research.

4.5 Summary

The chapter has given an overview of the study areas in terms of its location, camps selected and the major economic activities done in the study area. Also the major farming systems that are prevalent have been analysed indicating the major crops grown. A multi

stage sampling procedure has been used with the province being the first stage. A questionnaire was used as method of data collection. Secondary sources of data used are published and unpublished reports. The chapter analyses the procedure for data analysis, which involved descriptive analysis and use of the logit model using the specified variables, which have been defined. The chapter has also given the empirical model that was used in the analysis. These procedures are used in the next chapter. The chapter closes with the limitations of the study.

CHAPTER 5
RESULTS AND DISCUSSIONS

5.1 Introduction

In this chapter the results of the survey that was done is given. The first section of the chapter looks at the descriptive analysis of the survey data. The second section of the chapter reports on the econometric analysis while the final section gives an extended discussion of the results as well as draw policies that pertain to land use.

5.2 Field Survey Results - Descriptive Analysis

5.2.1 Characteristics of Sampled Households

The sample comprised of ninety (90) respondents obtained from the study areas described previously. All 90 respondents were interviewed. There were no missing cases. Out of these 20% were females. About 8% of those interviewed were wives of household heads since their spouses were not there. The rest of the females were female-headed households.

5.2.2 Age, Household composition and contribution

Age distribution of the farmers ranged from 23 to 95 years and the distribution is as shown below in Figure 4. The average age was 48 years old. Out of those interviewed 85.6% were married showing that the majority had complete households. The others (14.4%) were single, divorced or widowed. All these were heads of households
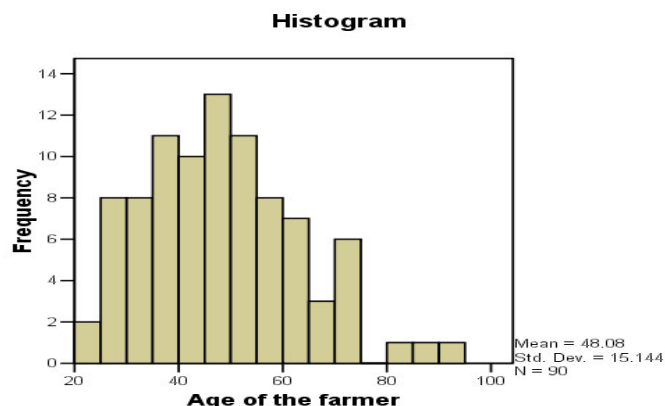
Fig 4: Age distribution of farmers

On average the household size is 7 members with an average number of 4 children. A child in this case is defined as a person below the age of 15 years (CSO, 1990). The survey results were within the range of what has been found by other studies done. For example, household sizes of 5.1 (CSO, 2003), 6 – 10 members (Agriculture Support Programme, 2004) and 5-6(Kasama Distict, 2002) are all in line with our finding. Household size can give an indication of the extent of pressure that could be exerted on the household resources. On the other hand it can also be an indication of the available labour. *Chitemene* is a labour intensive activity; therefore a large household size might be an advantage for those who practice *chitemene* (FAO, 2004; Moore and Vaughan, 1994). Table 6 shows the household sizes for the camps that were surveyed.

Table 6: Household size in the different sample areas in Kasama

Surveyed Area	Household size
Chilongoshi	7.3
Luabwe	4.80
Misamfu	5.73
Mwamba	7,07
Nseluka	8.45

Household contribution is mainly in terms of labour and income with adult male (30.9%) and female (25.1%) contributing the highest (Table 7). Most of the children contribution is in the form of labour (15.1%). The other contribution came from children begging (3.5) % for food or gifts from others as was asked in the survey questionnaire. Most of the children who contributed none (12.4%) are those who are too young to be able to work in the field.

Table 7: Contribution to livelihood and well-being[7] of the Household

Contribution	Male contribution (%)	Female contribution (%)	Child contribution (%)	Total (%)
Income	1.2	0.73	-	1.9
Labour in the field	1.2	7.5	15.1	23.8
Labour and income	30.9	25.1	2.3	58.3
In kind (gifts/begging)	-	-	3.5	3.5
None	-	-	12.4	12.4
				100*

*All the percentages were calculated in relation to all the contributors for comparisons sake

5.2.3 Literacy Level

Education plays a very important role in farmers' perception of technologies, how it is disseminated and its sustainability. It influences the level of understanding and assimilation of development issues (Agriculture Support Programme, 2004). This will affect the adoption or responsiveness of farmers to issues or technologies disseminated in the long run. Illiteracy level among the farmers interviewed was 7.8%. The majority of the farmers (74.4%) had gone up to primary school level. Only 17.8% went as a far as secondary.

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[7] Well being is the quality of life and livelihood is a dynamic realm that integrates both opportunities and assets available to an individual or group of people for achieving their goals and aspirations (Kirsten and Hease, 2003)

5.2.4 Land ownership, acquisition and mode of cultivation

Almost all the farmers (94.4%) interviewed do not have title deeds to the land. The area surveyed was all under rural status falling under what is called traditional land. All the land that the farmers have was either given to them by the traditional leader (38.9%) or inherited from their parents/relatives (61.1%). Land in most areas of Northern Province is readily available and is not a factor limiting production (Moore and Vaughan, 1994). The majority of the farmers in the areas surveyed own 5 or more hectares (ha) of land. Out of this, the majority of farmers cultivate less than 5 hectares (Table 8). The literature also shows that the farmers cultivate less than 5 ha (Agriculture Support Programme, 2004). The questionnaire in this case had a range of 1 to 5 ha which can be misleading. Most small-scale farmers cultivate less than 2 hectares of land (Kasama District, 2002)

Table 8: Land size

Land area range (Ha)	Percentage of farmers Owning a given area of land	Percentage of farmers cultivating given area of land
>0.5 Ha	2.2%	5.6
0.5 – 1Ha	2.2%	17.8
1 – 5Ha	22.2%	61.1
> 5Ha	71.1%	13.3

5.2.5 Farming Experience

Farmers in the area covered had vast experience in farming ranging from 1 to 59 years. On average each farmer has an experience of 19.3 years of farming. Most of the farmers learnt their farming from their parents/relatives (66.7%). Only 18.9% learnt from Ministry of Agriculture staff. Looking at where the farmer learnt farming might have an influence of what type of farming practice a farmer follows. Chances might be that those who have had contact with extension officers are less likely to practice *chitemene*. However, this information was not collected in this study. Further research might be needed to solicit this information. Despite having a number of visits from the extension officers it looks like they really do not have much influence on the farmers. Actually

most of the farmers mentioned that the officers never mentioned anything about advantages or disadvantages of practicing *Chitemene.*

5.2.6 Livelihood and resource endowment

The survey results indicate that all the households interviewed depend on agriculture as a major source of income. The major agricultural sources of income were sale of crop produce, sale of livestock, sale of aquaculture and sale of horticultural produce as shown Table 9.

Table 9: Sources of Income

Agricultural Income source	Percentage (%)	Non agricultural income source	Percentage (%)
Sale of crop produce	59.3	Beer Brewing	68
Sale of livestock	35	Trading	24.1
Horticultural produce	5.7	Remittances	7.9

Apart from the above the forests also provides income-generating opportunities through collection and sale of caterpillars, mushrooms, wild fruits and many other products (FAO, 2004). Forests are also sources of timber, fuel wood, charcoal, grass for thatching and poles. These are mostly consumed within the province especially in Kasama. However, some hardwood is also exported to Lusaka (Kasama District, 2002). The survey unfortunately did not solicit for information on forests as a source of income.

