DETERMINANTS OF CHOICE OF ALTERNATIVE LIVELIHOOD DIVERSIFICATION STRATEGIES IN SOLIO RESETTLEMENT SCHEME, KENYA

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Declaration

This thesis is my original work and has not been presented for an award of degree in any other University.

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Dedication

I dedicate this work to the late ACP (RTD) Julius Waiganjo Runo for his efforts in promoting environmental conservation, education access, peace and cohesion in the society he lived in, all that promote livelihood diversification and sustainability. You are and will always be the Mahatma Gandhi and Dr. Martin Luther King Jr who lived in our time and the Nelson Mandela who was near us, talked to us and believed in us. Your legacy will outlive you.

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Abstract

Livelihood diversification by agricultural households in sub-Saharan Africa contributes significantly to household income. Over the last three decades there has been increased interest in literature on the subject. However, little has been done on the determinants of choice of alternative sets of strategies by households as well as the livelihood strategies chosen by resettled households. This study fills this gap in knowledge. This is important because it will guide policy makers in coming up with policies, programs and projects, that enable resettled households to easily reconstruct their livelihoods.

The study addressed two objectives; first, it described the livelihood activities carried out by households in Solio, a resettlement scheme in central Kenya. Secondly, it evaluated the factors that influence the choice of alternative sets of livelihood strategies in the study area. To achieve the first objective, descriptive statistics were used to characterize the resettlement scheme using data collected through a semi-structured questionnaire and focus group discussions. The second objective was achieved by running a negative binomial regression model using data collected through a semi-structured questionnaire involving 196 respondents.

The study found that households had diversified livelihoods from agriculture, where off-farm activities contribute over 67.4% of total household income. Age of the household head and possession of a technical skill were found to positively influence the number of livelihood strategies a household was involved in. Time taken to a water source was found to negatively influence the number of livelihood strategies a household was involved in.

The study recommended, first, the improvement of access to water for domestic purposes as well as irrigation for crop production to supplement the low rainfall in the study area. Secondly,

improvement of access to technical skills and training, and increased funding to village vocational training centers, for them to be better equipped to offer technical skills training which positively influence livelihood diversification. Such programs will positively influence livelihood diversification in rural areas and therefore curb the problems of food insecurity and youth unemployment.

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List of Abbreviations and Acronyms

CDF-constituency development fund

FGD- focus group discussion

GDP- gross domestic product

GoK- government of Kenya

Ha- hectares

IFSS- international food safety standards

KMs- kilometers

Kshs- Kenya shillings

MNL- Multinomial logit

NBRM- negative binomial regression model

PCA- Principal Component analysis

PRM- Poisson regression model

RUM- random utility model

SAPs- structural adjustment programs

SSA- sub-Saharan Africa

TLU- Tropical livestock units

VIF- Variance inflation factor

Chapter 1: Introduction

1.1 Background

1.1.1 Rural Livelihood Diversification

Livelihood diversification as a development strategy has gained wide acceptance among development theorists based on its capacity to reduce poverty and deal with food insecurity (Ellis, 1998; 2000; Bryceson, 2000; Reardon et al., 2000; Lanjouw and Lanjouw, 2001and Davis, 2003). This is because livelihood diversification allows households to reduce income risk associated with relying on agriculture alone. Development literature is rife with debate on whether livelihood diversification can be explored as a way of curbing rural poverty, unemployment and food insecurity particularly in sub-Saharan Africa (SSA). This debate is necessitated by the increasing youth unemployment as well as frequent food shortages in SSA countries, which leads to increased rural poverty.

In the rural development literature, there has been a tendency for policy debate equating rural income with farm income (Reardon, 1998). In this regard, the Ministries of Agriculture, agriculturists as well as those interested in rural development have tended to neglect the rural non-farm sector (ibid.). Nevertheless, there is increasing evidence that the income derived from the rural non-farm sector is important in stabilizing farm incomes and raising consumption in rural households that include rural town dwellers, the landless and the poor (ibid.).

Lanjouw and Lanjouw (2001) argue that the rural non-farm sector has the potential to promote growth and welfare in a country's economy, both by slowing rural-urban migration and providing alternative employment opportunities for those either left out of agriculture or seeking to diversify from agriculture. This argument emanates from the fact that the major driver of

rural-urban migration especially among the youth in SSA is to seek employment opportunities (ibid.). The presence of off-farm income-generating activities in the rural areas apart from agriculture, engages some of the young people, who would otherwise migrate to urban centers (ibid.).

Ellis (2000) noted that the diversification of rural livelihoods has important implications on rural poverty. This is because increasing incomes, employment and productivity in single occupations like farming using conventional approaches has a tendency of missing their targets (ibid.). Households that have diversified income sources have better welfare indicators in terms of food security, healthcare, and school fees availability among others (Zerai and Gebreegziabher, 2011). Nevertheless, the literature shows that livelihood diversification by households is not new and neither is it only confined to the rural sector of developing countries. It has actually been referred to as "pluriactivity", implying that households are involved in diverse income sources in rural SSA apart from agricultural income sources (Shucksmith et al., 1989; Evans and Ilberry, 1993; Ellis, 2000). The literature also recognizes an increase in farm families participating in multiple livelihood activities in SSA, after the implementation of the structural adjustment programs (SAPs) of the late 1980s and early 1990s (Kelly and Ilberry, 1995; Hearn et al., 1996; Ellis, 2000). This shows that livelihood diversification from agriculture has been going on over the years. However, whether livelihood diversification has increased due to SAPs is still an open question.

In SSA, livelihood diversification is widespread across farm sizes, ranges of income and wealth. It has an enduring character because it is not a transient phenomenon caused by lags in the otherwise smooth adjustment of resource use between equilibrium states that will quickly disappear with further economic growth in these countries (Barrett et al., 2001). This is due to

the fact that specialization remains an unachievable goal among many households whose major preoccupation is survival and hence the key driver of diversification of most households in SSA (ibid.). The literature further notes that most rural families in SSA have diversified income sources that include wages from farm and non-farm activities, non-farm self-employment as well as remittances from urban areas and abroad (Ellis, 2000). Livelihood diversification strategies are different for different households given the constraints that they face.

Past literature shows that non-farm income sources in SSA's rural households account for between 30 and 50 percent of total household income (Reardon, 1997; World bank, 2008; Zerai and Gebreegziabher, 2011). In the southern African region, studies show that these sources can reach up to 80-90 percent of total rural household income (May, 1996; Baber, 1996). These statistics underscore the importance of the non-farm rural sector in rural poverty alleviation and dealing with food insecurity in rural areas.

In Kenya, more than 70 percent of the labor force is found in the rural areas, where agriculture is the main livelihood activity (GoK, 2010). The sector accounts for 24 percent of Gross Domestic Product (GDP) and 60 percent of foreign exchange earnings (GoK, 2014). However, as in other SSA countries, rural households have diversified livelihood strategies with a large component in the non-farm sector.

Evidence shows that the rural non-farm sector is an important contributor to total household income in SSA. An increase in household income improves food security and market participation for factors, products and services. It is therefore important for policy makers to be

informed about the importance of this sector as they come up with rural development programs and policies.

1.1.2 Resettlement and Livelihood Diversification

Resettlement entails the planned and controlled relocation of populations from one physical place to another (Muggah, 2008). In Africa, it has traditionally been attributed to conflict, development pressure or extraction of natural resources (Munshifwa, 2007). However, in countries such as Zambia, retrenched persons, retirees and unemployed youths are forced by circumstances such as lack of employment and the resultant poverty to migrate to resettlement schemes from urban areas (ibid.).

