ASSESSMENT OF THE EFFECTS OF DIVERSIFICATION OF LIVELIHOOD STRATEGIES ON AGRICULTURAL PRODUCTION AND HOUSEHOLD INCOME IN NYAMIRA COUNTY, KENYA

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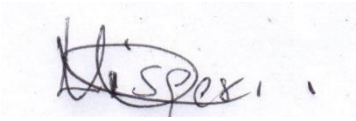
DECLARATION

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

Signature:  Date: **18/07/2022**

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DEDICATION

This thesis is dedicated to my family for their support, encouragement and prayers during my studies.

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LIST OF ABBREVIATIONS AND ACRONYMS

ANOVA	Analysis of Variance
CIDP	County Integrated Development Plan
FAO	Food and Agriculture Organization
GDP	Gross Domestic Product
Ha	Hectares
HIV	Human Immunodeficiency Virus
IHI	Inverse Herfindahl Index
KIPPRA	Kenya Institute for Public Policy Research and Analysis
KNBS	Kenya National Bureau of Statistics
KShs	Kenya Shillings
KTDA	Kenya Tea Development Agency
MNL	Multinomial Logit
NBR	Negative Binomial Regression
NBRM	Negative Binomial Regression Model
NGOs	Non-governmental Organisations
NIE	Number of Icome Earners
OLS	Ordinary Least Squares
PRM	Poisson Regression Model
RoK	Republic of Kenya
SDGs	Sustainable Development Goals
SDI	Simpson's Diversity Index
SEI	Shannon Equitability Index
SID	Simpson's Index of Diversification
SID	Shannon Index of Diversity
SIDA	Swedish International Development Agency
SPSS	Statistical Package for the Social Sciences
SSA	Sub-Saharan Africa
THI	Total Household Income
TSLS	Two-Stage Least Squares
UNICEF	United Nations International Children's Emergency Fund
VCE	Variance-Covariance matrix of the Estimators
VIF	Variance Inflation Factor

ABSTRACT

Farming as a source of income for rural households has failed to solely sustain livelihoods. Consequently, there has always been a need for diversification into off-farm activities and which often is not a panacea. Livelihood diversification is seen as a coping strategy for most rural households, although there is limited empirical evidence that shows if' and even why' the households diversify. Furthermore, little is known about the effect of diversification on agricultural production and household income. This study examines the factors influencing livelihood diversification and its effects on agricultural production and household income in Nyamira County, Kenya. Cross-sectional data were collected through semi-structured questionnaires involving 120 households. The first objective of the study was to assess the factors that influence the choice of different livelihood strategies in the study area; the second was to assess the effect of livelihood diversification on agricultural production while the third was to determine the contribution of off-farm income on the total household income of residents in the study area. Multi-stage sampling technique was used whereas the sample size was determined by the use of proportionate to size approach. Both descriptive and inferential statistics were used to analyse the collected data. Seven livelihood strategies adopted in the study area were identified. The most popular off-farm livelihood strategy was casual labour in the agricultural sector and the least was rents. Poisson regression results suggest that; average years of schooling of other household members, number of household members with secondary education, time taken to the water source (P=0.002), access to extension services (P=0.036), group membership (P=0.001) and electricity access (P=0.000) were the factors that influenced the number of livelihood strategies a household selected. Off-farm income accounting for about 44 percent of household income had an effect on agricultural production through the purchase of inputs used in the farm. In conclusion, both farm and off-farm sectors of the rural economy are important in sustaining livelihoods thus efforts towards enhancing both sectors should be put in place. Also, farming households in the study area need to diversify their livelihood sources to increase their cash earnings and to well utilize the existing production resources. To enhance livelihood diversification, the government, both the National and County government, should improve rural infrastructure in terms of provision of electricity and construction of tap water points near homes of people especially in hilly areas of the County.

Keywords: *Household income,livelihood diversification, mean income shares, off-farm income, Poisson regression*

CHAPTER 1: INTRODUCTION

1.1 Background Information

In most developing economies, 75 percent of the population still lives in rural areas, and is highly dependent on agriculture for their livelihood (Todaro & Smith, 2009). This is despite numerous on-going structural transformations in these counties. Similarly, in Kenya, farming is a key source of income, food and employment. According to FAO (2018) Kenya's agricultural sector contributes about 26 percent directly and indirectly to Gross Domestic Product (GDP). The sector plays a role in poverty alleviation, food security enhancement and is also a major driver of the off-farm sector.

Smallholder farmers dominate the Kenyan agricultural sector where they account for about 80 percent of total output and who operate on average farm land of 0.47 ha. Within some regions there exist smallholder farmers that operate on relatively larger farms approximately 2.1 ha. Most smallholder farmers use family labour as their major source of labour with most of the produce consumed at home and merely quarter of their production being sold (Rapsomanikis, 2015). Smallholder farmers are characterized by high poverty rate, limited access to markets and financial services and food insecurity. About 46 percent of Kenya's population is deprived of their necessities hence categorized as absolutely poor (Mwangi, 2013). This situation is contributed by unemployment, the decline in agricultural production and income inequality among other factors especially in rural areas.

According to FAO (2015), about forty percent of Kenya's total population and more than seventy percent of the rural people work in the agricultural sector. This sector also contributes for about 70 percent of the total household income of rural farmers (Davis *et al*. 2016). Despite this, the sector alone cannot sustain livelihoods as its faced by several challenges among them; high population growth, progressive reduction in land sizes, seasonal changes, reduction in soil fertility, incidences of pests and diseases and other adverse effects of global climate change. Consequently, livelihood diversification has become a rational response amongst rural farming households.

Livelihood diversification can be defined as the ability of an individual to generate cash, invest in assets to increase their income levels and engage in several activities (Ellis, 2000). This implies diversifying income sources, occupation and assets (Barret *et al*. 2001). In most rural households, people are involved in different activities such as crop growing, livestock rearing,

hiring out their labour in the neighbourhood, running their own businesses enterprises or migrating to other areas to look for employment (Khai & Ngoc, 2010 ; Mathebula *et al*. 2011). All these activities act as different sources of income and help cushion families against risk.

Rural households diversify their livelihood strategies when they want to spread risk or/ and even to take advantage of better opportunities in the off-farm sector (Reardon, 2006; Barrett *et al*. 2001). However, some households who are either too busy in the farm work, are financially constrained, and/or fear risk or lack skills required in the off-farm sector do not diversify. Also, when there are no off-farm activities available most households choose to practice farming alone (Abebaw, 2017).

Whereas off-farm income directly boosts total income, there are two possible indirect effects of livelihood diversification on the household. These effects depend on the strategies of a household in a particular context and on the development opportunities (Oseni & Winters, 2009). Off-farm earnings, helps to relax liquidity constraints of households during periods of capital scarcity which might lead to increased farm investment on farm inputs. During off-peak agricultural seasons it tends to reduce family labour available on the farm (Lopez-Feldman *et al*. 2007; Pfeiffer *et al*. 2009; Huang *et al*. 2009).

Diversification of activities is essential in maintaining a regular flow of income to the household to cater for its needs and provide funds to invest in farming activities (Haggblade *et al*. 2007; Woldehanna, 2000). It also bridges agricultural labour seasonality as it absorbs excess labour during agricultural off-peak periods, smooths consumption and acts as risk insurance mechanism through its contribution to the household income (Ume *et al*. 2018, Wanyama *et al*. 2010). Moreover, earned income from off-farm work can be used as collateral for loans and provides easy access to modern inputs (Fikru, 2008).

When complemented with farming in most rural areas, livelihood diversification mitigates the effects of poverty (Babatunde and Qaim, 2010; Awoniyi and Salman, 2012; Edoh and Nwibo 2013). According to Lay and Schuler (2008) diversification is led by the desperation rather than new opportunities. The findings are echoed by Riithi (2015), who states that most of the resettled households within a resettlement scheme in Kenya diversified their activities after being faced with environmental and infrastructural challenges.

Factors influencing livelihood diversification can be classified into "*push"* and "*pull factors"* (Maniriho and Nilsson, 2018). "*Push factors"* are survival- led mechanisms adopted by people and are the undesirable reasons that motivate people to pursue alternative sources of income both in and/or outside farming. These include market access problems, missing or incomplete markets, land constraints, seasonality, risks and shocks. "*Pull factors",* on the other hand, are termed as opportunity-led mechanisms that people use in order to take advantage of opportunities with offer better returns in the off-farm sector. They include proximity to urban areas, infrastructural improvement, development of labour markets, improvement in education and technology and improvements in market access (Eshetu and Mekonnen, 2016; Jayne and Headey, 2014).

1.2 Statement of the Research Problem

Most residents in densely populated rural areas with increasingly reducing land sizes, reducing soil fertility and increasing effects of climate change like Nyamira County face several challenges in trying to secure their livelihood. These challenges include high post-harvest losses, limited access to extension services and new farming technologies. About 90 percent of Nyamira residents, directly and indirectly, depend on agricultural production and marketing and according to many earlier researchers farming alone cannot sustain livelihoods of people in such areas. Most households in Western Kenya, rely on cereals and vegetables as their main staple food. Unfortunately, only about 1,000,000 tonnes of cereals are produced against 1,200,000 tonnes demanded. Majority of people in such areas, therefore, tend to diversify their livelihood strategies for survival. Livelihood strategies adopted by households in Nyamira County and factors influencing their choices are not documented. As documented above, livelihood diversification affects agricultural production positively or negatively. Diversification of livelihood strategies can increase farm income hence total household income. With increased farm income a household can purchase modern farm inputs, rent in land for agricultural use and even hire labour in the farm. Eventually, this will increase farm productivity hence farm income. On the other hand, livelihood diversification can reduce labour use on the farm. Small-sized farming households that participate in off-farm activities may earn less from farming if they do not invest off-farm earnings on the farm to replace the lost labour. Moreover, sometimes resources meant for investment in the farm are used to start or expand various off-farm activities. The "if and how" such adopted strategies affect farming and incomes generally in Nyamira County are not known either.

1.3 Study Objectives

1.3.1 General Objective

The main objective of the study was to assess the determinants of diversification of livelihood strategies adopted,and the effect of diversification on agricultural production and household income in Nyamira County.

1.3.2 Specific Objectives

The specific objectives of the study were to:

1. Determine factors that influence the type and number of livelihood strategies households in the study area engage in.
2. Determine the effects of diversification of livelihood strategies on agricultural production.
3. Assess the contribution of livelihood diversification on total household income.

1.3.3 Research Hypotheses

1. Socio-economic, institutional and biophysical factors taken singly do not influence the type of livelihood strategy pursued by the household.
2. Diversification of livelihood strategies has no effect on agricultural production.
3. Diversification of livelihood strategies has no contribution on household income.

1.4 Justification of the Study

The government of Kenya continues to make various efforts to achieve its international commitments to food security and nutrition which are the Malabo Declaration and the Sustainable Development Goal (SDG) number two. The most recent local commitments being the Big Four Action Plan. This study seeks to find out the contribution of livelihood diversification to farm production and household income. Livelihood diversification helps to smoothen household's consumption and diversify their diet (Ume *et al*. 2018; Wanyama *et al*. 2010). The findings of this study will therefore, contribute to local policy since both the local and County governments can use results of this study to enhance food security and reduce poverty by improving infrastructure and facilitating access to information concerning off-farm sector.

The study contributes to the scant literature on the effect of livelihood diversification on agricultural production. Identifying the factors influencing livelihood diversification will help the agricultural development institutions to come up with policies that improve the patterns of diversification of rural households and this will eventually result to increase in total household income and food production of households.

Share of different livelihood strategies to total household income will show the livelihood activity that contributes more to the total household income and this will enable rural development policy to target that livelihood strategy as a sustainable livelihood option for rural households. Also, Rural development planners, policymakers and Non-Governmental Organisations (NGOs) can use the findings of this study as an input in informing the appropriate policies for rural income diversifications.

1.5 Outline of the Thesis

This thesis is organized as follows: Chapter one presents the general introduction, the problem statement, objectives and hypotheses. Chapter two presents literature review pertinent to the objectives. The third chapter covers the methodology of the study. Study results and discussions are presented in chapter four while chapter five presents study summary, conclusions and recommendations.

CHAPTER 2: LITERATURE REVIEW

2.1 An Overview of Agricultural Production in Kenya

Agricultural production in Kenya is dominated by smallholder farmers. Smallholder farmers are characterized by subsistence production, non-participation in farmer group associations, poor access to infrastructure, susceptibility to shocks and diseases and pests such as fall armyworm attacks. Smallholder farmers often lack farm support programs, training, grants and input subsidies. These farmers do not easily adopt improved technologies due to high cost of the technologies, low disposable incomes and lack of access to markets for products produced through the use of new technologies (AGRA, 2017; Makhathini, 2013).

Kenya's smallholders produce about 63 percent of the food in the country. Maize makes up to 50 percent of the smallholder household production. Most of the smallholders are poor, have limited access to markets and other services and are also food insecure. They produce for home consumption and only a small portion (25 percent) of their production is sold.

Nyamira County residents produce both food and cash crops. The major food crops produced are maize, vegetables, beans and finger millet. While tea, coffee, pyrethrum and banana are the major cash crops grown. Maize is the most depended on cereal by most residents. But due to declining farm sizes, only about 0.101 hactares to 0.2025 hactares of farm sizes are under maize. The County government has set up various interventions to improve maize production, although optimum levels of production have not been achieved with farmers getting as low as four bags per acre.

Beans, on the other hand, are the most popular pulse among the Nyamira farming households (Nyamira County, CIDP, 2018). A majority of the farmers plant beans as an intercrop with maize. The main challenges facing bean production include lack of certified seeds, low soil fertility and soil acidity, high rainfall and occasional storms during flowering and harvesting stage.

Banana production is also common in the county. The main challenge facing banana production is low yielding local varieties and crop diseases. Various interventions have been put in place by the County government. These include the provision of tissue culture materials to farmers, training of farmers on value addition and husbandry and the formation of banana marketing groups. In addition to this, the County started a processing plant at Nyamusi where banana is

processed into products like bread, flour and other confections. This has resulted in a rise in income from banana.

The county's high altitude (1,250 m and 2,100 m) has allowed for the growing of tea. It is the main cash crop earner. Tea is also a source of employment for most residents. The major challenges facing the tea sector are tea hawking and old bushes and clones which results in low production. Most farmers in the county produce tea on a small scale with an average acreage of less than 1 acre. This has resulted in low-profit margins enjoyed by farmers.

2.2 A Review of Empirical Studies on Determinants of Livelihood Diversification

Most rural households engage in both farm and non/off-farm income activities. According to Davis *et al*. (2007), engagement in one of the two activities does not hinder participation on the other. A household can earn inome from both sectors of the economy but participation in one of the sectors may have a direct or indirect effect on the other (Babatunde, 2012).

Most past studies have identified household assets and their respective quantities and qualities as the factors influencing livelihood diversification. The evidence about the importance of these factors is however mixed. This would be explained by the fact that the off-farm sector is made of several different components. Therefore, particular factors are important for particular activities (Barret *et al*. 2001; Sarah, 2012; Lay *et al*. 2009). For instance, Education is a source of human capital. Households with formal education and skills diversify their income sources into the off-farm sector more these households benefit more from diversification in terms of income earnings than those without education and skills (Senadza, 2010; Marenya *et al*. 2006; Bigsten & Tengstam, 2011). Education also facilitates entry into high paying jobs in the formal and non-formal rural economy ((Marenya *et al*. 2003; Haggblade *et al*. 2005). The unskilled and uneducated rely mainly on labour-intensive, low-paying casual labour in the farm sector. This is confirmed by Woldehanna and Oskam (2001) and Babatunde and Qaim (2009) studies in Ethiopia and Nigeria respectively.

Abebe (2018) indicates that years of schooling the head of the household had attained positively influenced livelihood diversification. Similarly, (Eneyew, 2012; Bigsten & Tengstam, 2011; Asmah, 2011; Matsumoto *et al*. 2006; Lay *et al*. 2009; Saha & Bahal, 2010; Karugia *et al*. 2006; Fausat, 2012) reported that educated households diversify more. Contrary to those findings, studies by Oluwatayo (2009) and Ersado (2006) found that education had a negative and significant effect on livelihood diversification.

Access to information such as improved seed varieties, fertilizer use (rate, type, time of application and method of application), post-harvest loss management, market access information and new technologies in the rural sector influences household's decision to participate in the off-farm activities. Extension service provides knowledge and information on rural diversification (Berjan *et al*. 2015). Many studies indicate a positive relationship between livelihood diversification and extension service access (Teshome & Edriss, 2013; Amankwah *et al*. 2017; Karugia *et al*. 2006). Contrary to that thought Asmah (2011) found no effect of extension service access on livelihood diversification.

Riithi, (2015) in a Solai resettlement scheme in Kenya found that the availability of off-farm activities depends on the available infrastructure in terms of roads. Moreover, infrastructural development in terms of roads and electricity encourages the poor to diversify (Babatunde, 2012). Electricity access facilitates participation in self-employment activities in the off-farm sector. These observations are echoed by Babatunde and Qaim,(2009); Babatunde, (2012); Wanyama *et al*. (2010). Contrary to those finding, Lay *et al*. (2009) report that distance to market does not influence household decision towards off-farm sector activities. The finding is in line with that of Senadza, (2010) in Ghana that found that distance to market had insignificant effects on diversification.

In Sub-Saharan Africa, there is a one percent increase in rural labour force annually. This increase in rural population, however, does not match with income earned from farming which is the major sourve of living. Rural labourers, therefore, tend to seek for work in both in the agricultural and off-farm sector (Makhathini, 2013). However, rural labour demand and supply is also determined by seasonal changes like droughts, floods, pests and price fluctuations.