For non-agricultural income sources there was beer brewing, trading and remittances from relatives as shown table 9.

5.2.7 Farming system practiced and major crops grown

The vast majority of crops in Kasama are derived from individual smallholder farming, grown on small plots (Kasama District, 2002). From the survey the major crops grown in order of importance are maize, cassava, finger millet, groundnuts and beans. Despite

maize having fallen out in terms of area grown it is still the most preferred crop among the farmers. Maize used to be a very important crop grown during the time of fertilizer subsidy in the second republic. It only started declining in importance after liberalization of the economy in the early 1990's when subsidy was removed. Finger millet has come back into the limelight again. It is the crop mainly associated with *chitemene* (Holden 1993; Moore & Vaughan, 1994; Goma et al., 2003) as the first crop planted.

5.2.8 Cultivation methods and *chitemene* (slash and burn) practice

Kasama has predominantly a traditional land based management system. The majority of land users are subsistence farmers in both trust and reserve lands both combined to form traditional land tenure system (Kasama District, 2002). From the survey the predominant land use system observed is a combination of conventional and *chitemene* (slash and burn) – 78.9%. *Chitemene* fields are larger than the conventional field in terms of area cleared. Traditional farming methods are hampered by limited access to agricultural inputs such fertilizer and improved seed, use of simple equipment like axe and hoe. About 80% of those interviewed practice *chitemene*. By the time of the survey all of them had cut *chitemene* in preparation for the coming season of 2004.
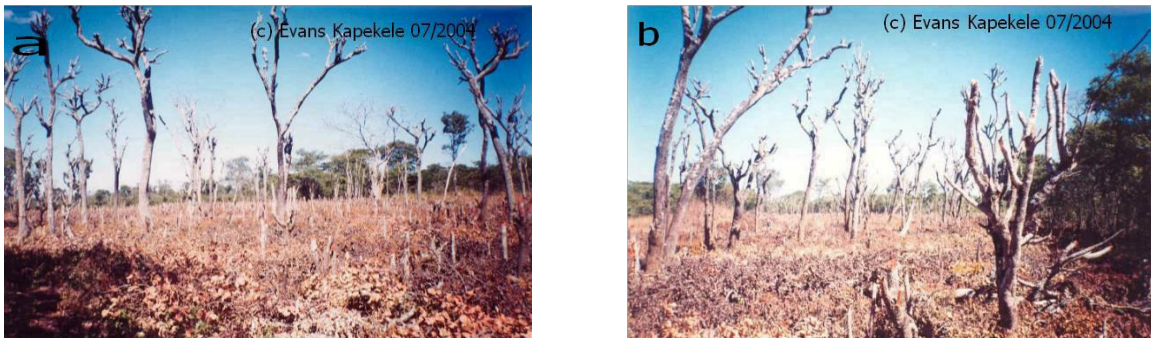
Fig 5: The cut chitemene, (a) Selu Village and (b) Mwamba Village, Kasama, Zambia

The cultivation cycle in all the areas covered is as follows. Men start cutting the trees/bushes from May up to September. They lop the branches off the trees as shown in Fig 5a & b. The women then carry the branches and bushes and pile them to 1m to 2m high (Velded et al, 1982) in the middle of the cleared area or circle as shown in Fig 6(a). Just before or after the first rains the heap is put on fire and the first crop finger millet (Fig 6(b)) is broadcast in the ashes and lightly hoed to cover the seeds.
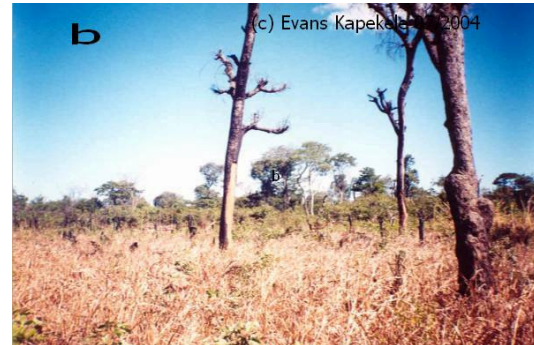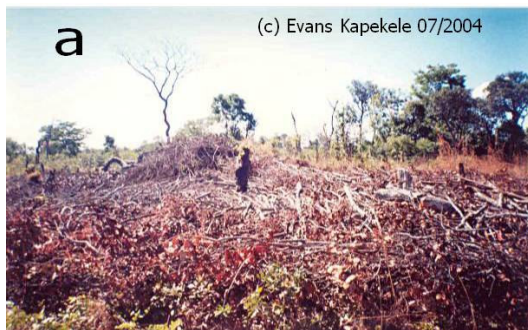
Fig 6 (a) The heaped *chitemene* ready for burning, Selu Village, and (b) Dried Finger millet, first crop of the *chitemene* field of 2003 seen in July, 2004, Kasama, Zambia

The major implement used in *chitemene* field is axe and hoe (100%). These are labour intensive implements. However many farmers (94.6%) indicated that given a choice they would rather use oxen drawn implements. Most of them could not afford draught power (89%).

5.2.9 Land Tenure

In Zambia there are two land tenure systems and these are customary and statutory tenure. The customary (also known as the traditional land tenure system) allows persons within a given area to easily access land through traditional rulers (GRZ, 2002). The land could be freely passed on to family members through inheritance in accordance with the existing traditional customs. The larger part of the land in Northern Province and Kasama in particular falls under customary tenure.

From the study only very few farmers had title deeds (5 out of 90 respondents). In the survey areas the chief has the power over the land in the area (FAO, 2004). He decides what land is to be cultivated and how it is to be divided between his subjects. He performs these duties through himself or headmen (Loyland, 1987; Holden, 1988). Inhabitants usually inherit land through their family lineage. The village headman or the chief himself settle any disputes that arise. In many instances there have been many disputes. Some respondents have mentioned lack of title deeds in the survey as having been responsible for some land disputes. However, land in Northern Province is still abundant despite population increase (FAO, 2004). Table 10 shows the per capita land available per household. This is quite high and FAO reports that incidents of land grabbing are very rare.

Table 10: Average and per capita available land in Agriculture communities

	Land size (Hectares)
Average total available land	4.64
Per capital available land	0.71
Available land per active member	1.16

Source: FAO, 2004

5.2.10 Livestock

Livestock found in Kasama is mainly used for meat during ceremonies and sold to pay for things like *lobola* or school fees. There are very few farmers who use their animal

especially cattle for draft power. Despite having animals, farmers still use hoes for tilling the land (Kasama District, 2002).

Livestock owned by farmers include cattle, pigs, goats, sheep, chickens, ducks and rabbits. The most common type of livestock owned by farmers are chickens (Fig 7).

