DETERMINANTS OF LIVELIHOOD STRATEGIES AMONG FOREST DEPENDENT HOUSEHOLDS IN MT ELGON REGION, KENYA

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Determinants of Livelihood Strategies among Forest Dependent Households in Mt Elgon Region, Kenya

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DECLARATION

This research thesis is my original work and it has not been submitted for a degree in any other university.

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This research thesis has been submitted for examination with our approval as the university supervisors.

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DEDICATION

I dedicate this study to my parents Joseph and Mary Yego and my siblings for the support and encouragement they gave me during the whole period of study.

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LIST OF ACRONYMS

ANOVA Analysis of Variance

BTS Bartlett's Test of Sphericity

CA Cluster Analysis

CFA Community Forest Association

FAO Food and Agriculture Organization

FD Forest Department

FGD Focus Groups Discussion

FUG Forest User Group

GDP Gross Domestic Product

HH Household Head

KNBS Kenya National Beareu of Statistics

KFS Kenya Forest Service

KMO Keyser-Mayor-Olkin Test

KSH Kenyan Shilling

PCA Principal Component Analysis

RNFE Rural Non-Farm Economy

SLF Sustainable Livelihood Framework

SSA Sub-Saharan Africa

NACOSTI National Commission for Science Technology and Innovation

USD United States of Dollar

NGO Non-Governmental Organization

ABSTRACT

The majority of the world's poor people live in rural areas of low-income countries, and their main source of income is subsistence farming. Low productivity in agriculture and limited access to non-farm income sources, have increased these people's vulnerability to livelihood shocks and stress. In order to respond to these challenges, many rural households diversify their livelihood portfolios to include extraction of environmental resources and non-farm activities. However, the understanding on the choice of livelihood strategies rural households living near forest margins make and their determinants remain outstanding. This is in part because the choice of livelihood strategies rural households make, vary by context, including geographical region and household conditions. While many previous studies have categorized forest extraction decisions as either for survival (for the poor) or for accumulation (for wealthier households), recent evidence has found that the poor can engage in forest extraction for accumulation. The majority of studies also do not take into account heterogeneities in rural household's context based on gender, wealth categories and geographical locations. This study therefore sought to assess the rural households' livelihood strategies and their determinants among forest dependent households in Mt Elgon region, Kenya. The study implemented three interrelated objectives, namely; i) to assess the livelihood strategies employed by rural households in Mt Elgon region, Kenya; ii) to assess the determinants of choice of livelihood strategies among forest dependent households; and iii) to assess the determinants of forest extraction among forest dependent households in Mt Elgon region, Kenya. Multistage, simple random sampling designs were used to select a sample of 924 households from Bungoma and Trans-Nzoia counties in western Kenya. Data was collected through administration of questionnaire, Focus Group Discussions (FGDs) and key informant interviews to the respondents. Quantitative data were then coded, edited and entered in Statistical Packages for Social Sciences (SPSS) and analyzed using Stata version 14 software. The household choices on livelihood strategies was analyzed using Principal Component analysis (PCA) and cluster analysis, whereas the drivers of livelihood strategies were analyzed using Multinomial logit. A Double Hurdle model was also used to evaluate the factors influencing intensity of forest extraction. The findings of the PCA and cluster analysis show that, households engaged in three main livelihood strategies: farming and forest extraction (75.7%), business-based strategies (19.7%) and farming + business + wage employment (4.6%). Institutional characteristics, including access to markets, all-weather roads, education, credit and extension increased the households' diversification to high income generating activities. The findings also reveal that households with lower asset value, membership in forest user associations, lower levels of education, male headed, lower access to credit, and those further away from markets and all-weather roads were more likely to engage in forest extraction. While majority of households in low-wealth category were involved in forest extraction, households in the middle-wealth category extracted relatively higher-value products. Similarly, the study shows that household diversification into forest extraction differs depending on differential access to entitlements, and opportunities as well as incentives and wealth disparities. In order to address the challenges of forest degradation in poor nations, it is critical to incorporate diversification knowledge into forest management strategies. In the view of the above findings, the study

recommends the promotion of formal education, specific safety nets, social networking programmes, social amenities such as all-weather roads and access to credit facilities to promote rural livelihood diversification in rural areas. Additionally, extraction regulations should be enforced to reduce environmental degradation. The findings from this study provide policy insights that will help in putting in place intervention that will strengthen sustainable rural livelihoods among forest communities in Kenya.

CHAPTER ONE

INTRODUCTION

1.1 Background Information

The majority of the world's poor people live in rural areas in low-income countries, relying on subsistence farming and other natural resources for their livelihoods (FAO, 2016). Low agricultural productivity and limited access to non-farm income sources, have increased the vulnerability of these people, who are often poor and living below the poverty line (Adhikari *et al.,* 2004; Zenteno *et al.,* 2013). In response, many households therefore diversify their livelihood strategies to cope with such stresses and shocks (Nguyen *et al.*, 2015).

Diversification of livelihood strategies across rural households commonly include a combination of remittances, business, agricultural activities and exploitation of natural resources (Ellis, 2000). A livelihood strategy is defined as "activities undertaken by households to provide a means of living (Ellis, 2000)." While agriculture is a major source of income in rural areas of developing countries (employing 90% of the population), it faces a number of challenges, including crop failure, imperfections in input and output markets and the inability to cope with unexpected stresses and shocks (Angelsen *et al.,* 2014; Brown *et al.,* 2006; Ellis & Manda 2012). Many rural households are therefore diversifying their livelihood portfolios to include exploitation of environmental resources such as forests, which account for 61 percent of their income (Angelsen *et al.*, 2014).

The distribution of assets and resources is critical in households' choices over which type of livelihood diversification strategy to select and apply (Amevenku *et al.,* 2019; Nguyen *et al.,* 2015). Households create a portfolio of activities by combining assets with activities and choices. According to Apphia *et al.,* (2009) and Babulo *et al.,* (2008), the ability to pursue various livelihood strategies is dependent on the ownership of or access to assets, from which various productive streams and livelihoods are derived. In this sense, rural households' participation in various livelihood strategies reflects their economic choices in the pursuit of a living, based

on asset endowments, household characteristics, and exogenous factors (Ellis, 2000). In Kenya, rural households face variability in resource endowments which constrains the viability and productivity of other forms of livelihoods (Achiba, 2018). Further, the current resource base is inadequate to support agriculture and so the need to avail other livelihood strategies (Gathiaka & Muriithi, 2017).

Forest resources make a significant contribution to livelihoods of poor rural households (Nguyen *et al*., 2015). It is estimated that about 1 billion extremely poor people depend on forests for part of their livelihoods, with 350 million entirely dependent on forests (Belcher, 2003; Dave *et al*., 2019; FAO, 2016). Forests also provide a wide range of goods and services to rural households including food (vegetables and wild fruits), fuelwood, construction materials, plants, fodder, cash income, honey, cultural and ceremonial sites (Ellis, 2000; Velded *et al*., 2004). In addition, they act as insurance in cases of risks and uncertainties, gap filler in cases of shortages and acts as pathway out of poverty to rural households (Heubach *et al*., 2011; Mamo *et al.,* 2007; Paumgarten, 2005). Moreover, they also provide significant ecological services such as: biodiversity conservation and watershed protection (Nguyen *et al*., 2015). However, poor rural households' overdependence on forest resources is often associated to forest resource degradation, which leads to a decline in forest income for the same communities (Angelsen *et al.,* 2011; Nguyen *et al.,* 2015).

Literature identifies two broad motivations for household diversification into forest extraction- push factors (the need for survival or necessity) or pull (diversification by choice or for accumulation) (Ellis, 2000; Imfumu, 2020; Babulo *et al.*, 2008; Mamo *et al.,* 2007; Melaku *et al.,* 2016; Nielsen *et al.,* 2013; Zenteno *et al.,* 2013). This categorization of forest users is based on the idea that poor households are often engaged in forest extraction as means of survival, while participation by their wealthier counterparts is driven by accumulation motives. This argument posits that low-asset endowed rural households are pushed into forest extraction activities to support their current consumption or cope with risks and shocks such as drought and floods (Kaitibie *et al*., 2009; Nguyen *et al.,* 2015). Conversely, better-off households

diversify into forest extraction because of having better capacity by virtue of their high asset endowment (Kimengsi *et al.,* 2019).

The dichotomy of forest users, however, is being challenged by new research demonstrating that some poor households can choose to engage in forest extraction as a means of accumulating wealth (Angelsen *et al.*, 2014; Kimengsi *et al.*, 2019). On the other hand, data suggests that some well-off households can engage in forest extraction to supplement their income or cope with shocks and risks like crop failure and animal epidemics (Kamanga *et al.,* 2009; Melaku *et al.,* 2016). As a result, empirical research on the motivations and drivers of household forest extraction (in terms of either push or pull) is mixed (Babulo *et al,* 2008; Paumgarten, 2005; Zenteno *et al.,* 2013). Despite this knowledge, previous studies have categorized forest extraction decisions as either for survival (for the poor) or for accumulation (for wealthier households) (Babulo *et al.,* 2008; Paumgarten, 2005; Zenteno *et al.,* 2013).

In addition, despite evidence that rural people diversify their sources of income to include environmental revenue, forest extraction is often considered as farm income (Brown *et al.,* 2006; Homewood *et al.,* 2009; Lidestav, 2010). Environmental revenue refers to the income obtained from all the environmental related aspects like land, water and forest with forest income being part of it (Angelsen *et al*., 2011). Similarly, the majority of existing studies on livelihood diversification ignore differences in the nature and extent of forest extraction based on geographical region, gender, and wealth categories (Thondhlana and Muchopondwa, 2014; Uberhuaga *et al.,* 2012; Zenteno *et al.,* 2013). Extent of forest extraction is the measure of the value of forest products extracted by households and it can show how households differ with regard to their levels of extraction.

1.2 The context of Forest-based Livelihoods in Kenya

Kenya's forest cover has declined by 12400 hectares per year between 1990 and 2015 (FAO, 2018). The rising degradation rates have been in part because of the increase of human population which has led to increased human activities around the

forest. The ongoing forest degradation is set to interfere with human livelihoods as well as the natural biodiversity. Due to high rate of forest loss, government and policy makers are now working towards achieving the 10% forest cover. In order to address the challenges of forest degradation, the government has formulated policies that allow the transfer of management of forests to local forest depended communities (Kimutai & Watanebe, 2016). This strategy has been implemented in Kenya through participatory forest management (PFM), which began after the enactment of the Forest Act (Kenya Forest Act, 2005). Its main aim was an attempt to establish community participation in the co-management of gazetted forests. The act calls for the formation of Community Forest Associations which allows the forest depended communities to extract forest resources and at the same time manage forests in association with the Kenya Forest Service which is the state agency in charge of protected forests (Chomba *et al*., 2015). The extraction of forest products by communities is accompanied by responsibilities such as; establishing plantation forests, firefighting and protecting sacred groves for sustainable forest management in general (Kenya Forest Act, 2016).

Majority of studies in the Kenyan context have looked at diversification of livelihood strategies and forest extraction activities (Brown *et al*., 2006; Lagat *et al*., 2016; Maua *et al*., 2018; Mutaki, 2018; Musyoka *et al*., 2019). The studies show that households diversify their livelihood strategies to include a combination of remittances, business, agricultural activities and exploitation of natural resources. Further, the studies reveal that forest resources contribute to rural livelihoods through provision of food (vegetables and wild fruits), fuelwood, construction materials, plants, fodder, cash income, honey, cultural and ceremonial sites (Ouko *et al*., 2018; Waruingi *et al*., 2021).

Even in similar context, studies done on rural livelihood diversification consider forest extraction as part of agricultural income (Brown *et al*., 2006; Homewood *et al*., 2009). Further, most of the studies done on forest extraction ignore differences in the nature and extent of forest extraction based on geographical region, gender, and wealth categories (Lagat *et al*., 2016; Maua *et al* 2018; Mutaki, 2018; Musyoka *et al*., 2019). It is therefore critical to understand rural livelihood strategies and the

determinants of intensity of forest extraction for designing rural livelihoods and achieving sustainable resource management. Intensity of extraction is the measure of how far the households can go in terms of the value of extraction of forest products which is used interchangeably with extent of extraction. This study responds to these gaps by examining rural households' livelihood strategies as well as the nature, extent and determinants of forest extraction decisions in Mt Elgon, Kenya. The findings will play an important role for designing sustainable rural livelihood strategies (Babulo *et al.,* 2008; Mai *et al.,* 2011; Zenteno *et al.,* 2013). Apart from analyzing the choice of rural households' strategies, understanding the determinants driving them is equally essential for policies seeking to improve rural livelihoods. Exploring the choices of rural households' livelihoods, determinants of livelihood diversification and the heterogeneities in rural household contexts is important to inform future policies and interventions for livelihood enhancement and ecological conservation (Maua *et al,* 2018; Nguyen *et al.,* 2015; Wunder *et al.,* 2014).

1.3 Statement of the Problem and Justification

Rural households in developing countries diversify their livelihood options. In Kenya, households diversify their livelihood strategies to cope with shocks and stresses facing agriculture. Forest extraction is one of the livelihood sources that has captivated the interest of scholars, and it plays a significant part in rural households' livelihoods in most developing nations. Over 1 billion people worldwide rely on forests for food, medicinal products, fuelwood, construction materials, and timber, while about 200 million indigenous tribes rely on forests as their natural home (FAO, 2016).

Despite of the evidence that rural households diversify their livelihood sources to include forest extraction, there is a gap in understanding regarding the choices of livelihood strategies since forest extraction is considered as farm income in previous studies (Brown *et al*., 2006; Homewood *et al*., 2009). Furthermore, the majority of studies also do not take into account heterogeneities in rural household's context based on geographical region, wealth disparities and gender (Thondhlana and Muchopondwa, 2014; Uberhuaga *et al.,* 2012; Zenteno *et al.,* 2013). This study fills

in the gaps by examining rural households' livelihood strategies, as well as the nature, extent, and determinants of intensity of forest extraction among forest dependent households in Mt Elgon, Kenya. It is critical to understand rural livelihood strategies and the determinants of forest extraction decisions for designing rural livelihoods and achieving sustainable resource management.

1.4 Objectives

1.4.1 Main objective

To assess the determinants of choice of livelihood strategies among forest dependent households in Mt Elgon region, Kenya.

1.4.2 Specific objectives

To assess livelihood strategies employed by forest dependent households in Mt Elgon region, Kenya

To assess the determinants of the choice of livelihood strategies among forest dependent households in Mt Elgon region, Kenya

3. To assess the determinants of intensity of forest extraction among forest dependent households in Mt Elgon region, Kenya

1.4.3 Hypothesis

1. The household asset base does not influence the choice of livelihood strategies employed by rural households

2. There are no significant differences in the intensity of forest extraction based on wealth categories and institutional characteristics

1.5 Significance of the Study

Understanding the choice of rural households' livelihood strategies will enable the poor rural households make the right choices of livelihood strategies. Understanding the determinants of livelihood strategies will also provide useful insights to policy makers and other relevant stakeholders concerned with the rural economy. Further, the results of choice of income generating activities will play a key role to NGOs and other agencies involved in supporting rural livelihoods by improving response mechanisms related to poverty and promote sustainable livelihood outcome in the study area. The study would additionally benefit the local and national government on the interventions concerning development of rural economy by coming up with strategies that will enable rural households to reconstruct their livelihoods for example improvement in infrastructure. The findings on the determinants of intensity of forest extraction also play a role in guiding the conservation agencies like Kenya Forest Service on the measures to be put in place in order to conserve the forest resources. The findings would further benefit the CFA officials by giving them insights on strategies to be put in place concerning the use of forest resources like firewood through ensuring that households join forest user groups. The methodologies used in the study contribute to the research and academic community by providing current empirical evidence on forest extraction and rural livelihood strategies which will be used in further research in the same field.

1.6 Scope and limitation of the study

The scope of this study was Mt Elgon region and aimed to evaluate the livelihood strategies undertaken by forest dependent households and their determinants. The study targeted all households living 5Km radius adjacent to Mt. Elgon forest. The study used a one-year recall period to obtain key information regarding forest dependence and livelihoods. The scope of the study covered three forest stations that were closer to the forest namely, Saboti, Kimothon and Kaberwa.

1.7 Organization of thesis

The thesis is organized into five sections. Chapter one presents the background, problem statement, objectives, hypothesis, and significance of the study. The second chapter examines theoretical and empirical literature, as well as the knowledge gap and conceptual framework. Chapter three presents the methodology, information on the study region, data sources, and data collection methods employed in the study. Chapter four presents the findings and discussion of the research. Chapter five entails the summary, conclusion and recommendations of the research.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

The theoretical and empirical literature for the study is presented in the chapter. The theory on which the study is based is outlined in Section 2.2, and the available literature relevant to the study is presented in Section 2.3. The summary of literature and knowledge gap are presented in part 2.4, while the conceptual framework is presented in section 2.5.