There are two types of resettlement; land-based and cash-compensation resettlements. Land-based resettlement is where displaced persons are given land to resettle while in cash compensation resettlement, displaced persons are given money to compensate them for lost land and assets to purchase land (Mathur, 2013). Land-based resettlement is by far a more successful strategy than compensation in cash in the developing world, because cash compensation most often fails to lead to income restoration, let alone its improvement as compared to before resettlement (Cernea, 2000). However, providing new land alone is not enough for achieving success in the resettlement process; technical assistance and favorable social policy measures must accompany land-based resettlement (MacMillan et al., 1998).

Cernea (1997) stresses that forced resettlement can cause impoverishment among resettled people, unless specifically addressed by targeted policies, by bringing about the following:

- ***Landlessness*** – Land is the basis of any agricultural production system. Normally, in a situation of displacement, the settler loses occupation and/or use of this physical asset. Therefore, unless the foundation is rebuilt, the effort of reconstruction may be wasted.
- ***Joblessness*** – Displacement will affect settlers more if in the process of moving they also lose their jobs.
- ***Homelessness*** – In the process of movement, settlers may also lose their dwellings. This may be either temporary or chronic if not attended to on time.
- ***Marginalization***- In the process of resettling, the settlers may not regain their lost economic strength resulting in feeling left out.
- ***Food insecurity*** – Forced movement increases the risk that people would fall into chronic food insecurity.
- ***Loss of access to common property resources*** – Common resources provide other products such as fruits and other edible products, firewood, etc. Therefore, a loss of common resources due to forced migration results in loss of such products.
- ***Increased morbidity and mortality*** – People forced to relocate tend to have a higher degree of exposure to illness than those who are not.
- ***Community disarticulation*** – Movement results in social disorganization which compounds the individual's loss of social capital.

Livelihood diversification is therefore an option in creating sustainable new employment in resettlement schemes (Cernea, 2000). This is because relocation of a large number of people causes major changes in their livelihood activities and presents difficulties in adapting to their new environment. The resettled group is usually less secure in their livelihoods and in most cases

is vulnerable to food insecurity and poverty (Cobo et al., 2009; Magaramombe, 2010). This is particularly so if resettlement places people in environments different from their origins. In this case, livelihood insecurity does not necessarily have to be as a result of infertile land but shortfalls in other factors influencing livelihood reconstruction. Kinsey and Binswanger (1993) note that environmental conditions for growing crops can be significantly unfamiliar thereby forcing the resettled households to adopt new cultivation practices, or even to seek other income-generating activities out of agriculture.

In Kenya, conflict-based resettlement is not a new phenomenon. During the colonial era, large populations were moved from the "white highlands", and after independence the landless and the squatters were resettled in government-planned resettlement schemes (Cook, 1994). Politically-instigated conflicts in post-colonial Kenya have led to the establishment of many resettlement schemes across the country, as well as large infrastructural projects like the seven folks project, which lead to construction of large dams hydropower production, e.g., Masinga dam (ibid.).

Planned resettlement schemes are therefore not new in Kenya and they are faced by unique challenges as compared to normal rural dwellings (Cook, 1994). This is because the resettled households have to adapt to new environments they are not used to and their traditional livelihood strategies may not be sustainable. Therefore, due to the unique challenges the resettlement schemes face, it is important for policy makers and development agencies to understand the livelihood strategies chosen by immigrant households and what determines their choices as they reconstruct their livelihoods. This would enable them to come up with policies, programs and projects that make livelihood reconstruction easy for the immigrant households.

1.1.3 Solio Resettlement Scheme

The Kenya Government bought about 15,000 acres of land from the Solio ranch in 2008 and resettled 3,082 households in 2009 that had been internally displaced in Nyeri County. The immigrants were displaced following evictions from Mt Kenya and Aberdare forests in the late 1980s and mid-1990s, as well as the post-election violence of 2007/2008. The Government constructed dry weather roads, schools, a hospital and boreholes in the scheme and provided a tractor to the scheme so that the residents could use it to open up land for crop production. However, in 2013 much of the land remained fallow while most households were food-insecure and depended on relief food offered by the Government and other aid agencies (Zeeman et al., 2012). Due to the aridity of the resettlement scheme, poor rains had resulted in total crop failure in some seasons coupled with acute food shortages in many households while the water from boreholes was too saline to support any significant crop production (Kaguara et al., 2009 and Zeeman et al., 2012).

The availability of abundant pasture had led to increased livestock production particularly sheep, goats and cattle (Zeeman et al., 2012). Poultry was also kept as well. However, in spite of the huge potential that livestock have in the reduction of poverty and food insecurity, poverty levels are still high in the scheme (Mancinelli et al., 2012 and Zeeman et al., 2012). The level of food insecurity and malnutrition in the scheme had also been increasing since resettlement (Kaguara et al., 2009). These issues raise doubts on the capability of the farm sector to adequately support income and food supply in the scheme and therefore merit further systematic interrogation.

1.2 Problem Statement

Conflict-based resettlement schemes such as the Solio resettlement scheme are remarkably different from conventional rural agricultural households. This is because they are often faced by low resource endowment amidst heavy demand for services by the immigrants. In addition, residents of conflict-based resettlement schemes tend to adapt to their new environment fraught with underdeveloped physical infrastructure and poor provision of social amenities such as clean water, energy, schools and health facilities (Cernea, 1997; Cobo et al., 2009; Magaramombe, 2010). However, available literature on the determinants of livelihood diversification has focused on conventional rural agricultural households (Berhanu et al., 2007; Adi, 2007; Zerai and Gebreegziabher, 2011; Rahut and Scharf, 2012), while little attention has been paid on conflict-based resettlement schemes.

There is a dearth of knowledge on the livelihood strategies that resettled people engage in and how the social amenities affect the way they reconstruct their livelihoods. Further, little is known of what determines the number of livelihood strategies adopted by resettled households. This study addresses these gaps in knowledge. The study contributes to the growing literature on livelihood diversification in conflict-prone rural areas of SSA using Solio as a case study.

1.3 Purpose and Objectives

The purpose of this study was to evaluate the determinants of livelihood diversification strategies among immigrant households in the Solio resettlement scheme, Kenya. The specific objectives were to:

1. Identify and describe the livelihood strategies of resettled households in Solio resettlement scheme.

2. Assess the factors that influence the number of livelihood strategies adopted by immigrant households in Solio resettlement scheme.

1.4 Hypotheses

The following hypothesis was tested: that social, economic and biophysical factors taken singly do not influence the choice of the set of livelihood strategies adopted by immigrant households in Solio resettlement scheme. This means that:

i. The gender of the household head has no influence on the choice of the set of livelihood strategies adopted by immigrant households in Solio resettlement scheme.
ii. Possession of technical skills has no influence on the choice of the set of livelihood strategies adopted by immigrant households in Solio resettlement scheme.
iii. Time taken to a water source has no influence on the choice of the set of livelihood strategies adopted by immigrant households in Solio resettlement scheme.

1.5 Justification

The Kenya Government has been involved in the resettlement of persons internally displaced during 1992, 1997 and 2007/2008 post-election violence. This study sheds light on how resettled people in Solio resettlement scheme are reconstructing their livelihoods and how the social amenities around them are aiding in livelihood reconstruction, given the constraints that they face.

The current study also contributes to literature on livelihood diversification particularly focusing on conflict-based resettlement schemes. The information generated by this study will be useful to policy makers and interest groups in coming up with rural development programs; policies and strategies that promote livelihood diversification in order to minimize the suffering of internally displaced persons.

This study gives empirical evidence of the sets of livelihood strategies resettled households choose and the determinants of the sets chosen. Solio resettlement scheme is used as a case study of a government planned scheme composing of conflict-based internally displaced persons as well as forest evictees, hence giving a good understanding of determinants of livelihood diversification among resettled people. This is important for the government as it gives guidance on how best to plan resettlement schemes as this affects government spending in line with its policy to resettle all internally displaced households. It is also important to the government due to the possible resettlements that may come up in the future due to the large infrastructure projects envisioned in the Kenya vision 2030 like the LAPSET project.