Fig 7 Livestock kept by farmers
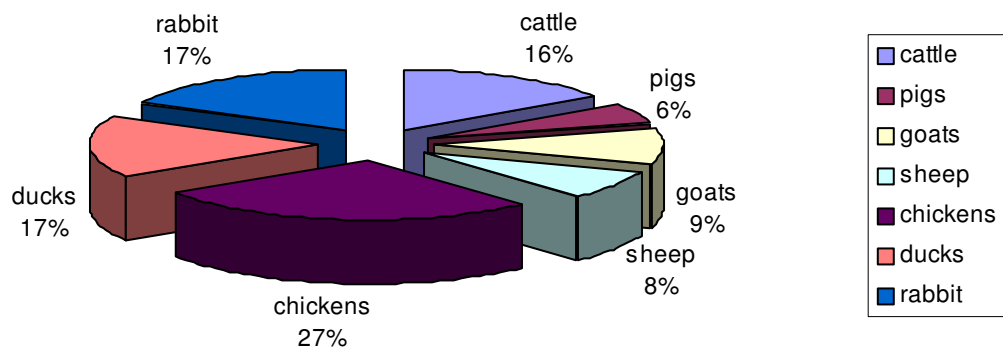
Keeping of livestock has little influence on the farmers (78.9%) practicing of *chitemene* as shown in Table 11. The assumption was that farmers owning livestock might reduce on *chitemene* by using manure to fertilize their fields. Only 2% (Table 12) said they used livestock manure in their fields

Table 11: Livestock keeping influence on *chitemene*

	Valid Percent
Yes	12.2
No	78.9
n/a	8.9
Total	100.0

But some farmers (7.8%) mentioned that owning of animals have helped them to increase fields of their *chitemene* fields through the sale of these animals (Table 12). They employ people to help them cut the trees and pile them in the circles. This was mentioned by those farmers who said keeping of livestock have helped them increase their *chitemene* fields.

Table 12: Livestock ownership Influence it has on *chitemene* practice

Influence	Percent
Don't practice Chitemene because I use manure	2.2
It has no effect and I still practice Chitemene	75.6
Have reduced on Chitemene	2.2
Help to increase Chitemene	7.8
n/a	12.2
Total	100.0

5.2.11 Support services

The performance of agriculture is affected by many factors, which include primary resources like land, labour, capital and rainfall, institutional, and infrastructural factors.

The support services considered here is extension service for capacity building. This involves both agricultural and forestry extension and credit facilities and infrastructure availability.

Research and extension ensures that the necessary and appropriate technology is available. Almost all the farmers (98.9%) interviewed indicated that there is an extension officer stationed in their areas with about 50% saying they had been visited about three times in a year. However, more than half of the respondents mentioned that the extension officer has not provided information or advice about *chitemene* and its effect. About 69% of the respondents said the presence of the extension officer has no influence on their *Chitemene* practice. They actually mentioned that since they need to produce food and this is the only alternative to them. They have to continue despite the advice given by the extension officer if any. However some (25%) have managed to stop or reduce (6%) *chitemene* based on the advice given.

While extension officers were praised for being available there was however, little mention of new research technologies that are being used in the areas. A lot of research has been done on alternative soil fertility management options (Goma et al., 2003). Soil Productivity Research Programme (SPRP) responsible for soil fertility improvement has been in Zambia for over 20 years (from early 1980's to late 1990's). Most of these technologies developed have not reached the farmers. Goma et al. (2003) might be right when he mentions that there seems to be a transfer gap rather than a technology gap. The farmer extension research linkage seems to be very poor despite collaboration being spelt out clearly in policy documents. None of the camp officers in the areas surveyed mentioned of having any interagency meetings at community level that bring the various concerned ministries to together.

Other sources of information on *chitemene* have not helped as very few farmers (less than 30%) have indicated getting information from there. Dissemination of information on *chitemene* is also supposed to be done by the Forest officer. However, 73% mentioned that forest officers are not there and even those from the district offices rarely visit them.

Before liberalization of the Zambian economy the government through Zambia Cooperative Federation used to provide credit facility for maize production. This credit facility was discontinued in 1991 with the liberalization of the economy (MAFF, 1992). This is seen from the respondents' response on availability of credit facility. About 89% mentioned there is no input credit facility. However 11% mentioned availability of credit. It was found that there are some NGOs that operate in these areas who give credit in form of inputs like seed and fertilizer. Two NGOs identified were Program Against Malnutrition (PAM) and Agricultural Support Program (ASP). These NGOs have a targeted approach to their credit delivery (ASP brochure 2003). They select household who they would like to work with. In the surveyed villages most members (67.8%) are not even aware of these NGOs presence.

5.2.12 Policy Issues

Policies are instruments that government uses to achieve certain objectives. The Ministry of Agriculture and Cooperatives and that of Tourism and Natural Resources have similar policies as pertains to natural resources (MAFF, 1992; GRZ, 1998) as has been portrayed in literature review. One set of agricultural policies is aimed at maintaining and improving the productivity of agricultural lands and protecting Natural resources.

The forestry department has a policy of promoting sustainable forest management and utilization through active participation of all stakeholders with a view of obtaining a sustainable forest resource base (GRZ, 1998). Government has put up certain regulations for the above policies/objectives to be achieved. These regulations are supposed to be implemented by government officers. From the sample 93.3% of the respondents said they are aware of the government regulation concerning cutting of trees. Despite being aware of this regulation *chitemene* practice is still high. Ninety five percent (95.6%) mentioned that these regulations are not reinforced. About 73% of the farmers mentioned that they don't have a forest officer in the area.

5.2.1.3 Infrastructure

The infrastructure that links production areas with other parts of the country especially the market is important. Infrastructure is the backbone of rural development strategies, be it education, agriculture, health or enterprise (IFPRI, 2003) Infrastructure connects people to markets, reduces prices of certain commodities like fertilizer and allows access to services necessary for human welfare.

From the survey transportation facilities, which include roads, are very poor and the district suffers from deteriorating road network (Kasama Distict, 2002). Transport constraints and their impact on rural livelihoods and service provision are of high priority for the rural poor (Davies, 2000). The rural poor have to transport their produce if they have to sell it. Even for those who might have the money to purchase inputs, the infrastructures in terms of roads prevent them from getting them as it becomes expensive to transport. The roads in remote areas of the province are in a poor condition. The furthest village visited was 70km from Kasama town. All the villages are linked by either gravel road or foot paths (Survey observations). Lack of attention to provision of essential services in rural areas such as roads being non-existent or poorly maintained was mentioned in the document framework for agricultural policies, towards the year 2000 and beyond (MAFF, 1992).

In the survey areas most of the roads have become almost impassable from observation. Even when farmers were interviewed just to confirm what we saw, more than 60% of them said roads are bad and poorly distributed. In a place where we were supposed to take thirty minutes it took us one and half hours. This has resulted in transport being rarely available (66.7%). As a result of this traders who go to these places impose unfair trading terms (Davies, 2000). 82% of the farmers said formal markets for produce are very far from the village. Because of lack of a formal market farmers usually sell their produce from their homes (43%) as shown in Fig 8 below.