2.2 Theoretical Literature

This study is based on the theory of household utility maximization.

2.2.1 Theory of Household Utility Maximization

The theory of household utility maximization is used to evaluate livelihood possibilities (Singh *et al.,* 1986). According to the household utility maximization theory, a rational household makes decisions based on a set of options (livelihood strategies) that maximize its utility levels. Households are allowed to rank alternatives (livelihood strategies) in order to select the one they prefer. A random utility on the other hand is based on stochastic preferences in that an individual is assumed to draw utility function at random on each choice which makes the theory of household utility maximization the efficient theory to be used in this study. Thus, households make comparisons of net benefits generated from various livelihood strategies with an objective of maximizing utility over income (Brown *et al*., 2006). Since the income of the household is determined by the livelihood option that is selected, faced with alternative livelihood options (agriculture, wage employment, business and forest extraction), a utility maximizing household will (given its technology and preferences) select the option that will give the highest utility. Based

on the above scenario, households will therefore allocate different assets to various livelihood strategies that maximizes their utility levels. Furthermore, any households found to have chosen a lower-return livelihood strategy must have been constrained in their choice of the dominant option. The objective function of the household is therefore to maximize utility subject to income constraint (De Janvry *et al*., 1991) as shown:

$Max\ U\ (x_1 x_2)$

2.1

Subject to

$p_1 x_1 + p_2 x_2$=M

2.2

The Lagrangian equation can be written as:

$L = u(x_1 x_2) + \lambda\ (M - p_1 x_1 - p_2 x_2)$

2.3

The first order conditions given the optimal demand functions that maximizes utility levels as shown:

$\frac{\varphi L}{\varphi x_1}$= $\frac{\varphi U(x_1 x_1)}{\varphi x_1} - \lambda p_1$=0

2.4

$\frac{\varphi L}{\varphi x_2}$= $\frac{\varphi U(x_1 x_2)}{\varphi x_2} - \lambda p_2$=0

2.5

$\frac{\varphi L}{\varphi \lambda} = p_1 x_1 + p_2 x_2 - M = 0$

2.6

Where $p_1$is the price of goods, x_1 is the quantity of good 1, p_2 is the price of good 2, x_2 is the quantity of good 2 while M is the consumers income. A household chooses

a bundle of goods that will maximize the utility given a budget constraint. The indirect utility which gives the maximum utility is achieved at given prices and incomes and can be stated as:

$V(P1, p2, M)$
2.7

The level of utility achieved when $x1(p1, p2, M)$ is chosen thus will be the highest level permitted by the consumers budget constraint facing prices $(p1, p2)$ and M. The discussion on how household allocate their assets to different livelihood strategies is further explained in the conceptual framework (Fig 2.1).

2.3 Empirical literature

This section presents the empirical literature. First, previous studies of various livelihood strategies undertaken by households and their determinants are outlined. Second, studies that evaluate the determinants of intensity of intensity of forest extraction are provided.

2.3.1 Assessing household livelihood strategies

Majority of households in sub-Saharan Africa (SSA) rely on smallholder agriculture to sustain their livelihoods (FAO, 2016). The GDP's of many SSA countries is reflected by the direct contribution of the agricultural sector which entails crops, forestry, livestock and fisheries Majority of smallholder households produce a large portion of the household's food basically for consumption purposes (FAO, 2016). Agricultural production in Africa is also undertaken in a small scale (FAO, 2011). Most the smallholder farmers also depend on labour provided by family members in production. Literature has indicated that land size and family labour are the main determinants of agricultural production in rural areas (Brown *et al.,* 2006; Ellis, 2000).

Despite the fact that subsistence farmers in Africa rely on agriculture for sustenance and monetary revenue, research shows that they also engage in rural non-farm

activities (Brown *et al.,* 2006; Ellis, 2000; Mamo *et al.,* 2007). Rural families gain from non-farm work in a range of ways. It aids as a way of risk mitigation and risk management, including provision of revenue and handling regular demand changes (Babulo *et al*., 2008; Uberhuaga *et al.,* 2012; Thondhlana and Muchopondwa, 2014). Access to markets is a key factor in a household's transition to a non-farm economy in rural areas. Closer proximity to markets allows households to take advantage of opportunities.

Recent studies have also shown that households combine various livelihood strategies to cope with shocks and risks. In order to attain their livelihood goals, households pick from a variety of livelihood strategies (Homewood *et al.,* 2009; Zenteno *et al.,* 2013). In some prior studies, total income was utilized to analyze rural households' livelihood strategies (see for example Nielsen *et al.,* 2013). This method is however exposed to stochastic nature of income which could introduce some variation in superficial income reliance year to year. As a result, some recent research has proposed a new strategy to account for the many activities that households engage in and the nature of their outcomes (Nguyen *et al.,* 2015). Rather than utilizing relative income shares, the research evaluated income strategies based on households' asset allocations to various income-generating activities. The term "livelihood strategy" refers to the mix of assets and activities. Recent studies have also shown that principal component analysis and cluster analysis can be used to group livelihood strategies that households undertake (Nguyen *et al*., 2015; Mamo *et al*, 2007). Cluster analysis is a calculation data decrease process that condenses a large sum of sample data by allotting them to a minor number of distinct sets of clusters with a small number of controlled clusters. The method assumes that there are specific characteristics that allow single observations to be grouped into a small number of groups based on resemblance along specific pre-determined proportions. In Kenya, the main source of income for rural households is agriculture (GOK, 2010). The sector contributes to 24% of Gross Domestic product (GDP) and 60% of overseas exchange earnings (GOK, 2014). However, just like SSA countries, households in rural areas in Kenya have diversified their income generating sources to either survive or accumulate wealth (Brown *et al*., 2006).

For example, studies such as Brown *et al.,* (2006) identified five clusters of livelihood strategies using cluster analysis in rural highlands of Kenya. The first cluster entailed the "subsistence smallholder" who were mainly unskilled and had smaller lands. The second was the "mixed smallholders" who had average employment in unskilled off-farm work. The next was the "staple producers" that grew both perennial and annual food crops. "Off-farm skilled employment" was the fourth and they mainly relied on skilled off-farm employment as well as kept many small ruminant animals. The last was the "diversified commercial" which grew less food crops and mainly engaged in cash crop production.

Further, Nguyen *et al.,* (2015) in their study on ''Rural livelihoods and environmental resource dependence in Cambodia'' assessed income sources employed by rural families together with their determinants. The following categories of livelihood groups were identified: "low-skilled/non-permanent wage employment and farming" (38%), "environmental resource extraction and farming" (32%), and "high-skilled/permanent wage employment and/or self-employment and farming" (30%).

On the other hand, Nielsena *et al.,* (2013) identified the livelihood strategies as 'small scale- farmers' (because of low mean values of all activity variables), 'large scale farmers' (because of the engagement in higher activities as compared to cluster 1), 'off-farm workers' (those engaging in non-farm activities), 'livestock producers and off-farm workers'(those who rear animals and engage in non-farm activities), and 'off-farm workers and business operators' (those who engage in non-farm activities and business related activities).

In conclusion, sustainability of rural households' livelihoods strategies require a clear understanding of households' engagement in various income generating activities. Given the diverse activities engaged by a household, it is not always clear what establishes a distinct livelihood rather than just a slightly different mix of activities within the same general livelihood. This study utilized the Principal Component Analysis (PCA) and Cluster Analysis (CA) to assess the various livelihood strategies undertaken by rural households in Mt Elgon region, Kenya.

2.3.2 Assessing determinants of household livelihood strategies

Studies have suggested that natural (size of land and distance to forests, physical (access to infrastructure), financial (access to credit), social (membership to groups) and human (age, gender and education) capital assets are key factors that determine livelihood options (Babulo *et al.,* 2008; Nielsena *et al.,* 2013; Nguyen *et al.,* 2015). Household education level is a crucial factor which influences livelihood diversification activity. The most educated households in the society are able to access opportunities that pushes them to engage into higher income generating activities, while the low-educated households engage in to low income generating returns (Babulo *et al.,* 2008; Nielsena *et al.,* 2013; Nguyen *et al.,* 2015).

Regarding gender, female headed households are discriminated against in employment and face time constraints which reduces their likelihood to engage in livelihood diversification (Maua *et al.,* 2018). Further, households closer to markets have more opportunities to diversify into non-farm activities than households located in remote villages (Imfumu, 2020; Kimengsi *et al.,* 2009). Close proximity to marketplaces lowers transaction costs, allowing for livelihood diversification into higher-income-generating activities. The household size id one of the factors which determines the capacity of rural populations to offer labor in livelihood diversification (Ellis and Manda, 2012). Due to this, larger household sizes which constitutes more male members are more likely to engage in diverse livelihoods due to their ability to possess more physical energy in terms of calorific energy.

In conclusion, research has found that families diversify their income sources depending on the kind of assets they can access. The assessment of factors influencing the income generating activities maybe an important approach for policy makers in augmenting sustainable rural incomes. However, most studies have not deliberated heterogeneities of rural households' context depending on wealth variation, geographical region and gender. This study therefore uses the Multinomial Logit model to assess the determinants of livelihood strategies in Mt. Elgon region, in Kenya.

2.3.3 Determinants of intensity of forest extraction

The literature has implied that diversification of income generating activities is a common activity among majority of rural households in developing countries (Ellis, 2000; Kimengsi *et al.,* 2019; Nguyen *et al.,* 2015). The determinants of various income generating activities such as; farming or non-farming, wage employment or self-employment, are diverse and are linked with both positive and negative results (Babulo *et al.,* 2008). The literature also largely concurs that diversification of livelihoods takes many diverse forms and can be employed to aid in spreading of risks, coping with shock or accumulation of wealth (Lax and Kothke, 2017; Maua *et al.,* 2018; Nguyen *et al*., 2020; Wunder *et al.,* 2014).

Livelihood diversification is an adaptive rejoinder to longer-term deteriorations in income or privileges due to solemn economic or environmental changes outside local control (Nguyen *et al.,* 2015). This recognition has led majority of scholars to denote rural livelihoods as built from a collection of resources and activities that are trailed via a variety of alternatives that are by nature specific to the local context (in relation to natural resources, resources available, culture, climate etc.) (Babulo *et al.,* 2008; Ellis, 2000; Nguyen *et al.,* 2015). This thesis focuses on forest extraction which is one of the livelihood source that is gaining massive interest in literature (Angelsen *et al.,* 2011; Nguyen *et al.,* 2015; Wunder *et al.,* 2014).

Most current findings on forest extraction offer sufficient acknowledgement on the contribution of forest resources in nourishing the incomes of rural families through provision of numerous goods and services including wild food, medicinal products, timber, fodder and cash income (Pouliot *et al.,* 2013; Wunder *et al.,* 2014). The preceding research findings indicate different groups of forest dependent households and show that some people engage in forest extraction because of lack of an options, while others do so by choice, which is linked to other livelihood diversification results (Babulo *et al.,* 2008; Mamo et al., 2007; Melaku *et al.,* 2016; Nielsen *et al.,* 2013; Zenteno *et al.,* 2013). This difference could be explained by the belief that poor households harvest forest resources to survive, but wealthier households do so to amass wealth. Recent data suggests, however, that some low-income households

may opt to harvest forest resources in order to build wealth, while their counterparts may do so in order to cope with risks and uncertainties such as animal diseases and crop failure (Angelsen *et al.,* 2014; Melaku *et al.,* 2016). Hence, the findings on the determinants of forest extraction are mixed and inconclusive.

Apart from considerations on asset endowment, the other key drivers of forest extraction recognized in literature include; institutional and environmental variables such as market access, tenure arrangements, transaction costs and cultural norms (Babulo *et al*., 2008; Fisher, 2004; Lax and Kothke, 2017). According to studies, transaction expenses associated to the market or all-weather roads have a negative impact on forest extraction decisions and intensity (see for example Thondhlana and Muchopondwa, 2014). Studies therefore suggest that better infrastructure could motivate households to undertake alternative livelihood sources. Access to extension services and finance facilities are crucial elements that may impact the extent to which forest extraction is carried out. People that have access to monetary resources as well as awareness and skills are most likely to undertake higher remunerative activities than their counter parts (Paumgarten, 2005).

The high demands of farm materials could force households with large lands to engage in forest extraction (Babulo *et al*., 2008). On the other hand, they may not also engage in forest extraction due to the high income obtained from agricultural production (Zenteno *et al*., 2013). But beyond the generic recognition in literature, the relative role of these factors is not well understood or well-articulated. Overall it is evident that diversification strategies including those in forest extraction are complex and vary in arrangement and degree by wealth differences and distinct access to opportunities, various socio-economic factors, constraints and various prospects.

In conclusion, previous studies have categorized forest extraction decisions as either survival (for the poor) or for accumulation (for wealthier households). However, recent evidence has found that the poor can engage in forest extraction for accumulation. The study therefore uses the Double Hurdle model to assess the determinants of intensity of forest extraction in Mt Elgon in Kenya.

2.4 Summary of review and research gaps

The theoretical literature reviewed in this study is theory of household utility maximization. The theory of household utility maximization postulates that households engage in income generating activities that will maximize utility given market, environmental and income constraints. The review of household utility maximization theory served as a theoretical foundation for modeling the determinants of livelihood options.

Despite of forest resources being an important source of livelihood to rural households, previous studies on livelihood diversification consider forests to be part of agricultural income, resulting in their underestimation (Brown *et al.,* 2006; Nielsen *et al.,* 2012; Zenteno *et al.,* 2013). Additionally, previous studies have categorized forest extraction decisions as either survival (for the poor) or for accumulation (for wealthier households). However, recent evidence has found that the poor can engage in forest extraction for accumulation (Lagat *et al*., 2016). Further, studies have not considered heterogeneities of rural households' context based on geographical region, wealth disparities and gender. This study utilized the Principal Component Analysis (PCA) and Cluster Analysis (CA) to assess the various livelihood strategies undertaken by rural households in Mt Elgon region, Kenya. Additionally, the Multinomial Logit model was employed to analyze the factors influencing the income generating activities in Mt Elgon region in Kenya. Lastly, a Double Hurdle model was employed to assess the factors influencing the intensity of forest extraction in Mt Elgon region in Kenya. The findings of this study were important to policy makers in enhancing sustainable rural livelihoods.

2.5 Conceptual Framework

In this study, the sustainable livelihood framework was used to characterize the livelihood activity choices made by rural households (Scoones, 1998). A livelihood is defined as a way of life's capabilities, assets, and activities. The livelihoods framework offers a broad and sophisticated method to comprehending how people create a living. It can be used as a loose guide to a range of issues which are

important for livelihoods (Barret *et al.,* 2005; Ellis, 2000). The framework has been used to emphasize understanding of the context within which people live, the assets available for them, livelihood strategies they follow in the face of existing policies and institutions, and livelihood outcomes they intend to achieve (Babulo *et al.,* 2008, Ellis, 2000). However, this study used SLF with a particular focus on the aspects livelihood platforms and livelihood strategies and livelihood outcomes (survival and wealth accumulation) to provide understanding on how rural households allocate various assets to different income generating activities to achieve their livelihood goals. Natural capital, which is the natural ecosystems available to the home and produces a flow of valuable ecosystem goods and services, is included in the livelihood platforms.

Other household capital is divided into four categories: physical capital, human capital, financial capital, including remittances, and social capital, such as social network integration (Zenteno *et al.,* 2013). These many forms of capital serve as the foundations for a household's livelihood strategy, which consists of a mix of assets and activities. Survival and wealth accumulation are examples of positive outcomes. A household's assets can be allocated to a variety of activities, including environmental resource extraction (forest product collection and fishing), agricultural production (crop production and livestock rearing), non-farm self-employment (cottage industry or small-scale trade), and permanent or temporary off-farm wage employment (Nielsen *et al.,* 2013). The livelihood sources chosen by households has a set of each outcomes, such as survival and wealth accumulation. The conceptual framework of this study is as shown in figure 1.