Entry barriers prevent the poor from participating in high return off-farm activities like self-employment. Households with better access to assets such as credit services, livestock units, capital and land have been reported to diversify into better livelihood opportunities than those with low asset endowment. The credit provides the working capital necessary for the development of farm enterprises, hire labour and to mobilize savings. Also, according to Wanyama *et al*. (2010); Olale *et al*. (2010) and Khatun & Roy (2012) studies credit is used for buying farm inputs and assets. Livestock can be used as collateral for loan and oxen can be leased out to earn extra income (Agyeman *et al*. 2014; Barret, 2001: Gebru & Beyene, 2012). The other barriers to entry into better opportunities include; market information, geographical

location, access to appropriate production technology and lack of access to land (Woldenhanna *et al*. 2000; Karugia *et al*. 2006; Yizengaw, 2014; Bigstern *et al*. 2013; Lay *et al*. 2009).

A household consists of people who stay together, use common resources and make decisions as a unit. Most past studies report a positive relationship between household size and diversification of livelihood strategies (Wanyama *et al*. 2010, Deininger & Olinto, 2001; Akundambeni, 2015; Brown *et al*. 2006). Large-sized household spends much on consumption and another household needs hence they diversify more. For instance, Schwarze *et al*. (2005) found that smallholder households endowed with much labour but relatively small parcels of land, in situations where they cannot rent in land for farming, they tend to use some labour on its own farm, and hire some out on other people's farms. According to Riithi (2015) household size has no effect on household decision to diversify. This finding is in line with that of Senadza (2010) in Ghana found that household size did not influence diversification decisions.

Household head's age also had mixed results from the literature. Whereas others indicate positive (Karugia *et al*. 2006; Ersado, 2006; Senadza, 2010; Wanyama *et al*. 2010; Khatun & Roy, 2012; Fausat, 2012), others report negative (Korir, 2011; Kassie *et al*. 2017; Ersado, 2006) link of the age of household head with livelihood diversification. However, Sisay (2010) reported that age had no significant effect on livelihood diversification.

Social networks enable households' members to participate in new income-generating activities. Participation of households in different group activities have been reported to increase the likelihood of household diversification into off-farm activities (Schwarze & Zeller, 2005; Ellis, 2000; Fausat, 2012. Social relationships and institutions can provide social insurance, facilitate credit access, acts as a source of capital for engaging in various activities and provides a ground for risk-sharing. However, according to Akundambeni, (2015) and Grote and Loc, (2015), group membership has no significant effect on livelihood diversification.

Land is a determinant of a households' investment and accessibility of income required for off-farm activities. Apart from being used as security for loans in the presence of imperfect credit markets,it also enables households to participate in social groups (Senadza, 2010; Reardon, 2006 ; Bassie, 2014). The relationship between landholding and participation in the off-farm sector is complex. The literature presents mixed findings on the size of land under cultivation as a determinant of livelihood diversification. According to Bigstern *et al*. (2011) a household with poorly educated members and with very small land parcels participate in low paying off-farm activities while Wanyama *et al*. (2010) show that households with large farm sizes

diversify more than those with small farm sizes. However, sometimes households with large farm sizes may not participate in off-farm activities even if they have the ability to do so because they get enough earnings from farming which they use to cater for their needs (Senadza, 2010).

Household's decision towards participation in any livelihood source depends on incentive and capacity variables (Reardon *et al*. 2006). Incentives such as relative prices of outputs from and inputs to the off-farm income versus farm activities. A household can diversify if it has access to capital assets. Incentives and capacities to diversify are also referred to as push and pull factors in most diversification studies. Whereas pull factors are positive factors or opportunity-led factors like improved infrastructure and improved market access which encourage diversification push factors are survival-led factors which force poor households to diversify their income. These include, need to increase family income, desire to cope with risks experienced in agricultural production and need to increase earnings needed for financing farm investments (Babatunde, 2012).

2.3 Models Used for Determining Factors Influencing the Choice of Livelihood Strategies

Livelihood diversification has been studied widely and its evident that different researchers use different methods to measure livelihood diversification. In most cases measurement of livelihood diversification is determined by the method of livelihood classification used by a particular study. For instance, Mathebula *et al*. (2011) in South Africa focused on how various income sources vary. It was found out that poor households had many income sources that were more evenly distributed than for the rich. They used Barret (2001) classification to categorize diversification. The number of Income Earners (NIE) and Number of Income Sources (NIS) were used to measure livelihood diversification. To measure the degree of income diversification, Shannon Equitability Index (SEI) was used. Following Babatunde (2010) the current study classified livelihood diversification into the farm and off-farm diversification.

Khatiwada *et al*. (2017) analysed the household livelihood strategies in rural areas of Central Nepal and its implications for poverty reduction. The study defined household livelihood strategy as a combination of income activities. Sustainable Livelihood Framework was used to analyse the sustainability of poor people's livelihoods. Livelihood strategies were identified through Principle Component Analysis followed by factor and cluster analysis. To test for the

differences in income share from each sector one-way ANOVA and Post-hoc Tukey's test were used. The current however defined livelihood diversification as the ability to earn income from several sources. By the use of welfare outcome, business/enterprise strategy was found by Khatiwada's study to the most remunerative livelihood strategy which was followed by commercial farming. A Multinomial logistic (MNL) regression was used to determine the factors that determine the livelihood choices of a household. Several other past studies on diversification of livelihood (Amankwah *et al*. 2017; Kimengesi *et al*. 2019) have used multinomial logit (MNL) to describe determinants of the likelihood of a household to engage in alternative income strategies. MNL is used when the dependent variable has several unordered options like in this case. MNL is a model of choice used to determine the probability that the i^{th} household adopts alternative livelihood strategy set a if the sets are not ordered (Riithi, 2015).

MNL clusters livelihood strategies hence assume that a household can only take part in a livelihood strategy in a certain group and not in any other strategy adopted by other households in a different group. This is not true in reality. Usually, households choose livelihood strategies depending on their accessibility to resources and the available constraints facing them. To overcome the limitations of MNL a model which relaxes this assumption, a count data model was therefore used by this study. Poisson Regression Model (PRM) treats all the livelihood strategies adopted by a household as count data.

According to Amankwah *et al*. (2017), farmers who diversified their income sources in non-cocoa activities received more income than those who undertook on-farm diversification. This study categorized diversification into no diversification, farm diversification and off-farm diversification. To measure the extent of diversification of a household Simpson's Index of Diversification (SID) was used. Simpson's Diversity Index (SDI) has also been used by studies like that of Agyeman (2014) and Aneani *et al*. (2011) to estimate the household's extent of diversification.

Alobo *et al*. (2017) which sought to determine the patterns and factors which determine diversification of a household's income in rural areas of Senegal and Kenya. This study measured diversification using income because it is a welfare outcome. Inverse Herfindal Index (IHI) was used to measure the contribution of each income source to total income earned by household. The index measures diversification of income as a combination of income sources rather than dependence on farming as the only source. IHI was used as a proxy of livelihood

diversification. This index's strength is that the patterns between income and diversifications produced are consistent compared to one- dimensional indices. Although this index has a limitation in that, it gives limited information about the structure of household diversification since it is two dimensional. The current study used the number of livelihood strategies as a proxy for diversification and mean income shares approach to determine each household strategy's contribution to total household income. Mean income shares approach has been used by Agyeman *et al*. (2014) and Davis *et al*. (2007) and as noted, it is easy to compute the share of a single livelihood strategy on total household income by use of this method.

Different researchers have also used different methods to analyse the determinants of livelihood diversification. For instance, Ghimire *et al*. (2014) used a Probit model to find the livelihood diversification determinants. A Probit model is used when the dependent variable has two values only. With this model, the determinants of diversification of income strategies will be found but will not be explained (Ghimire *et al*. 2014; Riithi, 2015). Therefore, this model was not suitable for this study since if used, the study would not have achieved its objective of describing the determinants of households' participation in certain livelihood strategies. Other studies used Ordinary Least Squares multiple regressions (Prowse, 2015), Tobit model (Teshome & Edriss, 2013; Schwarze & Zeller, 2015; Idowu *et al*. 2011) and Negative Binomial Regression Model (Riithi, 2015; Akundambeni, 2015). On the other hand, when analysing the determinants of income diversification Babatunde and Qaim (2009); Senadza (2012) and Toyin, (2017) used the number of income sources as a proxy for income diversification and Poisson regression model. Following Babatunde and Qaim (2009); Senadza (2012) and Toyin (2017), the current study used a Poisson regression model to determine the factors influencing livelihood diversification in the study area and number of livelihood strategies as a proxy for livelihood diversification.

2.4 Livelihood Diversification and Agricultural Production

In developing countries, most poor households are constrained in terms of liquidity and access to credit which are necessary for improving agricultural production. Therefore, assessing the effect livelihood diversification into off-farm activities on agricultural production is crucial. Off-farm sector ensures that farming households do not experience cash constraints by enabling them to buy most inputs they need to use in the farm and employ labour which facilitates agricultural production. In addition to this, off-income is used as security for the acquisition of agricultural loans now that land sizes have greatly reduced (Babatunde, 2012).

There are three different effects of livelihood diversification into off-farm activities on agricultural production. One, if income earned from off-farm source is used to finance investment in the farm, then the effect is positive. Two, there is a negative effect when earnings from the off-farm sector are not invested in the farm but rather used to meet a households' immediate needs like shelter, clothing, food, health care and school fees. There is also the same effect when this income is used to finance investment in off-farm activities or to completely move out of agriculture. Thirdly, livelihood diversification effects on agricultural production are nil when the benefits realized from agricultural financing are equivalent to family labour contribution not engaged in agriculture (Babatunde, 2012; Oseni & Winters, 2009).

According to Babatunde (2012), farm output was greater for diversified households that those who did not. These findings challenged the notion that participation in those activities reduces agricultural production since the two activities compete for time and labour. These observations showed that labour lost is over-compensated for when farmers' demand for purchased inputs is satisfied through the use of earnings from off activities. The researcher, therefore, concludes that farm and off sectors of the rural economy complement each other. Collier and Lal. (1986) findings agree with Babatundes' study. They reported that after controlling for production inputs, off-farm income had a significant and positive effect on crop output. According to Lay *et al*. (2009) households who participated in non-agricultural activities had high agricultural productivity.

de Janvry *et al*. (2005) reports that diversification of income sources enhance the investment capacity in farm activities, help in mitigation of income fluctuation, acts as insurance system and thus support household agricultural production. It helps to deal with market failures in

agriculture particularly for credit and insurance hence solves the conflict between cash shortage and agricultural investment.

According to Pfeiffer *et al*. (2009), sometimes income earned from off-farm activities is not spent on agricultural production but instead, some households use it to; finance investments in non-agricultural activities, increase their consumption and even to completely move out of agriculture. This situation is said to be determined by the risky nature of agriculture. Pfeiffer's findings agree with Kilic *et al*. (2009) which reported that most households in Albania used earnings from off-farm sector to move out of crop farming.

Most of the other studies on diversification have focused on its effect on farm investment but not on agricultural production. Majority of these scholars indicate that there is a positive relationship between diversification and farm investment. For instance, Pfeiffer *et al*. (2009) found a positive effect on demand for purchased inputs. Pfeiffer's findings agree with Evans and Ngau (1991) in Kutus which indicated a positive effect of diversification on the farm expenses. Karugia *et al*. (2006) also reported that households with stable off-farm income used the income to finance on-farm investments. The current study seeks to find the effect of diversification on farm output.

Fertiliser and other variable inputs use, agricultural services, livestock inputs, use of hired labour and land productivity or land size under cultivation has also been a focus by many past studies (Oseni & Wnters, 2009; Stampini & Davis, 2009; Lamb, 2003; Ruben & Van den Berg, 2001; Woldenhanna, 2009; Ellis & Freeman, 2004; Maertens, 2009). These studies reported a positive effect of off-farm income and re-investment on the farm and land productivity.

Contrary to the above findings, Wambugu and Karugia (2014) conducted in Nyeri and Kakamega Counties that found that there were negligible impacts of off income with regards to agricultural intensification and specialization and use of improved inputs.

There are mixed findings from the literature on the effect of livelihood diversification where some researchers indicate positive, others negative while others find no effect on agricultural production and investment in farm inputs. This study hypothesized that off-farm income has a positive contribution to agricultural production in terms of large farm output and input expenses.

2.5 Livelihood Diversification and Household Income

The effects of livelihood diversification on total household income vary from region to region, country to country, and even from area to area with unclear patterns (Alobo, 2010; Asfaw et al. 2019). Off-farm income from literature can be used to increase farm production or to develop the off-farm sector (Haggblade, 2007; Babatunde, 2012).

About half of the world population are involved in agriculture as either farmers or hired labourers (AGRA, 2017). Households endowed with much labour but with small pieces of land hire some of their labour to the off-farm sector to sustain their livelihoods. According to Pfeiffer *et al*. (2001), participation in off-farm work reduces family labour use on the farm and even results in a reduction in farm output. Similarly, Hoang (2014) found that diversification decreases labour use in the farm but does not reduce farm income. However, according to Babatunde (2012), off-farm income contributes to household use of improved farm inputs and increases agricultural output. Babatunde's study concluded that even though diversification takes away labour which would be used in the farm it relaxes liquidity problems of households and hence increases agricultural production.

Sometimes diversified farming households use the income they earn to hire labour. Households who use hired labour minimize losses in the farms by for instance harvesting produce at the required time. Through hired labour use in the farm, households can almost fully exploit the available resources. Use of hired labour and inorganic fertilizers has been found to increase agricultural output in the literature (Huang, 2009).

Off-farm income is important in the management of household food consumption fluctuations (Wanyama *et al*. 2010; Babatunde, 2012). Income earned from the off-farm sector is used to buy food in the household more especially when there is crop failure due to bad weather or crop and disease infestations. It can also be used to meet household immediate needs like school fees, child care, medical bills, and shelter. Some households use this income to rent land for agricultural purposes more especially in land constrained areas (Amankwah *et al*. 2017; Woldenhanna, 2009; Babatunde, 2009).

Off-farm income is more important to poor households than richer ones. Poor households with very small pieces of land benefit more from the off-farm sector than from the farm sector (Reardon, 1997). As noted elsewhere (Haggblade, 2007; Yenesew *et al*. 2015; Babatunde,

2012), off-farm income leads to increased household income and well-being, better utilization of labour in the rural areas, improved food security and household consumption.

There are also mixed findings on the contribution of off-farm activities to total household income. Whereas other indicates higher shares (30-89.5percent) of off-farm income in the total household income (Ambachew & Ermiyas, 2015; Beyene, 2008; Babatunde, 2010; Zhao & Barry, 2013; Jayne *et al*. 2003; Riithi, 2015) other indicate low contribution, that is, between 10percent to 23percent (Haggblade, 2005; Alemu, 2012; Oseni & Winters, 2012).

This study hypothesized that off-farm income will contribute highly to the total household income of the people in the study area. This follows the observation that the farm sizes under cultivation have greatly reduced in the study area where farming is the major source of livelihood.

CHAPTER 3: METHODOLOGY

3.1 Introduction

This chapter provides a representation of analytical methods used by this study, techniques used to collect and analyze data and details of data collected.

3.2 Research Design

Both quantitative and qualitative research design methods were used. This ensured that more accurate, necessary and detailed data were collected for use in the study. The sample comprised of farming households in Nyamira County, Kenya. Focus on livelihood diversification arose due to its crucial role in financing agricultural investment and its contribution to the total income of the household emphasized in the literature.

3.2.1 Sampling Procedure and Sample Size Determination

A sampling procedure involving multiple stages was used to select respondents. In the first stage, Nyamira County was purposively selected because of its high (90 percent) rural population hence high number of farming households.

In the second stage, two sub-counties in the county namely, North Mugirango and Kitutu Masaba were purposively selected because of their high population (198,171 and 121,287 respectively) and high agricultural productivity (55.2 percent and 58.3 percent respectively) compared to the other two sub-counties which have for instance, West Mugirango has a population of 157,470, with 5 wards and its agricultural production is 53.2 percent whereas Borabu sub-county has a population of 115,321 people, with four wards and a low agricultural production of about 42.5 percent. A high rural population was relevant to this study because of the close linkage between rural livelihoods and agriculture. Also, rural households depend on agriculture for their food needs and as a source of income.

In the third stage, with the help of area chiefs, wards with the highest population and high agricultural productivity within the selected locations were then selected. This study was carried out in five wards namely; Gachuba, Gesima, Bokeira, Bomwagamo and Itibo wards.In the fourth stage, half the number of sublocations within each of the selected wards were selected depending on their population size. In Itibo ward, Kenyoro and Nyamauro sublocations were selected. In Bokeira, Nyakenimo sublocation was selected while in Bomwagamo Mageri sublocation was selected. In Gesima ward in Kitutu Masaba sub-county

Nyamakoroto and Nyatieno sublocations were selected while in Gachuba ward, Girango and Rigena sublocations were selected. In the fifth stage half the number of villages within the chosen sublocations were randomly selected. Finally, respondents for this study were selected in the sixth stage using a systematic random sampling technique. This was done by randomly selecting one household in the chosen village and interviewing them. Then every fifth household in the chosen village was interviewed. The process was repeated until the required sample size was obtained. This ensured that there were no bias.