A combination of limited roads and poor road network infrastructure available for transportation and marketing facilities (Bientema et al, 2004) has led to high transaction

costs. This has led to poor marketing systems for agricultural produce, unattractive prices and even unavailability of credit from the formal sector, which though near in distance is far because of poor road infrastructure. This is confirmed by the increased number of farmers who sell from their houses and less of those transporting to formal markets as shown in Fig 8

Fig 8 where farmers sells produce
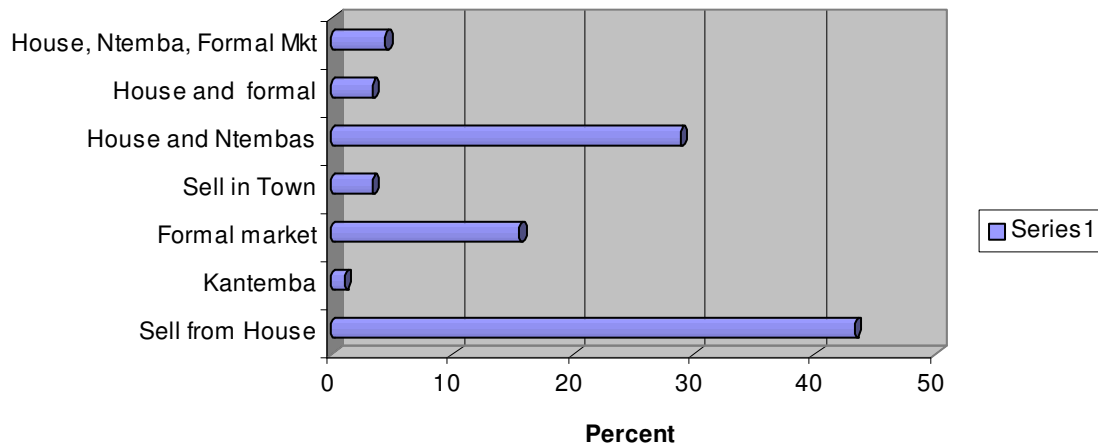
The distance from the main road also influences the intensity of *chitemene* practice. Out of the 90 farmers interviewed 86.7% of the farmers said *chitemene* increases as you go further away from the main road. As you go away from the main road the gravel road and footpaths become bad and impassable for a vehicle to go there. This is worse during the rain season (Davies, 2000). Farmers (75.6%) said the main reason for this increase is that there are more trees there unlike along the road where most trees have been cut for human settlement and firewood. The other reason given (6.7%) is that along the road they fear law enforcement Officers like forest officers who pass through the road once in a while.

5.3 Underlying factors that influence farmers' decision to practice *Chitemene*.

There are relationships between factors affecting *chitemene* practice. These relationships were examined using cross tabulations (bivariate analysis). Bivariate analysis looks at the relationship between pairs of variables (Bryman and Cramer, 1997). Cross tabulation is one of the most frequently used ways of demonstrating the presence or absence of a relationship.

From the data it was observed that availability of land increases the chances of a farmer practicing *chitemene* as shown in Table 13. Most of the farmers with bigger fields practice *chitemene*

Table 13: Farmer practices *chitemene* by Total land area in hectares

	Total land area in hectares				Total
	Less than 0.5Ha	Between 0.5 and 1 Ha	Between 1 and 5 Ha	More than 5 Ha	
Farmer practices chitemene Yes	2%	2%	21%	64%	89%
No	0%	0%	2%	9%	11%

There is also a relationship between *chitemene* practice and farmers response to non-availability of credit facility (Table 14). Non availability of credit increases the chances of a farmer practicing *chitemene* as shown in Table 14.

Table 14: Farmer practices *chitemene* by Non-availability of credit

Influence *chitemene* practice

	Non-availability of credit influence *chitemene* practice		Total
	Yes	No	
Farmer practices Yes *chitemene* No	74%	17%	91%
	8%	1%	9%
Total	82%	18%	100.0%

Although most of the farmers practice *chitemene*, they mentioned that non-availability of credit facility (74%) influences their decision to practice *chitemene* (Table 14). Farmers will reduce on *chitemene* practice if there is a credit facility for inputs like fertilizer.

However, there was not a significant influence on the extension officer providing information on the effects of *chitemene* and its practice (Table 15). Most farmers actually mentioned that despite the information coming to them indicating that the practice is not good they still continued because they do not have a cheaper way of producing food apart from slash and burn.

Table 15: Farmer practices *chitemene* by Extension Officer provides   information on *chitemene*

	Extension. Officer provides information on chitemene		Total
	Yes	No	
Farmer practices Yes chitemene No	43.4%	47.0%	90.4%
	6.0%	3.6%	9.6%
Total	49.4%	50.6%	100.0%

63

Tradition was also mentioned to be the reason why farmers practice *chitemene*. Tradition here means that it is a practice that has been there for as long as farmers could remember, such that it has become a

> *Chitemene* a life style – chitemene represents a life style – but not a static one. Cultural factors limit possibilities for change. To what extent it is difficult to say. The real incentive for change has not yet come. This may occur when trees have disappeared and productivity from *chitemene* fields falls below permanent systems. At the moment most farmers find chitemene production more rational within the socio economic framework. This indicates that unless the transition to permanent cultivation is stimulated and made a better alternative, the chitemene producers will not be motivated to change (Vedeld, 1981)

part of their lives or way of life or life style as Vedeld (1981) put it in the box above. The Bemba tribe was known for their system of agricultural production called *chitemene* (Moore and Vaughan, 1996). This way of life was there long before the European colonizers came and therefore it is seen as connected to their history. However this system has been seen to be wasteful and unsustainable. However, despite it being a tradition, lack of money and non availability of credit to acquire inputs came out as the main contributor to the farmers' decision to slash and burn as shown in the cross tabulation Table 16. About 63% of the farmers mentioned that lack of credit/money has a greater influence on their decision to practicing chitemene than the other reasons.

Table 16: Farmer practices *chitemene* by reason for *chitemene* practice

		Reason for *chitemene* practice			Total
		Lack of money/credit to purchase fertilizers	Traditional way of producing food for these people	Lack of money/credit and also traditional way of food production	
Farmer practices *chitemene*	Yes	63%	27%	9%	99%
	No	0%	1%	0%	1%
Total		63%	28%	9%	100%

Age of the farmer was also seen to contribute to farmers' decision to practice *chitemene* as shown Table 17. According to CSO (1990) the active age group is between 15 to 49 years. Although the population in Northern Province is considered to be young with median age of 16.2 years (CSO, 1990), the population in the study area was seen to be elderly with median age of 49 years old. The majority of those interviewed fail between 35 and 55 years old as shown in Fig 3. There have been a number of changes in government policy that most of the older farmers have experienced. Their decisions therefore are usually based upon what they have gone through and they usually go for less risky alternatives like *chitemene*.

Table 17**:** Reason for *chitemene* practice by Age of the farmer

			Age of the farmer (years)				Total
			19 - 29	30 - 45	46 - 65	Above 65	
Reason for *chitemene* practice	Lack of money/credit to purchase fertilizers	% within Age of the farmer	100%	65%	55%	50%	63%
		% of Total	11%	25%	20%	6%	63%
	Traditional way of producing food for these people	% within Age of the farmer	0%	26%	35%	40%	28%
		% of Total	0%	10%	13%	5%	28%
	Lack of money/credit and also traditional way of food production	% within Age of the farmer	0%	10%	10%	10%	9%
		% of Total	0%	4%	4%	1%	9%

The age group 19 to 29 years old all indicated lack of inputs or money to buy inputs as one contributing factor to the practice of *chitemene* as shown in Table 17 above. None of them mentioned tradition. Tradition was mentioned more by the elderly i.e. 46 years and above (18%) compared to the young (10%). The reason is that young farmers would like to change to alternative methods but are hampered by either lack of money/credit or other alternative methods better than *chitemene* not being there, which would sustain their livelihood**.**

5.4 Field Survey Results - Econometric Analysis

The previous section dealt with the characteristics of the sampled households and the underlying factors that influence farmers to practice *chitemene*. This section presents the estimated results of the econometric model using the data from the survey.