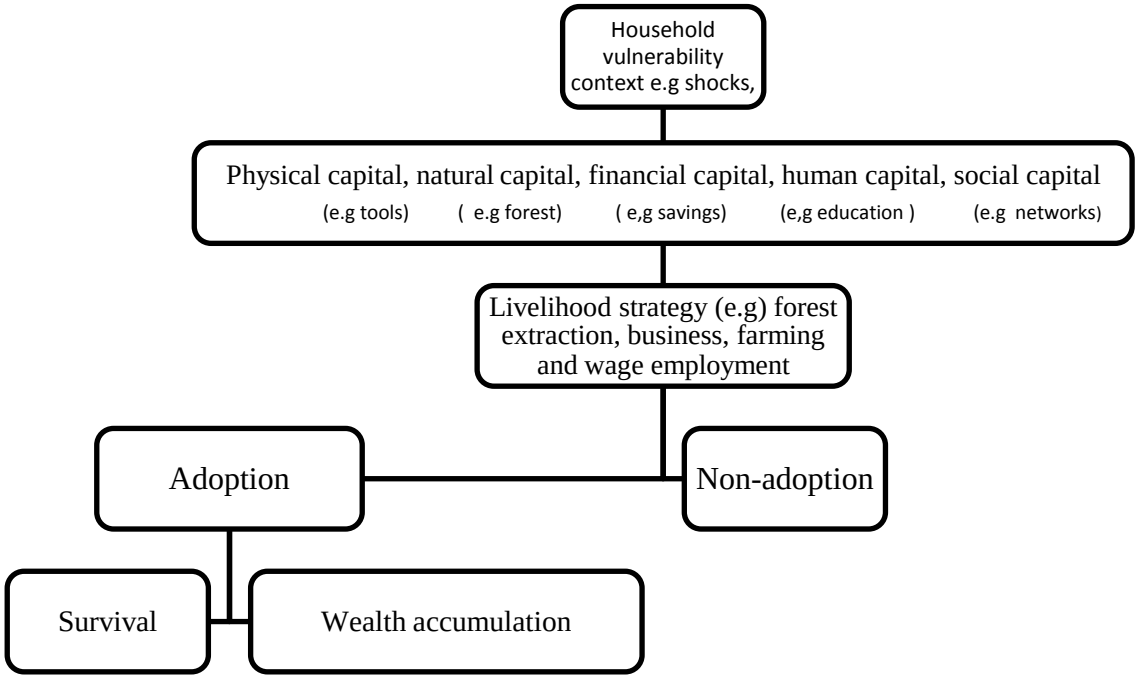

Figure 2.1: Household livelihood strategies

Source: modified from Nguyen et al., 2015

CHAPTER THREE

METHODOLOGY

3.1 Introduction

This chapter presents the methodology of the study. Section 3.2 presents the research design of the study. Section 3.3 entails theoretical framework on which the

study is built. Sections 3.4, 3.5 and 3.6 outline the empirical model specification, the definition and measurement of variables and the study site respectively. Sections 3.7, 3.8, 3.9 and 3.10 provide the target population and sample size, sampling procedure, data type and sources and data collection instruments respectively. Sections 3.11-3.14 present the reliability testing, the validity of the study, data analysis application and ethical considerations respectively.

3.2 Research design

The study employed a descriptive research design to address its objectives. The design was preferred over the experimental design for two reasons. First, it describes what naturally occurs at certain period and two it does not provide room for the researcher to control any aspect of the situation under study hence it is not manipulative (Kothari, 2004). The findings of the data were useful in making inference to a large population.

3.3 Theoretical Framework

The study is based on the theory of household utility maximization framework (Singh *et al.*, 1986). The theory considers a farm household that makes consumption and production decisions together to maximize utility. Utility is maximized subject to a set of constraints which would include production technology, time and cash income constraints. Hence, the objective function of the household is to maximize utility from livelihood strategies (X), market and non-market goods (Z_i) and leisure (L) subject to income constraints as shown in equation 3.1.

$$MAX\ U = U(X, Z_i, \quad \text{L}) \tag{3.1}$$

Subject to income constraint

$$GpQ^C + WL_w + S = E \tag{3.2}$$

Where, Gp is the market price for home produced goods, Q^C is the quantity of home produced goods, W is the wage rate for labour, L_w are the hours spent in wage labour and S represents other income sources. The income constraint indicates that income derived from various sources cannot exceed household expenditure.

When faced with risks and uncertainties, the household diversifies its portfolio of activities to meet their livelihood goals. Given the household characteristics and various capitals such as human (household size, education level), social (membership to forest user groups and farmer groups), natural (distance to the forest and land size), physical (value of assets) financial (savings), the household has to decide whether to adopt a certain livelihood strategy (X) or not. The first order conditions of the Lagrangian functions will give the optimal choices which are the livelihood strategies in this case. The indirect utility obtained from adoption of livelihood strategies can be written using the decision prices as follows where P_m is price for market goods, P_g is price for home produced good and Z_i represent factors that explain transaction costs such as costs of transport.

$$V^p = V(P_g, P_m, Z_i) \quad 3.3$$

$$V^N = V(P_g, P_m, Z_i) \quad 3.4$$

It is assumed that a household will compare the levels of utility from adoption and non-adoption of livelihood strategy and choose to adopt to a certain livelihood strategy if $V^p > V^N$. Households make comparisons of net benefits generated from various livelihood strategies with an objective of maximizing utility over income (Brown et al., 2006). Households will choose to allocate their assets and resources on livelihood strategies which maximizes utility.

3.4 Model specification per objectives

3.4.1 Assessing livelihood strategies

In order to assess livelihood strategies undertaken in Mt Elgon, the study employs multivariate analysis to examine household-level data from forest dependent households of Mt. Elgon, Kenya. Firstly, a principal component analysis was conducted to reduce the data sets into smaller and non-correlated components. The reduction thus shortens the dimensions while retaining the original information. PCA describes the difference between the correlated variables using smaller sets of uncorrelated variables (Chatterjee *et al*., 2015). PCA is guided by the assumption of data interdependence normality, matrix factorability, and sampling adequacy. The factors were rotated using the varimax method, and highly correlated variables were put under each factor. All factors with an eigenvalue of above one were retained and explained. In this case 6 components were retained.

A two-step clustering method was adopted, namely: hierarchical and partitioning clustering, to establish the number of clusters. The method was used due to its ability to automatically select clusters and create clusters based on categorical and continuous variables. As eminent in prior studies, summarizing the data through PCA is a significant step before applying the CA to the data set. Prior to undertaking the PCA approach, the Bartlett's test and the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy were executed to assess the suitability of the variables to be utilized as inputs to the Principal Component Analysis (PCA) approach. The null proposition that the inter-correlation matrix initiates from a population in which all of the variables to be utilized in the PCA are non-collinear is tested using Bartlett's test of Sphericity (BTS). On the other hand, the KMO test compares the correlations and the partial correlations between the variables with a smaller KMO suggestive of highly correlated data (Suhr, 2006). Also to simplify the interpretability of the PCA results the components were rotated using the Kaiser normalization applicable when the number of variables does not exceed 30, which is the case with the analyzed data. This approach has also been applied in the recent and related studies (Nguyen *et al.,* 2015). The resulting Principal Components (PCA) components were then used as the

inputs to the Cluster Analysis (CA) to typify the different clusters of households in the data set. Additionally, a one-way analysis of variance (ANOVA) was conducted by the study to identify the alterations in variability between the obtained groups. This method allows for the identification of distinguishing characteristics among the clusters (Jolliffe *et al.*, 2016).

3.4.2 Determinants of livelihood strategies

After that, a multinomial logit model was used to determine the likelihood of a household belonging to a certain livelihood cluster. Unlike the binary probit or logit models, which are limited to a maximum of two choice categories, the multinomial logit model allows for discrete choice analysis when the result variable includes more than two unordered categories (Greene, 2003). As a result, the dependent variable could represent a variety of distinct outcomes, each with its own cluster number derived from the study analysis. The coefficients of independent variables were interpreted as factors that increased or decreased the likelihood of belonging to a specific cluster.

Mathematically, the probability to be part of a livelihood strategy can be represented on,

$$p_{ij} = \beta_0 + \beta_1 X_1 + \cdots + \beta_k X_k + e$$

3.5

Where p_{ij} represents the choice of livelihood methods (farming and forest extraction=1, business strategies=2, farming, business, and wage employment=3). The factors influencing the choice of livelihood strategies are represented by Xi, the parameters to be estimated by β, and the error term by e. The probability of choosing is given by

$$\Pr ob = (Y_1 = j) = \frac{e_{zj}}{\sum_{k=0}^{j} e_{zk}}$$

3.6

Where Z_j represents a choice and Z_k represent the alternative choice that could be chosen by the household (Sigei *et al*., 2014). The model estimate is used to determine the probability of choice of a livelihood strategy given j factors that affect choice X_i. With a number of alternative choices, coefficients will be computed as follows,

$$\ln\left(\frac{P^{ij}}{p^{ik*}}\right) = \propto + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_k X_k + e_i$$

3.7

where P_{ij} and P_{ik} are probabilities that a household will choose a given livelihood strategy and alternative livelihood respectively. $\ln(\frac{P^{ij}}{p^{ik*}})$ is the natural log of probability of choice of j relative to probability choice k, $\propto$ is constant, β is the matrix of parameters that reflect the impact of changes in X on probability of choosing a given livelihood strategy and e is the error term which is independent and normally distributed. The direction of the influence of the independent variable on the dependent variables is only shown by parameter estimates of the multinomial logit model, and the estimates do not represent the actual size of the change or the probability. The marginal effects are therefore used since they not only show the direction of influence, but show the magnitude of the change of the independent variables. (Greene, 2003). The marginal effect of the model can be obtained by getting a differential of probability of a choice as shown below

$$(\delta) = \frac{\delta P_i}{\delta X_i} = pi(\beta_j - \sum_{k=0}^{j} P_k \beta_k) = P_i(\beta_j - \beta)$$

3.8

Therefore, multinomial logit model will be;

$$P_{ij} = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_t X_t + e_i$$

3.9

$$(P_{ij}) = \beta_0 + \beta_{1N} + \beta_{2H} + \beta_{3P} + \beta_{4F} + \beta_{5S} + \beta_{6SK} + \beta_{7Vi} + e_i$$

3.10

Where P_{ij} represents the households' chance to be part of a given livelihood cluster which is a dependent variable in this case the livelihood strategy. Independent variables are the various capitals in the livelihood platform i.e. N is the natural capital (Distance to the forest and land), *H* is the human capital (level of education, household size), *P* is the physical capital (access to infrastructure), F is the financial capital (access to credit) and S the social capital (membership to groups). SK represents shocks faced by households in the past 5 years such as death of animals, death of a reproductive household member and sickness while e is the error term, β_0 is the constant and $\beta_1, \ldots, \beta_7$ are the coefficients to be estimated by the model.

3.4.3 Determinants of intensity of forest extraction

A Double Hurdle model was employed by the study to assess the factors influencing intensity of forest extraction. The intensity of extraction was measured in terms of the value of forest products collected. The value of forest products was derived from the market prices and actual cost (e.g transportation cost or fee payable) incurred in extraction. The two-step Heckman model was used to estimate the robustness and it showed results which are almost similar as shown in appendix A3. The choice of the Double Hurdle model was based on the assumption that the household's forest extraction decisions follow a two-step sequential process. First, a household chooses whether to extract forest products or not. Second, a household then decides the intensity at which to engage in forest extraction. The model combines both a binary Probit with a Tobit model (equation 3.11 to 3.13), which allows the simultaneous analysis of two sequential household decisions on forest extraction:

$$Y_1 = \beta_0 + \beta X_i + \varepsilon$$

(3.11)

$$Y_1 = \{1\ if\ participates\ 0\ if\ otherwise$$

(3.12)

$$Z_1 = \beta_0 + \beta X_i + \varepsilon$$
(3.13)

Where Y_1 is the decision to engage in forest-based livelihood activities while X_i is a vector of variables such as socioeconomic characteristics, demographic characteristics, asset endowment, institutional characteristics and shocks hypothesized to influence the household forest extraction decisions. The intensity of forest extraction is denoted by Z_1 while β is vector representing the parameters to be estimated and ε is the error term.

3.5 Definition and measurement of variables

The definition and measurement of variables that will be applied in the models of the study are represented in Table 3.1.

Table 3.1 Definitions and measurements of variables

Dependent variable	Description and measurement	Expected signs	Literature reviewed
Livelihood strategies	Categories of households based on variables related to households capital allocation		
Intensity of forest extraction	Value of the forest products extracted in Kenyan shillings		
Independent variables	Description and measurement		
Human capital			
Age	Age of household head in years	+/-	Nguyen *et al* 2020
Gender	Dummy = 1 If household head is a male, 0= otherwise	+/-	Angelsen *et al.,* 2011
Level of education	Number of years spent in school	-	Zenteno *et al.,* 2013
Household size	Number of members in the household	+	Pouliot *et al.,* 2013
Financial capital			
Access to credit	Dummy = 1 If the household head or any member of the household had access to credit from banks and other financial institution during the preceding year, 0 = otherwise	-	Ofoegbu *et al.,* 2017
Village variables			
Distance to the nearest market	Distance from homestead to the market in kilometers	+-	Melaku, 2016
Distance to the nearest tarmac road	Distance from homestead to the nearest tarmac road in kilometers	-	Maua *et al.,* 2018
Access to insurance facilities	Dummy = 1 If the household or any member of the household possesses an insurance cover 0=otherwise	-	Kimengsi *et al.,* 2019
Access to extension services	Dummy = 1 If household head or any member of the household received extension service within the preceding year, 0 = otherwise	+/-	Paumgarten, 2005
Natural capital			
Distance to the forest	Distance from homestead to the edge of the forest in kilometers	+	Nguyen *et al.,* 2015
Land size	Total amount of land owned by the household in acres	+/-	Langat *et al.,* 2016
Shocks			
Shocks experienced	Dummy = 1 if the household head or any member of the household experienced the shock, 0 = otherwise	+	Fisher, 2004
Physical capital			
Household assets	Measured in terms of their current value in Kenyan Shillings	-	Melaku, 2016
Social capital			
Group membership	Dummy =1 If household head or any member of the household belonged to a farmer's group or association, 0 = otherwise	+/-	Maua *et al.,* 2018

3.6 Study sites

The study was undertaken in Mt Elgon region which falls between Bungoma and Trans-Nzoia Counties in western Kenya. Mt Elgon region was selected due to high levels of dependence, history of communal forestry and degradation of forest resources due to high human activities. The regions offer remarkable benefits to the local livelihoods in terms of forest products and other income generating activities (Kenya Water Towers Agency, 2018).It also lies in the border between Uganda and Kenya and is located approximately 100 Km North East of Lake Victoria. Mt. Elgon is of volcanic origin and has an altitude of 4320 meters above sea level. The mountain is also one of the highest mountains in East Africa region. It is one of the major water catchments in Kenya offering a water source to Lake Victoria, River Nzoia and River Turkwell. The good water condition favors both agriculture and forestry (Mburu and Wakhungu, 2007). The dominant economic activity in the region is agriculture especially dairy farming and crop production (Kaitibie, 2009). Its cooler heights offer respite for humans occupying the hot plains below the mountain, and its higher altitudes provide a refuge for flora and fauna (Jansen *et al.,* 2006). Mt Elgon and its tributaries are home to several tribes; Luyah, Sabaot, Teso, Kikuyu and some other Kalenjin such as the Nandi. The Forest Department (FD) of the Ministry of forestry and environment manages three forest stations in Bungoma County and five forest stations in Trans-Nzoia. A forest station is an administrative region through which KFS interacts with local communities and therefore is a unit through which you can assess forest dependence. The study took place in three forest stations that is Kaberwa in Bungoma while in Trans Nzoia, it was undertaken in Kimothon and Saboti forest stations. The map of the Mt. Elgon region is as shown in Figure 3.1.