Chapter 2: Literature Review

2.1 Livelihood Diversification Concept

A livelihood strategy is the combination of assets and activities to earn income and support the needs and wants of a household (Brown et al., 2006). It encompasses not only activities that generate income but also many other kinds of choices, including cultural and social, that come together to make up the primary occupation of a household (Ellis, 1998). Livelihood diversification has been defined in different ways in literature, depending on the field of interest. This study adopts the definition by Ellis (2000) that "rural livelihood diversification is a process by which rural households construct an increasingly diverse portfolio of activities and assets in order to survive and/or improve their standards of living" (p. 290). Ellis (2000) further notes that households diversify by adopting a range of farm, non-farm, and off-farm activities that generate income.

Barrett et al. (2001) divided the motives behind livelihood diversification into two. First is the push factors which include (i) reducing risk associated with one income source, (ii) response by the household to diminishing factor returns in any given use, e.g., family labour supply in the presence of land constraints driven by population pressure and land holding fragmentation, and (iii) reaction to a crisis or liquidity constraints in the household. From the push factors perspective, livelihood diversification is driven by limited risk-bearing capacity in the presence of incomplete or weak financial systems that create incentives to select a set of strategies in order to stabilize income flows (Barrett et al., 2001).

The second set of motivations for livelihood diversification is the pull factors (Barret et al., 2001). These include (i) realization of strategic complementarities between activities, e.g., crop-

livestock integration, (ii) specialization based on comparative advantage accorded by superior technology, and (iii) skills as well as other endowments. With regard to pull factors, income diversification opportunities are created by local engines of growth such as commercial agriculture or proximity to an urban area.

Livelihood diversification has also been referred to as "de-agrarianization", which means that rural households reduce their reliance on farm income but increase reliance on non-farm income sources (Bryceson, 1996). This is in response to structural transformation of African economies denoted by a decline in the share of agriculture in both GDP and the labor force and the convergence of agricultural factor incomes and productivity towards those of other sectors (Timmer, 2009 and Binswanger et al., 2010).

Several studies have shown that there has been an increase in rural livelihood diversification in SSA in the last twenty or so years due to effects of structural adjustment and economic liberalization policies of the late 1980s and early 1990s (Booth et al., 1993; Bryceson, 1996; 1999; 2000; Bryceson and Jamal, 1997). Ellis (2001), on the other hand, argues that there are few reliable longitudinal studies that would permit the inference that livelihoods are more diverse now in SSA than they were twenty years ago. The author had earlier remarked that it was difficult to substantiate the said increase in diversification due to lack of inter-temporal data sets in SSA (Ellis, 1998). Carswell (2002) agrees with Ellis (2001) by showing that diversification has historical and social contexts which are critical for a better understanding of livelihood change and the changing role and importance of diversification activities. Barrett et al. (2001), note that few people in SSA collect all their incomes from one source, which therefore makes livelihood diversification a norm.

Studies show that livelihood diversification is not only driven by constraints or "the unrelenting struggle for survival of the poor" but also by incentives to engage in other activities apart from agriculture that would bring higher incomes (Hart, 1994; Barrett et al., 2005). Therefore, livelihood diversification could be voluntary or involuntary where the motives for diversification are different across households with different stock of endowments (Adi, 2007). Due to the large number of heterogeneous and interacting factors that contribute in shaping households' livelihood diversification activities, disaggregated strategies in specific communities should be used to assess what determines the choice of livelihood diversification activities (Barrett et al., 2005).

2.2 Theoretical review

2.2.1 Theories on livelihood diversification

Several theories have been proposed to explain the concept of livelihood diversification. The theories try to explain why households diversify their livelihoods.

First is the Boserupian theory of population and economic development (Boserup, 1965) Boserupian theory challenged the Multhusian theory that predicted the extermination of humans due to population increase beyond the carrying capacity (ibid.). Multhus had proposed that an increase in human population over the land's carrying capacity would lead to the elimination of the excess population either by direct starvation or by other positive checks which can be traced back to the insufficiency of food supplies (ibid). The Boserupian theory countered this view by asserting that increase in human population would lead to the adoption of intensive systems of agriculture and an increase of total agricultural output through innovations such as use of fertilizers and mechanization (ibid.). Further, sustained growth of total population and total output in a given territory would have secondary effects which would set off a process of

economic growth, with rising output per man-hour, first in the non-agricultural activities and later in agriculture (ibid.). This would arise due to the transition to permanent settlements from nomadic settlements as a result of increased population density in rural areas (ibid). Additionally, an increase in human population and establishment of permanent settlements would lead to the development of non-agricultural activities as a result of emergence of a social framework within which professional artisans and traders would develop a more lasting and specialized activity (*ibid*.). Davies (1996) supports this theory and posits that as food stress due to population pressure on natural resources, increasing competition for natural resources, pressure on dry season grazing and increased dependence on markets sets in; livelihood diversification becomes a strategy to ensure survival.

Secondly the theory of structural transformation of economies argues that diversification of rural employment is part of a positive dynamic whereby economic growth entails a shift in employment from agriculture to industry and then to services (Timmer, 2009 and Binswanger et al., 2010). However, this theory has been challenged by some economists who argue that livelihood diversification is generally a form of adaptation that remains essentially negative (i.e. a change of livelihood to support a lower quality of life than was previously possible) (Bernstein et al., 1992). Therefore, the spread of non-agricultural employment in rural areas reflects the growing desperation of the rural poor for income generating opportunities, hence employment in the nonagricultural sector in the rural areas arises from the survival strategies of rural households unable to obtain employment or self-employment in agriculture. Thus livelihood diversification from agriculture is a last resort rather than an attractive alternative (ibid.).

Finally, some economists have argued that livelihood diversification is a survival strategy in the context of stress (Ghosh and Bharadwarg, 1992). The stress conditions could be population

pressure, drought, poorly performing agriculture among others which cannot enable the households to build sustainable livelihoods, hence the households diversify their livelihoods simply to survive rather than to improve livelihoods and invest in production (Jiggins, 1986; 1989; Davies, 1996). The households therefore pursue non-agricultural activities which represent a risk minimization strategy to achieve basic household subsistence needs (Hussein and Nelson, 1998). The current study follows this theory because the households in Solio resettlement scheme were under stress due to challenges of adapting to new environmental conditions which led to poor performance of agriculture, hence the need to diversify their livelihoods as a survival strategy (Kaguara et al. 2009).

2.2.2 Methods for Analyzing Choice of Livelihood Diversification Strategies

A number of empirical methods have been used in the past to examine household choice of alternative livelihood diversification strategies. They can be grouped into non-parametric and parametric approaches. Non-parametric statistical methods are a class of statistical procedures that do not rely on assumptions about the shape or form of the probability distribution from which the data were drawn (Rosner, 2000). This approach includes the following methods: (i) Wilcoxon rank-sum test, which compares means between two distinct/ independent groups; (ii) Wilcoxon signed-rank test, which compares two quantitative measurements taken from the same individual; (iii) Kruskal-Wallis test, which compares means among three or more distinct/ independent groups and (iv) Spearman's rank correlation, which estimates the degree of association between two quantitative variables (Conover, 1980).

Parametric methods, on the other hand, rely on assumptions about the shape of the distribution about the distribution based on the theory of central tendency (Walsh, 1962; Conover, 1980; Motulsky, 1995; and Rosner, 2000). Predominantly, the underlying population is assumed to

follow a normal distribution (Rosner, 2000). The main parametric methods are: (i) two sample t-test, which compares the means between two distinct/ independent groups, (ii) Paired t-test, which compares two quantitative measurements taken from the same individual, (iii) Analysis of variance (ANOVA), which compares means among three or more distinct/ independent groups, (iv) Pearson coefficient of correlation, which estimates the degree of association between two quantitative variables, and (v) Regression analysis, which estimates the quantitative effects of the causal variables that they influence (Walsh, 1962).