The sample size for this study was determined by a formula by Kothari (2004) which is proportionate to size sampling method specified as;

$$n = \frac{Z^2.\mathrm{p.q.N}}{e^2(N-1)Z^2.\mathrm{p.q}} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots .. (20)$$

Where,

N = population size that is the number of farming households in the county (372,408)

n = required sample size

p = the sample proportion with the characteristics of interest that is, diversifying farmers (0.5)

q = is the weighting variable computed as (1-p) that is farmers who do not diversify (0.5)

e = is the marginal error, this study assumed ME of 10 percent (0.1)

Z= is the critical value at the desired confidence interval for this case assumed to be 95 percent (1.96)

As documented on Nyamira County Integrated Development Plan, 2018-2023 report, the County's population is about 705,317 people. According to Mwangi (2013), 52.8 percent of Nyamira County residents practice farming as their main source of livelihood, 9.6 percent in business and 15.3 percent earn their income by hiring their labour out. The study selected a sample from 52.8 percent of the people of Nyamira County and this gave about 372,408 farmers. Upon application of the formula suggested by Kothari (2004),

$$\frac{1.96^2 * 0.5 * 0.5 * 372{,}408}{0.1^2 * 372{,}407 + 1.96^2 * 0.5 * 0.5} = 96$$

the study arrived at a sample size of 96 but since the study was conducted in five different wards within Nyamira County, about 5 percent attrition was added for each ward and this resulted to a sample size of 120.

3.2.2 Data Needs and Data Collection Methods

This study used primary data which was collected in October and November 2018 by use of semi-structured pre-tested questionnaires which were administered by trained enumerators. The questionnaires were first pretested and later administered to respondents in face-to-face interviews where farmers were asked questions in Kiswahili and/or Ekegusii.

During data collection, emphasis was put more on the inputs used in the farm and farm outputs obtained from the household farm during the last twelve months before the study. This allowed for the collection of the required information on the production of the farm households who diversify and those who do not. This is also important because it catered for all the cropping seasons across the year. Data on household characteristics, food consumption and marketing were also captured. For this study, off-farm income is defined to include all cash received by households from all other sources: agricultural wage employment, pensions, self-employment, remittances and formal employment expect from farming as an occupation.

Total output was be attained by converting total harvest of individual crops that is, if from crop enterprises into their grain equivalent and individual animal products from livestock enterprises into marketable quantities. They were then converted to their market value in shillings using the prevailing local market value.

3.2.3 Data analysis

The questionnaire data were input in Statistical Package for Social Sciences (SPSS). Descriptive statistics involving the computation of percentages, frequencies, mean, mode and standard deviations was used to characterize households in the study area. The first objective used SPSS to fit in PRM in Equation 8 of the data collected to assess the determinants of livelihood diversification while for objective two, Stata was used to fit the TSLs equations. Equations 12 and 15 were used to assess the effects of off-farm income on agricultural production. The third objective of the study used Ms. Excel to calculate the contribution of off-farm income on total annual household income of the respondents.

3.3 Study Area

The study area was Nyamira County. It is part of the highlands of the Lake Victoria basin. The county receives a bimodal pattern of rainfall which ranges between 1200mm-2100mm per annum hence allows for the growth of a variety of crops. The County's bimodal rainfall pattern

is however affected by climate change. The notable effects of climate change on agricultural production in the County include; unpredictable onset and end of the short and long rains, occasional hailstorms, new cases of pests and diseases for example Fall Armyworm in maize and *Tuta absoluta* in tomatoes and skewedness of rainfall intensity and distribution. These has resulted to poor harvests by farmers in the area.

The County has rich nitro soils which are deep and fertile; and has the readily available labour force and markets (Nyamira County, CIDP, 2018). About 87 percent of the residents live in rural areas where 80 percent of them depend on farming as their livelihood source (Wiesmann *et al*. 2014).

As documented on Nyamira County Integrated Development Plan, 2018-2023 report, the County's population is about 705,317 people. About 634,785 are rural dwellers. The county population density is estimated at 3,232 persons per square kilometre. The agricultural sector faces challenges like low crop and livestock yields.

Farm sizes range between 0.73ha and 4.05 ha. On average each household has put 0.70 Ha of land under cash and food crops production. The sizes of farms continue decreasing as a result of sharing amongst family members (Mwangi, 2013).

About 9.6 percent of children under five years in Nyamira County are underweight while 25.5 percent are stunted. The County has the highest (4.1 percent) wasting rates amongst the six Nyanza region counties. There is poor (39.4 percent) Vitamin A coverage amongst children 6-59 months against a target of 80 percent. County has a high teenage pregnancy rate of 28 percent. Only 65 percent of women access family planning services against the expected target of 80 percent. The County has an HIV prevalence of 6.4 percent compared to the national prevalence of 5.3 percent (Nyamira County CIDP, 2018).

The major food crops grown and harvested in the study area include; kales, African nightshade, spider plant, tomatoes, sweet potatoes, onions, spinach, cabbage, sorghum, wheat, irish potatoes, beans and maize. Maize, millet and beans are the staple food crops. Tea, coffee, bananas, sweet potatoes and pineapples are the major cash crops. The main type of livestock kept includes cattle, sheep, goats, poultry, donkeys, bees and rabbits. Both indigenous and exotic types, especially of livestock, are kept by most households.

Figure 3.2 below shows the location of Nyamira County in Kenya and its administrative boundaries.

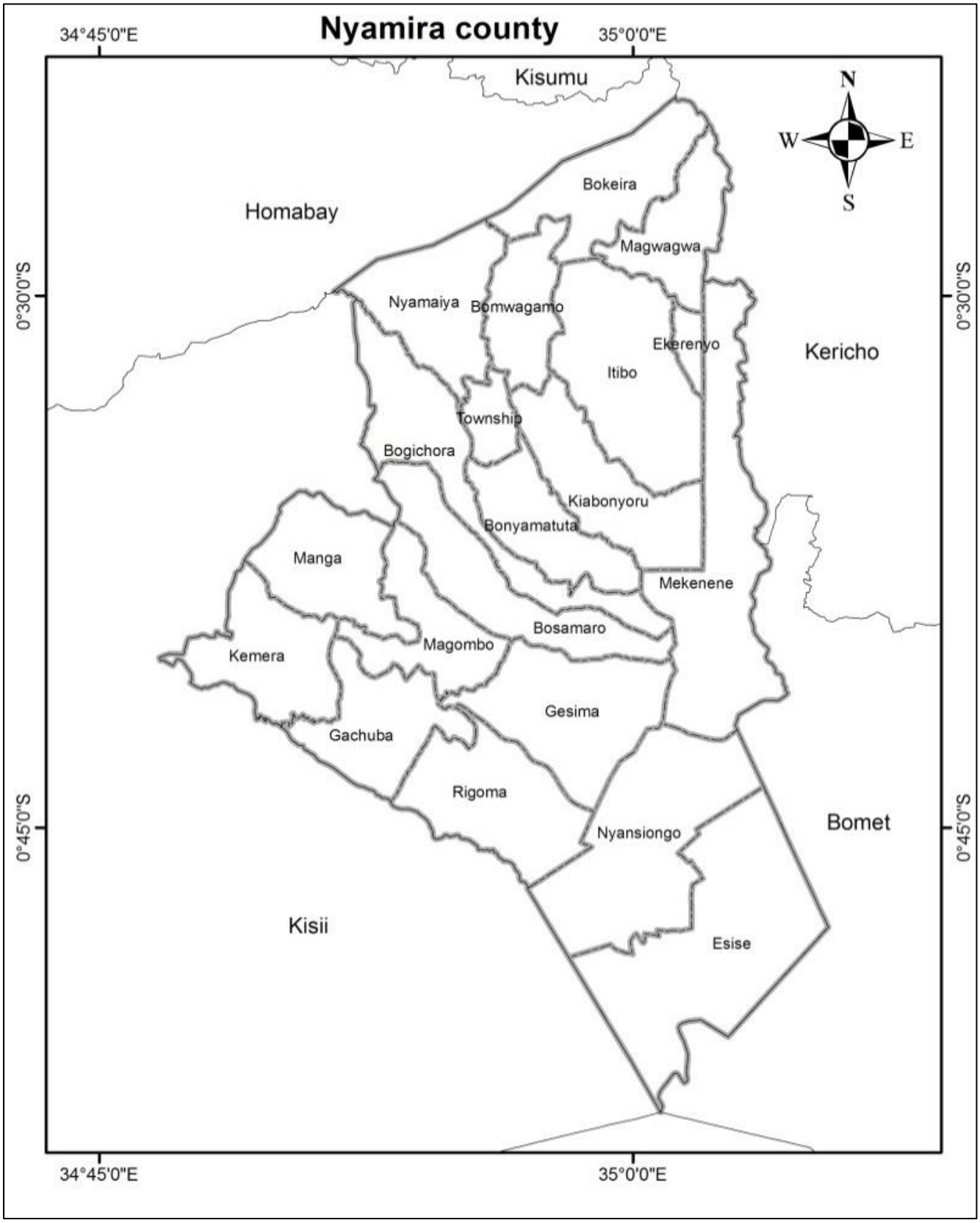

Figure 3.1: Map of the study area.

3.4 Target Population

The target population of this study was the farming households in Nyamira County.

3.5 Conceptual framework

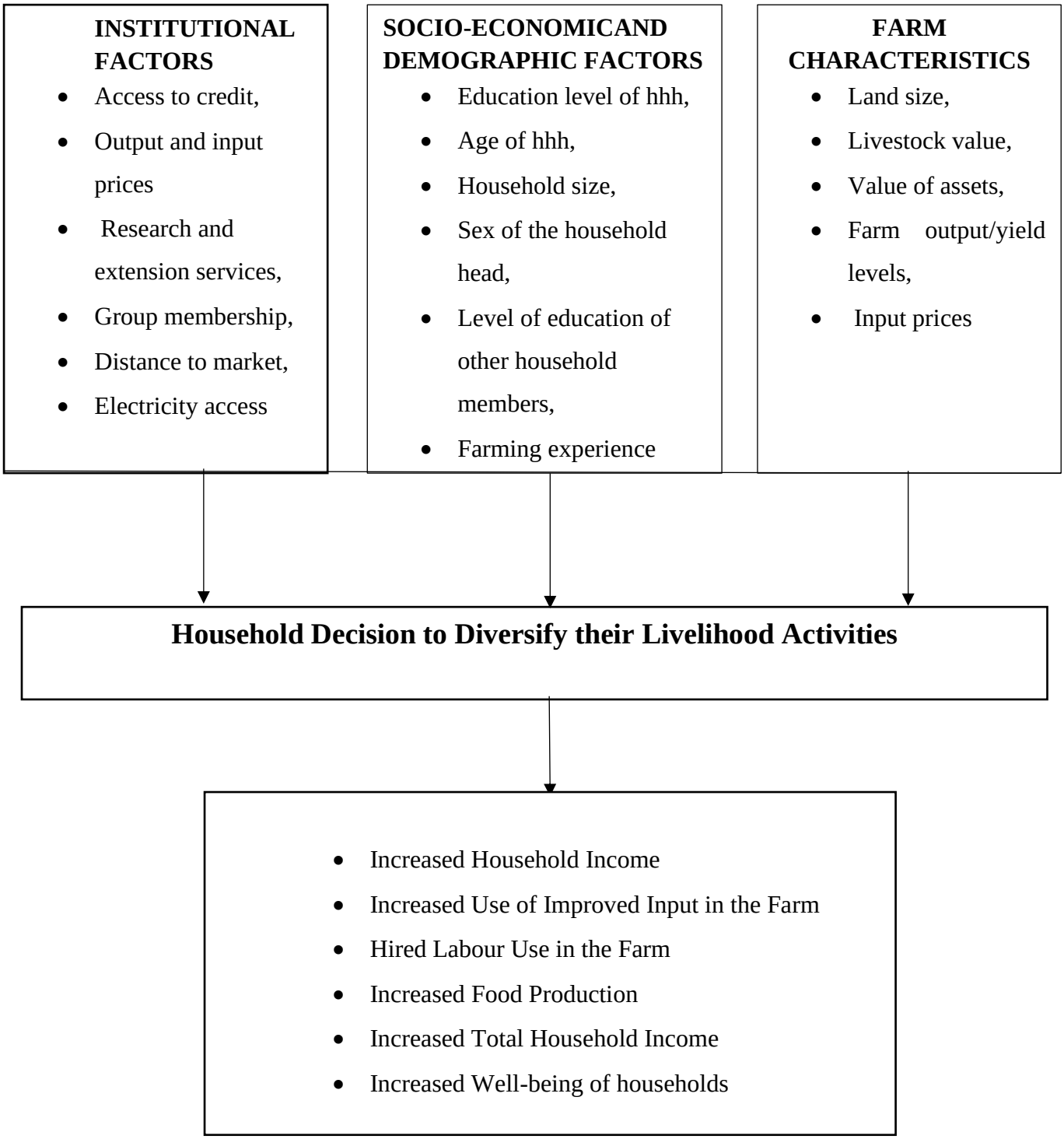

Figure 3.2: A Conceptual framework showing the relationship between the household decision to diversify and agricultural output and household income

Exploiting various off-farm opportunities could offer a pathway out of poverty for the rural poor (Barrett *et al.* 2001a) as illustrated in figure 3.1 above. This study conceptualized that a farm household's decision to diversify is influenced by socio-economic, demographic and institutional factors. Its expected that when a household diversifies into off-farm activities, its cash earnings increases. This income can be invested in the purchase of improved farm inputs, hiring labour in the farm and fully exploitation of other resources available in the farm hence leading to increased farm output, total household income and consequently improved wellbeing of the farming household.

Agriculture has been the focus of poverty reduction strategies in rural areas (RoK, 2002). Nevertheless, with increased population growth and increased sub-division of land into uneconomical sizes especially in densely populated areas, agriculture as a major income source cannnot sustain livelihoods of farming households in developing countries (Karugia *et al*. 2006). Due to land scarcity, agriculture may not be the only or the major income source and therefore for households to move out of poverty they need to participate in several income generating activities (Barrett *et al*. 2001; Haggblade *et al*. 2010).

3.6 Theoretical framework

This study assumed that households in the study area derived their income from both farm and off-farm activities. In this study, off-farm activities were classified into six categories that are; casual labour in the non-agricultural sector, casual labour in the agricultural sector, business/self-employment, formal employment, pensions/remittances/gifts and rents. Diversification on the farm was not considered by this study hence seven livelihood strategies were reported.

Farm income comprised of both crop and livestock earnings. Crop income included all crop produced and values of earnings of crops consumed at home. Livestock income included net returns from traded livestock and livestock products. Livestock earnings also included income from the use of animal draft power and values of earnings from livestock and livestock products consumed at home. Total income earned from farming was arrived at by converting crop and livestock and livestock products produced, sold and consumed at home to current market value.

This study was based on the agricultural household model that combines agricultural production, the household's consumption and off-farm decision in a single framework. Time is allocated to different activities as well as to off-farm work. This model views household

decision to diversify livelihoods as a function of the incentives and capacity variables (Singh *et al*. 1986). The study treated a household as a single decision-making unit which tries to maximize its utility subject to several constraints that differ from one household to another (Babatunde, 2012).

Following Babatunde (2012), this study considered a farming household that allocates time between farm work, non/off-farm work and leisure. Such a household is therefore faced with utility maximization problem. Rationally, this household is expected to optimally allocate time between leisure (*L)*, farm work (*F)* and off-farm work (*OW*). A household is therefore required to maximize utility subject to a number of constraints such as budget and time. Non-negativity constraints are included in the amount of time allocated to both farm and off-farm work in order to capture the possibility of a household deciding not to participate in off-farm activities.

Assuming that markets are perfect, the optimization problem for this model is presented as;
$Max\ V = EU(P, C, L; Z)$ …… (1)

$$T_{Fw,}T_{Ow,}T_{Les}$$

Subject to constraints:

$\bar{T} = T_{Fw} + T_{Ow} + T_{Les}$ …… (2)

$C = \bar{Y} = (P_q - K)\bar{Q} + \bar{W}_{Ow} + H$ …… (3)

$T_{Fw,}T_{Ow} \geq 0$ …… (4)

Where;

in Equation (1) V is the household's expected utility; P denotes production; C represents consumption; L denotes leisure while Z is the household attributes. Equation (2) is the *time constraint*. In the equation, $\overline{T}$ is the household's time endowment; $T_{Fw,}$ is a household's time allocated to farm work; T_{Ow} is a household's time allocated to off-farm work and T_{Les} is a household's time allocated to leisure. Equation (3) is the *budget constraint*, where $\bar{Y}$ is the (random) total household income, $\bar{Q}(P_q - K)$is the net income from farming ($P_q$is the price of farm output, $\bar{Q}$ is the (random) value of farm output and K denotes cost of producing a unit of output); $\bar{W}_{Ow}$ is the net income from off-farm activities and H is the exogenous income (income not derived from farm or off-farm work). Equation (4) gives the *non-negativity* constraints on the time variables. Time allocated to farm work and leisure is assumed to be strictly positive.

3.7 Empirical Framework

This study's main objective was to assess the determiinants of livelihood diversification adopted,and the effect of diversification on agricultural production and household income. This was achieved by use of both descriptive and inferential statistics.

3.7.1 Objective One: Factors influencing choice of livelihood strategies in the study area

This study used a count data model to analyse the factors influencing the adoption of different livelihood strategies in the study area. For this study, a count of the number of livelihood strategies served as the dependent variable proxy for livelihood diversification while a number of household characteristics were used as independent variables.