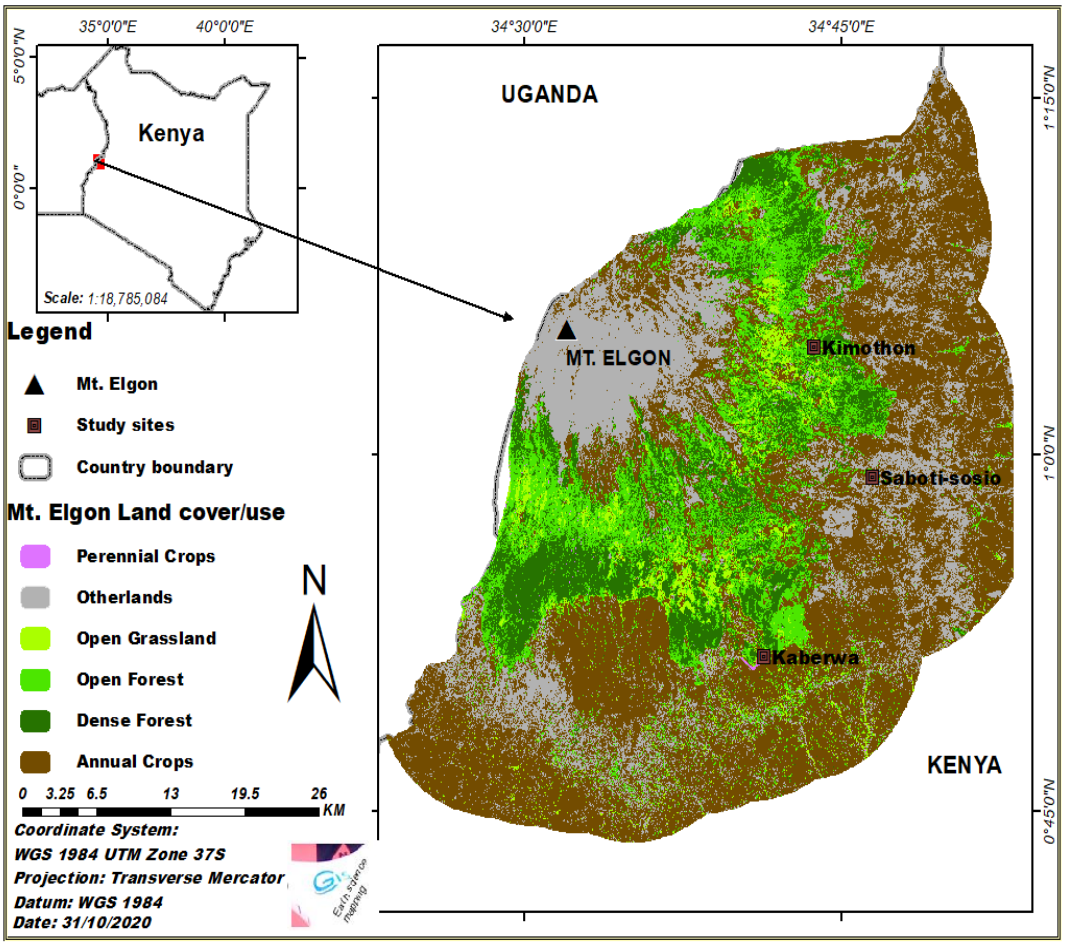

Figure 3.1: Map of Mt. Elgon region

3.7 Target population and sample size

The target population of this study was 35, 676 households within the three forest stations of Mt. Elgon who live adjacent to five (5) kilometer radius within the forest reserve since they represented forest dependent households. The sample was drawn from the following population of three-forest stations: Saboti (8,259), Kimothon (11,396) and Kaberwa (4,567) (KNBS, 2019). The sample size of the study consisted of a total of 924 households. To determine the sample size, the power sample size estimation formula was used as:

$$n = \frac{2(Z_a + Z_{1-\beta})^2 \sigma^2}{\Delta^2} \qquad (3.13)$$

Where n is the required sample size

Z_a, Z is a constant (1.96)

$Z_{1-\beta}, Z$ is a constant according to power (90%) of study (1.2816)

σ is the estimated standard deviation.

Δ is the difference in effect of intervention which is estimated.

$$n = \frac{2(1.96+ 1.2816)^2 0.7^2}{0.18^2} \quad (3.14)$$

From this formula the sample size of this study was 924 households which consisted of 317 households from Saboti, 300 households from Kimothon and 307 households from Kaberwa stations who were interviewed.

3.8 Sampling procedure

The study employed multistage random sampling procedure. The first stage of the sampling process entailed purposive sampling of the two counties (Bungoma and Trans-Nzoia) because they both border Mt. Elgon forest reserve. Second, three forest stations were purposively selected one from Bungoma County (Kaberwa station) and two from Trans-Nzoia (Saboti and Kimothon forest stations) based on geographical boundaries to cover ethnic communities living closer to Mt Elgon, region – the Luhya, Sabaot and other communities. Third stage involved purposive selection of the 30 villages taking into account proximity to the forest edge and their sociocultural and socio economic differences. The list of the 30 villages was obtained from the chief. A list all the respondents residing in the villages were obtained from the village elders in the regions. Finally, a simple random sampling method was used to select the respondents for the study.

3.9 Data type and sources

The study involved both primary and secondary data. Primary data was obtained through a cross sectional survey, FGDs and KIIs of forest dependent communities living around Mt. Elgon region.

3.10 Data collection instruments

The tools for primary data collection involved household questionnaires, key informant interviews and focus group discussions.

3.10.1 Survey

Household questionnaires were used to collect primary data. Research assistants administered the questionnaires to the household heads or their representatives where the head was not available. The data collection period took one month with a recall period of one year. A pilot study involving 20 households was used to pretest the questionnaires. A pilot study was important as it was used to test the consistency and the reliability of the data collection instruments. The information gathered from the pilot survey was used to refine the final survey tool that was administered to the respondents. The questionnaires contained information on households' asset endowment, extraction of forest resources and socio economic characteristics used.

3.10.2 Key Informant Interviews

Key informant interview was used to gather expert opinion on the nature of livelihood strategies and various income generating activities in the study area. About 15 key informant interviews with forest officers, leaders of the CFAs and local government officials were conducted to get a broad understanding of forest dependent livelihoods.

3.10.3 Focus Group Discussion

Focus Group Discussions (FGDs) was used to obtain information from several people within a very short period of time. According to Kothari (2004), FGDs generate new thinking about the study objectives which improve on the output of the study. The discussions focused on livelihood sources, nature and type of forest extraction and patterns on forest exploitation. In total 30 FGDs were conducted in August and September 2018 each lasting 2-3 h. The households were asked to discuss on topics concerning their livelihoods sources, the kind of products extracted from forests and their membership in various social groups. The information collected from FGDs were analyzed based on the identified themes and was used to validate the survey tool. Participants in FGDs were identified with the help of CFA leaders and local forest officers. The qualitative data was useful in informing the design of the sampling approach of the survey.

3.11 Reliability

Reliability occurs when repeated observations draw the same conclusions. Reliability also increases with the number of respondents. The use of questionnaire, key informant interviews, focus group discussions and face to face questions increased the reliability of the study. The study tested the reliability of the tool by use of Cronbach Alpha test which was 0.69 indicating that the tool was reliable.

3.12 Validity

Kothari (2004) defined validity as the degree to which the sample of test item present the content that it is designed to measure i.e. the instruments measures the characteristics or trait it is intended to measure. The research adopted content validity which refers to the extent to which a measuring instrument provides adequate coverage of the topic under study. Twenty households were selected for pilot study. The pilot study was then used to pretest the questionnaire hence validating the research tool. The pilot test considered the questionnaire content completeness and appropriateness in addition to duration.

3.13 Data analysis

Data was coded, edited and entered in Statistical Packages for Social Sciences (SPSS). Stata version 14 software was used to analyze the data. The first objective which was to assess the livelihood strategies and their determinants was analyzed by use of PCA, cluster analysis and multinomial logit regression model. The second objective on assessment of the determinants of intensity of forest extraction was analyzed by use of the Double Hurdle model.

3.14 Ethical Consideration

The study kept the responses of the participants confidential and anonymous. This sought to ensure protection of their rights. The data and findings were used only for research purposes.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Introduction

This chapter presents the descriptive results and econometric results. Descriptive results include the socio economic and institutional characteristics of the forest dependent households, while the econometric results include the Cluster analysis, Multinomial logit model and Double Hurdle model. Section 4.2 presents the socio-economic results of the households. PCA and Cluster analysis are presented in section 4.3 while section 4.4 presents Multinomial logit findings. Section 4.5 presents the nature and extent of forest extraction. Section 4.6 presents the Double Hurdle model results.

4.2 Descriptive statistics

This section provides a statistical summary of the study respondents. The statistics are organized under the five forms of household capitals.

Table 4.1 Household profile

Variables	Whole sample	Kaberwa forest station	Saboti forest station	Kimothon forest station	F-test
	Mean	Mean	Mean	Mean	p-value
Human capital					
Age (yrs)	46.4	44.9	47.2	46.4	0.1656
Household size (numbers)	6.2	6.0	6.3	6.1	0.1432
Gender :0=male	87.8	89.4	86.1	88.9	0.3770
Education: Tertiary	2.4	2.0	2.7	2.2	0.8556
Secondary	23.1	22.6	19.8	27.6	0.0442
Primary	50.6	41.2	44.1	65.1	0.0000
Employment: Farming	89.7	90.5	89.0	90.2	0.8207
Wage employment	5.6	4.5	5.9	6.0	0.7438
Business employment	3.2	2.0	3.9	3.2	0.4650
Natural capital					
Land size(acres)	1.3	1.9	1.0	1.4	0.2406
Forest dist.(km)	2.6	1.6	2.7	2.9	0.0000
Financial					
Credit (1=Yes)	14.3	12.1	15.4	14.3	0.5509
Social capital					
CFAs(1=Yes)	50.5	50.3	51.5	49.5	0.8712
Farmer groups (1=Yes)	55.6	48.2	56.1	59.7	0.0381
Shocks					
shocks val.(Ksh)	45675.0	38793.5	51487.4	42456.9	0.0892
Physical					
Market dist (km)	3.1	4.2	3.6	1.7	0.0000
Assets (Ksh.)	28785.5	27461.6	31604.9	25952.1	0.7930
Road dist. (Km)	13.8	3.1	18.9	14.0	0.0000
Extension (1=Yes)	51.5	46.7	50.0	56.5	0.0692

The findings reveal that the average age of the households' heads was 46.4 years which compares well with findings of census conducted in 2019 (KNBS, 2019). The average households' size of the respondents was 6.2. However, households in Saboti had a relatively larger number of households' size as compared to those of Kaberwa and Kimothon forest stations which might have implication on households' livelihood diversification to various livelihood strategies. Studies have shown that a higher household size might imply a higher consumption needs among families

which pushes to diversify into various livelihood strategies to smoothen their consumption (Ellis, 2000; Paumgarten, 2005). The results further indicate that 23.1% of the households had attained secondary education however Kimothon forest station had a significantly higher number of members with secondary level education as compared to Kaberwa and Kimothon forest stations. About 50.6% of the households had attained primary education as their highest level of education with households in Kimothon having a relatively higher number of households as compared to the households in Kaberwa and Saboti forest stations. The findings suggest that most households in the region have lower levels of education which has implication on their engagement in higher remunerative activities. The less educated households are constrained when it comes to skills required for wage employment as explained in studies such as (Fisher, 2004; Mamo *et al*., 2007). The average distance to the edge of the forest was 2.6Km with households in Kimothon forest station located further away from the forest as compared to households' in Kaberwa and Saboti forest stations. The distance to the forest edge has implication to access of forest resources with households living closer to the forest having a likelihood of engaging in to forest extraction activities as compared to those that live further as suggested by (Nguyen *et al*., 2015). More than half of the respondents (55.6%) had membership to farmer groups with households in Kimothon having a higher membership to farmer groups as compared to households in Saboti and Kaberwa forest stations. Membership to farmer groups represents households' participation in social groups which have implication regarding households' engagement to different livelihood strategies. Findings imply that membership to farmer groups allow households to share farming skills and knowledge which increases agricultural returns as corroborated by Fisher, (2004). The results suggest that the average distance to the market was 3.1 Km with households in Kaberwa station significantly located further away from Kapsokwony market as compared to households in Saboti and Kimothon forest stations (Kisawai and Endebess markets respectively). Proximity to markets has implication on households' engagement to lucrative livelihood strategies as suggested by Angelsen *et al*., (2011). The findings of the study reveal that the average distance to all-weather roads was 13.8 with households in Saboti forest station significantly located further away as compared to households

in Kaberwa and Kimothon forest stations. Distance further away from all-weather roads may imply higher transaction costs which reduces households' engagement to higher remunerative jobs like business activities (Jansen, 2006; Nguyen *et al.*, 2015). About 51.5% of the households accessed extension services in the last 12 months before the study with households in Kimothon having a significantly higher access as compared to households in Saboti and Kaberwa. Access to extension services has implication on households' access to agribusiness knowledge and skills which supports farming as implied by Lax and Kothke, (2017).

4.3 Assessing livelihood strategies

This section presents the results for the principal component and the various livelihood strategies obtained. The findings indicate that households engaged in three livelihood strategies namely: forest and farming, business strategies and farming, business and wage employment.

4.3.1 Results from principal component analysis interrelated variables

A total of 18 variables were included in PCA, of which 6 principal components of Eigen values greater than one were retained for further analysis as shown in Table 4.2 (a scree plot of Eigen values is also shown in Figure 4.1) (Goswami *et al.*, 2014). The study applied the 'elbow' criteria (Ledesma *et al.*, 2015) in explaining the PCA results. The results indicate that the 18 variables explained 56.1% of the total variance showing substantial variation from each other and hence retained (Goswami *et al.*, 2014). Components loadings with scores greater than .35 indicate how strongly the components were associated with each other. Principal component analysis is a mathematical procedure which transforms a number of correlated variables into smaller number of uncorrelated variables called the principal components. Rotation in PCA is a mathematical procedure that uses an orthogonal transformation to convert a set of values of possibly M correlated variables into a set of K uncorrelated variables called principal components (Kuivanen *et al.*, 2016). Rotation was important because it maximizes the difference between variance captured by the components.

The results from the Kaiser-Meyer-Olkin (KMO) test of sampling adequacy are shown in Table 4.2. The test indicates a test of overall sampling adequacy of 0.69 which implies that the components were uncorrelated (Bidogeza *et al.,* 2009). The BTS value was 2953.981, with a P-value of 0.00, indicating that the data was appropriate for principal component analysis (Yong and Pearce, 2013). Additionally, the Cronbach alpha test yielded a coefficient of 0.65 on all items indicating that the scale was reliable.

Table 4.2: Kaiser-Meyer-Olkin (KMO) test results

Variable	**KMO results**
Access to extension services	0.820
Land size	0.553
Access to credit	0.734
Number of years in school	0.734
Membership in farmer groups	0.747
Membership in forest user groups	0.753
Forest distance	0.700
Land	0.625
Livestock ownership	0.701
Getting Livestock product	0.734
Employed	0.588
Business engagement	0.518
Total crop cost	0.696
Crop land area	0.674
Forest products quantity (Kg)	0.325
Livestock number	0.787
Wage income	0.625
Business income	0.527
Overall score	0.697
P-value	0.000
Chi-square	2953.981
DF	435
Cronbach Alpha test	0.65

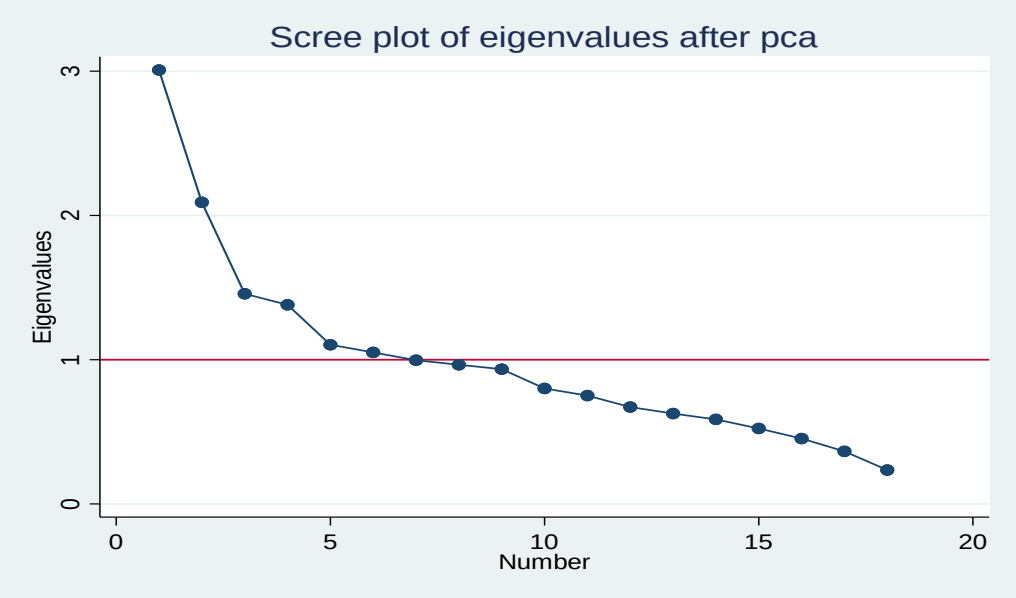

Figure 4.1: Scree plot showing eigenvalue

Table 4.3 shows the six principal components which were retained with their factor loadings.