The maximum likelihood method of estimation was used to elicit the parametric estimates of the binomial logistic regression model and the statistically significant variables were identified to measure their relative importance on farmers slash and burn decision. The model required six iterations to generate the parameter estimates.

The results of the empirical model specified in the equation are presented in Table 18. The statistically significant variables were identified in order to determine the relative importance of each on the farmers' decision to practice *chitemene*.

Table 18: Econometric model results of the factors affecting the farmers' decision to practice *Chitemene* in Northern Zambia

Variables	Estimated coefficients	Std. error	Z- statistics
Age (age of the farmer)	0.049937	0.028694	1.740347*
Crediteffect(Effect of non availability of credit)	1.739619	1.024606	1.697841*
Edulevel(effect of having minimal education)	1.266901	1.132315	1.118859
Farmexp(farming experience in years)	0.024509	0.039173	0.625672
Hhsize(size of household)	0.344862	0.185230	1.861797*
TDAffechite(Effect of not having land title deeds)	1.725141	1.376827	1.252983
Total area (Total land area owned)	-0.380179	1.185059	-0.320810
Whychite(reason for practicing *chitemene)*	-3.725365	1.136616	-3.277592**

** Significant at 1%

* Significant at 10%

Source: Model Output from survey data

From the model (Table 18) four variables out of the eight hypothesized to influence chitemene practice were found to be statistically significant at 1 and 10 percent probability levels. These are age of the farmer, effect of non-availability of credit facility, effect of household size and influence of tradition. The model had an estimation prediction of 94.4 percent, which is good for explaining the relationship between the dependant and independent variables.

In the model except for total land area owned and influence of tradition, all the other variables were consistent with a priori expectations as indicated in the hypothesis. The binomial logistical model revealed that older farmers are more likely to practice *chitemene* than younger ones. The young farmers are better disposed to trying new innovations and have lower risk aversions and planning horizons than their counterparts (Adesina et al., 2000). It looks like as farmers get older their vigour to try new things diminish. Also they more or less base their practice on experience. From what some farmers (from informal discussions) were saying, *chitemene* is a system for which if things go bad like when the government withdrew subsidies for inputs, you have to fall back to.

The educational level of the farmer was insignificant. This may also mean that the farmers' education alone may not have a greater influence on the farmer decision in deciding what kind of land use system to use. Other means of education like extension farmer training could be used in influencing his decision apart from the formal education attained through a formal school. Most of the farmers (74.4%) had only gone up to primary school level. Illiteracy levels were very low (7.8%). This might be the same with farming experience of the farmer. Depending on what the farmer has been exposed to, it influences his decision accordingly. There are some farmers who had been involved in a number of extension activities and even on-farm research, which has made them, see the advantages and disadvantages of *chitemene*. Others might have never been exposed to such and might just be relying on what they have learnt from their parents. So the insignificance of these might be due to these reasons. It is therefore important to consider the education in order to determine entry points for intervention

The significant and positive sign for non-availability of credit indicates that farmers are more likely to practice *chitemene* where credit for inputs like seed and fertilizer are not available. The estimated coefficient (β) for non-availability of credit causes the odds of *chitemene* practice that is chances of the farmer practicing *chitemene* by 1.7. The main reason for farmer burning the branches is to improve the fertility of the soil. The ash provides nutrients for the plants planted i.e. millet. So if there is an alternative to this ash, which in this case is provision of credit to enable the farmer to purchase fertilizer, the farmer will either reduce or stop the practice (Moore and Vaughan, 1994). The change of agricultural policies, which included among others removal of fertilizer subsidies and credit facility, may have contributed to the increase in *chitemene* practice in Northern Zambia (Holden, 1998).

The significant and positive sign for influence of household size on *chitemene* indicates that as the size of the household increases, the greater are the chances that a household will practice *chitemene*. A unit change in the household size increases will increase the chances of the farmer practicing chitemene by 0.34. *Chitemene* is a labour intensive practice (Moore and Vaughan, 1994, Holden, 1993). Family labour in Northern Zambia constitutes the major source of labour for households. Larger households are more likely to have bigger fields of *chitemene*. However this also depends on age and household composition (Vosti and Witcover, 1996).

The estimated coefficient for money to purchase inputs as a main reason for continued practice of *chitemene* is negative indicating that lack of money for purchase of inputs increases the probability of *chitemene* practice. The significant and negative sign of this variable (whychite) implies that it is more likely that for farmers who lack money for either purchase of inputs like fertilizer or even food are more likely to practice *chitemene* than those who look at it as a way of life or tradition. The responses that farmers gave as the main reason why they go for *chitemene* are lack of money and tradition with the others saying both contribute as shown Table 17. When these two are used as benchmarks for practice, farmers who lack money are more likely than those basing it

only on tradition. One reason given is that *chitemene* as a tradition is not static and this might explain why the coefficient is negative. It changes depending on socio economic situation existing at the time. These conditions can be political, social, institutional or government policy (Holden, 1993, 1998; Moore and Vaughan, 1994; FAO, 2004). Farmers go for *chitemene* against all odds especially when conditions are not suitable because of its flexibility and diversification.

From the above discussion it is clear to see that the credit constraint and even lack of money on the farmers' side very much increases the chances of the farmer deciding to either start or continue practicing *chitemene*. The negative sign has ruled out the possibility that *chitemene* is a way of life for the people of Northern Province. This is actually confirmed by the significant and positive coefficient of the variable of non-availability of credit. It is an indication that a clear policy on credit will play a critical role in influencing the farmers decision as to which land use option to adopt.

The insignificance for the effect of not having title deeds shows that at the moment this is not relevant to the farmer and the government should put much emphasis on it. However this does not mean that it is not important. The effects of this will start having more influence as the population increases. So there is need for government to plan for this by collaborating with traditional leaders. It has positive effect on *chitemene* as seen in Table 18 though it is insignificant statistically.

CHAPTER 6
SUMMARY AND CONCLUSIONS

6.1 Summary

Over 90 per cent of deforestation in Zambia is as result of land clearing for agriculture. C*hitemene* contributes half the loss of this woodland. The main objective of this study was to investigate the determinants of *chitemene* type of farming system in Northern Zambia and identify effective policy responses that will help in policy formulation. Previous studies have shown that slash and burn is in the long run unsustainable and that it hinges on the balance between population and availability of suitable woodland. Since *chitemene* is practiced by small-scale farmers who constitute the majority of farmers the impact that the practice have on the environment is big. In order to help reduce this practice it is important to understand the role that household decisions play and the factors that influence these decisions in determining land use.

Literature review done to understand the underlying factors that make farmers decide on how to use their land especially as it pertains to slash and burn have shown that these factors can be broken down into internal and external factors. It also showed that the primary objective for the small-scale farmer, which forms the basis under which other factors are affected, is that of household food security. Literature search also shows that the various explanatory variables like the factors that influence the farmers' decision do not have the same impact on influencing the farmers' decisions.