Poisson regression and Negative Binomial regression (NBRM) are the most commonly used methods for estimating count data. The two techniques are used mostly for analysis when the dependent variable is a non-negative integer and has few zero counts (Greene, 2008). This study interviewed households who participated in farming as a livelihood strategy. Therefore, there was no zero-livelihood strategy. Since livelihood strategies in this study are non-negative PRM is more suitable for this study.

According to Maddala (2001), count data should not be estimated by Ordinary Least Squares method (OLS) because they are non-normal. Although both PRM and NBRM techniques are used to analyze count data, the two models are slightly different. Whereas PRM assumes that the dependent variables' conditional mean and variance are equal, NBRM does not assume an equal conditional mean and variance.

The major limitation of this model is that it assumes that households with an equal number of income sources have similar welfare levels. The other limitation of PRM is that it assumes that the conditional mean and variance functions are equal to an assumption that is rarely met in practice. Observed data mostly display excess variation and under-dispersion. This leads to a large variance of coefficient estimates than expected in the data hence can lead to misleading inferences.

Poisson Regression Model (PRM) was used in this study to find out the number of livelihood activities adopted by households in the study area. For a household to be taken as diversified, it has to have more than one livelihood source and vice versa.

The Poisson regression model postulates that the dependent variable y_i, which is the number of livelihood strategies is non-negative and is drawn from a Poisson distribution with parameter (λ_i), the mean of the number of livelihood strategies which are related to a set of independent variables (X_i)(Gujarati, 2012).

The general main equation of a Poisson model which will reflect its probability function or density function is;

$$prob(\ Y_i = y_i|x_i) = \frac{\mathrm{e}^{-\lambda}{\lambda_i}^{yi}}{y_i!}, yi = 0,1,2,3, \dots\dots\dots, n \qquad (5)$$

With conditional mean, $E(y_i|X_i) = \lambda_i = \exp\ (X_1{}'\beta) = \exp(\beta_1 X_{1i} + \beta_2 X_{2i} + \cdots + \beta_k X_{ki})$ ….…(6)

The regression model for Poisson variable in the estimation form was;

$$y_i = \lambda_i = \exp\left(X_1{}'\beta\right) + \varepsilon i = \exp(\beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \cdots + \beta_k X_{ki}) + \varepsilon i \dots\dots\dots\dots\dots\dots\dots\dots (7)$$

Where y_i the number of livelihood strategies proxy for livelihood diversification, and x_i is the set of explanatory variables which determines diversification of livelihood sources. ($\beta_1 \dots\dots \beta_{13}$) are coefficients associated with each explanatory variable and ε_i is the error term. The following model was fitted into the data;

$$\begin{aligned} y_{i=}\beta_0 + \beta_1 AGEHHH + \beta_2 SEXHHH + \beta_3 LEDHHH + \beta_4 TIMEWTSC + \beta_5\ DIST.MARKT \\ + \beta_6 LIVVALUE + \beta_7 TTLNDHLNG + \beta_8 CREDITACS \\ + \beta_9 MMBERORGAN. + \beta_{10} ELECT.ACCESS + \beta_{11} EXTNACS \\ + \beta_{12} AVEGEDUCOTHER + \beta_{13} MMBERSCEDU + \varepsilon_i \dots\dots\dots\dots\dots\dots\dots (8) \end{aligned}$$

The first hypothesis that social-economic, institutional and biophysical factors taken singly do not influence the choice of livelihood strategies adopted by households was tested. This hypothesis was rejected in a situation where the coefficient estimates of each of the variables tested individually in Equation 8 were statistically significant.

3.7.1.1 Description and justification for inclusion of explanatory variables

Choice of variables that wee used by this study was guided by extensive literature review of past studies on livelihood diversification. Expected outcomes of various variables that were included in the model are discussed below.

Sex: Sex of the household head. Sex is used because the household head is the main decision head (Bassie, 2014). This was a dummy variable, 1= Male 0 otherwise. This study hypothesized that households lead by men have a high likelihood of diversifying their income sources than female-headed ones. This would be because female farmers face some cultural, political and economic barriers in dealing with cash economy (Fausat, 2012; Alemu, 2012).

Age: Age in years of the household head. This variable is continuous. Mixed findings have been reported from literature.

Level of education: The level of education of the household head is a continuos variable. Household heads with many years in formal school are expected to diversify more. This is because education facilitates entry into high paying jobs in the formal and non-formal rural economy. Also, acquisition and possession of a wide range of skills increase with more formal education (Senadza, 2010; Marenya *et al*. 2006 ; Bigsten & Tengstam, 2011). The literature presents mixed-effects though.

Average level of education of other household members: Average level of education of other family members other than the household head. This variable is continuous. Households with a high number of educated family members are expected to diversify more and generate more income (Babatunde, 2012; Alemu, 2012 ; Kilic *et al*. 2009).

Household size: this was accounted for as a continuous variable. This is the number of household members who use common resources and make decisions as a unit. Large families are not expected to diversify much since a large percentage of the income they earn is used on food and other household needs. Other studies though indicate that large family size has more labour which will be hired out (Akundambeni, 2015 ;Brown *et al*. 2006).

Working-age family members: this is the number of household members between 15 and 64 years. A positive relationship is expected. This is because households with more economically active members diversify more hence their income increases (Riithi,2015 ; Alemu,2012).

Farming experience: This is the number of years the household has been farming. This variable is continuous. Households with many years of farming are expected to diversify less out of agriculture (Korir, 2011).

Credit access: This variable was dummy, 1= yes, 0 otherwise. Household's access to credit services. It is expected that access to credit by the household increases chances of livelihood diversification. This is because credit provides the working capital necessary for the development of farm enterprises, used by households to hire labour and to mobilize savings. Furthermore, farm inputs and other assets ckd be purchased on credit (Wanyama *et al*. 2010; Olale *et al*. 2010 ; Khatun & Roy, 2012).

Input cost: Household's expenditure on seeds, labour and chemicals over the past twelve months. This variable is continuous. There is an expectation of a positive relationship between household's expenditure on chemicals, seeds and equipment with agricultural production and hence income.

Livestock value: value in Kenya shillings of the number of livestock owned by the household. This variable was continuous. Households with a high number of oxen and dairy livestock are expected to diversify more than those with less. Livestock can be used as collateral for loan and oxen can be leased out to earn extra income (Agyeman *et al*. 2014; Barret, 2001; Gebru & Beyene, 2012).

Group membership: Household's membership in groups and associations. Dummy, 1= yes, 0 otherwise. It is expected that there is a positive relationship between a households' member being an affiliate or leader of a group or organization. This can be attributed to the ability of social relationships and institutions to provide social insurance, facilitates credit access, acts as the source of capital for engaging in various activities and provides a ground for risk-sharing (Ellis, 2000; Schwarze & Zeller, 2005 ; Fausat, 2012).

Distance to the nearest market: Distance in kilometres covered by the household to reach the market. This variable was continuous. A negative relationship is expected with an increasing number of livelihood strategies adopted by a household (Reardon *et al.* 1997; Riithi, 2015).

Electricity access: Household's ability to access electricity. This variable was dummy, 1= yes, 0 otherwise. Access to electricity enables and promotes livelihood diversification. Electricity access facilitates participation in self-employment activities in the off-farm sector (Babatunde, 2012; Riithi, 2015). Access to electricity leads to improved business environment as well as

establishment of income generating activities at the household level such as the Jua Kali sector. It enables mechanized farming methods for improved food security and increases productive men hours (Sahah & Markandya, 2009).

Extension service access: Households' ability to access extension services. Dummy,1= yes, 0 otherwise. A positive relationship expected with agricultural output and number of livelihood strategies selected (Amankwah *et al*. 2017).

Members with secondary education: Number of household members who attained secondary education. This variable was continuous. A positive relationship with the number of livelihood strategies a household adopts expected.

The number of off-farm livelihood strategies: Number off-farm activities the household is engaged in. This variable was continuous. It is expected that households with more off-farm livelihood sources will have a higher total income than those with few income sources. But there is a mixed expectation between the number of activities and agricultural production.

Farm size: this variable was continuous. It was hypothesized that households with large farm sizes diversify more than those with small. Apart from being used as collateral for agricultural loans in the presence of imperfect credit markets land is a determinant of a households' investment and accessibility of income required for off-farm activities (Senadza, 2010 ; Bassie, 2014).

3.7.1.2 Diagnostic tests for Poisson

3.7.1.2.1 Statistical test for over-dispersion and under-dispersion

To test for over and under-dispersion, score test was used which is simply deviance and Pearson chi-squared divided by degrees of freedom.

Over-dispersion occurs when the variance is larger than the conditional mean. When over-dispersion is present in Poisson use of Negative Binomial Regression (NBR) is recommended (Winkelmann & Zimmermann, 1995). NBR model loses the restrictive assumption that variance is equal to the mean made by the Poisson model. In the presence of over-dispersion Poisson regression model estimates are consistent but inefficient and biased and thus inferences made may be misleading (Cameron & Trivedi, 1999).

The score test was used to test for over-dispersion and under- dispersion. Deviance and Pearson chi-square divided by degrees of freedom was used to carry out these tests (Gujarati, 2012).

$$Deviance\ ratio = \frac{Deviance}{df}$$

$$Pearson\ chi-square\ ratio = \frac{Pearson\ chi-square}{df} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (9)$$

Decision rule; if the ratio is greater than unity (1) this indicates the presence of over-dispersion and if less than unity (1) then there is an indication of under-dispersion. That is,

$$\frac{Deviance}{df} > 1 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots over - dispersion \quad (10)$$

$$\frac{Pearson\ chi-square}{df} < 1 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots under - dispersion \quad (11)$$

In this study, the likelihood test for over-dispersion results in a chi-squared statistic of zero (P-value = 1.000) and therefore fails to reject the null hypothesis of no over-dispersion. This is further proved by the Pearson chi-square and deviance ratios which are 0.1777 and 0.1811 respectively (Appendix 5). The ratios are less than a unit indicating that the variance was less than the conditional mean hence this study concludes that data was under-dispersed. Lack of evidence of over-dispersion means that the model can be estimated using the standard Poisson. Negative Binomial Regression is in-appropriate if data is under-dispersed and use of Poisson regression with heteroskedastic robust standard errors leads to reliable results (Cameron &Trivedi, 1999; Berk & MacDonald, 2007). Therefore this study used Poisson Regression Model to analyse the data.

3.7.1.2.2 Multicollinearity

Multicollinearity exists when there is an exact linear relationship among the regressors (Gujarati, 2012). Presence of multicollinearity also means that there is inter-correlation among the explanatory variables. Presence of multicollinearity leads to inflation of the variances of the model and that of the coefficients which then results in wider confidence intervals hence the inferences based on the coefficients becomes unreliable.

Variance Inflation Factor (VIF) was used to check for the presence of multicollinearity. VIF is a measure of the degree to which the variance of the Ordinary Least Square (OLS) estimator is inflated because of collinearity. The decision rule is, if the VIF of a variable exceeds 10, that variable is said to be collinear (Gujarati, 2012). In this study, the highest VIF was 1.92 while the mean VIF was 1.36 (Appendix 2). The highest pair-wise correlation was 0.46 (p =0.000) (Appendix 1). The two tests revealed the absence of multicollinearity.

3.7.1.2.3 Heteroscedasticity

Heteroscedasticity is a situation where there is unequal variance in the error term. In the presence of heteroscedasticity, the variance of the dependent variable varies across the data (Gujarati, 2012). Breusch-Pagan Cook-Weisberg test which tests the null hypothesis that the error variances are equal against the alternative that the error variances are a multiplicative function of one or more variables was used. Heteroscedasticity was not a problem in the data since there was a small chi-square that was statistically not significant (chi-square = 1.86, $p>\chi^2= 0.1724$) (Appendix 3).

3.7.1.2.4 Goodness of fit of Poisson Regression Model

The likelihood test for the goodness of fit Wald chi-squared statistic = 196.91 $P>chi^2 = 0.000$ (Appendix 4) indicated that all the explanatory variables were jointly statistically significant in explaining household's choice of the number of livelihood strategies. The goodness of fit was also tested by the deviance and Pearson chi-squared statistic. The model fitted the data well since both deviance and Pearson chi-squared statistic were insignificant (P-value= 1.000) (Appendix 4).

3.7.2 Objective Two: Effects of Off-Farm Income in Agricultural Production

The second objective of this study sought to assess the effects of livelihood diversification on agricultural production. Two-stage least squares (TSLS) method in combination with instrumental variables was used.

Picking up from equation (3) of the theoretical model, a rational household makes production and consumption decisions jointly and that this household earns income from both farm and off-farm sources. Based on the logic of agricultral household model therefore, a household with labour-market participation was presented as;

$$\bar{Q} = \beta_0 + \bar{W}_{Ow} + Z + \varepsilon_i \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots . \dots (12)$$

Where; $\bar{Q}$: the value of farm output, $\beta_{0:}$ constant term, $\bar{W}_{Ow}$ household off-farm income, Z: set of household characteristics, ε_i: is the error term.

To analyse the effect of off-farm income on agricultural production equation twelve was estimated by regressing the total output from the farm against off-farm income and several independent variables.

In the first stage, the Instrumental Variable Regression of off-farm income was carried out. The instrumental variable approach was used to tackle endogeneity bias which was expected to be brought about by the fact that income earned from off-farm income sources could be invested in the farm and vice versa.

To control endogeneity instrumental variables like; households' access to electricity and the number of off-farm activities were used after testing for their suitability.

Let $\bar{W}_{Ow}$ be Y. The model for first stage estimation was specified as;

$$Y = \beta_0 + Z + I + \varepsilon_i \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots .. (13)$$

Where Y= off-farm income, $\beta_{0=}$ constant term, Z= household characteristics, I= household characteristics used as instrumental variables, ε_i is the error term.

$$Y = \beta_0 + \beta_1 AGEHHH + \beta_2 SEXHHH + \beta_3 EDUCHHH + \beta_4 FARMSIZE + \beta_5 TTINPUTCOST + \beta_6 AGROCHEMUSE + \beta_7 CERTMAIZEUSE + \beta_8\ ELECTRACCESS + \beta_9 NOOFACT \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots . (14)$$

In the above equation coefficients, β_8 and β_9 are Instrumental Variables (IV). IVs are variables that are correlated with the endogenous regressors but uncorrelated with the error term. They are used to correct the endogeneity problem in an equation. They were used here because it was assumed that off-farm income was endogenous.

In the second stage farm output was determined by use of the following equation;

$$\bar{Q} = \beta_0 + \beta_1 \bar{W}_{0w} + \beta_2 AGEHHH + \beta_3 SEXHHH + \beta_4 EDUCHHH + \beta_5 FARMSIZE + \beta_6 TTINPUTCOST + \beta_7 AGROCHEMUSE + \beta_8 CERTMAIZEUSE \ldots\ldots (15)$$

As documented, off-farm income has three effects on agricultural production (Lopez-Feldman *et al*. 2007; Wang *et al*. 2011). One, it could be positive that is if off-farm incomes are used to finance farm investment (Pfeiffer *et al*. 2009). Two, it is negative when earnings from the off-farm activities are used in meeting other household needs other than increasing agricultural production. Thirdly, off-farm earnings have no effects on agricultural production if its' positive effect through agricultural financing equals negative effect of family labour loss from farming.

The hypothesis of this second objective that off-farm income has no effect on farm production was rejected in a situation where the coefficient estimate of off-farm income in equation (15) was positive or negative.

3.7.2.1 Diagnostic tests for Two-Stage Least Square Method

3.7.2.2.1 Multicollinearity

We say that there is multicollinearity when there is one or more linear relationship among the regressors (Gujarati, 2012). Presence of multicollinearity also means that there is inter-correlation among the explanatory variables.

Variance Inflation Factor (VIF) was used to check for the presence of multicollinearity. VIF is a measure of the degree to which the variance of the Ordinary Least Square (OLS) estimator is inflated because of collinearity. The decision rule is, if the VIF of a variable exceeds 10, that variable is said to be collinear (Gujarati, 2012). Here the highest VIF was 2.26 while the mean VIF was 1.46 (Appendix 6). The VIF test revealed the absence of multicollinearity.

3.7.2.2.2 Heteroscedasticity

Heteroscedasticity is a situation where there is unequal variance in the error term. In the presence of heteroscedasticity, the variance of the dependent variable varies across the data

(Gujarati, 2012). Breusch-Pagan Cook-Weisberg test which tests the null hypothesis that the error variances are equal against the alternative that the error variances are a multiplicative function of one or more variables was used. There was Heteroscedasticity problem in the data since there was a large chi-square that was statistically significant (chi-square = 53.93 p>chi^2= 0.0000) (Appendix 7). Robust standard errors were used for estimation.

3.7.2.2.3 Goodness of fit of Two-Stage Least Squares method

The Wald chi-squared degree of freedom statistic is used. Wald test follows that the chi-squared statistic with degrees of freedom equal to the number of regressors estimated. Here the Wald chi-squared (7) = 46.85 P>chi^2 = 0.001 (Appendix 8) rejected the null hypothesis that collectively none of the explanatory variables had any effect on the value of total farm output. Here the chi-squared value is about 47 and the probability of obtaining such a chi-squared value is zero. This then brings the conclusion that all the explanatory variables were jointly statistically significant in explaining households total farm output value (Gujarati, 2012).