Table 4.3: The principal components factor loadings

Component and item description	**Factor loading**	**% variance explained**	**Cronbach Alpha Test**
Component 1: Forest extraction and farming		16.7	0.639
Membership in forest user groups	0.5067		
Total crop cost	0.5567		
Crop land size	0.5777		
Component 2: Livestock Keeping		11.62	0.6384
Access to extension	0.3811		
Owned livestock	0.5558		
Obtain livestock products	0.546		
Component 3: Wage employment		8.1	0.6472
Number of years in school	0.4053		
Employed	0.5788		
Wage income	0.5587		
Component 4: Business activities		7.7	0.6483
Business engagement	0.6974		
Business income	0.6869		
Component 5: Farming activities		6.1	0.6540
Land size	0.7242		
Owned land	0.3704		
Component 6: Forest extraction	0.7653	5.8	0.6503
Forest product quantity			

Component one, with a Cronbach Alpha of 0.639, explained 16.7% of the variation and was positively linked with participation in forest user groups, agricultural field area, and total crop cost, as shown in Table 4.3. As a result, it represents households involved in forest extraction and farming. Component two, with a Cronbach Alpha of 0.6384, explains 11.62 of the variation and was positively linked with access to extension services, animal ownership, and livestock product receipt. As a result, this component reflected households that kept animals. Component three, with a Cronbach Alpha of 0.6472, explains 8.1 percent of the variation and is positively connected with school years, employment and wage income. As a result, it represented educated households that had wage employment.

Component four, with a Cronbach Alpha of 0.6472, explains 7.7% of the variation and was positively linked with business participation and business income, indicating that it represented households involved in business activities. Component five, with a Cronbach Alpha of 0.6540, explains 6.1 percent of the variation and is positively

associated to land area and its ownership. As a result, it represented households with land and hence engaged in farming. Component six, with a Cronbach Alpha of 0.6540, explains 5.8% of the variation and is positively linked with the amount of forest products extracted. As a result, this component was associated with households involved in forest extraction.

Table 4.4: Eigen values

Component	Eigen value	Difference	Proportion	Cumulative
Component 1	3.00859	0.917586	0.1671	0.1671
Component 2	2.091	0.634026	0.1162	0.2833
Component 3	1.45698	0.076514	0.0809	0.3643
Component 4	1.38046	0.276755	0.0767	0.4409
Component 5	1.10371	0.053129	0.0613	0.5023
Component 6	1.05058	0.053937	0.0584	0.5606
Component 7	0.996641	0.031811	0.0554	0.616
Component 8	0.964831	0.030548	0.0536	0.6696
Component 9	0.934283	0.13378	0.0519	0.7215
Component 10	0.800503	0.049264	0.0445	0.766
Component 11	0.751239	0.079495	0.0417	0.8077
Component 12	0.671744	0.044853	0.0373	0.845
Component 13	0.626891	0.040606	0.0348	0.8799
Component 14	0.586285	0.062947	0.0326	0.9124
Component 15	0.523338	0.070007	0.0291	0.9415
Component 16	0.453331	0.088799	0.0252	0.9667
Component 17	0.364532	0.129467	0.0203	0.9869
Component 18	0.235064	.	0.0131	1

4.3.2 Results from cluster analysis

The six retained components were used as inputs for cluster analysis to characterise the livelihood strategies following (Goswami *et al.,* 2014). The livelihood strategies were grouped in three clusters. The dendrogram in figure 4.2 shows the relationship between variables.

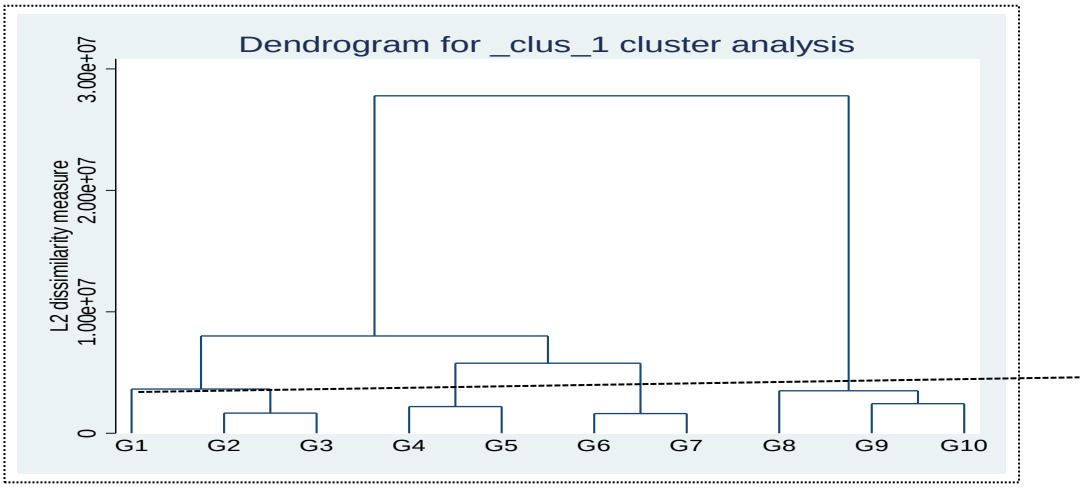

Figure 4.2: Dendrogram showing the relationship between the variables

The findings of the one-way analysis of variance for the various characteristics of the three clusters are presented in Table 4.5. Cluster analysis was used to divide the 924 households into groups based on their assets and activities. Based on the combination of assets and activities, three clusters were obtained and named as follows: (i) forest extraction and farming, (ii) business strategies and (iii) wage employment, farming and business livelihood strategies. The characteristics of selected clusters of the households in Mt Elgon region and P-values of one-way analysis of variance (equality of group means) are outlined in Table 4.5.

Table 4.5: One-way analysis of variance for the three clusters

Variable	**Cluster 1 (**Farming and forest extraction strategies)	**Cluster 2** (Business livelihood strategies)	**Cluster 3** (Farming, wage employment and business livelihood strategies)	**All clusters**	
	Mean	**Mean**	**Mean**	**Mean**	**P-value**
Natural capital					
Owned Land (Yes)	0.98	0.98	1.0	0.98	0.5900
Land size (acres)	1.15	0.88	2.01	1.13	0.0001
Crop land area (acres)	0.78	0.52	0.86	0.739	0.0072
Forest distance (Km)	2.4	2.6	3.1	2.5	0.2796
Value of sum of forest products (Khs)	34682	10081	10925	28731	0.615
Total crop cost (Khs)	11086.744	6427.52	8032.32	10026.87	0.0017
Financial capital					
Business engagement (Yes)	0.075	0.170	0.093	0.095	0.0005
Business income (Ksh)	1190.05	31210.23	9794.18	7503.53	0.000
Access to credit (Yes)	0.12	0.15	0.34	0.14	0.0002
Human capital					
Employed (Yes)	0.24	0.90	0.95	0.403	0.000
Access to extension (yes)	0.48	0.59	0.72	0.51	0.0006
Wage income (Ksh)	1917.57	48271.07	488860.47	33708.57	0.000
Education level (years)	6.0	7.0	10.2	6.44	0.000
Social capital					
Membership in farmer groups (Yes)	0.53	0.59	0.72	0.55	0.0254
Membership to forest user groups (Yes)	0.53	0.42	0.37	0.505	0.0082
Physical capital					
Own livestock (Yes)	0.87	0.84	0.93	0.87	0.2546
Obtain livestock products (Yes)	0.67	0.708	0.930	0.695	0.0020
Livestock (number)	9.5	9.03	15.3	9.75	0.0008

Examining cluster, I which represented the farming and forest extraction strategies, the results indicate that the cluster constituted about 75.7% of the sample and was

distinguishably characterized by high membership to forest user groups (53%) and higher amount of total crop cost (ksh. 11086.74). The high membership in forest user groups could explain their higher engagement to forest extraction. Studies have shown that membership to forest user groups (FUGs) enables households to share information regarding use of various forest products which in return encourages them to engage in extraction of forest products (Morsello *et al.,* 2014; Pouliot *et al.,* 2013). Further, the cluster had the highest cost of crop production which implies that households were engaged in crop production. In addition, the cluster was characterized by comparatively high livestock numbers (9.5) and larger crop land areas (0.78ha).

This cluster, on the other hand, had the following lower characteristics: lower access to extension services (0.48 %), access to credit facilities (0.12 %), number of years of schooling (6), membership in farmer groups (53 %), received livestock products at a lower rate (67 %), employment rate (24 %), low rate of business engagement (7.5 %), small wage income (Ksh 1917.57), and small business income (Ksh 1917.57). (Kshs1190.05). The low access to credit facilities, lower number of years of schooling, lower membership to farmer groups, low employment rate, low wage income and low business income could explain why households opted for forest extraction activities as their livelihood source since income from farming was not possibly adequate to sustain the households. The literature has shown that households who could access credit facilities were more likely to borrow loans that support alternative livelihoods such as business activities (Melaku *et al.,* 2016). Additionally, members that are more educated are able to have skills that enable them to engage in wage employment as compared to the less educated members (Babulo *et al.,* 2008).

Cluster II which represented the business livelihood strategies, the results indicate that the cluster constituted about 19.7% of the sample and is distinguishably characterized by highest business engagement (17%), high business income (ksh 31210.23). This cluster constituted of households that engage in retail businesses such as groceries, retails shops and posho-mills. The highest amount of income from business activities allowed them to plough back their profits in their business.

Moreover, the households had a higher rate of access to extension services (59 %), a higher rate of access to credit services (15 %), a higher number of years in school (7), a higher rate of membership in farmer groups (59 %), a higher rate of receiving livestock products (70.8 %), and a higher rate of employment (90 %). The higher access to extension services enabled households to acquire knowledge and skills regarding prices, markets and credit which could be applied for a successful business (Nielsen *et al.,* 2013). Education level of the households also is important in equipping households with knowledge to manage their businesses in the right ways (Paumgarten, 2005). On the other hand, it is characterized by small land sizes (0.88), comparatively lower crop cost (ksh 6427.52), comparatively lower crop land area (0.52), comparatively lower number of livestock (9.03) and comparatively lower wage income (ksh 48271.07). The findings reveal the reasons why the households engaged in business activities as their livelihood strategies.

Examining the Cluster III which represented farming, wage employment and business livelihood strategies. The results of the cluster constituted of about 4.65% of the sample and was distinguishably characterized by higher access to extension services (72%), higher access to credit facilities (34%), higher membership to farmer group (72%), high wage income (Ksh 488860.47), large number of members with wage employment (95%), obtained livestock products at a higher rate (93%) and had a higher number of livestock (15.73). This cluster therefore constituted of households that engaged in farming (crop production and livestock keeping), engaged in business activities such as groceries, retail shops and posho-mills and were either casual laborers or permanently employed. The higher access to extension services by households enables them to acquire skills good farming techniques and agribusiness which support their engagement to both business, wage employment and farming. The higher access to credit among the cluster explained their engagement to business strategies as compared to cluster 1 since they could obtain loans that supported the livelihoods (Mamo *et al.,* 2007). Additionally, the higher number of people with employment explains their difference with cluster 1 and 2. The households in this cluster are able to benefit from extension services hence polishing their skills on agribusiness and good farming techniques. This cluster was therefore for households

that engaged in mixed livelihood strategies (farming, wage employment and business strategies).

In addition, this cluster was also characterized by large land sizes (2.01ha), higher number of years of schooling (10.2) and large crop land area (0.86 ha). On the other hand, it had low membership to forest user groups (37%), comparatively low engagement in business (9.3%), they incurred lower total crop costs (Ksh. 8032.32) and comparatively earned lower income from businesses (Ksh 9794.18). The lower membership in forest user associations may explain cluster III's lower engagement in extraction activities. Their ability to engage in higher-return pursuits such as business, on the other hand, could explain why they were not involved in forest exploitation. Alternative sources of income, such as economic activities, allow households to earn more money, negating the need for forest extraction (Uberhuaga *et al.,* 2012).

Overall, the findings show that cluster 1 was distinguishably characterized by higher membership to forest user groups and higher amount of total crop cost. Cluster 2 on the other hand was distinguishably characterized by high business income and highest business engagement. Further, cluster 3 was distinguishably characterized by high higher access to credit facilities, higher membership to farmer group, high wage income, large number of members with wage employment, obtained livestock products at a higher rate and had a higher number of livestock.

4.4 Determinants of livelihood strategies

Table 4.6 shows the results of the multinomial logit regression model for determinants of livelihood strategies. Multicollinearity test was used to test the goodness of fit of the multinomial logit model. VIF was specifically used to test the multicollinearity with all the variables having a VIF of less than 10 and a mean VIF of 1.11 implying that there was no multicollinearity as shown in appendix A1. The coefficients only show the direction and not the magnitude of the findings. The marginal effects are therefore considered the most effective in this case. The marginal effects allow researchers to examine the impact of a single variable on a

household's decision to engage in livelihood diversification activities while keeping the other factors constant (Greene, 2003). Because the literature has indicated that it is best to discuss the marginal difference caused by each significant variable in order to provide useful policy suggestions for each livelihood activity, the discussion was limited to marginal impacts (Greene, 2003). The choice of a livelihood strategy was measured as the probability of a household to belong to a certain livelihood cluster.

Table 4.6: Multinomial logit results on determinants of livelihood strategies

Variable	Cluster 2 Coefficient	P-value	dy/dx	Cluster 3 Coefficient	P-value	dy/dx
Human capital						
Gender	**0.4120**	**0.133**	**0.0561**	**1.5918*** **	**0.002**	**0.0264**
Age	**-0.0102**	**0.151**	**-0.0015**	**-0.0123*** **	**0.001**	**-0.0041**
Household size	**0.0938** **	**0.029**	**0.0135**	**0.1233**	**0.133**	**0.0018**
Education (Years)	**0.0668*** **	**0.003**	**0.0090**	**0.2826*** **	**0.000**	**0.0047**
Physical capital						
Market distance	**-0.0387**	**0.212**	**-0.0053**	**0.1408**	**0.086**	**0.0023**
Distance to all-weather roads	**0.0281*** **	**0.005**	**0.0042**	**0.0268*** **	**0.009**	**0.0201**
Access to credit	**0.1669**	**0.499**	**0.0227**	**0.6345*** **	**0.001**	**0.0055**
Access to extension services	**0.4228** **	**0.023**	**0.0653**	**0.4610**	**0.248**	**0.0065**
Assets value	**-1.77e-07**	**0.903**	**-3.15e06**	**1.59e-06** **	**0.023**	**0.0082**
Social capital						
Membership to farmer groups	**-0.0660*** **	**0.005**	**-0.0091**	**0.2203**	**0.588**	**0.0036**
Financial capital						
Expenditure	**3.88e-06*** **	**0.003**	**0.0051**	**1.59e-06** **	**0.030**	**0.0053**
Shocks						
Shocks value	**-8.36e-06*** **	**0.003**	**0.0430**	**9.99e-06**	**0.552**	**2.01e-06**
Natural capital						
Size of land	**-0.1271**	**0.124**	**-0.0189**	**-0.0045**	**0.886**	**0.0003**
Forest distance	**-0.0111**	**0.752**	**-0.0017**	**0.0353**	**0.550**	**0.0006**
LR Chi^2	**198.56**					
Prob>Chi^2	**0.000**					
Log-likelihood	**-523.38**					
Pseudo R^2	**0.1594**					

Sign 1% ***, 5%**, 10% * Cluster 1 is the reference group dy/dx is for discrete change of dummy variable from 0 to 1

The results from table 4.6 show the factors influencing the choices of rural livelihood strategies among households in Mt Elgon, Kenya. Household size was found to have a positive influence to the household decision to diversify into business strategies with a marginal effect of 1.3 % relative to farming and forest extraction. The

explanation could be that a larger number of household size could provide enough labour required to run the businesses. The other reason could however be that larger household sizes could have higher consumption needs which pushes them to diversify to smooth consumption. The results are similar with those of Lax and Kothke, (2017) who suggested that larger household sizes had higher requirement in terms of consumption needs hence pushing them to diversify into alternative income sources for smooth consumption.

Further, the number of years of schooling had a positive influence on a household's decision to diversify into business activities with a marginal effect of 0.9 % relative to farming and forest extraction. Access to extension services enables households to acquire knowledge and skills on agribusiness which could be crucial in running the businesses. The findings are in line with those of Nguyen *et al.,* (2015) who found that literate individuals are more aware of better earning livelihood strategies.

The results further show that distance to all-weather roads had a positive influence to household decision to diversify into business strategies by 0.4 % relative to farming and forest extraction. Households who are not able to access good roads will opt to engage in other livelihood strategies such as farming and forest extraction which do not require regular access to markets. Access to all-weather roads reduces transaction costs such as transport costs hence supporting the engagement of business livelihoods. The results are similar to those of Maua *et al*., (2018) who found that access to all-weather roads enables households to engage in alternative livelihoods that are more remunerative.

The access to extension services on the other hand had a positive influence to household decision to diversify into business strategies by 6.5 % relative to farming and forest extraction. Extension officers could provide knowledge and skills in agribusiness that might support running of business hence motivating households to adopt business livelihood strategies. It can be done by training farmers on value addition of agricultural produce and matters to do with agribusiness and marketing of the farm products. The results are consistent to those of Paumgarten, (2005) who suggested that extension services provide information regarding value addition of

agricultural products and agribusiness which enable households to take advantage of diversification opportunities such as business livelihoods.