The current study used the parametric approach because although non-parametric tests have the desirable property of making few or no assumptions about the distribution of measurements in the population from which the sample was drawn, they have two main drawbacks. First, they are generally less statistically powerful than parametric procedures when the data are approximately normal (Walsh, 1962; Conover, 1980; Motulsky, 1995; and Rosner, 2000). This means that there is a smaller probability that the procedure will show the association between any two variables when they in fact truly are associated. One therefore requires a slightly larger sample to have the same power as the corresponding parametric test (Motulsky, 1995; and Rosner, 2000). Secondly, the results of non-parametric tests are often more difficult to interpret than those of parametric tests (Walsh, 1962 and Rosner, 2000). Many non-parametric tests use rankings of the values in the data rather than the actual data (Walsh, 1962; Conover, 1980; Motulsky, 1995; and Rosner, 2000).

Several econometric models have been used in literature to examine households' livelihood diversification behavior, depending on the variable of interest. They include probit, Heckman 2-stage, Tobit and multinomial logit (MNL) models.

The probit model is a binary model used when the dependent variable takes two values only. The purpose of the model is to estimate the probability that an observation with particular characteristics falls into one of the categories e.g. participant or non-participant in livelihood diversification (Greene, 2003). On the other hand Heckman 2-stage model is a two-step statistical approach which corrects for selection bias when carrying out statistical analyses based on non-randomly selected samples to avoid giving erroneous conclusions and hence poor policy recommendations (Heckman, 1979). The Tobit Model is used to describe the relationship between a non-negative dependent variable and independent variables (Tobin, 1958). Multinomial logistic regression is a classification method that generalizes logistic regression to multiclass problem i.e. with more than two possible discrete outcomes (Greene, 2003). In order to achieve the objectives of the current study a count data model was required because the dependent variable was the number of livelihood activities the household had. The Poisson regression model was therefore found to be appropriate because it is a count data model that assumes that the dependent variable is a count and hence it explains the independent variables that determine the count (Greene, 2003).

2.3 Empirical review

Zerai and Gebreeziabher (2011) examined the effect of nonfarm employment and household food security in Eastern Tigray, Ethiopia; using the probit and Heckman selection models. The objective of the study was to investigate the link between food security and nonfarm employment. The study found that family size, special skill, access to credit and village electrification positively influenced a household's participation in the nonfarm sector, while age of the household head, land size, distance to the nearest town and availability of irrigation negatively influenced participation in the nonfarm sector. Further, the study found that

participating in the rural nonfarm sector improved a household's food security. The study under review explains the factors that influence a household to participate in the rural nonfarm sector, hence having diversified livelihoods. It therefore focuses on the rural non-farm sector leaving out the farm sector. The Probit model gives the factors that determine a household to participate in the rural nonfarm sector but it fails to explain the factors that determine a household to participate in a given number of livelihood strategies. It does this through treating diversification as a binary variable, and therefore cannot explain the factors that determine the household's choice of a set of livelihood strategies to participate in. Hence, the probit model was not appropriate for the current study.

Karugia et al. (2006) evaluated the determinants of off-farm income in western Kenya using a censored Tobit model so as to correct for selectivity bias due to exclusion of households with no off-farm activities. The objective of the study was to assess the determinants of household per-capita income and determinants of off-farm earnings. The study found that education and age of the household head positively influenced the amount of off-farm earnings. Education was important in accessing off-farm opportunities while age of the household head positively influenced the amount of off-farm earnings perhaps reflecting the influence of assets accumulated over time on current incomes. The study under review focused on off-farm income to determine the factors influencing livelihood diversification. The current study focused on the set of livelihood strategies adopted by a household, and therefore there is a preponderance of small values in the dependent variable, which Tobit may not be the best model to use. Therefore, Tobit model was found to be inappropriate for the current study since it did not meets its objectives.

Woldenhanna and Oskam (2001) used both Tobit and MNL to analyze off-farm labour supply and farm households' choices between off-farm activities respectively, in the Tigray region of northern Ethiopia. The objective of the study was to assess the factors that determine the hours a household spent on off-farm activities and examine the determinants of a farm household's choice between off-farm activities. The study found that the age of the household head, farm output, off-farm equipment, family size and number of dependents influenced the number of hours a household spent on off-farm activities. Moreover, the study found that wage rate, age of the household head, farm output, livestock wealth, non-labour income, value of equipment for off-farm work, family size, number of dependents and area of land cultivated were the main factors that influenced the choice of off-farm activities. The study under review examined the determinants of a household's choice of off-farm activities. It therefore sheds light on the factors that influence a household to choose a given livelihood strategy but fails to explain the factors that influence a household to adopt a given number of livelihood strategies which the current study focused on.

Rahut and Scharf (2012) used MNL to assess the livelihood diversification strategies in the Himalayas. The objective of the study was to assess the determinants of rural households' livelihood diversification behavior in the Himalayas. They found that poor rural dwellers were mainly agricultural laborers and worked in the low return farm sector while the better-off diversified in high return non-farm activities. Moreover, the study found that education plays an important role in households' access to more remunerative non-farm employment. Larger household size was associated with a higher probability of diversification into the high return non-farm sector. Farm size did not constraint the decision to diversify into lucrative non-farm employment. Geographical location played a major role in diversification behavior of rural

households, indicating the importance of local context. The study under review assessed the determinants of choice of different livelihood strategies by rural households given the constraints they faced. The households were clustered in terms of livelihood strategies and an assumption made that if a household was in a given category it would not participate in a livelihood strategy in another category. The study was carried out in Asia among conventional rural households while the current study was in SSA among resettled households, where the household was observed in terms of a multiple choice of livelihood strategies it adopted. However, the study was useful for the current study as it gave ideas of possible variables that influence a household to choose a given set of livelihood activities.

Although the MNL is popular in livelihood diversification studies, it fails to explain the factors that lead a household to choose a given number of livelihood strategies by clustering households into livelihood strategies categories. It also assumes that if a household has been clustered in a given category of livelihood strategies it does not participate in a strategy that is in another category. Frequently, households choose a set of livelihood strategies to engage in given the set of capabilities and constraints that they are faced with. The question of what determines household choice of alternative sets of livelihood diversification strategies is better captured by a model that relaxes the above assumption.

The model of choice for analysis of count data which relaxes the assumption above is Poisson regression model (PRM) (Winkelmann and Zimmermann, 1995; Greene, 2008). The PRM recognizes that a household/decision maker can adopt one or more livelihood strategies as a set. It therefore overcomes the assumption of MNL by counting all the livelihood strategies a household is involved in.

PRM has been used in studies where the decision maker was faced by several alternatives taken in sets. For instance, Ramirez and Schultz (2000) used PRM to evaluate the factors influencing the adoption of agricultural and natural resource management technologies by small farmers in Central America. The objective was to evaluate the factors that determine the number of environmental conservation technologies adopted by farmers. They found that participation in community organizations/ farmer activities, access to credit, hired/family labor available, education, farm size and type of cropping system were important determinants of adoption. In the study under review, the farmers were faced with a number of alternatives that they could adopt in non-negative sets, which is similar with the current study where the households were faced with alternative livelihood strategies that they could adopt in non-negative sets. The similarity with the current study is that in the study under review the households were choosing natural resource management strategies while in the current study the households were choosing the livelihood strategies to participate in where in both studies a decision maker made his/her choices in sets. Therefore, the current study adopted the same model.