3.7.2.2.4 Endogeneity

Endogeneity is tested by Durbin and Wu-Hausman tests when normal standard errors are used but when robust Variance-Covariance matrix of the Estimators (VCE) is used at the estimation time score tests are used. Durbin test of endogeneity uses an estimate of the error terms variance based on the model assuming the variables being tested are exogenous while Wu-Hausman test uses an estimate of the error variance based on the model assuming the variables being tested are endogenous. The Durbin and Wu-Hausman test null hypothesis is that the variable under consideration can be treated as exogenous by checking for a statistically significant difference between the OLS estimates and TSLS estimates. Statistically significant tests mean rejection of the null hypothesis and conclusion that the variable under consideration is endogenous and vice-versa.

This study used robust VCE. According to Bound *et al*. (1995) when this type of standard errors are used, Wooldridge's 1995 score test and regression-based test of exogeneity is reported. In this study the Robust score chi-squared test was (Robust score chi2 (1) = 8.12698, p= 0.0044) and the robust regression test was (Robust regression F (1,110) = 10.3574, P= 0.0017) (Appendix 8).

Here Wooldridge's score test at the conventional significance level (p= 0.0044) and the robust regression F test at the 1 percent significance level (p=0.0017) rejects the null hypothesis that off-farm income is exogenous.

3.7.2.2.5 Instrument Validity

This study treated off-farm income as being endogenous therefore, to avoid bias that would be brought about by using Ordinary Least Squares (OLS), an instrumental regression was used. This study used two instruments which are; the number of off-farm activities of a household and household access to electricity. However, it must be noted that it is hard work to find a valid instrument (Wright & Yogo, 2002).

For any variable to be used as an instrument it must meet the characteristics of an instrument that is, relevance and exogeneity. Relevance here means that the variation in the instrument is related to the variation in the instrumented variable. In this case, for instance, it is expected that as the number of off-farm activities increases the number of off-farm income increases and vice versa.

The relevance of the variables used here as an instrument is proved by the statistically significant and positive value of the number of off-farm activities in the first stage regression results (Appendix 9). Although, access to electricity used in this study as an instrument was not statistically significant that is, according to the first stage regression results, it was still used because a number of earlier studies have emphasized on its importance in livelihood diversification and has also been used to verify the endogeneity effect of off-farm income (Babatunde, 2012; Matshe & Young 2004 ; Escobal, 2001).

Other studies on diversification have also used education level of other households that is, that of the household head excluded, distance to market and time taken to a water source as instrumental variables (Babatunde, 2012 ; Kilic, 2010).

An exogenous instrument is one that is uncorrelated with the error term but strongly correlated with the endogenous variable. An instrument does not directly affect the dependent variable but only through its effect on the endogenous variable. Here, for instance, access to electricity does not affect rural households' value of farm output directly but only through necessitating participation in several off-farm activities and this will increase the total household income. It is expected that the income earned will then be invested in the purchase of improved farm

inputs and even be used to hire labour on the farm and this eventually will lead to an increase in farm production.

An over-identification test was carried out to test for the validity of the instruments. Sargan chi-squared statistic and Basmann chi-squared statistic over-identification test estimators are normally used to test for the validity of instruments. Score chi-squared test is used when robust VCE is used. The null hypothesis for the over-identification test is that instruments are valid and that the excluded instruments are correctly excluded from the estimated equation. Significant Sargan, Basmann and score tests show that the instruments are not valid.

This study used robust VCE and therefore instrument validity test is based on the score chi-squared test. The score chi-squared over-identification test estimator was (score chi^2 (1) = 0.641617, p= 0.4231) (Appendix 10). We, therefore, fail to reject the null hypothesis and conclude that the instruments are valid.

3.7.2.2.6 Instrument strength

F-Statistic is used to test for the strength of the instruments used. According to Gujarati (2012), an F-statistic must be significant at typical 1 percent, 5 percent or 10 percent and must be greater than 10 for inference based on estimator to be reliable when there is one endogenous regressor. Stock and Yogo (2005), on the other hand, suggests another test of weak instruments. The two researchers used Monte Carlo simulation to show that simply having an F-statistic that is significant at the typical 5 percent and 10 percent is not sufficient and recommend that the first stage Minimum eingenvalue must be greater than 10 especially when there is one endogenous variable and this is the only way inference based on two-stage least squares estimator will be reliable. This is the first characterization of weak instruments by these scholars.

The second characterization of weak instruments by these researchers has the null hypothesis that a set of instruments are weak if a Wald test at the 5 percent level can have an actual rejection rate of no more than 10 percent, 15 percent, 20 percent or 25 percent. The decision rule is if the test statistic exceeds the critical value at the largest rejection rate of a nominal 5 percent Wald test one is willing to tolerate then the instruments used are not weak.

Here, apart from having a significant F-statistic that was above 10 (Robust F(1,110)= 11.3974 P>F= 0.000) (Appendix 9), the first stage Minimum eingenvalue statistic was 12.0687 (Appendix 9) and after choosing 15 percent as the largest rejection rate of nominal 5 percent

Wald test the study was willing to tolerate the test statistic exceeded the critical value, 12.0687>11.59 (Appendix 9). This indicated that the instruments used were not weak. In this study also, the values of partial R-squared statistics were fairly high ($R^{2} =$ 0.1799 and Adjusted $R^{2}=$ 0.3562) (Appendix 9).

3.7.3 Objective Three: Contribution of Off -Income on the Total Household Income

Mean income shares approach was used to determine the contribution of off-farm income to total household income. Calculations were carried out in Microsoft excel. This approach estimates the shares of incomes at the individual household level by finding the share of each livelihood strategy in total household income for each household (Agyeman *et al*. 2014; Davis *et al*. 2007; Wang *et al*. 2011). The mean share for each livelihood strategy for all households is then found.

The general Mean of Income Shares formula is given as;

$$MSi = \left(\sum_{h=1}^{n} \frac{y_{ih}}{Y_y}\right)/n \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (16)$$

Where i= the livelihood strategy
Y= total income
y= income from particular livelihood strategy
h= the household
n= the number of households

The sum of Total Household Income (THI) is given as;

$$\text{THI} = \sum_{j=1}^{7} Yj \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (17)$$

Where THI= Total Household Income generated from all strategies j, j= 1, 2, 3, 4…….7, farm and off-farm income.

(i) The mean share of farm income is given as;

$$SFI = \frac{\sum\left(\frac{vtfo}{thi}\right)}{n} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (18)$$

Where SFI= Share of farm income

vtfo = value of total farm output

thi= total household income

n= number of households

(ii)The mean share of off-farm income is given as;

$$SNOFI = \sum\left[\frac{\left(\sum \frac{clnas}{thi}\right)}{n} + \frac{\left(\sum \frac{clas}{thi}\right)}{n} + \frac{\left(\sum \frac{bsse}{thi}\right)}{n} + \frac{\left(\sum \frac{fm}{thi}\right)}{n} + \frac{\left(\sum \frac{prg}{thi}\right)}{n} + \frac{\left(\sum \frac{rt}{thi}\right)}{n}\right] \ldots\ldots\ldots\ldots (19)$$

Where thi= total household income

SNOFI= share of off-farm income

n= number of households

clnas= casual labour in the non-agricultural sector

clas= casual labour in the agricultural sector

bsse= business or self-employment

fm= formal employment

prg= pensions/remittances/gifts

rt= rents

Total household income was calculated by summation of incomes from all livelihood strategies in the study area and each livelihood strategies' share of income in the total household income was then computed in percentage (Agyeman *et al*. 2014).

The third hypothesis of this study that off-farm income has no contribution on total household income was tested. This hypothesis was rejected in a situation where the share of off-farm income in total household income was greater than zero percent.

CHAPTER 4: RESULTS AND DISCUSSION

This chapter provides a representation of the results of both descriptive and econometric results. The subsections give a guideline and results of the three objectives of this study.

4.1 Socio-economic and Demographic Characteristics of Households of Nyamira County

This sub-section provides information on the characteristics of the respondent households in this study. These results were achieved from data that was analysed through descriptive statistics.

4.1.1 Farmer socio-economic attributes

Table 4.1 below presents results of descriptive statistics on the various household characteristics of interviewed households of Nyamira County.

Table 4.1: **Summary of Social-economic and demographic characteristics of households**

Characteristic		**n=120**
Education level HHH (percent)	None	14.2
	Primary	29.2
	Secondary	47.5
	Post-secondary	9.2
Farm size owned (Mean)		2.32
Farm size under cultivation (Mean)		1.47
Household size (Mean)		4.75
Male-headed Households (percent)		88.33
Age of female-headed households (Mean)		55.21
Household Members between 17 to 64 years (Mean)		2.81
Household members 65 years and above (Mean)		0.32
Dependants household members (Mean)		1.98
Distance to nearest market in Kilometres (Mean)		2.19
Distance to a water source in walking minutes (Mean)		24.91
Access to credit (percent)		50
The main source of credit (percent)		22.5
Access to extension services (percent)		52.5
Hired labour use (percent)		58.3
Improved maize seeds access (percent)		83.3

Source: Survey data (2018)

4.1.2 Discussion

With regard to education level, a higher percentage (47.5) of the household heads had attained secondary education compared to other form or level of education. It is expected that the level of education of the household head determines the number of livelihood strategies selected since most of the off-farm income strategies require skills. Households with many years of formal education are expected to engage in many and better-paying livelihood strategies than those with few years of schooling. Household heads that attain more years of schooling possess a wide range of skills required for entry into the off-farm sector and even the formal sector. Also, salaried employment provides a steady cash flow that aids investment in the farm activities. Therefore, this study finding corroborates with that of Marenya *et al*. (2003) that educated people have potential to invest in farm and off-farm sectors.

The average farm since owned by the households was 0.9396 hactares while that under cultivation was 0.5954 hactares. A majority (19.2 percent) of the households had allocated 0.10 hactares of land under cultivation at the time of the survey. The minimum farm size under cultivation was 0.051 hactares while the maximum was 3.24 hactares. In most cases, farm size has mixed results for the diversification of a household.

Households with small farm sizes but with more labour are assumed to hire the extra labour to off-farm sectors to earn a livelihood. Small farm sizes in the study area indicate that most households are small-scale farmers and therefore, diversification of their livelihood activities would help them raise their living standards above the poverty level.

Households in the study area had a minimum of 1 member and a maximum of 10 members. On average each household had 5 members this is close to the national household size of four members (KNBS, 2018). Household size is expected to affect the number of livelihood strategies selected by the household.

A majority (88.33 percent) of the households were male-headed. This differs slightly higher with the Kenya Integrated Household Budget Survey (2015/16) that reported an average of 70 percent. Men are the major decision-makers of most households. It is expected that households with male household heads diversify more than those with female heads. Majority of households being male-headed also indicates that men dominated farming activities.

Mean age of female household heads was 55.21. Since they have more experience in farming, they cannot diversify easily. On average most households reported about 26 years of farming. As the farming experience increases the likelihood of participation of a household in off-farm activities decreases.

During the time of the survey, there were about 2 members on average in each household who were below 16 years and above 65 years of age (dependants). Most households reported a minimum of 0 dependants and a maximum of 7. It is expected that households with more working-age members diversify more than those with few.

The mean distance to the nearest market was reported at 2.19 kilometres. Access to market place influences diversification. Springwater was the main source of drinking water for most (79.2 percent). The average time taken by households to a water source and back was 25 minutes. Accessibility to a safe water source is expected to influence diversification.

About 50 percent of households accessed credit and most of them 22.5 percent borrowed funds from table banking. It is expected that access to credit influences diversification and also has a positive effect on agricultural production. Agricultural credit increases the purchasing power of farming households who are resource-constrained in most cases.

About 52.5 percent of households accessed extension services. Households who access extension services are more likely to increase their farm output and thus their total income. It is expected that access to extension services positively influences agricultural production and number of livelihood strategies a household selects.

Most households (58.3 percent) used hired labour in their farms. Use of hired labour facilitates farm utilization hence promotes agricultural production. At the time of the survey 83.3 percent of the interviewed households used improved maize seeds. This then implies that Kenya has well-developed seed systems. In addition to this, participation in group activities enabled farming households to access improved maize seeds easily and at the planting season on credit.

4.2 Household Livelihood Strategies in Nyamira County

4.2.1 Main livelihood strategies reported

As shown in Table 4.2 below, all the households that were interviewed, that is 100 percent were involved in both crop and livestock farming. Among the interviewed households, 20.8 percent worked for wages in non-agricultural sectors.

Table 4. 2: Livelihood Strategies identified in Nyamira County

Livelihood Strategy	Number of households	Participation rate (percent)
Farming	120	100
Casual labour in the non-agricultural sector	25	20.8
Casual labour in agricultural sector	67	55.8
Business/self-employment	61	50.8
Formal Employment	18	15
Pensions/remittances/gifts	27	22.5
Rents	7	5.8

Source: survey data

About 50.8 percent of the households were involved in businesses and/or were self-employed at the time of the survey. A majority of the households (55.8 percent) worked as casual labourers in the agricultural sector. Formal employment was reported by 15 percent of the interviewed households. Pensions/remittances /gifts and rents were reported at 22.5 percent and 5.8 percent respectively.

Figure 4.2 presents livelihood strategies in terms of their dominance with respect to the number of households that identified the given strategy as their main livelihood strategy.

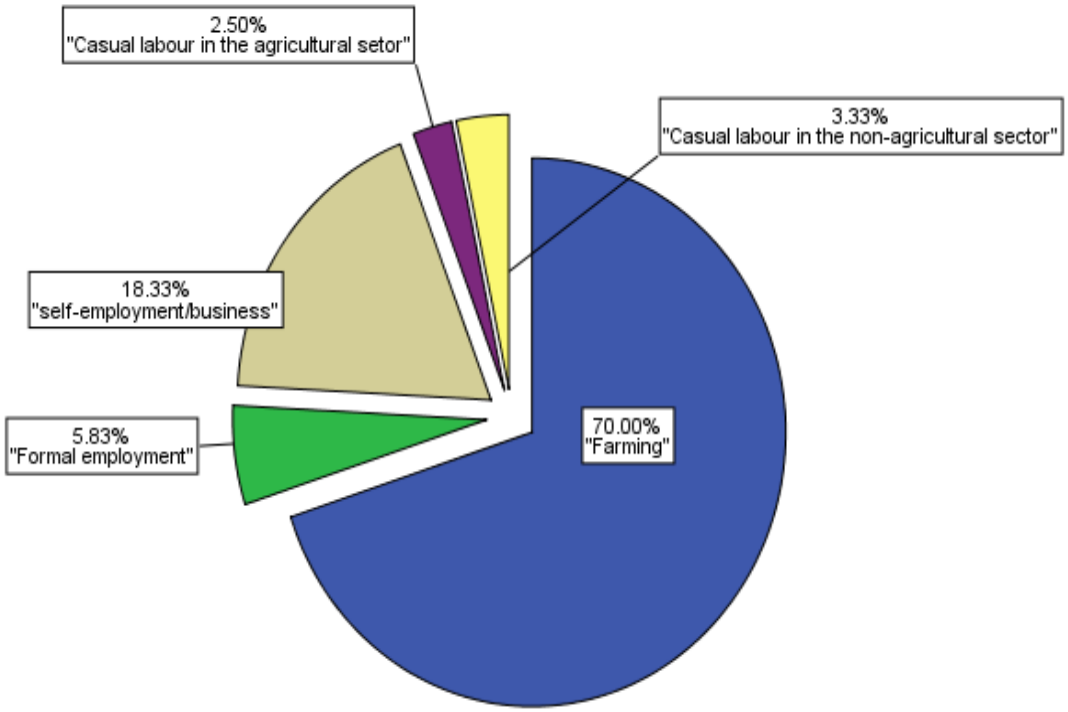

Figure 4. 1: Household choice of the main source of income in Nyamira County

Source: Survey data.

4.2.2 Description of livelihood strategies in Nyamira County

(a) **Farming:** Livestock and crop farming was practised by all interviewed households (100 percent). In Kenya, the agricultural sector employs 40 percent of the total population and more than 70 percent of the rural people (FAO, 2015). Most households in the County grow both food and cash crops. Farming was done either by use of family labour or hired labour. The average land under cultivation was 0.6 hactares. Contrary to prior expectations that only a wealthy household with large farm sizes would afford hired labour, most households (52.5 percent) would afford to hire labour. This may well be attributed to the fact that the cost of farm labour was relatively affordable as it ranges from 150 to 200 Kenya shillings. In most cases, hired labour wages were received directly from farming especially from tea, milk and vegetable sale. Hired labour was mainly used for animal tendering, land preparation, planting, harvesting, tea plucking, and weeding of field crops.

About 65 percent of funds used for the purchase of farm inputs were from farming. Source of inputs used in the farms varied from agrovets, general shops and Non-Governmental Organizations (NGOs). Some NGOs like Farmers United, One Acre Fund and Kenya Tea Development Agency (KTDA) were major sources of seeds and fertilizer used by some farmers.

Crop and livestock farming was the most dominant source of income reported by interviewed households (70 percent). This could be because the study area achieves substantial rainfall which is well distributed throughout the year hence there are minimal risks of drought and subsequent crop failure and death of livestock. It is also because most parts of the County have high agricultural potential with minimal cases of reported crop and livestock diseases. Households in relatively arid and semi-arid areas would easily keep livestock since they can grow Napier grass which grows well in such areas or would leave open fields for grazing.

Farming requires little or no education since in most cases it depends on the experience of the respective household. Farming, therefore, has few entry barriers that would limit some households from venturing into it (Barret *et al*. 2001).

Farming is the main source of food for most households in the area given that it is 90 percent rural. Also, households with small land parcels rent in land from those with relatively large farm sizes and put them under cultivation. This will not only increase their farm output but also

their total income. Crop and livestock keeping also was necessitated by the availability of surface water in most parts of the County.