Expenditure levels had a positive influence to household decision to engage in business strategies by 0.2 % relative to farming and forest extraction. This implies that households that had high expenditure levels were likely to diversify their livelihoods to business strategies in order to obtain additional income. Business livelihoods are able to provide income throughout the year unlike farming and forest extraction which are seasonal. These results are similar to those of Angelsen *et al*., (2011) and Nguyen *et al*., (2015) who found that high expenditure levels motivated households to engage in diverse livelihood strategies so that they can be able to obtain enough income to meet their expenditure levels.

Shocks value had a negative influence to household's adoption to business livelihood strategies with a marginal effect of 4.3 % relative to forest extraction and farming. It is explained by the fact that households who face a lot of shocks which reduces their income (Nielsen *et al.,* 2013). Diverse income streams are important in reducing the effects of shocks to rural households. This is consistent with the findings from Fisher, (2004) who found that shocks reduce the income sources of the households hence pushing them to diversify into better earning livelihood strategies to supplement their income.

Membership to farmer groups had a negative influence to the adoption of business strategies by a marginal effect of 0.3% relative to farming and forest extraction. Membership to groups allows individuals households to share information on good farming methods hence increasing their production levels hence more returns. The knowledge and skills shared among the members are crucial in improving their yields in their farms and better forest extraction techniques. They might therefore not see the need of engaging in to business livelihood strategies as suggested by Zenteno *et al.,* (2013).

In Cluster III the results indicate that male headed households had a likelihood of engaging in farming, wage employment and business livelihood strategies with a marginal effect of 2.6% percent relative to farming and forest extraction. It could be

explained by the fact that time constraints due to household chores and poverty levels among women prevents them from engaging in diverse livelihood sources as compared to the male headed households. The other reason could also be that the societal norms could dissuade the female households from going to school hence lower engagement in wage employment. This finding is consistent with various studies that have shown that male headed households were positively related to diversification due to their ability to own various assets in the households which could support livelihood diversification (Fisher, 2004).

Age had a negative influence on the adoption of farming, wage employment and business livelihood strategies at a marginal effect of 0.4% relative to forest extraction and farming. The younger household heads were more likely to diversify their livelihoods sources to wage employment and business strategies since they are more educated as compared to the older households as suggested by the various studies (Pouliot *et al.,* 2013). Additionally, livelihood diversification involves a lot of time and energy hence preventing the older households from engaging in cluster 3.

As expected, the number of years of schooling had a positive influence to household decision to engage in farming, wage employment and business livelihood strategies by 4.7% relative to farming and forest extraction. This implied that educated household heads were able to access alternative opportunities of livelihood sources through opting for activities such as salaried jobs, self-employment and farming. This result was supported by various studies done by Thondhlana and Muchopondwa, (2014) who found a positive correlation between years of schooling and engagement in farming, wage employment and business livelihood strategies.

Expenditure levels had a positive influence to household decision to engage in farming, wage employment and business livelihood strategies by 0.5% relative to farming and forest extraction. This is expected since diversification into various livelihood sources yields additional income which thus enables households to cater for the high expenditure levels as corroborated by Imfumu, (2020).

With a marginal effect of 2.0 % relative to farming and forest extraction, distance to all-weather roads had a positive influence on the adoption of farming, wage

employment, and business. Because of the close proximity to paved roads, households may readily access market places, thereby strengthening their enterprises. The results are consistent with those of Ofoegbu *et al.,* (2013) who found that proximity to all-weather roads reduces transaction costs like transportation costs for business activities.

Access to finance had a marginal effect of 0.5 % and a positive influence on the adoption of farming, wage employment, and business techniques when compared to farming and forest extraction. Households with access to credit were more likely to engage in business, boosting their income and supporting alternative livelihood diversification. The findings are consistent with Pouliot *et al.,* (2013) who found that access to credit facilities enable households to borrow loans which can be used to start businesses.

Assets value had a positive influence to the adoption of farming, wage employment and business livelihood strategies with a marginal effect of 0.8% relative to farming and forest extraction. Wealthier households are more likely to engage in diverse livelihood strategies due to access to assets. Agricultural activities face a lot of challenges for example seasonality and lower prices. As observed by Kimengsi *et al.,* (2019), households with more asset values are likely to access alternative livelihood opportunities such as business and wage employment. In conclusion, the findings of the study show that households' engagement to various livelihood strategies differ according asset endowment and geographical location.

4.5: Nature and Extent of forest extraction

The findings show that only 597 households participated in the extraction of forest products. The study first assessed the extent (value) of forest-based livelihood disaggregated by wealth groups and type of products extracted (firewood, wild vegetables, fruits and honey). This was then followed by a comparison of extraction intensities between the female-headed and male-headed households. This comparison was necessary to deepen the understanding of gender dynamics in forest-based livelihood decisions. Specifically, the study tested the hypothesis that there were no

significant differences in forest extraction intensity between male and female-headed households across the wealth groups and product categories. The results are as shown in Table 4.7.

Table 4.7: Extent and nature of participation in forest-based livelihood

Nature of forest extraction	Combined	Male HH	Female HH	P-value
Aggregate extracted value (ksh)	1,24962	101299	700.18.92	0.052
● Wealthiest	59948	63790	10000	0.113
Middle wealthy	77523	87430	15959	0.004
● Poorest	31568	12892	14830	0.103
Extracted value by product category (ksh)				
● Firewood	72396	77914	36319	0.006
● Wild vegetables	37261	8080	33701	0.005
● Wild fruits	7065	7065	0	
● Honey	8240	8240	0	

(Wealth Index ≤ -1), middle income (1< Wealth Index < -1), high income (Wealth Index ≥1)

Table 4.7 shows that, except for wild vegetables, male-headed households have a higher value of all main forest products extracted. This could be explained by inequalities in gender roles that create barriers that prevent women from participating in commercial forest extraction (Amevenku *et al.,* 2019; Belcher and Schreckenberg, 2000; Mai *et al.,* 2011). In the study area, harvesting of food products from the forest is usually viewed as women's work because of gender norms that limit them to reproductive and subsistence- based roles (Nguyen *et al.,* 2020; Powel *et al.,* 2013; Pouliot *et al.,* 2013). This would explain why female-headed households extracted wild vegetables at a higher intensity for home consumption. These findings are consistent with other studies which show limited engagement in commercial-based forest livelihood among women (Imfumu, 2020; Lax and Kothke, 2017; Rasmussen *et al.,* 2017). In addition, other studies also show that men often dominate the

governing jurisdiction over forest resources implying differential access, which may disadvantage women (Lidestav *et al.,* 2010; Mai *et al.,* 2011).

As shown in table 4.7, the intensity of extracting forest products was higher among middle-wealthy group compared to the other wealth categories. The lower extraction intensity among the wealthier households could be explained by their access to other alternative livelihood opportunities which raises the opportunity costs of engaging in forest-based livelihoods (Heubach *et al.,* 2011; Nguyen *et al.,* 2015). Similarly, the intensity of extraction among the resource constrained (poorer) households can be dissuaded because of their inability to meet the direct and transaction costs of obtaining forest products. These findings imply that forest extraction decisions vary among households depending on the household type (gender, wealth category), nature and extent of forest-based livelihood.

4.6 Determinants of intensity of forest extraction

Table 4.8 presents the results of Cragg's Double hurdle model, which includes the household decision levels on forest-based livelihood (decision to engage in forest-based livelihood (Column 2) and the household decisions on the intensity of forest extraction (Column 3). Multicollinearity test was used to test the goodness of fit of the Cragg's Double hurdle model. VIF was specifically used to test multicollinearity with all the variables having a VIF of less than 10 with the mean VIF of 2.99 implying that there was no multicollinearity as shown in appendix A2. The Cragg's Double model was used based on the assumption that households make two simultaneous decisions. The decision to engage in forest extraction was measured in terms of yes=1 for those that chose to participate in forest extraction. On the other hand, the intensity of forest extraction was measured in terms of value pf forest products extracted in Kenyan shillings. The analysis includes variables representing various households' capitals (human, physical, financial, social and natural) which are assumed to influence the decision and extent of forest extraction.

Table 4.8: Cragg's Double Hurdle model results

Variables	1st Hurdle (Decision to extract-yes=1)		2nd Hurdle (intensity of forest extraction-value of forest products)	
	Coefficient	**P-Value**	**Coefficient**	**P-Value**
Human capital				
Gender: 0=Male	0.0940	0.854	0.2112**	0.050
Age (yrs)	-0.1607**	0.040	-0.1065	0.941
Household size (Numbers)	0.1037***	0.003	0.0654	0.898
Access to extension 1=Yes	-0.2192***	0.005	-0.2192	0.162
Education level: Primary	0.5693	0.432	-0.4250	0.451
Secondary	0.6541	0.417	-1.0839**	0.032
Physical capital				
Distance to market (Km)	-0.0504	0.541	-0.1009***	0.005
Distance to all-weather roads (Km)	-0.0516	0.650	-0.2041***	0.003
Natural capital				
Land size (yrs)	-0.0252	0.538	-0.2355***	0.005
Social capital				
Membership in a farmer group 1=Yes	0.1122**	0.051	0.1350	0.897
Membership in a forest user group 1=Yes	0.1265**	0.031	0.9641	0.451
Financial capital				
Access to credit1=Yes	-0.2967	0.781	-0.0454**	0.023
Wealth category: High income	-0.4184**	0.03	0.1213	0.391
	0.4276	0.658	0.9620	0.782
Middle wealthy				
LR Chi^2	176.89			
Prob>Chi^2	0.000			
Log-likelihood	-498.25			
Pseudo R^2	0.2214			

Dependent variable: value of forest products, low income (Wealth Index ≤ -1), middle income (1< Wealth Index < -1), high income (Wealth Index ≥1) Tertiary education is the reference level for education, Poorest is the reference level for wealth categories

The results show that while gender did not influence households' decision to extract, it positively affected the intensity of extraction with a magnitude of 21.1%. This could be due to inequalities in time endowment between male headed and female headed, with female headed having limits due to other home responsibilities. Similarly, in the research region, societal norms prevent women from participating in specific forest-based livelihood activities, such as collecting firewood for sale (see also, Fisher, 2004). As demonstrated in Table 4.8, the age of the household head had a negative influence on the decision to harvest forest products with a magnitude of 16%. This could be explained by the fact that older household heads have access to more resources accumulated over time, allowing them to pursue other alternative and possibly more lucrative livelihood activities. A global study on environmental resource dependence Angelsen *et al.,* (2011), Babulo *et al.,* (2009) and Cavendish, (2000) found that older household heads engaged in forest-based livelihood at a lower level in part because they had accumulated assets over time which allowed them to engage in alternative livelihood activities. Besides, extraction processes such as the harvesting of timber or fuelwood may be physically strenuous or labour intensive which may dissuade older people from engaging in these activities (Ellis and Manda, 2012; Lax and Kothke, 2017). The size of the household had a positive influence on forest-based livelihood decisions with a magnitude of 10.3%. Angelsen *et al.,* (2011) found that households with more household members are more likely to have the capacity to supply the labor needed for forest extraction activities, which is consistent with this study. Furthermore, households with more members are more likely to experience increased demand for food and other non-food products, perhaps pushing them towards forest-based livelihoods (Maua *et al*., 2018).

Table 4.8 further shows that while access to agricultural extension services negatively influenced the households' decision to engage in forest-based livelihood with a magnitude of 21.9%, its influence on the intensity of extraction was not important. Households with access to extension services gain skills and expertise on value addition and agribusiness therefore reducing their likelihood of engaging in

forest extraction operations. Babulo *et al.,* (2008) and Melaku, (2016) illustrate that access to extension services can enable a household to access various alternative livelihoods through increased agricultural profitability and agribusiness. Similar to the variable extension, the level of education did not influence the household's choice of forest extraction but it did have a negative impact on the intensity of forest extraction. One explanation could be that educated household heads are more likely to have other sources of income, such as paid labor, teaching, or government jobs which increases their earnings (Naidu, 2011; Pouliot *et al.,* 2013).

The results show that transaction costs reflected in distance to the market or to an all-weather road negatively affected the decision on the intensity of forest extraction with a magnitude of 20.4%. This is consistent with other studies Ofoegbu *et al.,* (2017) and Zenteno *et al.,* (2013) which show that households with better access to physical capital such as paved roads tend to have lower engagement with forest-based livelihood since they can easily access alternative livelihood sources. Similarly, land size had a negative influence on the intensity of forest extraction with a magnitude of 23.5%. Access to land increases the potential to earn from agricultural activities therefore reducing the need for forest extraction (McElwee and Bosworth, 2010; Melaku, 2016; Wunder, 2001). Group membership was included in the analysis to measure the influence of social capital on forest-based livelihood activities. The results show that being a member in forest user group positively influenced extraction decisions with a magnitude of 12.6%. This association could be as result of sharing of information on the opportunities for forest extraction (Langat *et al*., 2016; Paumgarten, 2005). Similarly, communal forest extraction activity performance can reduce transaction costs, boosting the chance of engaging in forest-based livelihood.

Financial capital, such as access to credit, had a negative influence on the intensity of forest exploitation with a magnitude of 4.5%. Access to credit may enable households to engage in alternative livelihood activities such as retail stores and mobile money transfer services, which is consistent with other research (Babulo *et al.,* 2009; Kimengsi *et al.,* 2019). Furthermore, income had a negative influence on the decision to extract, meaning that higher income diminishes the possibility of

engaging in forest-based livelihoods since households have the capacity to engage in alternative livelihoods (Ofoegbu *et al*., 2017).

CHAPTER FIVE

SUMMARY, CONCLUSION AND POLICY IMPLICATION

5.1 Introduction

This section presents the summary for the findings of the study (section 5.2), the conclusions drawn from the study (section 5.3) and their policy implication (section 5.4).

5.2 Summary of the findings

This study investigated the rural households' livelihood strategies and their determinants in Mt Elgon, Kenya. First, the study assessed the livelihood strategies employed by rural households. Second, the study investigated the determinants of the livelihood strategies in Mt Elgon, Kenya. Lastly, the study assessed the determinants of intensity of forest extraction. Multistage, purposive and simple random sampling designs were used to select a sample of 924 households from Bungoma and Trans-Nzoia counties in western Kenya. Data was collected through administration of questionnaire, FGDs and key informant interviews to the respondents. Data was coded, edited and entered in Statistical Packages for Social Sciences. Stata version 14 software was used to analyze the data. PCA and cluster analysis was used to analyze the livelihood strategies undertaken by households in Mt. Elgon region,

Kenya. Multinomial logit was employed to analyze the determinants of livelihood strategies, while a Double Hurdle model was applied to assess the factors influencing forest extraction.

The findings from cluster analysis and PCA revealed that households pursued different livelihood strategies due to their asset endowment. The livelihood strategies identified by the study were classified into three distinct clusters: cluster I consisting of farming and forest extraction livelihood strategies, cluster II comprising of business strategies and cluster III consisting of mixed livelihood strategies (Farming, wage employment and business livelihood strategies). The first cluster constituted about 75.7% of the sample and was distinguishably characterized by high membership to forest user groups (53%) and higher amount of total crop cost (ksh 11086.74). The second cluster constituted 19.7% of the sample and was characterized by highest rate in business engagement (17%) and high business income (ksh 31210.23). The third cluster constituted 4.65% of the sample and was characterized by the following: higher access to extension services (72%), higher access to credit (34%), higher membership to farmer group (72%), high wage income (Ksh 488860.47), high number of employed members (95%), received livestock products at a higher rate (93%), and had high number of livestock (15.73). This cluster therefore constituted of households that engaged in farming (crop production and livestock keeping), engaged in business activities such as groceries, retail shops and were either casual laborers or permanently employed hence received wages.

The Multinomial logit results show that household size (1.3%), number of years in school (0.9%), distance to all-weather roads (0.4%), access to extension (6.5%) and expenditure levels (0.2%) had a positive influence to household engagement to cluster 2 while membership to farmer groups (0.3%) and shocks (4.3%) had a negative influence to household engagement to cluster 2. Further, the findings show that gender (2.6%), number of years in school (4.7%), expenditure levels (0.5%), distance to all-weather roads (2.0%), access to credit (0.5%) and asset value (0.8%) had a positive influence to household engagement to cluster 3 while age had a negative influence (0.4%) to household engagement to cluster 3.