Okello and Swinton (2011) used PRM to assess the effect of monitoring farmers for International Food Safety Standards (IFSS) on the use of alternative pest and disease management strategies in Kenya. The objective of the study was to evaluate the effects of IFSS compliance on the Kenyan green bean industry. The study found that monitoring farmers for compliance with IFSS increased the expected number of alternative pest and disease management practices used by a farmer. Age of the farmer, education, experience, and distance to clinic, extension and possession of a radio increased the expected number of alternative pest and disease management practices used by a farmer. Cigarette smoking reduced the expected number of alternative pest and disease management practices used by a farmer. The study concluded that compliance with

IFSS brought health and environmental benefits in addition to increased access to high value overseas markets. The similarity between Okello and Swinton's study and the current one is that the households were choosing alternative pest and disease management practices while in the current study the households were choosing the livelihood strategies to participate in. Therefore, the current study adopted the same model.

2.4 Summary

Most studies on livelihood diversification using the parametric approach use the multinomial logit (MNL) mainly due to the presence of a polytonomous response variable. The main objective of using MNL in this regard is to explain the factors that determine the probability of a household engaging in alternative livelihood options. However, the assumption that is put by MNL through clustering livelihood strategies and assuming that a household only adopts strategies in a given category, may not be true in practice. Hence, there was need to use a model that relaxes this assumption and observes a household given all the strategies it adopts. Therefore, the current study adopted the PRM model since it overcomes the above assumption by treating all the livelihood strategies a household is involved in as count data.

Chapter 3: Methodology

3.1 Theoretical Framework

One of the underlying motivations for household choice of alternative livelihood strategies is to maximize utility from expected earnings from a particular strategy (Dearcon and Krishnan, 1996). Thus, household choice of which livelihood strategy to engage in can be analyzed within the random utility framework. The random utility model (RUM) postulates that household's livelihood choice is geared towards maximizing its utility. The utility derived from the livelihood strategy chosen by the ith household, can be expressed as a linear sum of two components: (i) a deterministic part, V_{ia}, that captures the observable components of the utility function, and (ii) a random error term that captures unobservable components of the function including measurement errors:

$$U_{ia} = V_{ia} + \varepsilon_{ia} \qquad (3.1)$$

where V_{ia} is the deterministic part, ε_{ia} is the stochastic error term (Thurstone, 1927). Equation (3.1) implies that U_{ia} is the utility for alternative ***a*** for individual *i*, V_{ia} is the explained/systematic component and ε_{ia} is a random term. The choice process is formulated in terms of probability that a given alternative livelihood set is chosen. Thus; the probability that the utility of a given choice "**a**" is higher than the maximum utility of another alternative "**i**" is given by:

$$P(a) = P\lfloor U_{ai} > MaxU_{ji} \rfloor = P\lfloor V_{ai} + \varepsilon_i > MaxV_{ji} + \varepsilon_j \rfloor \forall j \neq a \qquad (3.2)$$

The systematic component of the utility function is assumed to be linear in parameter combination (X_i) of characteristics of the decision maker (S_i), the attributes of the alternative ***a*** as perceived by individual i (Z_{ia}):

$$V_{ia} = h(S_i, Z_{ia}) = \beta' X_{ia} + \varepsilon_{ia} \quad (3.3)$$

where β are coefficients which are unknown parameters to be estimated and X_{ia} which are measured characteristics of the chooser and the choice which are assumed to remain constant across the chosen alternatives. The error term ε_{ia} is assumed to be identically and independently distributed across the alternatives.

The model of choice for determining the probability that the i^{th} household chooses alternative livelihood strategy set ***a***, is the multinomial logit (MNL) if the sets are not ordered (Judge et al., 1985). However, for one to use MNL, the households have to be clustered into different categories and an assumption made that households in a given category participate in some given livelihood strategies and hence cannot participate in strategies that are chosen by households in another category (Woldenhanna and Oskam, 2001; Brown et al., 2006; Berhanu et al., 2007 and Rahut and Scharf, 2012). In practice however, households choose a set of livelihood strategies to engage in given the set of capabilities and constraints they face. Therefore, it does not mean that households that engage in high remunerative strategies that have entry barriers like business are restricted from participating in activities that have low entry barriers such as crop farming. Thus, the restriction imposed by clustering households into given categories may not necessarily be true in practice. This study used the Poisson regression model (PRM) because it relaxes the assumption that some households cannot participate in some livelihood strategies by treating the number of livelihood strategies a household is involved in as a set. The idea was to assess the factors that influence a household to choose the actual number of livelihood activities hence relaxing the assumption that a household is restricted from participating in some activities which is not the case in practice. These choices constitute count data the analysis of which is better handled by the PRM.

The main weakness of PRM is that it does not recognize that having the same count of livelihood strategies does not mean that the households are at the same welfare level. A count data model was appropriate for this study because its focus was on the determinants of choice of the set of livelihood strategies by a household and not the difference in welfare as other studies have done (see Woldenhanna and Oskam, 2001; Brown et al., 2006; Berhanu et al., 2007 and Rahut and Scharf, 2012).

3.2 Poisson Regression Model (PRM)

PRM assumes that the dependent variable, y_i, given the vector of explanatory variables, X_i, has a Poisson distribution. PRM specification accounts for the preponderance of small values of the dependent variable of discrete nature. Hence, it is an improvement on least squares and the linear models (Greene, 2003).The probability density function of y_i given X_i is completely determined by the conditional mean, i.e.:

$$\lambda(x) = E(y_i \mid x_i) \tag{3.4}$$

$$\Pr ob(Y_i = y_i \mid x_i) = \frac{e^{-\lambda}\lambda_i^{y_i}}{y_i!}, y_i = 0,1,2,...,n. \tag{3.5}$$

According to Greene (2003), the most common formulation of λ_i is the log linear model:

$$\ln \lambda_i = x_i'\beta \tag{3.6}$$

The model specifies that each observation, y_i, is drawn from a Poisson distribution with parameter λ_i which is related to a vector of explanatory variables, X_i (Greene, 2008). Because the PRM is derived from the Poisson distribution, it introduces parameters into the relationship between the mean parameter, λ_i, and explanatory variables, X_i. According to Greene (2008), the

expected number of events y_i (in this study representing the number of livelihood strategies a household was engaged in) is given as:

$$E[y_i \mid x_i] = Var[y_i \mid x_i] = \lambda_i = e^{x'\beta} \quad (3.7)$$

Therefore,

$$\frac{\partial E[y_i \mid x_i]}{\partial x_i} = \lambda_i \beta \quad (3.8)$$

The main features of the PRM are the log-linear conditional mean function $E(y_i|x_i) = \lambda_i$ and its equi-dispersion $Var(y_i|x_i) = \lambda_i$ assumptions (Greene, 2008). The log-linear regression model accounts for the non-negative restriction imposed by Poisson on the dependent variable (Winkelmann and Zimmermann, 1995). This means that PRM assumes that the dependent variable has to be non-negative, which is the case with livelihood strategies since the study assumed that a household was involved in at least one livelihood strategy.

The merits of PRM as outlined by Winkelmann and Zimmermann (1995) are: (i) it takes into account the non-negative and discrete nature of the data, (ii) the assumption of the equality of the variance and conditional mean accounts for the inherent heteroscedasticity and skewed distribution of non-negative data, and (iii) the log-linear model allows for the treatment of zeros.

3.2.1 Model Specification

To achieve the second objective and therefore test the hypothesis that socio-economic and biophysical factors taken singly do not influence the set of livelihood strategies adopted by immigrant households in Solio settlement scheme, the i^{th} household was assumed to engage in y_i

livelihood strategies, where y_i is non-negative and Poisson distributed. The following model was fitted into the data:

$$y_i = \beta_0 + \beta_1 AGE + \beta_2 GENDER + \beta_3 EDUCATION + \beta_4 DEPENDANTS + \beta_5 WEALTH + \beta_6 SKILLS + \beta_7 DTOWN + \beta_8 DWATER + \beta_9 MEMBERSHIP \quad (3.9)$$

where y_i is the number of livelihood strategies a household was involved in. The explanatory variables, how they were measured and the expected signs are summarized in Table 3.1 below.