(b) **Casual labour in the non-agricultural sector**: Casual non-agricultural labour was practised by 20.8 percent of the interviewed households. To participate in this livelihood strategy requires some skills. Most participants in this category were trained hence had skills which enabled them to work for pay in this informal sector. In Kenya, the informal sector employs about 82 percent of the population (KNBS, 2015). This strategy was reported as the most dominant source of livelihood by only 2.5 percent of the households.

Casual labour recorded in Nyamira County included hired brick makers, shop attenders, posho mill attendees, gatekeepers, hired plumbers, carpenters, welders, painters, masons, "*Bodaboda"* riders, conductors, hired drivers and dressmakers. The wage rate for brick makers ranged between 250 to 500 Kenya Shillings per day while that for "*Bodaboda*" riders was about 200 to 350 Kenya Shillings a day. "*Bodaboda*" was the most preferred mode of transport by most households because of the following reasons; depending on the distance one can negotiate the fare, customers enjoy door to door services, motorcycles have no defined bus stops and can use any route, they are more affordable to poor people, unavailability of other modes of transportation especially because of poor road network in the study area hence inaccessible by vehicles more especially during heavy rains seasons, motorcycles are not easily affected by traffic jams and does not require packing like cars.

(c) **Casual labour in the agricultural sector**: this type of livelihood strategy was practised by 55.8 percent of the households. It was reported as the main source of livelihood by 3.3 percent of the interviewed households. Working for wages in the agricultural sector requires no training or skills but rather on the health status of a person and farming experience. The tasks include land preparation, animal tendering, tea plucking, planting, coffee berries harvesting, harvesting of dried maize, beans and wheat, weeding, deworming and tick control activities.

Casual labour in the agricultural sector attracted many people because most residents of Nyamira County grow tea, coffee, maize, beans, wheat and millet which are labour intensive more especially when grown on a large scale. The mentioned crops require more labour during planting, weeding and harvesting.

Engagement in this livelihood strategy would also be attributed to the reduction in farm sizes of most residents. Households with large family sizes but with small parcels of land prefer hiring out the extra labour to earn a living.

Average earning per day from planting and weeding was 150 Kenya Shillings at the time of the survey. The average earnings from tea and coffee harvesting per day ranged from 150 to 200 Shillings depending on the kilograms one harvested.

The demand for labour in the agricultural sector was almost constant since some activities like tea harvesting took place six days a week throughout the month. This demand, however, rose mostly during planting season which are from December to February, and in August. Weeding for tea, maize and other crops also happened once every month.

Past studies (Reardon, 2007 ; Babatunde, 2012) indicate that richer households diversify better than poor ones this is due to entry barriers which hinder poor household participation in some income-earning activities. This concurs with the findings of this study, that a wealthy household with more productive assets like oxen and improved farm implements like knapsack sprayers earned more income than poorer households.

(d) **Business or self-employment:** at the time of the survey 50.8 percent of the households earned income from this livelihood strategy. Participation in this income source requires both skilled and non-skilled people. It includes activities like; carpentry, electricians, dressmakers, saloon, retail shops, bars, pool dens, hotels, cloth sales, vegetable sales, brick making, barbershops, charcoal retailers, *"Bodaboda"* and tea buying and selling.

This livelihood strategy was the second most dominant (18.3percent). This is because it is easier to start and operate and even requires little space. It also requires few skills and has almost no legal requirements.

Most activities under this strategy are technical skill-based businesses. "*Bodaboda"* the most common and reliable means of transport. Few families owned donkeys and usually used them to fetch water from the rivers and to carry firewood, and even to transport tea to tea buying centres. Some households hired their donkeys out which earned them income.

(e) **Formal employment**: this livelihood strategy was reported by 15 percent of the households interviewed. About 5.8 percent of the interviewed households reported that formal employment was their dominant livelihood strategy.

Formal employment involves those households that had obtained training hence had skills that enabled them to be employed in the formal and informal sectors. It includes; teachers, chiefs, drivers, mechanics, clerks, police officers, doctors and nurses, among others.

Education enables households to acquire or enter high paying jobs in the formal and informal sectors. Households with low education levels only engage in unskilled off-farm activities hence they receive fewer benefits. Nyamira County transition rate from primary to secondary school is 87.5 percent (Nyamira County, CIDP, 2018). At the time of the survey, 35 percent of the household members had attained secondary education while 11.7 percent had attained tertiary education.

(f) **Pensions/ remittances/gifts**: About 22.5 percent of the households received income from this livelihood strategy. However, no household reported this strategy as their main source of livelihood.

Pension is income or returns received by aged household members (60 years and above), while remittances are cash transfers from migrant workers who are members of the household. Gifts can be defined as income earned from dowry and in kind.

Remittances contribute about 5.4 percent of Kenya's Gross Domestic Product (GDP) (Simiyu, 2013). Remittances are usually transmitted through mobile money transfer networks like M-Pesa, Airtel Money, Western Unions and commercial banks.

Most (87.5) of the interviewed households hardly received cash transfers from their migrant members and a small percentage of the households reported that they had migrant members.

(g) **Rents**: this strategy was reported by 5.8 percent of the households and no household reported it as its dominant strategy. Rents were not the common source of income for most households given that the study area is about 90 percent rural and therefore most residents own their dwelling places. Most of those who earned rent had built houses near market centres and learning institutions like youth polytechnics and colleges.

4.2.3 Number of livelihood strategies reported

Table 4.3 below shows the distribution of the number of livelihood strategies the household reported. Most (40 percent) of the households were involved in three livelihood strategies only.

Table 4. 3: Distribution of households by the number of livelihood strategies

Number of livelihood strategies	Number of households	Percent of households
1	16	13.3
2	33	27.5
3	48	40
4	19	15.8
5	4	3.3

Source: Survey data

3.33 percent of the households participated in five livelihood strategies which were the highest set of livelihood strategies reported. Another 27.5 percent of the households were involved in two livelihood strategies. Households involved in four livelihood strategies accounted for 15.83 percent while those engaged in one livelihood strategy accounted for 13.33 percent. Majority (86.67 percent) of households in Nyamira County diversified their livelihood activities into off-farm activities. This indicates that farming alone cannot sustain livelihoods of households in the study area.

4.2.4 Discussion of livelihood strategies in Nyamira County

Access to assets or possession of financial and productive assets and other endowments facilitates participation of households in various livelihood activities that generate income for the household (Barret *et al*. 2001). Many households use income from off-farm sources to solve liquidity constraints. It has been reported from the literature (Pfeiffer *et al*. 2009) that income earned from the off-farm sector is used to meet household immediate needs like schools fees, childcare, medical bills, food and shelter. In addition to, this other scholars have indicated that off-farm income can be used in funding investment in the farm through input purchase and use of hired labour and can even be used to rent land for agricultural purposes (Amankwah *et al*. 2017; Woldenhanna, 2009 ; Babatunde,2009).

The majority (40 percent) of the interviewed households were involved in three livelihood strategies. Most households reported that they participated mostly in the casual labour in the non-agricultural sector, casual labour in the agricultural sector and business/self-employment in the following percentages respectively, 20.8 percent, 55.8 percent and 50.8 percent.

Casual labour in the agricultural sector had the highest participation by households because it is not faced by constraints like education, distance to livelihood source and availability of opportunities in the income source throughout the year.

About 3.3 percent of the households were highly diversified as they were involved in five livelihood strategies. Some 13.33 percent of the households did not participate in any other livelihood strategy other than farming as the occupation. This study expected that households with more livelihood strategies would earn more income than those that do not.

Farming was the most (70 percent) dominant livelihood strategy that was reported by the households in the study area. This is because it is the main source of food for almost all the residents of the study area. The area receives adequate rainfall and that most parts of the County have a high agricultural potential. These results reveal that agriculture remains to be important to most households in Nyamira County. This is in line with literature where agriculture is a dominant livelihood strategy (Ellis 2000; Barett *et al*. 2005 ; Sallawu *et al*. 2016).

4.3 Factors Influencing the Choice of the Number of Livelihood Strategies in Nyamira County: Poisson Regression Results

Table 4.4 below shows the factors influencing the number of livelihood strategies chosen by households in Nyamira County. A Poisson regression model (equation 8) was fitted into the data, where six out of thirteen variables were statistically significant.

Table 4.4: Poisson Regression results with robust standard errors for factors influencing the choice of livelihood strategies in Nyamira County

Variable	Coefficient	P>|z|
Household total land holdings (TTLNDHLNG)	0.0083075	0.511
Access to credit (CREDITACS)	-0.0003326	0.995
Distance to the nearest market (DIST.MARKT)	-0.005701	0.503
Access to extension service (EXTNACSS)	-0.0948364	0.036**
Time taken to water source (TIMEWTSC)	-0.004805	0.002***
Age of the household head (AGEHHH)	0.0017127	0.400
Sex of the household head (SEXHHH)	0.033438	0.637
Level of education household head (LEDHHH)	0.0277827	0.359
Hh members with sec. education (MMBERSECEDUC)	0.402471	0.028**
Aveg years of schooling other hhmembers (AVEGEDUCOTHER)	0.0501433	0.002***
Group membership (MMBERORGAN)	0.1752022	0.001***
Livestock value (LIVVALUE)	-1.0000009	0.832
Electricity access (ELECT.ACCESS)	0.3992469	0.000***
Number of observations	120	
Wald chi^2 (13)	196.91***	
Log-likelihood	-178.51484	
Chi^2 deviance	19.1971	
Pearson chi-squared (106)	18.84116	

P-value level of significance *=10 percent, **=5 percent and ***= 1 percent
Source: Computed from survey data 2018

4.3.1 Discussion of factors influencing the choice of livelihood strategies in Nyamira County

Access to extension services and time to the water source by a household negatively influenced the number of livelihood strategies a household chose. While households' average years of schooling, group membership, electricity access and the number of household members with secondary education positively influenced the number of livelihood strategies that a household participated in. However, contrary to expectations, household total land holdings, access to credit, distance to the nearest market, age of the household head, value of livestock owned by a household and a household head being male and more educated did not influence the number of livelihood strategies a household participated in.

Households who accessed extension services were involved in few livelihood activities than those that did not. This is evidenced by the negative and statistically significant access to extension service variable at 5 percent level of significance (P= 0.036). This can be explained by the fact that most extension services in the study area focused on increasing agricultural production. They include good agricultural practices, new seed varieties; use of proper rate, type and quality of fertilizer and new and improved livestock breeds or types. Contrary to the above finding, other available studies, (Teshome & Edriss, 2013; Amankwah *et al*. 2017; Karugia *et al*. 2006) have reported a positive relationship between livelihood diversification and extension service access. In addition to this, Asmah (2011) empirical findings show that extension access had no significant effect on livelihood diversification. This finding leads to rejection of the null hypothesis that access to extension services does not influence choice of livelihood strategies.

As the time taken by a household to water source and back increased the number of livelihood strategies selected by that household decreased. This is evidenced by negative and statistically significant time to water source variable (P=0.002). This means households who spent more time fetching water were engaged in fewer income-generating activities. Most income-generating activities which require own labour reduce as time is spent on other activities like spent on fetching water. This finding agrees with that of Riithi (2015) which analysed alternative livelihood options for resettled households in Kenya. This result then validates the rejection of the null hypothesis that time taken to water source has no influence on choice of livelihood activities by households.

A household with higher average years of schooling for other household members that is years of schooling of household head excluded participated in many livelihood strategies than those with fewer average years of schooling for other household members. In addition to this, households with many members who had attained secondary education participated in more livelihood strategies than those with few members with secondary education. At a 1 percent and 5 percent level of significance, these variables were positive and statistically significant respectively. This means that education is important in determining the number of livelihood strategies one adopts.

Education equips one with work-related skills, entrepreneurial ability and ability to acquire new skills hence facilitating participation in well-paid non-agricultural activities. This finding is in line studies by Senadza (2010); Marenya *et al*. (2006); Bigsten and Tengstam (2011);

Babatunde (2012); Alemu (2012) ; Kilic *et al.* (2009). Contrary to the above finding, Oluwatayo (2009) and Ersado (2006) indicate that education had a negative and significant effect on livelihood diversification. Additionally, Akundambeni (2015) found no significant effect of education on livelihood diversification. The null hypothesis that years of formal education has no influence on livelihood diversification decisions is therefore rejected baed on this finding.

A household that participated in group activities engaged in more livelihood strategies than those that did not. This is proved by this variable is positive and statistically significant (P= 0.001). Households that are members in groups create social networks that enable them to get more information about markets, easily borrow credit and learn from other group members' skills and experiences. Social networks also enable households' members to participate in new activities. Participation of households in different group activities has been reported to increase the likelihood of households participation in off-farm activities (Schwarze & Zeller, 2005; Ellis, 2000; Fausat, 2012). Contrary to this study's finding, according to Akundambeni (2015) and Grote & Loc (2015), group membership has no significant effect on livelihood diversification. This result justifies a rejection of the null hypothesis that participation in group activities does not influence livelihood diversification decisions.

A household that accessed electricity was involved in more livelihood strategies than those who did not have access to electricity. Proved by this variable is positive and statistically significant at 1percent level of significance (P= 0.000). The null hypothesis that access to electricity has no influence on livelihood diversification decisions is therefore rejected. This finding is in line with Teame and Woldu (2016); Babatunde (2012) and Riithi (2015) findings that indicate that electricity access facilitates participation in self-employment activities in the off-farm sector. Literature also reports that rural infrastructural improvement like access to electricity reduces entry barriers into off-farm activities and this enables households to fully exploit their capabilities.

Access to credit was found by this study to have no significant effect on the number of livelihood strategies chosen by a household. This finding is contrary to various past studies (Wanyama *et al*. 2010; Khatun & Roy, 2012 ; Olale *et al*. 2010) that indicated a positive and significant effect of credit access on livelihood diversification. The literature on credit access indicate that credit provides the working capital necessary for the development of farm enterprises, is used by households to hire labour and to mobilize savings. Additionally, credit

can be used to purchase farm inputs and assets. The insignificance of access to credit factor might be attributed to the fact that most of the borrowed funds were invested on food, clothing, and medical care and school fees. Only a small percentage of borrowed funds were invested in farming and/or in off-farm activities.

From literature households near market centres incur less cost than that far away. Also, distance to market determines the livelihood option adopted by the household. The current study found no significant effect of distance to the nearest market on the number of livelihood activities households participate in. The finding is in line with that of Riithi (2015) in Kenya; Senadza (2010) in Ghana and Lay *et al*. (2009) elsewhere which found that distance to market had insignificant effects on diversification decisions. The available literature on market access though is mixed where some studies report positive and significant effect (Wanyama *et al*. 2010); others indicate negative and significant effects (Eneyew, 2012; Reardon *et al*. 1997; Riithi, 2015; Babatunde & Qaim 2010). Distance to market variable was insignificant and this can be attributed to the fact that most of the interviewed households reported that most of their agricultural produce was bought directly from their farms by the middlemen and that due to the presence of "Bodaboda" which is the most flexible and affordable means of transport.

According to some researchers households with large farm sizes diversify more since they possess financial assets required for off-farm activities or diversify to smoothen their incomes. However, according to other households with large farm sizes do not diversify outside farming but rely mainly on farming using hired labour while assuming managerial roles in the farm.

This study found that farm size had no significant effect on the number of livelihood strategies a household adopted. This finding contradicts that of Babatunde (2016); Wanyama *et al*. (2010); Senadza (2010); Kilic *et al*. (2009) ; Bassie (2014) that found a positive and significant effect of farm size on livelihood diversification. However, Abebe (2018) found a negative and significant effect of farm size on diversification. The insignificance of total landholdings can be explained by the fact that in general there is a high reduction of land sizes in the study area which affects all residents.

The current study found that value of livestock owned had no effect on the number of livelihood strategies a household selected. As observed by past studies, livestock is a source of food and income. Ownership of livestock is also seen as a sign of wealth and can be used as collateral for agricultural loans. This study's finding contradicts that of Eneyew (2012); Abebe (2018); Yenesew *et al*. (2015) who found that livestock holdings had negative and significant effects

on livelihood diversification. However, Amare and Belayney (2012); Agyeman *et al*. (2014); Barret (2001); Gebru and Beyene (2012) found a positive relationship between livestock value and livelihood diversification. Value of livestock owned by a household variable's insignificance can be explained by the fact that most of the interviewed households were involved in small-scale livestock activities primarily of extensive free-range. Also, the number of livestock kept per household is reducing due to the reduction in land sizes in the study area.

Age of the household head had no effect on the number of livelihood strategies a household selected. This finding is in line with that of Sisay (2010) which found no significant relationship between age and livelihood diversification. Age of the household head also has mixed results from the literature. Whereas others indicate positive (Karugia *et al*. 2006; Senadza, 2010 ; Faustat, 2012), others report negative (Korir, 2011; Kassie *et al*. 2017; Grote & Ngoc, 2015 ; Fausat, 2012) link of the age of household head with livelihood diversification. According to these studies, as farmers grow old they become economically inactive hence their participation in non/off-farm activities is low.

Gender of the household is important because the household head is the main decision-maker. From literature, most rural households are male-headed because female farmers face some cultural, political and economic barriers in dealing with the cash economy. This study found no significant effect of sex of the household head on the livelihood diversification. This finding agrees with that of Riithi (2015) . However, contrary to this finding, Fausat (2012); Bassie (2014) and Alemu (2012), found a positive and significant effect of sex on livelihood diversification.