The findings from the nature and extent of forest extraction shows that male-headed households have a higher value of all main forest products extracted. This could be explained by differences in gender roles which discourage women from engaging in forest extraction for commercial purposes. In addition, the intensity of extracting forest products was higher among middle-wealthy group compared to the other wealth categories. The lower extraction intensity among the wealthier households could be explained by their access to other alternative livelihood opportunities which raises the opportunity costs of engaging in forest-based livelihoods. These findings imply that forest extraction decisions vary among households depending on the household type (gender, wealth category), nature and extent of forest-based livelihood.

The results from the first step (decision to extract) of Double Hurdle model analysis indicated that household size (P=0.003), membership to farmer groups (P=0.051) and membership to forest user groups (P=0.031) had a positive influence to the decision to engage in forest extraction while age (P=0.040), access to extension services (P=0.005) and income(P=0.03) had a negative influence to the level of extraction. The results from the second step (extent of forest extraction) of Double Hurdle analysis indicated that being male (P=0.005) had a positive influence to the decision to extract forest resources while secondary level education (P=0.032), distance to market (P=0.005), proximity to all-weather roads (P=0.003), land size (P= 0.005) and access to credit were negatively associated with extent of forest extraction. From the findings, the young headed households were highly engaged in forest extraction as compared to the older households. Further, majority of the rural households utilized firewood for cooking and heating. Generally, households who had low level education were highly engaged into forest extraction as compared to those with high level education.

5.3 Conclusion and policy implications of the study

The following were the conclusions derived from the findings of the study. First, rural households in Mt. Elgon region of Kenya were found to engage in diverse livelihood strategies to sustain their livelihoods. Using PCA and cluster analysis the

study identified three key livelihood categories; i) forest extraction and farming, ii) business strategies iii) wage employment, farming and business livelihood strategies. Majority of the households (75%) are engaged in cluster I (farming and forest based livelihoods) suggesting limited levels of diversification beyond survival based strategies. This therefore calls for policy makers to reflect on the most suitable ways to support rural livelihoods.

Secondly, the findings show that household's engagement in different livelihood strategies differ by household asset endowment such as access to infrastructure (all-weather roads, access to credit, extension services and markets) and education. These differences define the differences in livelihood strategies and diversification by the household head. However, access to education and access to access infrastructure were observed as motivating factors for engagement in higher remunerative livelihood strategies. The implication is that interventions to promote education and infrastructural improvement could support rural households transition into high value livelihood options.

Thirdly, the intensity of forest extraction is influenced by various households' capital such as natural, human, financial, social and physical characteristics. The study concludes that rural households are highly dependent on extraction of forest resources even though the intensity varies among households. Poorer households in the study area engaged in forest extraction mainly for survival while middle wealth households appeared to engage for accumulation. Overall, the study has shown the importance of taking into consideration heterogeneity in term of livelihood platforms, strategies and outcomes when implementing interventions to support forest-dependent communities.

5.4 Recommendations

From the findings of the study, the following recommendations are made. First, the government and other policy makers should focus on increasing household asset endowment in rural areas to enable households diversify into various livelihood strategies. The study has shown that improving rural infrastructure, access to

extension and educational attainment have the potential to increase a household's engagement in higher earning livelihood activities. Therefore, interventions supporting extension, education and infrastructure would be critical for policy makers to focus on increasing households' assets if poverty level has to be reduced in rural areas.

Secondly, in view of the findings that credit access can enable households to engage in more lucrative livelihood sources such as business there is also need to improve households' access to financial resources. It can be done through various ways; promoting phone based money transfers, facilitating safe deposits to encourage saving, low-cost credit through joint group borrowing and lending. Specific safety nets should also be developed for households that participate in business only to help them recover from shocks, and social networking programs should be designed to help them access off-farm wage employment prospects.

Thirdly, to achieve a balance between forest extraction and biodiversity conservation, policymakers should work to create alternative livelihood options, which are critical for lowering forest extraction and so safeguarding forests for future prosperity. This can be done by improving social amenities such as infrastructure, access to credit, extension services and education level. The improvement of social amenities like roads can help in reducing the transaction costs like the transportation costs. The lower transaction costs will play a key role in supporting and promoting the adoption of alternative livelihood sources like business activities. This in turn helps in ensuring that forest resources are used in a more sustainable manner hence reducing degradation.

5.5 Areas for Further Research

This research can be expanded in a number of ways. Extending the research throughout many time periods would help to generalize the findings for Kenya. This research should be expanded to examine the role of forest revenue in income inequality among rural households in Kenya's Mt. Elgon region.

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APPENDICES

Appendix I: Tables showing Multicollinearity and Heckman results

Table A1: Multicollinearity results for Multinomial logit model

Independent variable	**VIF**
Expenditure (Ksh)	1.21
Farmer group (1=yes)	1.18
School years	1.17
Access to extension (1=yes)	1.14
Household size	1.13
Gender (0=male)	1.11
Access to credit (1=yes)	1.10
Age (no.)	1.10
Distance to roads	1.07
Shocks value	1.07
Market distance (km)	1.07
Asset value (Ksh)	1.05
Size of land (acres)	1.02
Mean VIF	**1.11**

Table A2: Multicollinearity results for Double Hurdle Model

Independent variables	**VIF**
Schooling years	9.96
Education level	9.74
Gender 0=male	1.11
Age (years)	1.09
Household size	1.07
Access to credit 1=yes	1.03
Wealth category: High income	1.02
Size of land (acres)	1.01
Road distance (km)	1.01
Farmer groups	1.37
Forest user groups	1.14
Mean VIF	**2.99**

Table A3: Heckman model results

Variables	1st Step(Decision to extract)		2nd step(Level of extraction)	
	Coefficient	P>|t|	Coefficient	P>|t|
Human capital				
Age (yrs)	-0.0003	0.941	-0.0095***	0.005
Gender: 1=Male	0.02405	0.898	0.1182	0.395
Household size (Numbers)	0.00175	0.954	0.0600***	0.005
Education level: 1=Tertiary	0.8593	0.279	-1.1829***	0.001
Village variables				
Distance to market(Km)	-0.0409*	0.085	-0.09025***	0.000
Distance to all-weather roads(Km)	-0.0127*	0.068	-0.01380***	0.009
Access to extension 1=Yes	-0.2172*	0.079	0.0376	0.676
Financial capital				
Access to credit1=Yes	-0.39378*	0.026	-0.0454	0.735

Social capital				
Membership in a forest user group 1=Yes	0.0267	0.874	0.4880***	0.000
Shocks				
Shocks val. (Ksh)	0.037	0.198	0.10576*	0.092
Physical capital				
Wealth category: 1=High income	-0.3124*	0.067	0.1213	0.391
Assets value (Ksh.)	-0.10222**	0.023	0.037	0.198

Appendix II: Focus Group Discussion Tool

1. What are the main income generating activities undertaken in this region?
2. Are you involved in hunting, logging, collecting and harvesting of forest products?
3. What quantities and values of forest products did you extract over the past years?
4. What other benefits do you obtain from Mt Elgon forest?
5. Is there any other forest related services that you engage in?
6. What are the most common type of shocks experienced in this region
7. What are the main type of crops grown in this region and during what seasons?

Appendix III: Questionnaire

SECTION 0. INTRODUCTION AND INFORMED CONSENT	
I AM FROM THE JOMO KENYATTA UNIVERSITY OF AGRICULTURE AND TECHNOLOGY. TOGETHER WITH RESEARCHERS FROM GERMANY, WE ARE DOING A SURVEY TO UNDERSTAND THE EFFECTS OF MARKET BASED INCETIVES ON FOREST CONSERVATION AND DEVELOPMENTIN RURAL AREAS OF KENYA. THE DATA COLLECTED WILL BE USED TO UNDERSTAND WHAT COULD BE DONE TO IMPROVE FOREST CONSERVATION AND FOREST DEPENDENT LIVELIHOODS. THE RESULTS AND RECOMMENDATIONS WILL BE SHARED WITH DECISION-MAKERS, WITH COMMUNITY REPRESENTATIVES AND WITH OTHER RESEARCHERS. THE INTERVIEW WILL TAKE ABOUT 1 HOUR. ALL THE INFORMATION WILL REMAIN ANONYMOUS AND CONFIDENTIAL; YOUR NAME AND THE NAMES OF ANY OTHER PEOPLE YOU MAY MENTION DURING THE INTERVIEW WILL NEVER BE PUBLISHED OR SHARED. IF YOU ACCEPT TO PARTICIPATE IN THE INTERVIEW, YOU CAN DECIDE TO WITHDRAW AT ANY MOMENT.	
DO YOU AGREE TO BE INTERVIEWED?	
☐ Yes, permission is given	☐ No, permission is not given
⇒*Proceed to the next page to*	⇒*Do the following*:
- *assign an ID to the interview* - *record the time*	- *Fill in the Household Sampling Log to explain why the interview cannot be conducted.* - *Move on to the next household*
Then start the interview	

DATA ENTRY INFORMATION (TO BE FILLED BY THE PERSON ENTERING DATA)

DE1. Data entry: enumerator's name and number DE1a. Name: _____ DE1b. Number: ___ ___	DE2a. Data entry done on (day / month / year): ___ ___ / ___ ___ / 201 ___ DE2a. Data entry done on (day / month / year): ___ ___ / ___ ___ / 201 ___

SECTION 1. HOUSEHOLDS' INTERVIEW INFORMATION HII	
HII1. Forest station number: ___ ___ ___ 1= Kaberwa, 2=Saboti Socio 3= Kimothoon	HII2. Household' s ID number (from label sheet or sticker) ___ ___ ___ ___ ___
HII3. Interviewers' name and number Name: _____ Number: ___ ___	HII4. Supervisors' name and number Name: _____ Number: ___ ___
HII5. Day / month / year of interview ___ ___ / ___ ___ / 201 ___	HII6. Interview area HII6a. County: _____

	HII6b. Sub-county: _____ HII6c. Village / area: _____
HII9. GIS Coordinates of the interview location HII9a. Latitude: ___ ___ ___ ___ ___ ___ HII9b. Longitude: ___ ___ ___ ___ ___ ___	HII9d. Was the interview conducted at: ☐ Respondent's residence AND farm / production site ☐ Respondent's residence ☐ Respondent's farm or production site ☐ Other (specify): HII8e. Respondent's phone number (if not available, ask for close family members number or neighbour's number):

1.1 HOUSEHOLD PROFILE

A01	**A02**	**A03**	**A04**	**A05**	**A06**	**A07**	**A08**	**A09**	**A10**	**REL CODES** 1. Head of household 2. Spouse / partner 3. Son / daughter 4. Grandchild 5. Sister / brother 6. Father / mother 7 Nephew / niece 8. In-law 9. Grandparent 10. Non-relative **EDU CODES** 1. Pre-primary 2. Primary 3. Post-primary, vocational 4. Secondary 5. College (middle-level) 6. University undergraduate 7. University post-
Person Nr	Name or other form of identification (This is only used to identify the person in the following questions. It does not need to be the real name)	What is the relation of (name) to the head of house-hold	Is (name) male or female?	How old is (name)?	What is the highest level of education completed by (name), or in which (name) is enrolled	How many months in the last year did (name) live away from home?	What is the marital status of (name)? Only ask for people above 12 years of age	What ethnic group do you belong to...?	What is the occupation of the household head?	
		REL CODES	1. F 0. M	Age in years.	EDU CODES	Number of months.	MARITAL CODES	ETHNIC CODES	OCCUPATION CODES	
P1		__	___	__ __	__ __	__ __	__ __			
P2		__ __	___	__ __	__ __	__ __	__ __			
P3		__ __	___	__ __	__ __	__ __	__ __			
P4		__ __	___	__ __	__ __	__ __	__ __			
P5		__ __	___	__ __	__ __	__ __	__ __			
P6		__ __	___	__ __	__ __	__ __	__ __			

P7		__	___	__	__ __	__	__ __			graduate 8. Madrassa / duksi 9. Other **MARITAL CODES** 1. Married monogamous 2. Married polygamous 3. Living together / de facto 4. Separated 5. Divorced 6. Widow or widower 7. Never married **ETHNIC CODES** 1 sabaot 2 Luhya 3 kikuyu 4 other kalenjins 5 other ethnic group (SPECIFY) **OCCUPATION CODES** **1**-farming
P8		__	___	__	__ __	__	__ __			

										2-Wage employment 3- business person 4- ecotourism 6- other specify

SECTION 2. 1 LAND RESOURCE BASE

2.0 Land

Do you possess land or use land for agriculture, aquaculture or forestry (This includes land owned, rented in/borrowed in or common land that is accessed for agriculture or forestry)

1= Yes 0= No

If Yes, please report the household's land and the area used for agriculture or forestry (owned and rental in/out) separately for each parcel. Please start with the homestead.

BO1	**B02**	**B03**	**B04**	**B05**	**B06**	**B07**			**B08**		**BO9**	**LAND USE CODES**
Land Parcel S.No	Land Area	Main land use	Tenure status	When was the land obtained	What is the current value of the land if you want to sell (only for owned land)	Rental rate per year whether rented in or rented out			Distance from household to the parcel of land		Perceived land security	1 = Cropland 2= pasture land 3= agroforestry 4= fallow/ Silvipasture 5= Other vegetation types/land uses (residential, natural forests plantations 6= Plantations and crops
codes	Acres	L/USE CODES	TENURE CODES	YEAR	Value in KSH.	In Cash (KES)	In Kind (KES)	Total in Kind (KES)	In Km	In minutes	SECURITY CODES	
1												
2												
3												
4												
5												
6												
7	Total Land Owned (to be calculated after the interview)											
8	Total Land Rented out											

9	Total Land Rented in						**Tenure codes** 1=own land (with title) 2= Owned land (without title) 3= Rented land [someone else's land 4= allocated forest land 5= Communal land 6=Family land 7= other (specify) **Perceived land security** 1 very secure 2 secure 3 moderately secure

							4 insecure 5 Very insecure

SECTION 3:1 INCOME SOURCES, EXPENDITURES, AND COSTS AMONG HOUSEHOLDS

Income from collecting, hunting, harvesting and logging activities.

Is your household involved in collecting, hunting, harvesting and logging activities? 1=Yes, 0=No

If yes, what are the quantities and values of forest products, the members of your household collected for both own use and sale over the past 12 months?

F01	**F02**	**F03**	**F04**	**F05**	**F06**	**F07**	**F08**	**F09**	**F10**	**F11**	**F12**	**F13**	**F14**	**F15**	**F16**	**F17**	
Do you collect any of the following products from the forest? **1=yes** **0=no**	**If yes who is responsible for collecting or harvesting the product (*Codes B*)**	**Distance from household location to forest**	**What is the main season for the activity in the la**	**On average, for how many months did you conduct the activity per month**	**How often do you conduct the activity per month**	**Units**	**How much time do you spend for this activity per month**	**Own use (including gifts)**	**Sold (including barter)**	**Type of market (*Market codes*)** **1=local open air mkt** **2=super market** **3=farmgate** **4=ot**	**Total quantity collected**	**Price per unit**	**Gross value**	**Transport /marketing costs(Total)**	**Purch Inputs and hired labour**	**Net income (F16-F17-F18)**	**Tenure codes** 1-own land, 2=family land 3-rented land, 4-someone else land

				st 12 months	**the activity?**	**(in days)**		**Hrs/day (Incl Walking distance, transport etc)**			**hers**							, 6-other, 7-Allocated forest land) **Codes B:** 1=only/mainly by wife and adult female household members; 2=both adult males
	Response											Per day	Per Yr					
Collecting forest products																		
Firewood (headload																		

)																		and adult females participate about equally; 3=only/mainly by the husband and adult male household members; 4=only/mainly by girls (<15 years);
Mushrooms (bunches)																		
Bamboo shoots																		
Black nightshade (Sucha)																		
Stinging nettle																		
Wild fruits (kgs)																		
Honey (litres)																		
Herbal medicine																		

(litres)																		5=only/mainly by boys (<15 years); 6=only/mainly by children (<15 years), and boys and girls participate about equally; 7=all members of household
Grass																		
Ndereema																		
Pumpkin leaves																		
Calabash leaves																		
Hunting																		
Rabbits																		
Antelopes																		
Loggiing																		
Timber																		
Poles																		
Harvesting																		
Rafters																		

																		ld
																		participate equally; 8=none of the above alternatives

3.3. INCOME FROM AGRICULTURE (OTHER PLOTS)

A. In addition to the crops listed above, please list the various crops planted and sold from other parcels of land and seasons in which they grew

H17	**H18**	**H19**	**H20**				**H21**		**H22**	**H23**	**H24**	**H25**	**H26**	**H27**			**H28**			**H29**
Crop	**Planted on parcel no. (Take land ID from 3.1)**	**Area planted (Size In acres)**	**Planting Seasons**				**Total production**		**Consu Ption**	**Give away**	**Seeds reserved**	**In-kind payments for labor, machine rental, laundry payment**	**Animal feed**	**Sale 1 (Sales for season 1)**			**Sale 2 (Sales for season2)**			**Total Revenue (sales 1 +sales 2)**
			4.Season 1		**5.Season 2**															
			Month	**Month**	**Month**	**Month**	Quantity	Unit	Quantity	quantity	quantity	quantity	quantity	quantity	Price /Unit sold	Total sales (Season 1)	quantity	Price/unit sold	Total sales (Season 2)	
Coffee																				
Tea																				
Staple foods (Starches, maize , matoke etc)																				
1 maize																				
2 Beans																				
3 Irish potatoes																				
4 Matoke																				
5																				

Pumpkins																				
6Arrowroots																				
7 Yams																				
8 Cassava																				
9 Sweet potatoes																				
10 Wheat																				
Vegetables																				
1Kales																				
2 Cabbages																				
3 Black nightshade																				
4Spinach																				
5 cowpea leaves																				
6 Calabash leaves																				
Sorghum																				
7Millet																				
8 onions																				
9 carrots																				
10 green peas																				
11 French beans																				
12.																				