In the study, apart from secondary data collected the questionnaire was the main tool used for data capture. Farmers were randomly sampled using multistage sampling in five camps in Kasama district of Northern Province. In the analysis the dependant variable was that the farmer either practices *chitemene* or not. Most studies have either used logit or probit model. This study used the logit model because of its simplicity

Bivariate analysis results showed that availability of land increases the chances of the farmer practicing *chitemene*. It also showed that non-availability of credit influences farmers' decision to practice *chitemene* positively. There was no significant influence on

extension officer providing information on the effect of *chitemene* practice since there is no alternative cheaper way of crop production. Lack of money to acquire inputs contributed more to farmers' decision to practice *chitemene* than tradition. Results from the econometric analysis showed that age of the farmer, effect of non-availability of credit facility, effect of household size and influence of tradition had a significant influence on *chitemene* practice. It was found that the main reason for *chitemene* practice is lack of money for acquisition of inputs. This is closely tied to availability of credit. It is more likely that farmers who lack money to purchase inputs are more likely to practice *chitemene* than those who look at it as a way of life or tradition.

6.2 Policy discussion

There were many factors that were considered from the beginning but some were dropped off because of multicollinearity. However empirical analysis may not be the 'gospel truth' for all the factors that determine the practice. There are others based on anthropological and cultural studies that have been found to contribute to the continued practice of the system (Moore and Vaughan, 1994). In trying to come up with recommendations for intervention, these findings should be considered together with other factors determined through other methods. This is due to the complexity of the farmers' decision to continue practicing *chitemene*. The results of the econometric estimation in this study however, showed that the practice of *chitemene* is highly influenced among others by tradition/lack of money, household size, age of the farmer and non-availability of credit facility.

This study has identified some entry points for policy. It will also help improve the chances of policy success by deliberately choosing and using policies that take into account farmers objectives and constraints. In considering this the objective of any policy or development programme should be to enhance sustainability, growth and poverty alleviation (Vosti and Witcover, 1996) especially in this province where poverty levels have been persistently high for some time (CSO, 1990; FAO, 2003). Initiatives that do not take into account farm household behavior as put by Vosti and Witcover (1996) to either reduce or better manage slash and burn agriculture will probably not succeed.

Slash and burn has a relatively weak potential to provide rural populations either with adequate food supplies or sufficient income to support healthy and prosperous lives (FAO, 1985). The FAO (2004) report reaffirms this by saying that food produced through *chitemene* does not last them up to the next harvesting season. Poverty may prevent poor farmers from investing in land conservation due to high subsistence requirements. Other research has found that promotion of cassava, which does not necessarily need *chitemene*, can help in reducing poverty and also reduce deforestation (FAO, 2004, Moore and Vaughan, 1994). There is need for more promotion of cassava by the department of agriculture.

Title deeds did not come out as an important issue to be considered in addressing *chitemene*. It was insignificant in the econometric model. Some few farmers however, mentioned disputes arising from lack of title deeds. This might become a problem as population increases. However, Mandivamba(unspecified year) says that traditional or customary tenure systems offer as much security as any other system provided that communities have legal ownership and authority over their land and natural resources. He goes on to say that governments can strengthen this tenure system by supporting and empowering the local communities. This view is good as it will be very difficult for the government to monitor these tenural rights if it was centralized. This tarries well with what the forest department is trying to implement by involving community and local leaders in managing and preserving the forests (GRZ, 2004).

Non-availability of credit and lack of resources (capital) are policy issues, which came out in the study as contributing to the continued practice. Agricultural development has been promoted through the provision of interlinked input (fertilizer and seeds) and credit packages, which have efficiently promoted the adoption of technology in many cases (Holden and Binswanger). Holden and Shanmugaratnum (1995) promoted this idea by saying that interlinkage mechanisms may be powerful tools for promoting sustainable agricultural development. This can be followed by public investment in infrastructure. All these should be done in collaboration with local community participation for it to

succeed. Since age came out as one contributing factor, it would be advisable if this collective action would be led by relatively young persons exposed to the outside world (Balland and Plateau, 1996).

From the above discussion it is quite clear that the solution to the problem of *chitemene* is a multifaceted one. It needs a combination of policies pertaining to infrastructure development, credit, market and extension (forestry and agriculture) and other factors to be addressed. This is not just the mandate of the Ministry of Agriculture but all the ministries like Environmental and Natural Resources, Lands, Transport and Communication, Local Government and financial institutions and others not mentioned that have a role to play in influencing the farmers decision.

So unless the government employs policies that target these factors, there is every reason for the farmers to continue the practice of slash and burn. As Moore and Vaughan (1994) put it *'What history has taught the farmers of Northern province is that it is possible to adapt to changes and that for the time being, there is every reason to continue cutting trees'*. Until conditions become favourable for farmers to adapt to new changes, they will behave in their rational way and continue to practice slash and burn to sustain themselves. Farmers are rational people who realize that these inadequate fallow periods are not doing them good and are actually depleting the soils and the forests, but persistent poverty usually will give today's production priority ((Vosti and Witcover, 1996).

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Appendix 1: Questionnaire

QUESTIONNAIRE FOR DETERMINANTS OF SLASH AND BURN IN NORTHERN ZAMBIA

(To be filled in by enumerator before interview)

Date of Interview:...…………………..…..

Name of Interviewer:.……………………………………………………………………

Language used by the respondent:.…………………………………………………….
.
Coded by:.……………………………………………………………………………….

Date Coded:.…………………………………………………………………………….

(Farmer interview starts here)

Identification details

1. Province:

……….....…………………………………………………………...……………………….

2. District….……………………………………...

3. Area Status: 1. Rural 2. Urban 3. Peri - urban

4. Name of the farmer (Household head)... ...

(Question 4 to 7 refer to household head)

5. Age of the farmer: { }

6. Sex of the farmer: 1. Male   2. Female

7. Marital Status of the farmer: 1. Single   2. Married   3. Widow

 4. Divorced

8. Village name:.............................Camp................Block.................

9. Name of the respondent if different from household

…………………………………………………………………

10. Relationship with the household head

1. Wife   2. Son/daughter   3. Nephew/niece   4. Brother/sister

11. Type of house   1. Grass thatched   2. Iron sheet roofed

(observed by enumerator)

HOUSEHOLD BIODATA

12. Size of the household

Adult males   ……

Adult females   ……

Children under 16   ……

Total   ……

13.   Household member contribution towards well being of household

Adult males contribution.☐ Adult female contribution ☐…

Children under 16.☐

1 =Income towards purchase of food   2 =Labour in the field   3 =Labour & Income   4 = In kind (gifts, begging) 4 = None

14.   Education level of farmer(Household head)……………..

1 =No formal education   2 = Primary   3 = Secondary   4 = Tertiary

15.   Farming experience in years (Household head)……….

16.   How did you learn about farming (Household head)?………….

1. Agricultural extension   2. NGO   3. Fellow farmer   4.parents
 5. Other (Specify)

17.   What is your most important source of income? …….

1. Agriculture   2. Non-agriculture

18.   List your three (3) most important agriculture source of income in order of Importance…………..

1. Sales of crop produce   2. Sales of livestock   3.Aquaculture
 4. Horticultural produce   5. Other (Specify) ☐ ☐ ☐

19   List your three (3) most important non-agriculture source of income in order of importance

1. Wage labour   2. Trading   3. Tailoring   4. Carpentry
5. Remittances from relatives
6. Donations/gift   7. Other (specify) ☐ ☐ ☐