Age, sex and years of schooling of the household head were not significant and this can be explained by the fact that household decisions towards livelihood diversification are not only determined by the household head but also by other household members.

Thus, this study rejects the null hypothesis and adopts the alternative that the socio-economic, institutional and biophysical factors taken singly have an influence on the choice and number of livelihood strategies pursued by households.

4.4 Effect of Off-Farm Income on Agricultural Production

Table 4.5 below shows the results of the first stage estimation of off-farm income presented by equation 14. The results of this stage were used to show the relevance of the variables which were used as instruments.

Table 4. 5: First-stage of IV regression of off-farm income

Variable	Coefficient	P>|t|
Household head's education level (EDUCATION LEVELHHH)	29920.02	0.135
Household total landholding (FARMSIZE)	4305.029	0.500
Total cost of inputs used in the farm (TOTALINPUTCT)	2.755327	0.000***
Age of the household head (AGEHHH)	690.9649	0.512
Sex of the household head (SEXHHH)	-31311.62	0.344
Use of certified maize seeds (CERTMAIZEUSE)	-11342.15	0.719
Use of agrochemicals (AGROCHEMUSE)	-39782.66	0.120
Number of off-farm activities (NONOFARMACTIV.)	77110.76	0.000***
Household access to electricity (ELECTRIC.ACCESS)	-20895.8	0.575
Constant	-54384.61	0.575
Number of observations	120	
Shea's Partial R-squared	0.1799	
Adjusted R-squared	0.3562	
Robust F- statistic F (2,110)	11.1044**	
Minimum eigenvalue statistic	12.0687	
TSLS size of nominal 5 Percent Wald test	10% 15% 20% 25%	
	(19.93) (11.59) (8.75) (7.25)	

*P-value level of significance *=10 percent, **=5 percent and ***= 1 percent*

This study used two instruments which are; the number of off-farm activities of a household and household access to electricity. Variable relevance means that the variation in the instrument is related to the variation in the instrumented variable. In this case, for instance, it was expected that as the number of off-farm activities increases the number of off-farm income increases and vice versa.

The relevance of the variables used here as instruments were proved by the statistically significant and positive value of the number of off-farm activities in the first stage regression results above. Although, access to electricity used in this study as an instrument was not statistically significant that is, according to the first stage regression results, it was still used because a number of earlier studies have emphasized on its importance in livelihood diversification and has also been used to verify the endogeneity effect of off-farm income (Babatunde, 2012; Matshe & Young 2004; Escobal, 2001).

Table 4.6 below shows the second stage results of the instrumental variable estimation of the value of the farm output. Equation 15 was fitted into the data, where four out of eight variables were statistically significant.

Table 4. 6: Two-stage least square results for the contribution of off-farm income to agricultural production

Variable	Coefficient	P>|z|
Household total land holdings (FARMSIZE)	21592.06	0.001***
Total off-farm income (ONINC)	-0.3036746	0.128
Total input cost (TTINPUTCOST)	3.52272	0.006***
Age of the household head (AGEHHH)	1718.349	0.139
Sex of the household head (SEXHHH)	-2503.626	0.946
Level of education household head (LEDHHH)	25772.3	0.269
Household use of certified maize (CERTMAIZE)	86688	0.000***
Household use of agrochemicals (AGROCHEMUSE)	41540.81	0.063*
Number of observations	120	
Wald chi^2 (8)	46.85 ***	
Pseudo-R^2	0.4049	
Durbin (score) chi^2 (1)	15.227 (P=0.001)	
Wu-Hausmann F (1,110)	15.987(P=0.001)	
Robust score chi^2 (1)	8.1269(P=0.0044)	
Robust Regression F(1,110)	10.357 (P=0.0017)	
Sargan chi^2 (1)	0.58208(P=0.4455)	
Basmann chi^2 (1)	0.53617(P=0.4640)	
Score chi^2 (1)	0.64161(P=0.4231)	

*P-value level of significance *=10 percent, **=5 percent and *** = 1 percent*
Source: Survey data

4.4.1 Discussion of the effects of livelihood diversification on agricultural production

Total off-farm income was used as the endogenous regressor since it is believed that income earned from off-farm activities can be invested in farming. Contrary to prior expectations, off-farm income did not have any direct influence on the value of total farm output but only through farm inputs. This is evidenced by a positive and significant value of the total cost of farm inputs variable in first-stage regression results. This then means that the positive effect of off-farm income through agricultural financing equals the negative effect of family labour loss (Babatunde, 2012; Pfeiffer *et al*. 2009 ; Woldenhanna, 2009).

The IV estimation results show that for every additional one acre of land owned by a household there is a rise in the value of farm output by approximately KShs. 21,592. As expected as the number of hactares of land owned by a household increases the value of farm output increases.

Earlier researchers have reported that as a household farm size increases agricultural output increases and vice versa (Yizengaw, 2014; Babatunde, 2012; Senadza, 2010).

An increase in the cost of inputs used in the farm by a household for one year by 1 Kenya shilling increased the value of farm output by KShs. 3.52 on average. Other things being equal; households who used certified maize seeds increased their farm output by KShs. 86,688 while those that used agro-chemicals increased their farm output by KShs. 41540.81. There is a positive relationship between off-farm income and input use on the farm. This is in line with findings of Mathenge *et al*. (2009); Ruben *et al*. (2001) and Pfeiffer *et al*. (2009).

Thus, this study fails to reject the null hypothesis and concludes that off-farm income has no direct influence on agricultural production but only through purchase of farm inputs. This means that the positive effect of off-farm income through financing agricultural investment equals labour loss from farming.

4.5 Contribution of Diversification of Livelihood Strategies on Total Household Income: Mean Share of Income Results

Table 4.7 below presents the results of the contribution of various livelihood strategies to total annual household income.

Table 4. 7: Contribution of different livelihood strategies to total household income in shillings in Nyamira County

Livelihood strategy	n	Mean	Std. dev.	Min.	Max.	Percentage contribution to annual household income
Farming	120	187,915.87	149,598.60	8,400	927,100	56.54
Casual Labour in Non- agricultural sector	120	14280.83	41,115.85	0	336,000	3.77
Casual labour in Agricultural sector	120	34,432.92	54,671.29	0	380,000	11.67
Business/self-employment	120	61,947.5	108,621.61	0	720,000	15.83
Formal employment	120	47,466.67	134,583.76	0	840,000	7.22
Pensions/ remittances/gifts	120	13,975.00	3,090.12	0	195,000	4.17
Rents	120	3,575.00	15,149.49	0	84,000	0.80

Source: Survey Data

Farming was the largest contributor accounting for 56.54 percent to total household income with a mean of KShs. 187,916. Casual labour in non-agricultural sector contributed 3.77 percent to total annual household income and had a mean of KShs. 14,281 at the time of the survey. Casual labour in the agricultural sector contributed 11.67 percent to total annual household income with a mean of KShs 34,433 whereas; business/self-employment contributed 15.83 percent with a mean of KShs.57,793. Formal employment and pensions/remittances/gifts contributed 7.22 percent and 4.16 percent to total annual household income respectively.

The mean income from formal employment was KShs. 61,948 while that from pensions/ remittances/gifts was KShs. 13,975. Rents were the least contributor accounting for 0.8 percent to total annual household income with a mean of KShs. 3,575. The average annual total income per household was KShs. 363,694 at the time of the survey.

4.5.1 Discussion of the contribution of diversification of livelihood strategies to total household income

Farming as a livelihood strategy was the highest contributor (56.54 percent) to total household income at the time of the survey. This would be attributed to the fact that agriculture is the main source of food for many rural households. This would also be because farming does not face as many entry constraints as most off-farm activities. An entry barrier such as education that is, skills does not affect farming directly but in most cases, it depends on the farming experience of the household.

The off-farm income included income from the following sources: Casual labour in non- the agricultural sector which was defined as income earned from labour activities by members of the household from all labour- intensive activities except the farm (own and other peoples' farms). It contributed 3.77 percent to total household income. Casual labour in the agricultural sector involved all earnings from working on other people's farms. This off-farm activity was the second-highest contributor (11.67 percent) to total household income.

Formal employment income included gross wage income earned from regular formal sector and informal sector employment in the private sector and government. It contributed about 7.22 percent of the total household income of interviewed households. Business/self-employment income included profits and dividends from business/self-employment. This off-farm activity was the highest (15.83 percent) contributor to the total household income of households at the time of the survey.

Pensions/remittances/gifts included earnings from transfers and income from dowry. It accounts for about 4.17 percent to the total income of the household while rental income which included earnings from rented land and buildings was the least contributor (0.8 percent) to total household income. Generally, off-farm income contributed 43.46 percent to total household income. The results of this study indicate that farming is still important to rural households. These results are in line with findings of Haggblade *et al*. (2007); Jayne *et al*. (2003); de Janvry and Sadoulet, (2001) ; Reardon *et al*. (1998) who found that off-farm sector has relatively high and substantial share in total household income. This study then rejects the null hypothesis that off-farm income has no contribution on total household income.

By use of mean income shares method this study found that self-employment/businesses was the most remunerative livelihood strategy followed by casual labour in the agricultural sector.

Households in the study area are therefore encouraged to participate more in these two livelihood strategies. However, it should be noted that the type of livelihood strategy a household engages in depends on their accessibility to resources and the available constraints facing them.

CHAPTER 5: SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Summary

This study assessed the effects of diversification of livelihood strategies on agricultural production and household income in Nyamira County, Kenya. The study had three objectives which were: one, to assess the factors that influenced the choice of the number of livelihood strategies a household selected. Two, to find out the effect of diversification on agricultural production and three, to determine the contribution of off-farm income on total household income of residents in the study area. The study used primary household data that were collected through semi-structured questionnaires involving 120 households. Poisson regression was used to achieve the first objective of this study while for the second objective, Two-Stage Least Squares (TSLS) method in combination with the Instrumental Variable (IV) were used to address the possibility of endogeneity of the on-farm income and off-farm income. The Mean of Income Shares (MIS) approach was used to achieve the third objective. Descriptive statistcs results show that households in the study area participated in seven different livelihood strategies. Most (70 percent) households that were interviewed reported farming as their main source of livelihood. A majority (87.7 percent) of households participated both in farm and off-farm work. Out of the seven livelihood activities identified, most households participated in at most five livelihood activities. The Poisson regression model found six variables statistically significant out of thirteen fitted. Access to extension services and time to the water source by a household negatively influenced the number of livelihood strategies a household participated in while households' average years of schooling, group membership, electricity access and the number of household members with secondary education positively influenced the number of livelihood strategies adopted by a household. The results of TSLS estimation suggest that off-farm income does not have a direct significant effect on the value of farm output. Off-farm income contributed about 43 percent to total annua household income while farm activities contributed for about 57 percent to total annual household income.

5.2 Conclusions and Recommendations

Households in the study area are quite diversified but farming remains to be the most important source of livelihood. It contributes for up to 57 percent to total household income while the off-farm sector contributed for about 43 percent. Rural households should be encouraged to diversify their livelihood activities into the off-farm sector as this could increase their earnings. The Poisson regression results indicate that households with better education were more likely to diversify their livelihood strategies. Therefore, the study concludes that education is the key factor that determines the number of livelihood strategies a household selects. Rural poverty and food security may thus be reduced by enhancing better access to education by rural households. Households who were connected to electricity were more likely to diversify their livelihood activities than those who were not. Therefore, the government through the policy of rural electrification should reform energy subsidies by increasing investment in the rural electrification program, it should also increase private suppliers market ownership and performance and create markets that vary according to socio-economic and demographic groups. Results show that as time taken to water source increases the number of livelihood strategies a household selects reduces. This study, therefore, recommends for upgrading of rural infrastructure particularly water especially in mountainous areas of the County. Group membership was found to be an important factor in determining the number of livelihood strategies selected by a household. Policies that support and enhance group activities should be put in place in rural areas and be strengthened. Extension services negatively and significantly affected diversification of livelihood strategies. This would be because extension services in the region usually pay more attention to farm-related issues. Based on this finding, the study recommends that knowledge and information on rural diversification should also focus on the off-farm sector activities as this would promote and enhance the rural economy. Diversification of livelihood activities raised total household incomes since the off-farm sector contributed about 43 percent to total annual household income. This study, therefore, concludes that off-farm income is important for rural farming households and therefore poverty reduction policies should focus equally on improving both farm and off-farm sectors. Also, the study recommends that human capital investments that may expand off-farm earnings such as increased access to education, improved health care and entrepreneurial training programs should be made by the government.

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APPENDICES

Appendix 1: Results of the pairwise correlation matrix tests for objective one

	Farm size	Credit access	Distance to market	Extension service access	Timetaken to water source	Age HHH	
Farm size	1.000						
Credit access	-0.0289						
Distance to market	-0.1191	-0.0233	-1.000				
Extension service access	0.0772	0.0501	0.0453	1.000			
Time taken to water source	-0.0793	-0.0158	0.0710	0.0362	1.000		
Age HHH	-0.0328	-0.1020	-0.0448	-0.0183	-0.1487	1.000	
	Farm size	Credit access	Distance to market	Extension service access	Time taken water source	Age HHH	Sex HHH
Sex HHH	-0.0734	0.0519	0.1998	0.1222	-0.0754	-0.0748	1.000
Education HHH	0.0557	0.0788	0.1124	0.2455	-0.0309	-0.3750	0.2525
HH size	-0.0426	0.1814	0.0782	0.0497	-0.1875	-0.1253	0.3190
MembersSec educ.	-0.0219	-0.1687	0.0723	-0.1157	0.0539	-0.1817	0.3413
Average years schoolingother	-0.0633	0.2474	0.2480	-0.0206	0.0181	0.0248	0.0437
Group membership	0.2117	0.1549	0.0623	0.1939	0.0177	0.2018	0.0938
Livestock value	0.2034	0.1807	-0.1232	-0.0159	-0.0689	0.1497	0.1497
Electricity access	-0.1430	0.0854	0.0538	-0.1923	0.0979	0.1485	0.1469
	Education HHH	HH size	Member Sec educ.	Aveg. years Schooling other.	Group membership	Livestock value	Electricity access
Education HHH	1.0000						
HH size	0.3190	1.0000					
Member Sec educ.	0.3413	0.4296	1.0000				
Ave. years schooling other. Members	0.0846	-0.0463	0.4687	1.0000			
Group membership	0.1678	-0.0112	0.1975	0.1449	1.0000		
Livestock value	-0.0004	0.0048	0.0743	0.0198	0.1520	1.0000	
Electricity access	0.1469	0.1615	00.2403	0.1889	0.3306	0.0023	1.0000

Source: Author's computation, survey data (2018)

Appendix 2: Multicollinearity test results of Poisson Regression

VIF of explanatory variables used to model factors influencing choice of number of livelihood strategies of households in Nyamira County

Variables	VIF	1/VIF
Number of Members with Sec education	1.92	0.521968
Average years of schooling other hh members	1.66	0.603533
Education level household head	1.63	0.612843
Household size	1.55	0.643426
Age of the household head	1.40	0.715049
Group membership	1.39	0.719107
Electricity access	1.26	0.792125
Livestock value	1.21	0.829097
Credit access	1.20	0.832574
Sex of the household head	1.20	0.833887
Farm size	1.18	0.845712
Distance taken to nearest market	1.17	0.856721
Time taken to water source and back	1.15	0.872766
Household access to extension services	1.13	0.886802
Mean VIF	**1.36**	

Source: Author's computation, survey data (2018)

Appendix 3: Breusch-Pagan Cook-Weisberg test for heteroskedasticity of Poisson regression

Breusch-Pagan Cook-Weisberg test for heteroskedasticity

Ho: Constant variance
Variables: fitted values of NUMBEROFLIVELIHOODSTRATEGIES

chi2(1) = 1.86

Prob > chi^2 = 0.1724

Source: Survey data (2018)

Appendix 4: Poisson Regression results

Variable	Coefficient	Std. error	P>|z|
Household total land holdings (TTLNDHLNG)	0.0083075	0.0126435	0.511
Access to credit (CREDITACS)	-0.0003326	0.485503	0.995
Distance to the nearest market (DIST.MARKT)	-0.005701	0.0085053	0.503
Access to extension service (EXTNACSS)	-0.0948364	0.045315	0.036**
Time taken to water source (TIMEWTSC)	-0.004805	0.0015489	0.002***
Age of the household head (AGEHHH)	0.0017127	0.0020329	0.400
Sex of the household head (SEXHHH)	0.033438	0.0708954	0.637
Level of education household head (LEDHHH)	0.0277827	0.0302909	0.359
Hh members with sec. education (MMBERSECEDUC)	0.402471	0.183736	0.028**
Average years of schooling other hh members (AVEGEDUCOTHER)	0.0501433	0.165195	0.002***
Group membership (MMBERORGAN)	0.1752022	0.0165195	0.001***
Livestock value (LIVVALUE)	-1.0000009	5.16e-^{07}	0.832
Electricity access (ELECT.ACCESS)	0.3992469	0.0547093	0.000***
Number of observations	120		
Wald chi^2 (13)	196.91		
Prob>chi^2	0.0000		
Log likelihood	-178.51484		
Chi^2 deviance	19.1971		
Prob>chi^2	1.0000		
Pearson chi-squared (106)	18.84116		
Prob>chi^2	1.0000		

P-value level of significance *=10 percent, **=5 percent and ***= 1 percent

Robust standard errors used

Source: Survey data (2018)

Appendix 5: Results of the pairwise correlation matrix tests for objective two

Table : Correlation matrix for explanatory variables used to model the effects of off-farm income on agricultural production of households in Nyamira County