Table 3.1: Description of explanatory variables in equation 3.9 and their hypothesized signs

Variable	Meaning	Type	Measurement	Expected sign
AGE	Age of the household head	Continuous	Years	-
GENDER	Gender of the household head	Dummy	1=Male 0=Female	+
EDUCATION	Education of the household head	Continuous	Years of formal education	+
DEPENDANTS	Number of dependants	Continuous	Number of dependents	+/-
WEALTH	Household wealth status	Categorical	Wealth index	+
SKILLS	Household head possesses a skill	Dummy	1= possesses 0= otherwise	+
DTOWN	Distance to the nearest town	Continuous	Kms	+/-
DWATER	Time taken to a water source	Continuous	Walking minutes	-
MEMBERSHIP	Membership to a group	Dummy	1= Member 0= otherwise	+

Source: Author

3.2.2 Justification for inclusion of explanatory variables

AGE: The age of the household head in years was used because livelihood decisions are mostly taken by the household head in rural areas (Khatun and Roy, 2012). This study hypothesized that the younger the household head the higher the number of livelihood strategies the household would engage in, because supply of labour for off-farm activities is higher for younger household heads than for older household heads (Woldenhanna and Oskam, 2001). A negative relationship would therefore exist between age and the number of livelihood strategies the household engages in. Household age squared was used to assess whether the hypothesized effect of age would change as age increased and the study hypothesized that a negative relationship would exist because as the household head age increases the number of livelihood activities would decrease.

GENDER: This was a dummy variable where 1=male-headed households and 0= female-headed households. Being male was hypothesized to have a positive relationship with the number of livelihood strategies the household would adopt. In SSA, either traditionally or legally women have low property rights especially to land (Deere and Doss, 2006). This gives male-headed households a comparative advantage in participating in more remunerative strategies that require high investment, because they can overcome some entry barriers which female-headed households may not. In this regard, male-headed households were hypothesized to be involved in a higher number of livelihood strategies due to the positive correlation between wealth and livelihood diversification in literature.

EDUCATION: The number of years of formal education of the household head was used. It was hypothesized that the higher the number of years of education the higher the number of livelihood strategies the household head would engage in; hence a positive relationship would

exist. Higher levels of education contributes to the growth of the rural non-farm sector, through stimulating entrepreneurial capacity and making it easier to master skills provided through on-the-job training (Islam,1997). This makes it easier for more educated people to get non-farm employment.

DEPENDANTS: This was a continuous variable showing the number of dependants the household had. The study defined dependants as children under the age of 18 years old as well as older children who were students and depended on the household head for their upkeep at the time of the survey. In the same category were the very old members of the household as well as household members with disability and therefore could not be involved in any livelihood activity.

Dependants in the household might increase resource needs and drive the pursuit of extra income from off-farm work (Demeke and Zeller, 2012). Alternatively, having more dependants than active productive members in the household reduces participation in the off-farm sector as there are fewer laborers to allocate to additional jobs (Ibid). Therefore, the study hypothesized that the number of dependants would affect the number of livelihood strategies chosen by the household either positively or negatively.

WEALTH: A household wealth index was used which was derived using Principal Component analysis (PCA). PCA aggregates several binary asset ownership variables into a single dimension (Moser and Felton, 2007). The underlying principle of this method is that each asset has a latent (unobservable) variable C^i for each type of capital C^i which manifests itself for owning different types of asset $a^i....a^k$ in each household. For example, suppose a household t owns assets $a_{i,1}$ if $_i \sim _i C > w$. It turns out that the maximum likelihood estimators of the w's (weights) are the Eigen

vectors of the covariance matrix which are also known as the principal components of the data set (Moser and Felton, 2007).

The data subjected to PCA were of binary nature where 1 represented that a household owned an asset while 0 otherwise. The Eigen values generated by the PCA were used as weights for the asset ownership by the household (Moser and Felton, 2007). The principal components were multiplied by the number of a given asset (household and productive assets) owned by a household as follows:

$$HHWI^t = \sum_{i=1}^{n} w_i^t a_i^t \tag{3.10}$$

where w_i is the PCA weight of asset *i* owned by household *t* while a_i is the number of asset *i* owned by household *t*. $HHWI^t$ is the household wealth index for household t interviewed. A positive relationship was hypothesized to exist between household wealth index and the number of livelihood strategies adopted by a household. This is because participation in non-farm activities is typically positively correlated with wealth in rural Africa, because the poor face entry barriers to remunerative livelihoods in the non-farm sector resulting from inadequate or differential access to markets, due to low levels of physical and financial assets (Ellis, 2000; Barrett et al., 2001 and Khatun and Roy, 2012). Individuals own assets some of which (non-productive assets such as household valuables) generate unearned income and others in which (productive assets such as livestock, motorbike, sewing machine, welding machine, and donkey cart) generate income only indirectly through their allocation to activities such as tailoring, farming or commerce.

Diversifying into non-farm activities is made even more difficult for the poor than for rich farm households in the presence of entry barriers and rationing in the labour market (Reardon, 1997). This is due to liquidity constraints that make it difficult for poor farm households to finance investment (such as equipment purchase or rent, skill acquisition, capital for initial investment and a license fee) needed to participate in off-farm activities (Woldenhanna and Oskam, 2001). Household wealth can therefore affect the type of non-farm activities a household adopts (Reardon and Taylor, 1996).

SKILLS: This was a dummy where 1= household head who possesses a technical skill and 0= otherwise. The main technical skills were carpentry, masonry, mechanics, tailoring, cobbler, plumbing, driving, welding, weaving, painting, tinsmith, hair dressing and blacksmith. According to Khatun and Roy (2012), possession of a technical skill increases the possibility of a rural dweller getting a non-farm job and therefore diversifying their livelihood. Hence, this study hypothesized a positive relationship between possession of a technical skill by the household head and the number of livelihood strategies adopted by the household.

Distance to the nearest town: The distance to the nearest town in kilometers was used. Geographical variables are important determinants of livelihood diversification, because wage employment is more available in areas nearer towns (Woldenhanna and Oskam, 2001; Khatun and Roy, 2012). On the other hand, in areas far from urban centers, farm households can be engaged in petty trade, as competition from urban traders is very low (Woldenhanna and Oskam, 2001). This study therefore hypothesized an indeterminate relationship between distance to the nearest town and the number of livelihood strategies adopted by a household.

Time taken to a water source: This was measured in minutes an adult in normal conditions would take to walk to a water source. Water supply is a key constraint to households in Solio resettlement scheme, which does not have any surface water and depends on water from boreholes. Khatun and Roy (2012) note that basic infrastructure like water supply has an important role in the development of a region, because the time spent fetching water determines the time available for productive purposes. This study hypothesized a negative relationship between time taken to the water source and the number of livelihood strategies adopted by a household, because households that take lesser time to get to the water source would have more time for productive activities and therefore are likely to engage in more livelihood strategies as compared to those that take more time to walk to the water source.

Membership to a group: This was coded as a dummy where one denoted that a household head was a member of a group and zero otherwise. In a rural setting, there are several types of groups that a household head can choose to join. The groups of interest in this study were those related to livelihood strategies which were: marketing the produce e.g. milk, facilitated input access, saving and credit and asset purchasing groups. Membership to a group is important in determining livelihood diversification, because it elevates the household head's social status and increases access to common property resources as well as different government/NGO schemes (Khatun and Roy, 2012). This could give such a household comparative advantage in participating in the rural nonfarm sector. It was therefore hypothesized that group membership by the household head would positively influence the number of livelihood strategies adopted by the household.