Tomatoes																			

B. COSTS INCURRED IN CROP PRODUCTION **Please indicate the various costs related to crop production**																									
H30	**H31**																								
1.Inputs	**2. Quantity**																								
	Qty	**Unit**	**Price**	**total**	**Qty**	**unit**	**Price**	**total**	**Qty**	**unit**	**price**	**total**	**Qty**	**unit**	**price**	**total**	**Qty**	**unit**	**price**	**total**	**Qty**	**unit**	**price**	**total**	**TOTALINPUT COST**
1.Seeds																									
2.Fertilisers																									
3.**Pesticides**																									
Herbicides																									
Fungicides																									
Insecticides																									
4.Manure																									
5.Draught power																									
6. Hired labour																									
Land preparation																									
Planting																									
Hand weeding																									
Fertilizer application																									
Pesticide																									

application																									
Harvesting/Threshing																									
Irrigation																									
Family labour																									
7.Hired machinery																									
Land preparation																									
Planting																									
Weeding																									
Fertilizer application																									
Pesticide application																									
Harvesting/Threshing																									
Irrigation																									
8.Transport/marketing																									
9.Processing																									

3.5: INCOME FROM LIVESTOCK

H39 Did you keep any of the stocks listed below between 11/17-11/18			0=no 1=yes		
H40 If yes, please list stocks you kept since Nov 2017					
H41		H42	H43	H44	H45
Livestock ID	Animal species/ production activity	Stock at 11/2018	Stock sold during the past 12 months		
				Price/unit	Total sales
1	Cows				
2	Oxen				
3	Goats				
4	Sheep				
5	Pigs				
6	Donkeys				
7	Chicken				
8	Other (Specify)				

B: LIVESTOCK PRODUCTS						
H46 Did you get livestock products in the last 12 months			1=yes , 2=no			
H47 If yes please list and quantify the products produced during the last 12 months						
H48	**H49**	**H50**	**H51**	**H52**	**H53**	**H54**
Product ID	**Livestock products**	**Total Production Unit**	**Home use units**	**Quantity sold units**	**Price per unit**	**Sales value**
1	Meat (beef/pork/ mutton, chicken)					
2	Milk					

6	Eggs					
7	Hides and skins					
8	Wools					
9	Manure					
10	Draught power					
11	Bee wax					
12	Honey					
13	Curdled milk					
15	Dung					
15	Others					

	C. COSTS INCURRED IN LIVESTOCK PRODUCTION Please list the quantities and values of inputs used in livestock production during the last year (11/17-11/18																													
H55					**H56**																									
1.inputs	**Cows**				**oxen**				**goats**				**sheep**				**pigs**				**donkeys**				**chicken**					
	Qty	**unit**	**price**	**total**	**Qty**	**unit**	**price**	**total**	**Qty**	**unit**	**price**	**total**	**Qty**	**unit**	**price**	**total**	**Qty**	**unit**	**price**	**total**	**Qty**	**unit**	**price**	**total**	**Qty**	**unit**	**price**	**total**	**TOTAL COSTS**
1.Feeds/Fodder																													
2.Rental of grazing land																													
3.Medicines,																													

vaccinations and other veterinary services																													
4.Costs of maintaining barns, enclosures, pens, etc																													
5. Hired labour																													
6.Inputs from own farm																													
Other, specify																													
TOTAL																													

SECTION 3.6: WAGE INCOME		
H63 Has any member of the household had paid income in the last year	1 = yes, 0 =	If no proceed to section 4.7 (*Note: One person can be*

			N o	*listed more than once for different jobs.)*	
	H 6 4		H 6 6	H67	H68
1.Household member (PID)	**2.Type of work** **1=formal (specify) 2= Casual 3=informal (specify) 4= other**	**3.Do you commute from home village to place of work** **1=yes** **0=no**	**4.Days worked per month**	**5.Daily wage rate**	**6.Total wage income**

SECTION 3.7: INCOME FROM OWN BUSINESS (NOT FOREST OR AGRICULTURE)			*1) Codes: 1=shop/trade; 2=agric. processing; 3=handicraft; 4=carpentry; 5=other forest based; 6=other skilled labour; 7=transport (car, boat,…); 8=lodging/restaurant; 9=brewing; 10=brick making; 11=landlord/real estate; 12=herbalist/traditional healer/witch doctor; 13=quarrying; 14= contracted work (cleaning/maintenance); 15=renting out equipment; 19=other, specify:*
H69 Are you involved in any type of business?	0=no 1=yes		
H70 If yes, please indicate the income and costs related to that business. *Note: If the household is involved in several different types of business, you should fill in one column for each business.*			

	Business1	Business 2	Business 3	
H71. What is your business type [1]				
H72 Gross income (sales)				
COSTS:				
H73 Purchased inputs				
H74 Own- non-labour inputs (Equivalent market value)				
H75 Hired labour				
H76 Transport and marketing costs				
H77 Capital costs (Repair, maintenance, etc)				
H78.Other costs				
H79 Net income (H72-items H73-H78)				
H80 Current value of capital stock				

SECTION 3.8: OTHER INCOME SOURCES **Please list any other income that the household has received during the past 12 months.**	
Type of income	**Total income received in the past year**
Remittances /Transfer	
Support from government, NGO, organization or similar	

Gifts/support from friends and relatives	
Pension	
Payment for forest services	
Payment for renting out land (if in kind, state the equivalent in cash)	
Compensation from logging or mining company (or similar)	
Payments from FUG	
Other, specify:	

SECTION 3.9: HOUSEHOLD EXPENDITURE

How much did you spend for the following items Please estimate carefully how much the household spent on each item on a monthly/annual basis

	S/no.	ITEM	amount consumed over the last 7 days	Amount spent per week (Ksh)	Amount spent per year
Food	1	Rice	Kg		
	2	Maize/ maize flour	kg		
	3	Millet	kg		
	4	Banana	Kg		
	5	Beans , peas and other pulses			
	6	Milk and milk products			
	7	Bread/Maandazi/Kangumu			
	8	Herbs and spices e.g onions, chilli, ginger			
	9	Roots and tubers e.g potatoes, yam, cassava and their flour			
	10	Fats and oils e.g vegetable/groundnut	litres		
	11	Beef/pork/mutton	kg		
	12	Fish	kg		
	13	Poultry	kg		

		ITEM	AMOUNT SPE LAST TWELVE
Education	40	School fees	
	41	Student dress and uniform	
	42	books	
	43	Other cost of schooling	
	44	**Total education**	
Health	45	Medicinal Purchases in pharmacy only	
	46	Doctor fee	
	47	Hospital bills and medicine	
	48	Other health costs	
	49	**Total health including health expenditures later refunded by insurance**	
Social	50	funerals	
	51	Donations (to temples social organizations, schools)	
	52	Recreation and entertainment	
	53	Religious costs	
	54	Lottery	
	55	Transfers and remittances	
	56	Other gambling expenditures *Sometimes, government officials, police officer or business partners, ask people or expect people to pay a bribe for their service. How much did you have to spend...?*	
	57	Bribery/corruption-Police	
	58	Bribery/corruption-government	

	14	Eggs	pieces		
	15	Vegetables	kg		
	16	Fruit	kg		
	17	Food ingredients, spices (include salt/sugar	kg		
	18	Beverages; coffee, cocoa, juice	litre		
	19	Take home and eat out			
	20	Other food			
	21	**Total Food**			
		ITEM	**Amount spent in last 1 month**	**Amount spent in the last 12 months**	
Non-food	22	Personal care supplies			
	23	Clothes, shoes and bags, accessories			
	24	Detergent washing powder			
	25	hairdresser			
	26	Electricity			
	27	Water cost			
	28	House rent			
	29	Liquid propane gas/charcoal			
	30	firewood			
	31	waste			
	32	**Total Non-**			

		police
	59	Bribery /corruption-business partner
	60	**Total social**

		Food			
	33	Fuel for car and motorbike			
	34	Public transportation			
	35	Telecommunication (airtime and charging)			
	38	Maintenance for car and motorbike			
	39	Insurance and fee for car and motorbike			
		Total transport and communication			

4.1: SHOCKS, CRISIS OR UNEXPECTED EXPENDITURES										
		S1 Over the past five years, was your household sever	**S2** When did the event occur?	S3 Rank the MAIN THREE shocks experienced according to	S4 What was the estimated value lost due to this shock?	S5 Did this shock cause a reduction in household income and or assets	S6 Apart from your HH who else was affected by the event?	S7 Have you suffered from this shock in the past 1 year	S8 Coping activity to deal with the event	**CODE A** Yes= 1 No=0 **CODE B** Most severe =1 Second Most severe= 2

		ely affected negatively by any of the following events?			order of severity		?		1=yes 0=no			Third most severe=3 **CODE C** Yes= 1 No=0 **CODE D** No other HH=0 Some other HH=1 **<u>COPING CODES</u>** 1-spent cash on savings 2-sent childrem to live with relatives 3-sale of various assets and
EVENT ID	**Event**	Yes=1 No = 0	Year	Month	CODE B	**Ksh**	Yes=1 No = 0	CODE D		**Major activity**	**2nd activity**	
101	Drought											
102	Floods/heavy rains											
103	Crop damage by wild animals											
104	Crop disease or crop pest											
105	Bans (on logging, maize growing etc.											
106	Death of livestock/livestock diseases											
107	Killing of livestock by wild animals											
108	Killing of											

	people by wild animals (hyenas, bee attacks, snake bites)											products a-sold assets
109	Trees falling on people or livestock											b- sold animals
110	Livestock theft											c- sold more crops
111	Crop theft											
112	Frosts											
113	Erosion/landslides											d-sold farm land
114	Fire											
115	Large fall in sale price for crops											e- Sold food that would otherwise be used for household consumption
116	Death of household head											
117	Death of working merchant of the HH											
118	Death of other family member											
119	Loss of salaried employment or non-payment of salary											4-Worked longer hours or more
120	End of regular assistance, aid, or remittances from outside HH											5-Other members who were not working went
121	Large rise in price of food											

122	Large rise in agricultural input prices											to work 6-Started a new business 7-Got children from school to work 8-went elsewhere to find work 9-Borrowing a-Borrowed money from relative b-Borrowed money from money lender c-borrowed money
123	Severe water shortage											
124	Birth in the household											
125	Break-up of the household											
126	Bread winner jailed											
127	Robbery/buggery/assault											
128	Theft of bicycle, motorcycle or car											
129	Dwelling, damaged, destroyed											
130	Eviction											
131	Ethical/clan clashes											
132	Loss of land											
133	Payment for sale of HH products arrive later than expected											
134	Delayed income for forest products											
135	Conflict											
136	HIV/AIDS											
99	Others (specify)											

												from institutions-bank 10-Received assistance a-Received help from religious institution b-Received help from international bodies c-Received help from local NGOs d-Received help from government e-

												Received help from family and friends 11- Reduced food consumption 12- Consumed lower cost but less preferred food 13- Reduced non-food expenditures 14- Harvested premature crops 15- Changed cropping patterns or types

												of crops planted 16-Spiritual effort-prayer, sacrifices, consulted diviner 17-Rented out land 18-Dig terraces 19-Plant trees 20-Seek for compensation 21-Insurance 22-Traditional methods of dealing with pests

												a. Push and pull: plant crops that are not affected by pest close to core crop b-Use ashes to deal with pests c-Use kerosene to deal with pests 25- Steal forest resources 26- Did nothing 99- others (Specify)

5.1 : HOUSEHOLD ASSETS

Which of the following assets are owned by your household? Please indicate the number and value of implements and other large household items that are owned by the household.

	Asset	0=No 1=Yes	1. No. of units Owned	2. Total value (current sales value of all units, not purchasing price)		Asset	0=No 1=Yes	1.No. of units Owned	2.Total value (current sales value of all units, not purchasing price)
1	Electricity				16	Dvd player			
2	Radio				17	Cassettte/Cd player			
3	Television				18	Car/truck			
4	Smart phone				19	Tractor			
5	Non-mobile telephone				20	Motorcycle			
6	Refrigerator				21	Bicycle			
7	Solar panel				22	Handphone /phone			
8	Table				23.	Stove for cooking (gas or electric only)			
9	Chair				24	Fishing boat and boat engine			
10	Sofa				25	Chainsaw			
11	Bed				26	Plough			
12	Cupboard				27.	Scotch cart			
1	Clock				28	Wooden cart or wheelbarrow			
					29	Pump			

13					
14	Computer				
15	Microwave oven				

SECTION 6: INSTITUTIONAL AND SUPPORT SERVICES		RESPONSE
1) Are you or any member in your household a member of a registered farmers' group or association?	1=Yes 0=No	
2) If yes, to 1 what type of group?	1= Self-help group 2= SACCO 3= CBO 4= A producer cooperative society5= other (specify)	
3) Did any of the household members try to obtain or access credit over the last one year	1= Yes 0=No	
4) Did you obtain or get the loan/credit	1= Yes 0=No	
5) If yes to 4 who was the provider?	1= Commercial bank 2= Micro-finance institution 3=cooperative 4= shylock/ local money lender 5=mobile credit (Mshwari,branch,tala) 6=Sacco 7=Family/friends 8=Chama group 9= contractual outgrower arrangement 10=Other(please specify)	
6) What was the loan used for	1Agricultural investment, 2-Agricultural expenses (fertilizer, seeds, pesticides,) 3-business related expenses, 4-capital for business, 5-payback other debt, 5-house/land purchase/construction, 6-buy durable household goods, 7-buying food, 8-buying other consumption goods eg cellphone, credit, clothes 9-medical treatment, 10-ceremony (wedding, funeral), 11-study, 12-relend to family members or relatives, 13-Other(specify)	
7) Name of nearest town/market	Indicate name	
8) What is the distance from the homestead to nearest market	Km	
9) What is the distance from the homestead to the nearest tarmac road?	Km	
10) Did you receive any extension services in the last 12 months	1=Yes 0=No	
11) If yes to 10, what type of extension was	1=Crop 2=Livestock 3=Crop and livestock 4= conservation practises	

it?		
12) Who (main) provided the extension services	1=Government 2=private extension 3= cooperative/farmer association 4=NGO'S 5=Others(please specify)	
13) Who in the household accessed the service	1= HH 2= spouse 3=child 4= farm manger 5=other (specify)	
14) What was your level of satisfaction with the extension service	1= very dissatisfied 2=dissatisfied 3=neutral 4=satisfied 5=very satisfied	
15)Do you have an insurance cover?	1=Yes 0=No	
16)If yes in please specify	1-life insurance, 2-property insurance, 3-health insurance, 4-Disability insurance,5-livestock insurance, 6-crop insurance,7-funeral insurance, 8-accident insurance, 9-others (specify)	

<table>
<tr><td colspan="2">SECTION 7. NOTES AND OUTCOME OF THE INTERVIEW</td><td colspan="2">OUT</td></tr>
<tr><td colspan="2">OUT1. Result of the interview</td><td rowspan="2">OUT2.Time finished

___ : ___

(HH : MM, 24h)</td><td rowspan="2">OUT3.Who answered the questions:

☐ Only the respondent

☐ The respondent and other HH members</td></tr>
<tr><td>☐ Interview completed

☐ Partly completed

☐ To be rejected because of poor data quality</td><td>☐ Other (specify)</td></tr>
<tr><td colspan="4">OUT4.Notes on the interview and respondent (anything that could affect data quality and reliability)</td></tr>
<tr><td colspan="4">OUT5. Any additional information that could help identify buyers and sellers</td></tr>
<tr><td colspan="4">OUT6. Any additional information that could not be captured in the questionnaire</td></tr>
</table>