	Education Level HHH	Farm size	Total input cost	Age HHH	Sex HHH	Certified maize use	Agrochemical use
Education level HHH	1.0000						
Farm size	0.0557	1.0000					
Total input cost	0.2080	-0.0140	1.0000				
Age HHH	-0.3750	-0.0328	-0.0058	1.0000			
Sex HHH	0.2525	-0.0734	0.1767	-0.0748	1.0000		
Certified Maize use	0.0352	0.0688	0.1571	-0.0480	0.2554	1.0000	
Agrochemical use	0.0890	-0.1590	0.3052	0.1441	0.1099	0.1791	1.000
Number of off-farm activities	0.1933	-0.0759	0.2597	0.1930	0.0666	-0.0596	0.1099
Electricity access	0.1469	-0.1430	0.1971	0.0979	0.0807	-0.0382	0.2510

	Total off-farm income	Number of off-farm activities	Electricity Access
Total off-farm income	1.0000		
Number of off-farm activities	0.4985	1.0000	
Electricity Access		0.6508	1.0000

Source: Survey data (2018)

Appendix 6: Multicollinearity test results of IV two stage least squares regression
VIF of explanatory variables used to model the effect of off-farm income on agricultural production of households in Nyamira County

Variables	VIF	1/VIF
Number of off-farm activities the household have	2.26	0.442777
Electricity access	1.83	0.546709
Total off-farm income	1.68	0.595135
Total input cost	1.46	0.686370
Education level of the household head	1.42	0.702955
Age of the household head	1.32	0.759712
Agro-chemical use in the farm	1.26	0.795876
Sex of the household head	1.18	0.848873
Certified Maize use in the farm	1.15	0.867481
Farm size	1.07	0.933180
Mean VIF	**1.46**	

Source: Author's computation, survey data (2018)

Appendix 7: Breusch-Pagan Cook-Weisberg test for heteroskedasticity of Two Stage Least Squared method

Breusch-Pagan Cook-Weisberg test for heteroskedasticity

Ho: Constant variance

Variables: fitted values of VALUEOFFARMOUTPUT

chi^2 (1) = 53.93

Prob > chi^2 = 0.0000

Source: Survey data (2018)

Appendix 8: Second stage least square method results

Variable	Coefficient	Std. error	P>|z|
Household total land holdings (FARMSIZE)	21592.06	6704.926	0.001***
Total off-farm income (NOINC)	-0.3036746	0.1996521	0.128
Total input cost (TTINPUTCOST)	3.52272	1.293652	0.006***
Age of the household head (AGEHHH)	1718.349	1161.035	0.139
Sex of the household head (SEXHHH)	-2503.626	34522.61	0.946
Level of education household head (LEDHHH)	25772.3	23334.83	0.269
Household use certified maize (CERTMAIZE)	86688	20072.64	0.000***
Household agrochemicals use (AGROCHEMUSE)	41540.81	22321.22	0.063*
Number of observations	120		
Wald chi^2 (8)	46.85***		
R^2	0.4049		
Durbin (score) chi^2 (1)	15.2279 (P = 0.001)		
Wu-Hausmann F (1,111)	15.9877 (P =0.001)		
Robust score chi^2 (1)	8.12698 (P = 0.0044)		
Robust Regression F (1,111)	10.3574 (P= 0.0017)		
Sargan chi^2 (1)	0.582083 (P=0.4455)		
Basmann chi^2 (1)	0.536177 (P=0.4640)		
Score chi^2 (1	0.641617 (P =0.4231)		

*P-value level of significance *=10 percent, **=5 percent and ***= 1 percent*

Robust standard errors used

Source: Survey data (2018)

Appendix 9: First-stage of IV regression of off-farm income

Variable	Coefficient	P>|t|
Household head's education level (EDUCATION LEVELHHH)	29920.02	0.135
Household total land holding (FARMSIZE)	4305.029	0.500
Total cost of inputs used in the farm (TOTALINPUTCT)	2.755327	0.000***
Age of the household head (AGEHHH)	690.9649	0.512
Sex of the household head (SEXHHH)	-31311.62	0.344
Use of certified maize seeds (CERTMAIZEUSE)	-11342.15	0.719
Use of agro-chemicals (AGROCHEMUSE)	-39782.66	0.120
Number of off-farm activities (NOOFARMACTIV.)	77110.76	0.000***
Household access to electricity (ELECTRIC.ACCESS)	-20895.8	0.575
Constant	-54384.61	0.575
Number of observations	120	
Shea's Partial R-squared	0.1799	
Adjusted R-squared	0.3562	
Robust F- statistic F (2,110)	11.1044***	
Minimum eigenvalue statistic	12.0687	
TSLS size of nominal 5percent Wald test	10 percent	
15 percent 20 percent 25 percent	(19.93); (11.59); (7.25)	

*P-value level of significance *=10 percent, **=5 percent and ***= 1 percent*
Source: Authors' calculations (Survey data, 2018)

Appendix 10: Mean share of income calculations

a) Share of farming in total annual household income

$$\left(\frac{67.8426}{120}\right) * 100 = 56.54 percent$$

b) Share of off-farm income in total annual household income

$$\left[\left(\frac{4.528743}{120}\right) + \left(\frac{14.00113}{120}\right) + \left(\frac{19.00163}{120}\right) + \left(\frac{8.671203}{120}\right) + \left(\frac{5}{120}\right) + \left(\frac{0.95}{120}\right)\right] * 100$$

$$= 44.56\ percent$$

Appendix 11: Research Questionnaire

UNIVERSITY OF NAIROBI

INTRODUCTION

This study is being carried out by Lisper Kimathi a postgraduate student at the University of Nairobi. The study seeks to find out the income sources and/or strategies used by farm households and factors influencing adoption of each strategy. This study also seeks to determine the effect of diversification of livelihood strategies on households' farm production, and the contribution to total household income.

You are kindly requested to help in answering some questions which will help us achieve the objectives of the study. Your responses will be handled with confidentiality. Kindly provide honest and accurate information. You may seek for clarification when you don't understand the question. Thank you. May I start now?

If given permission begin the interview.

SECTION A: GENERAL INFORMATION	
A.1 Questionnaire number _____	A.2 Enumerator's name ……..
A.3 County…….	A.4 Sub-county ……
A.5 Ward ……	A.6 Sub-location …….
A.7 Village ……	A.8 Interview Time: Start ……. Stop……
A.9 Day/month/year of interview ……	A.10 Name of respondent _____
A.11 Respondent's phone no. _____	

SECTION B: FARM CHARACTERIZATION

B1. How many hactares in total land holdings does the household own? _____

B2. How much of your land (owned, rented or free access land) is under

(i) Cultivation _____ hactares (ii) Pasture _____ hactares

(iii) Homestead _____hactares (iv) Others (specify_____ _____ Hactares

B3. Does the household have title to the land? _____

B4. How many hactares do you hire in/out? _____

B5. What is the rent per year? _____

B6. **CREDIT ACCESS**

Member accessed credit over the past 24 months Tick where appropriate	If yes what is the source Tick where appropriate	Amount borrowed Kshs.	Purpose of borrowing Tick where appropriate	Main constraint to credit access Tick where appropriate
Yes=1 { } No= 2 { }	1= Table banking { } 2= commercial bank { } 3= MFIs { } 4= cooperative { } 5= AFC { } 6=Family, friends { } 7 Other specify_____		1= input purchase { } 2= livestock purchase { } 3= school fees{ } 4= medical bills { } Other specify_____	1= lack of collateral { } 2= long distance to credit source { } 3= high interest rates { } 4= not interested { } 5= not available { } Other specify please _____

ii) Did the household buy inputs on credit? 1= Yes { } 2= No { }

iii) If yes, where from? _____

B7. Do you sell your produce 1= Yes { } 2= No { }

B8. What is the distance to the nearest market? _____

B9. What are the main challenges that you face during marketing? (1) = low prices { }

2= lack of access markets { } 3= high transport costs { } 4= lack of storage facilities { }

B10. Did you have any extension contact? 1= Yes { } 2= No { }

B11. Did the household use certified maize seed? 1=Yes { } 2= No { }

i) If yes, where did you get money to make this purchase _____

B12. (i) Has the household run out of food for home consumption for the past one year?

1= Yes { } 2= No { }

if yes, (ii) How did the household feed itself in such a case? List in order of priority

(1) Sale of liquid assets such as chicken, sheep, cows, depleting cash savings { }

(2) Redeploying labour { } (3)Sale of farm equipment like wheelbarrows, jembes, sprayer { }

(4) Sale of productive assets like land (5) Borrowed from friends and relatives { }

(6) Reduced quantity of food consumed per unit of time { } (7) other please specify _____

B13. What are your farming objectives? ……

(1) Food supply (2) income/profit (3) food and income (4) other (Specify) _____

Purpose of labour	**Source of funds**	**Wage rate**	**Number hired**	**Total cost of labour**
TOTAL				

Codes for purpose of labour

1= Animal tendering 2= Land preparation, harrowing and ploughing

3= Tea plucking 4= Harvesting coffee berries 5= Brick making

6= Harvesting of dried maize, beans and wheat 7= Weeding 8 =others please specify _____

B14. Did you use hired labour in your farm over the last 12 months 1=Yes { } 2=No { }

If yes kindly fill in the table below

B15. **INPUT USE:** Kindly provide information on the costs incurred in production of Livestock and Crops in the last one year

Input bought used in the last 12 months	Quantity units(Kgs bags Mls, Litres, days)	Source of funds	Cost in KShs.	Source of inputs	Distance to input source in Kms where applicable	Constraints to input use
Fertiliser						
Seeds						
Agro-chemicals (Acaricides, pesticides and herbicides)						
Irrigation						
Transport						
Vaccination and other Veterinary services e.g Artificial Dissemination						
Feeds and minerals						

Codes for constraints to input use
1= None
2= High prices
3= long distance
4= Poor quality of inputs
5= lack of inputs in the right time
6=Other please specify

Codes for source of inputs
1= KALRO
2= Open market
3= Agro vets
4= NGOs
5= Kenya seed company
6= Other please specify

Codes for source of funds
1= Farming
2= Salary
3= Business/self-employment
4= Casual labour
5= Pension/rent/remittances
6= Other please specify

B16**. FARM OUTPUT**: Farm output of the household in the last twelve months.

Agricultural produce	**Quantity produced (unit kg litres bags/value)**	**Quantity consumed**	**Quantity sold**	**Cost in KShs.**
a. Maize				
b. Beans				
c. Sweet potatoes				
d. Irish potatoes				
e. Finger millet				
f. Sorghum				
g. Napier grass/other fodder				
h. Sugar cane				
i. Tea leaves				
j. Coffee berries				
k. Cabbage				
l. Sukuma wiki				
m. Onions				
n. Tomatoes				
o. Other vegetable products				
p. Wheat				
q. Bananas				
r. Groundnuts				
s. Cassava				
t. Fruits				
u. Milk				
v. Eggs				
w. Honey				
x. Pyrethrum				
y. Fish				
z. Livestock				
aa. Crop residues				
bb. Other animal/livestock products				

B.17 Did any member of the household earn income from nonfarm income sources?

1= Yes { } 2= No { } If yes, please fill the below table

Non- farm source of income	**Average amount of income earned per unit/day/month**	**Total income**
Casual labour in non-agricultural sector		
Casual labour in agricultural sector		
Self-employment/business		
Formal employment/salary		
Pensions/Remittances /gifts		
Rents		
Other please specify		

SECTION C: WATER AND SANITATION

WATER AND SANITATION	
C1. What is the main source of drinking water for members of your household?	Piped water……. 1 Borehole …… 2 Water from spring ……. 3 Rainwater collection …… 4 Surface water (river, stream, dam, lake, pond) … 5 Bottled water ……... 6
C2. What is the main source of water used by your household for other purposes such as for cooking, washing utensils, washing clothes, use in the farm, for bathing, cleaning foodstuffs and any other use?	Piped water……. 1 Borehole …… 2 Water from spring ……. 3 Rainwater collection …… 4 Surface water (river, stream, dam, lake, pond) ... 5 Bottled water …… ……. 6
C3. How long does it take to get there, get water and come back?	Number of minutes/hours ……
C4. Do you treat your water to make it safer to drink?	Yes……1 No …… 2
C5. What do you usually do to the water to make it safer to drink?	boil…… 1 Add bleach/chlorine ……. 2 Strain it through a cloth …….. ….. 3 Let it stand and settle …… 4 Other please specify ……
C6. What kind of toilet facility do members of your household usually use?	Flush……. 1 Pit latrine ……. 2 Bucket …….. 3 No facilities or bush or field ……4 Other please specify ……
C7. Do you share this facility with other households?	Yes ……. 1 No ……... 2

SECTION D: HOUSEHOLD INFORMATION

D.1 Name of respondent: _____

D.2 Year of birth: _____

D.3 Is the respondent the household head? ☐ 1= yes ☐ 2= no

b) if no what is the relationship with household head?

☐ 1= spouse

☐ 2= family member

☐ 3= nonfamily member

D.4 Sex of respondent ☐ 1= Male ☐ 2= Female

D.5 Marital status of the respondent

☐ 1=married

☐ 2=divorced

☐ 3= Single

☐ 4= never married

☐ 5 = Widow/widower

D.6 Education Level of the respondent

☐ 1= None

☐ 2= Primary

☐ 3= Secondary

☐ 4= Post-secondary

D.7 Household size ☐ 1= 1-2 ☐ 2= 3-4

☐ 3= 5-7 ☐ 4= above 7

D.8 How many of the household members are in school _____

D.9 In the table below please give details of your household members who live within the household

Name of household member	Relation ship with HH head	Age	Sex	Marital status	Main Occupation	Level of education	Average Monthly income earned

Relationship with HH codes 1=Spouse 2= child 3= Relative 4=Worker 5= No relationship

Age 1= 1- 16 years 2= 17-34 years 3= above 35 years

Sex 1=Male 2 =Female

Marital status = 1= Married 2= Single 3= Divorced 4= Separated 5= Never Married 6= Widow/Widower

Occupation 1= Student 2= farmer 3= self-employed/business 4= formally employed 5= casual labourer 6= Retired 7 other please specify _____

Education Level 1= none 2= primary 3= secondary 4= post-secondary

D.10 How many years has the household been farming? _____

D.11 What is the main source of income for the household? 1= Farming { }

2= formal employment { } 3= self-employment/business { } 4= casual labour in non-agricultural sector { } 5= casual labourer in agricultural sector { } 6 Pensions Remittances { } 7=rents { } 8= other please specify_____

D12. How long have you lived in this area _____?

D13. Is there any household member who participates in group activities?

1= Yes { } 2= No { }

b) If yes please fill the table below

Name of HH member	Name of Group/organization	Reason for participation

Reason for participation codes

1. Share information on farming business experiences

2. Mutual help in time of distress

3. To help in credit access

4. Generate income (Leadership)

5. Development of community activities

6. To help in market access

D14.Does your household have:

	Yes	No	Current value in KShs.
a. Electricity ……	{ } 1	{ } 2	_____
b. Radio ……	{ } 1	{ } 2	_____
c. Television ……	{ } 1	{ } 2	_____
d. Mobile phone ……	{ } 1	{ } 2	_____
e. Refrigerator…..……	{ } 1	{ } 2	_____
f. Blender or mixer …….	{ } 1	{ } 2	_____
g. Water heater ……	{ } 1	{ } 2	_____
h. Washing machine ……	{ } 1	{ } 2	_____
i. Computer/laptop ……	{ } 1	{ } 2	_____
j. Internet connection ……	{ } 1	{ } 2	_____
k. VCD or DVD ……	{ } 1	{ } 2	_____
l. Air conditioner ……	{ } 1	{ } 2	_____
m. Sewing machine ……	{ } 1	{ } 2	_____

D15. Does any member of your household own?

	Yes	No	Current value in KShs.
a. Watch ……..	{ } 1	{ } 2	_____
b. Bicycle……	{ } 1	{ }2	_____
a. Motorcycle ……	{ } 1	{ }2	_____
b. Car/track ……	{ } 1	{ }2	_____
c. Tractor ……	{ } 1	{ }2	_____
d. Jembe……	{ } 1	{ } 2	_____
e. Panga ……	{ } 1	{ }2	_____
f. Sprayer pump ……	{ } 1	{ }2	_____
g. Buildings (and other fixed assets	{ } 1	{ } 2	_____
h. Posho mill ……	{ } 1	{ }2	_____
i. Wheelbarrow ……	{ } 1	{ } 2	_____
j. Solar panel ……	{ } 1	{ } 2	_____
k. Water tank ……	{ } 1	{ }2	_____
l. Bank savings ……	{ } 1	{ }2	_____

D16. Do you or someone living in this household own this dwelling or do you rent?

Own …… 1

Rent ……...2

D17. Does this household own any livestock, herds or farm animals?

Yes …….. 1

No ……..2

D18. How many of the following animals does the household have?

	Current value in KShs.
a. Dairy/milk cows ……	…….
b. Bulls ……..	……
c. Donkeys …….	…….
d. Goats ……..	……
e. Sheep ……	……...
f. Chickens ……..	…….
g. Pigs ……..	……..
h. Beef cattle ……	…….
i. Rabbits ……	……..
j. Bees ……	……
k. Other poultry (ducks, turkey and geese (if any) …… ……	……...

D19. **Household Expenditure** for the last twelve months

On average how much does the household spend on the following per year

a. Clothing _____
b. Food _____
c. School fees _____
d. Medical services _____
e. Other expenses _____

THE END

THANK YOU