AGRICULTURE

Farming systems practices

20. What are the crops grown in order of importance

Crop	Rank	Area grown to it last season	Yield per ha

Crop code

01 maize   08 pigeon peas

02 finger millet   09 cow peas

03 cassava   10 sorghum

04 sweet potatoes   11 rice

05 groundnuts   12 Bambaranuts

06 beans

07 soybeans

21. Are you satisfied with your crop yields?   1.Yes   2. No

22. If no why…………………………………………………………….

Farming Systems Practiced

(Question 20 to 24 is for both chitemene and non-chitemene farmers)

23. What cultivation method do you practice?

   1. Conventional (Modern methods where you have permanent fields)

2. Chitemene

3. Both Chitemene and Conventional

24. Type of farming implements used

1. Hoe/Axe

2. Ox drawn implements

3. Tractor

25. Are implements like the hoe able to increase the hectarage?

1. Yes   2. No

26. If No what is the alternative

1. Ox drawn implements

2. Tractor

27. Can you afford to acquire the alternative?

1. Yes   2. No

28. Do you practice Chitemene?

1. Yes   2. No

(Questions 29 to 38 is only for those practicing chitemene)

29. If you practice Chitemene, how big is the field

30. Why do you practice Chitemene?

………………………………………………………………………………………

………………………………………………………………………………………

……………………………..

31. Did you at one time stop practicing Chitemene

1. Yes   2. No

32.   If yes, what was the reason?
      1. Provision of Agricultural inputs 2. Extension advice got
      3. Other (Specify).

33.   Why have you started again?
      1. No input subsidy (fertilizer)   2. Distance to input market far   3. No
      advice from extension officer   4. Other (Specify)……

34.   When did you start chitemene again?

35.   Do you apply any inorganic fertilizer?   1. Yes   2. No

36.   if yes for which fields do you apply?
      1. Conventional fields
      2. Chitemene
      3. Both of the above

37.   What major constraints/problems do you face in your chitemene fields?…………………………………………………………………………
        …………………………………………………………………………
        ………………………………………………………………………….

38.   What do you think would be the best way to improve soil fertility?
      ……………………………………………………………………………
      ……………………………………………………………………………

Land Utilization and Tenure System

(Questions 39 to 88 are for both chitemene and non-chitemene farmers)

39.   How did you acquire your land? …………

     1. Given by traditional leader/headman

     2. Inheritance from parents/relatives

     3.   Purchase   4. Rent

     5.   Other (specify)

40.   Total area of your land in hectares.

        1. Less than 0.5 ha

        2. Between 0.5 and 1 ha

        3. Between 1 ha and 5 ha

        4. More than 5 ha

41.   Area of land under cultivation …………

        1. Less than 0.5 ha

        2. Between 0.5 and 1 ha

        3. Between 1 ha and 5 ha

        5. More than 5 ha

42.   Do you have Title deeds to land? ………

    1. Yes   2. No

43.   Does lack of title deeds affect your chitemene practice?

    1. Yes   2. No

44. How ……………………………………………………………………………

       ……………………………………………………………………………

       ……………………………………………………………….……………

LIVESTOCK

(Both chitemene and non chitemene farmers)

45.   Do **you** own any livestock?   1. Yes   2. No

46. If yes, please provide details

Animal	How many (head)	Estimated Value (MK)	Number dead/stolen last 6 months	Estimated value (MK)	Number sold last six months	Categorized by age/sex	Value (MK

Codes

1. Cattle   2. Pigs   3. Goats   4. Sheep   5. Chickens   6.Ducks   7. Others (specify)

47.   Has keeping of livestock got any influence on your chitemene practice?

         1. Yes   2. No

48.   What influence

            1   Don't practice chitemene because I use manure to improve soil fertility

            2   It has no effect i.e. still practice chitemene

Services

49.   Do you have an extension officer operating in this area?

      1. Yes   2. No

50.   How many times does he visit you per year?

      1. 0nce   2. Twice   3. Three times 4. More than three times

51.   When was the last time the extension officer visited you

52.   Have extension officers provided information/advice on chitemene

      1. Yes   2. No

53.   Has the influenced your decision about chitemene?   1. Yes   2. No

54.   If yes how

      ……………………………………………………………………………….

      ……………………………………………………………………………….

55.   If you receive information from other sources apart from Government extension officer on chitemene, from where do you receive this information?

      1. Radio   2. Neighboring/other farmers   3.   NGO (specify……………   4. Others (specify)

56.   If there are other NGOs, how many are they?

Credit facility

57.   Is there an input (fertilizer, seed) credit facility in the area?

    1. Yes   2. No

58.   Did you get it in the last farming season?

    1. Yes   2. No

59.   If there is a credit facility but did not get any what was the reason?

    1.   Depot for fertilizer is very far from village

    2.   Conditions for credit are not good –Down payment too high

    3.   Other reasons

60.   If you did not get any credit, did you buy inputs for farming for the last season?

        1. Yes   2. No

61.   How much did you spend (If he/she can't remember get No of bags of fertilizer bought)

62.   Does availability of credit facility influence your decision to practice chitemene

        1. Yes   2. No

63.   If yes how does it influence your decision?

                1. Less practice of chitemene

                2. More practice of chitemene

Infrastructure

64.   Distance from village to town (District center)……………………………

65. Distance to nearest road………………………………..

66. Distribution of roads   1. Poor   2. Good   3. Very good

67. Type of roads 1. Tarred road   2. Gravel road   3. Footpaths

68. Transport availability/ frequency of vehicles going to village
   1. Readily available   2. rarely available   3. No vehicles go to the village

69. Market location   1. Within the village 2. very far from village
   (Market in this case means where they buy and sell produce)

70 Type of markets

71. Does distance to the road influence your decision to practice chitemene?
           1. Yes   2. No

72. If yes give reasons
   …………………………………………………………………………………
   …………………………………………………………………………………
   …………………………………………………………………………………