3.2.2.1 Limitations of Poisson Regression Model (PRM)

PRM imposes a restriction on the conditional moments on the dependent variable. Thus, in most cases its application is limited given that the observed data mostly display over-dispersion (Wooldridge, 2002; Greene, 2008). Over-dispersion is defined as the excess variation when the systematic structure of the model is correct (Berk and MacDonald, 2007). Over-dispersion leads to larger variance of coefficient estimates than anticipated in the data, under the Poisson regression. This results in inefficient and potentially biased parameter estimates as well as spuriously small standard errors (Winkelmann and Zimmermann, 1995; Wooldridge, 2002; Xiang and Lee, 2005).

There are two assumptions of the PRM that give rise to over-dispersion (Winkelmann and Zimmermann, 1995). The first is that the Poisson model process is a deterministic function of the predictor variable and it does not allow for the unobserved heterogeneity. Secondly events constituting each count are independent and occur randomly over time. This assumption ignores the fact that present occurrences can influence the probability of future occurrences (Berk and MacDonald, 2007). For example, if the households have tried a number of strategies in the past and they have seen some given set of strategies enable them meet their needs and wants better, this may influence their decisions on the set of strategies to choose in future.

Violating the two assumptions above may also lead to under-dispersion, where the variance is less than the conditional mean. Under-dispersion occurs if the events constituting the counts are negatively related (Berk and MacDonald, 2007). The consequences of under-dispersion are the same as those of over-dispersion. To control for over- or under-dispersion the negative binomial variant of the Poisson regression model is used (Wooldridge, 2002; Famoye et al., 2004; Greene, 2008).

Cameron and Trivedi (1999), identify the following as possible causes of over-dispersion in practical application of PRM: (i) unobserved heterogeneity: counts are viewed as being generated by a Poisson process, but the researcher is unable to correctly specify the rate parameter of this process; (ii) over-dispersion (and in some cases under-dispersion) may occur because the process generating the first event may differ from that determining later events. For example, a household may have adopted a given set of livelihood strategies since it was the only thing the household could do given the constraints in Solio when they were resettled. However, the set of livelihood strategies, gave the household high returns (high utility), hence the household chose to continue engaging in the same set of livelihood strategies, and (iii) over-dispersion may be due to failure of the assumption of independence of events which is implicit in the Poisson process. For example, participating in a given livelihood strategy makes participating in another more likely. That is, if a household is rearing livestock, it is likely to also produce crops because some crop residue is used as fodder for the livestock, while manure from the livestock is used for crop production. Produce from the farm (crops, livestock and livestock products) may lead to the household participating in some petty trade.

3.2.2.2 Statistical Test for Over-Dispersion and Under-Dispersion

Assumptions of equality of the mean and variance imposed by Poisson regression are rarely met in practice. While still consistent, the estimates of the PRM are inefficient and biased and may lead to misleading inferences if under- or over-dispersion is present (Winkelmann and Zimmermann, 1995; Famoye et al., 2004). It is therefore important to test for over- or under-dispersion. The score test is commonly used to test for over-dispersion, where deviance and Pearson chi-square divided by the degrees of freedom are used to detect over-dispersion or under-dispersion. The Pearson chi-square ratio can also be used to assess the appropriateness of

the PRM for analyses (Trentacoste, 2000). A Pearson chi-square ratio of between 0.8 and 1.2 indicates that the model can be assumed to be appropriate in modeling the data.

$$\frac{Deviance}{Df} = \text{Deviance Ratio} \tag{3.11}$$

$$\frac{Pearson\ chi-square}{Df} = \text{PearsonChi - square Ratio} \tag{3.12}$$

The decision rule is that ratios greater than unity indicate over-dispersion whereas if less than unity, the ratios indicate under-dispersion, i.e.

$$\frac{Deviance}{Df} > 1 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\text{over-dispersion} \tag{3.13}$$

$$\frac{pearson\ \text{chi - square}}{Df} > 1 \ldots\ldots\ldots\ldots\ldots\ldots\text{over-dispersion} \tag{3.14}$$

$$\frac{Deviance}{Df} < 1 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\text{under-dispersion} \tag{3.15}$$

$$\frac{pearson\ \text{chi - square}}{Df} < 1 \ldots\ldots\ldots\ldots\ldots\ldots\text{ under-dispersion} \tag{3.16}$$

In this study, the chi-square deviance ratio was 0.18241, while the Pearson chi-square ratio was 0.19037, which were less than unity, indicating that the variance was less than the conditional mean indicating the data had under-dispersion given that it was less than unity (Trentacoste, 2000). This meant that even though the estimates were still consistent, they were inefficient and biased and could lead to misleading inferences (Winkelmann and Zimmermann, 1995; Famoye et al., 2004).To correct for this anomaly a negative binomial regression was employed.

3.2.3 Negative Binomial Regression Model (NBRM)

The assumed equality of the conditional mean and variance functions is typically the major shortcoming of PRM. Many alternatives have been suggested in literature but the most common is the negative binomial regression model (NBRM), which arises from a natural formulation of cross-section heterogeneity (Greene, 2003). The NBRM is employed as a functional form that relates the equi-dispersion restriction of PRM. A latent heterogeneity is introduced in the conditional mean of the PRM. Following Greene (2007), the expected number of livelihood strategies can be presented as:

$$E(y_i \mid x_i \varepsilon_i) = \exp(\alpha + X'\beta + \varepsilon_i) = h_i \lambda_i \qquad (3.17)$$

where $h_i = \exp(\varepsilon_i)$ is assumed to have a one parameter gamma distribution $G(\theta,\theta)$ with a mean of one and a variance of $1/\theta = K$;

$$f(h_i) = \frac{\theta^{\theta} \exp(-\theta h_i)\, h_i^{\theta-1}}{\Gamma(\theta)}, h_i \geq 0, \theta > 0 \qquad (3.18)$$

After h_i is integrated out of the joint distribution, the marginal negative binomial distribution is obtained;

$$Prob[Y = y_i \mid x_i] = \frac{\Gamma(\theta + y_i)\, r_i^{\theta}\, (1-r_i)^{y_i}}{\Gamma(1+y_i)\,\Gamma(\theta)}, y_i = 0,1,\ldots\ldots, \theta > 0, r_i = \theta/(\theta+\lambda_i) \qquad (3.19)$$

The latent heterogeneity induces over-dispersion while pressing the conditional mean;

$$E[y_i \mid x_i] = \lambda_i, \qquad (3.20)$$

$$Var[y_i \mid x_i] = \lambda_i[1 + (1/\theta)\lambda_i] = \lambda_i[1 + k\lambda_i] \qquad (3.21)$$

where $k = Var[h_i]$.

The equi-dispersion restriction is relaxed by the functional form of the NBRM (Greene, 2008). The NBRM takes care of any model misspecification (Berk and MacDonald, 2007). The inherent unobserved latent heterogeneity is accounted for by the introduction of a gamma-distributed stochastic term in the conditional mean of the Poisson regression (Greene, 2008). The empirical model specified in equation 3.9 was estimated using maximum likelihood technique.

3.3 Research Design

3.3.1 Data Needs

This study used primary data collected using two methods. For the first objective, a focus group discussion (FGD) (see the FGD guide in Annex 1) was held so as to identify and fully describe the livelihood strategies available to the households in the entire resettlement scheme. The FGD also aimed at getting the background information of the residents, in terms of where they came from and the livelihood activities they carry out. The FGD involved sixteen people, a man and a woman from each of the seven villages to represent the resettled households, the scheme chairman to represent the local leadership and one assistant chief to represent the provincial administration. For the second objective, a household survey was undertaken using a pretested semi-structured questionnaire (see Annex 2). The questionnaire collected data on socio-economic and demographic characteristics of the households, livelihood strategies a household engaged in, distance from social amenities and utilities as well as the income of the households. The questionnaire was pretested and adjustments made prior to the actual survey.