Policy Issues

73. Are you aware of any government regulation concerning the cutting of trees?
           1. Yes   2. No

74. If yes, is it reinforced? 1. Wholly enforced   Not enforced (Reason why…………………………………………………………………………..

…………………………………………………………………………

75.   Do you have a forest officer in the area?

        1. Yes   2. No

76.   Does he visit you?

        1. Yes   2.No

77.   How many times in a year 1. Once   2. Twice   3. More than twice

78.   Does the presence of the Forest officer has influence on chitemene
        practice

        1. Yes   2. No

79.   If yes how has he got influence in the area?

        1. Some people have stopped chitemene

        2. Most people have stopped chitemene

80.   Are there alternative methods to chitemene in the area?

        1. Yes   2. No

81.   What are these?

…………………………………………………………………………………………

…………………………………………………………………………………………

82.   Are these being promoted by Government officers (Forestry and Agric) in
        the area?

        1. Yes   2. No
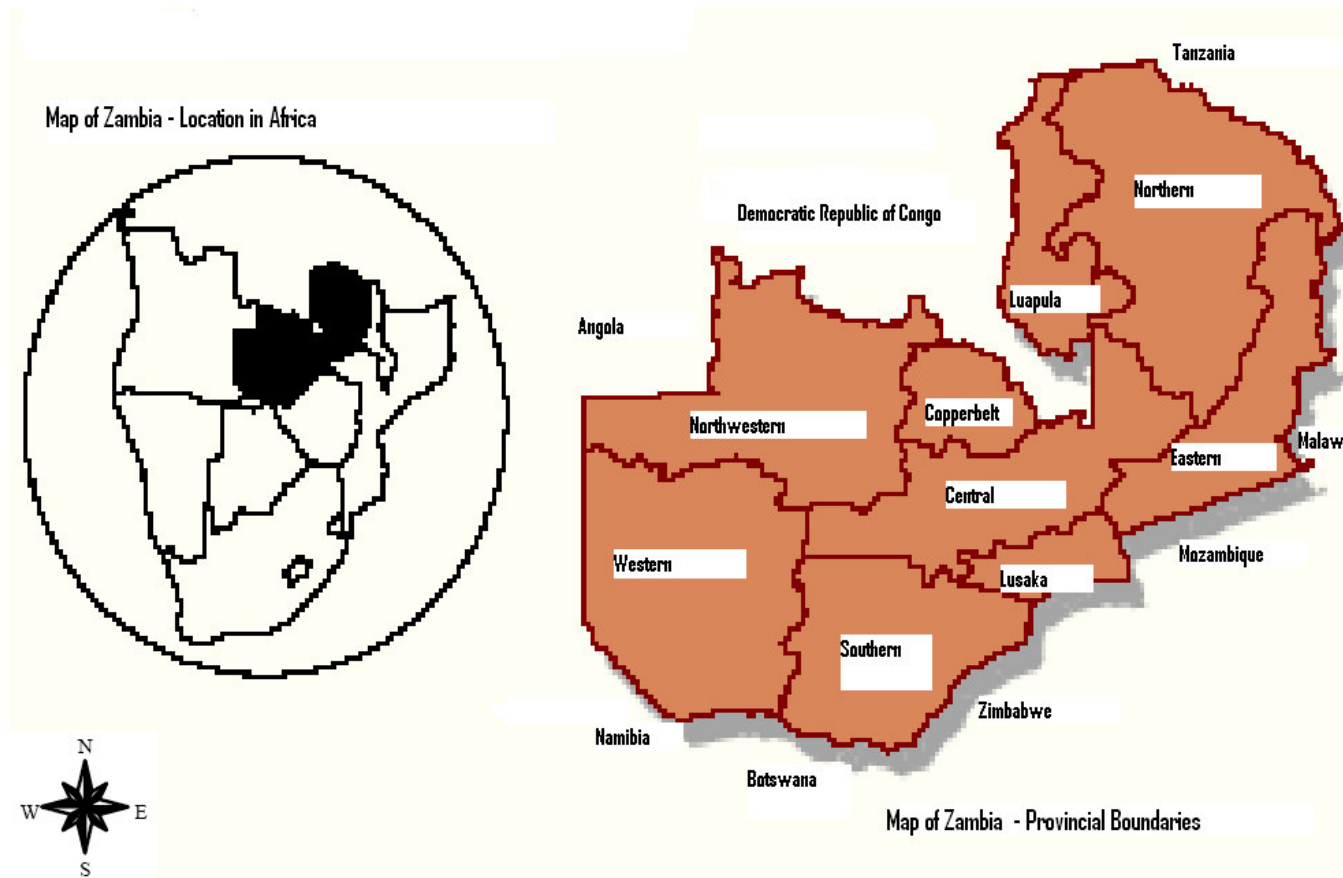

83.   Which ones do Extension officers promote?

        ………………………………………………

95

……………………………………………………

……………………………………………………

……………………………………………………

84.   Which of these have been adopted by the farmers

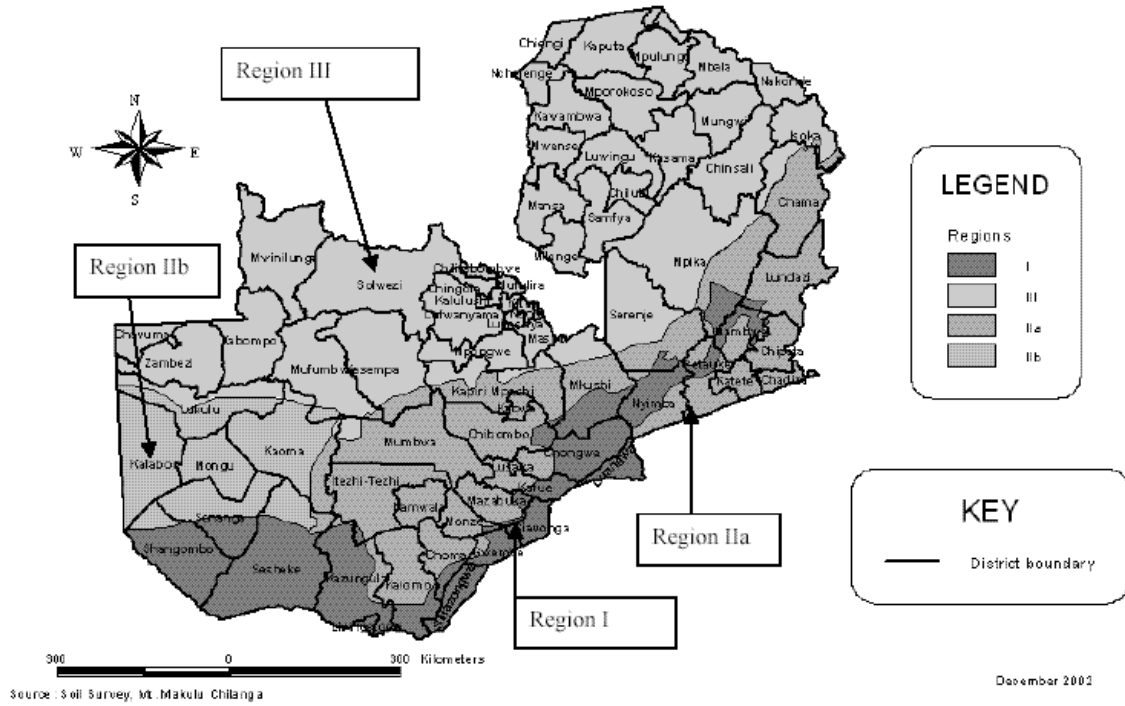………………………………………………………

………………………………………………………

………………………………………………………

Appendix 2: Map showing location of Zambia in Southern Africa and map showing provincial boundaries.

Source –Humanitarian Activities in Zambia National report, 2004

Appendix 3; Map for Agro ecological Zones in Zambia

Appendix 4: List of Key Informants seen.

E. Malauni   - Senior Agricultural Supervisor, Misamfu

R. K. Chikusela(Mrs) - Camp Extension Officer, Misamfu

E. Chawetu   - Camp Extension Officer, Mwamba

B. Chisanga(Mrs)   - Camp Extension Officer, Nseluka

C. Maini   - Camp Extension Officer, Luabwe

Goma H.C   -Kasama District Agricultural Coordinator

Yamanda M.   - Senior Agricultural Officer, Kasama

Phiri S. (Dr)   - Senior Agricultural Research Officer

Mortensen J.   - Forestry Administration Specialist, Forestry Support Programme

Mwamba B. K.   - National Coordinator, Forestry Support Programme

Lungu C.   - Technical Officer, Environmental Policy Development
                       Secretariat

C.L. Mutuna   -Participatory Process Development Officer, Forestry Resource
                       Management Project

Shawa J.J   -Deputy Director – Policy and Planning, Ministry of Agriculture
                       and Cooperatives.