3.3.2 Sample Size Determination

In determining the sample size, the following formula was used (Cochran, 1977):

$$n_0 = \frac{z^2 pq}{d^2} \qquad (3.22)$$

where $\mathbf{n_0}$ is the sample size, $\mathbf{Z^2}$ is the abscissa of the normal curve that cuts off an area of the tails (1-equals the desired confidence level, e.g., 95%), **d** is the desired level of precision, **p** is the estimated proportion of an attribute that is present in the population, and **q** is **1-p**. The value of **Z** is found in statistical tables which contain the area under the normal curve.

To compute the sample size, the study assumed that **p**= 0.85 because there were some households that were allocated parcels in 2009, but settled in them later on, which according to the participants of the FGD, was about 15% while the study was interested in the households that settled in 2009. A 95% confidence level was also assumed with ±5% precision. Based on these assumptions, the sample size was calculated as:

$$n_0 = \frac{z^2 pq}{d^2} = \frac{(1.96)^2 (0.85)(0.15)}{(0.05)^2} = 195.92 \text{ households}$$

Therefore, the study settled for a sample of 210 respondents; however 14 questionnaires were discarded because they were incomplete, leaving 196 valid ones.

3.3.3 Sample selection

Respondents were selected based on proportionate to size sampling with larger villages having more respondents. Accordingly, the selected households from the seven villages in Solio resettlement scheme are presented in table below.

Table 3.2: Sampling in Solio resettlement scheme

Village	Total Number of households	Sampled households
Furaha	450	30
Rehema	623	43
Bahati	554	37
Tetu	465	32
Mathingira	190	15
Mukandamia	410	27
Baraka	390	26
Total	**3,082**	**210**

Source: Author

In order to identify the specific respondents, lists of all households was generated with the assistance of the village elders, hence used as the sampling frame for the respective villages. Respondents were selected using systematic random sampling from these lists, where the household head was interviewed or the spouse in his absence in June 2013. The interviews were conducted by trained enumerators in kikuyu and kiswahili because majority of the respondents were kikuyu speakers and all the enumerators were kikuyu speakers. It took 30 minutes to fill in a questionnaire.

3.3.4 Data Capture and Analysis

The data collected using semi-structured questionnaires were captured in SPSS. Descriptive statistics were computed using SPSS software. The results were presented in tables and charts. The data collected through the FGD were triangulated with those collected through the questionnaires so as to effectively characterize the livelihood strategies available to the households. For the second objective, a negative binomial regression model was estimated in STATA.

3.4 Study Area

This study was carried out in Solio resettlement scheme in Laikipia County of Kenya. The scheme was established by the government of Kenya in 2009; and divided into seven villages. Village 4 in the map below is at the centre of the scheme. It is currently divided into two locations (Bahati and Mathingira), where each location is composed of three sub-locations. Each location has a chief and three assistant chiefs. The nearest towns to the scheme are Naro Moru to the north east and Mweiga to the south west of the scheme. Each household owned 1.82ha of land where 0.2ha is the residential area in the villages, and 1.6ha constitutes the main field. The government built one hospital in the scheme and a borehole in each village.

The scheme is situated in a semi-arid area between Mt Kenya and the Aberdares ranges; in the rain shadow of Mt Kenya, with an annual rainfall of between 550-900mm. It experiences strong dry winds and at times frost in the morning as well as prolonged droughts (Mancinelli et al., 2012).

The major livelihood activity in the area is mixed farming since the area experiences erratic bimodal rainfall with the long rains falling from late March to June and short rains between

October and December. The resettlement scheme is within a grass savannah with few scattered trees (Ibid).

Figure 3.1: Map of the study area

Source: Mancinelli et al. (2012)

Solio resettlement scheme was purposively selected for this study because it was the first resettlement scheme in Kenya to be established after the 2007/2008 post-election violence. The residents comprised of three categories of internally displaced people: (a) people displaced due to post-election conflicts, (b) people who were evicted from the Aberdares and Mt Kenya forest in the late 1980's and early 1990's, who had been squatters on the roadsides near the two forests,

(c) people who were squatters in Nyeri town. The resettlement scheme was seen appropriate for this study because the households had already established livelihoods and the fact that it was not too old to have attained the qualities of a typical rural setting.

3.5 Diagnostic Tests for the NBRM

3.5.1 Testing For Multicollinearity

Multicollinearity exists when there is a perfect or exact linear relationship among some or all explanatory variables as well as in the presence of an inter-correlation among the explanatory variables (Gujarati, 2004). Pair-wise correlation analysis among regressors (in Annex 3) revealed absence of multicollinearity since the highest correlation was 0.58 (p=0.000). Multicollinearity is a serious problem if pair-wise correlation among regressors is in excess of 0.8 (Gujarati, 2004). Further analysis was undertaken using the variance inflation factor (VIF). As a rule, if the VIF of a variable exceeds 10, that variable is said to be highly collinear (Greene, 2003). In this study the highest VIF was 1.83 while mean VIF was 1.26 (see Annex 4).

3.5.2 Testing for Heteroscedasticity

Heteroscedasticity is a situation where the variance of the dependent variable varies across the data (Gujarati, 2004). It was tested using the Breusch-Pagan/Cook-Weisberg test. It tests the null hypothesis that the error variances are all equal versus the alternative that the error variances are a multiplicative function of one or more variables. A large chi-square that is statistically significant indicates that heteroscedasticity is a problem (Parlow, 2009). As shown in Annex 5, heteroscedasticity was not a problem in the data since the results were all insignificant with a chi-square of 0.79 (Prob>chi-square=0.3744).

3.5.3 Testing For the Goodness-of-Fit

The goodness-of-fit is tested by both the deviance and the Pearson statistics. Statistically significant tests imply that the model is inappropriate (StataCorp, 2009). In this study the model fitted the data well because the deviance statistic was insignificant. This was confirmed by the statistically insignificant Pearson statistic (see Annex 6).

Chapter 4: Results and Discussion

4.1 Socio-Economic and Demographic Characteristics

4.1.1 Farmer socio-economic attributes

Socio-economic and demographic characteristics are presented in Table 4.1. Among the interviewed households 126 were male-headed while 70 were female-headed. The mean age of the household heads was 52.1 years, where the ages ranged from 24 - 93 years and only 30.6% were below 45 years old. The mean age for female headed households was higher than that of male headed households, which was 63.4 years while male headed was 45.8 years. The difference of means of age by gender was -17.6 and statistically significant (p=0.069). The mean number of years of formal education for the household heads was 6.9 years, ranging from 0 - 17 years of formal education. Male household heads had a higher mean of number of years of education which was 7.9 years as compared to female household heads who had a mean of 5.2 years of formal education. The difference of means was 2.7 and statistically significant (p=0.000).

The average household size in the resettlement scheme was 6.2 persons, where the size of the household ranged from a household of one to a household of 14 persons. Female-headed households had more house hold members with a mean of 7.2 persons as compared to male headed households which was 5.7 persons. The difference of means was statistically significant (p=0.053). The mean number of dependents was 1.8 persons. The dependents ranged from 0 – 8 persons in the households. Male-headed households had more dependents with a mean of 2.0 dependents as compared to female-headed households that had a mean of 1.5 dependents. The difference in means by gender was not statistically significant (p=0.794).

The mean household wealth index was 13.7 where male-headed households were wealthier with a mean wealth index of 16.0 as compared to female-headed ones, which had a mean wealth index of 9.8. The difference in means by gender was statistically significant (p=0.039). The households were divided into three into three wealth categories (poor, middle class and wealthy) as presented in Figure 4.1 below. The poor were 59.2%, middle class were 27.0% while the wealthy composed of 13.8% of the households in the scheme.

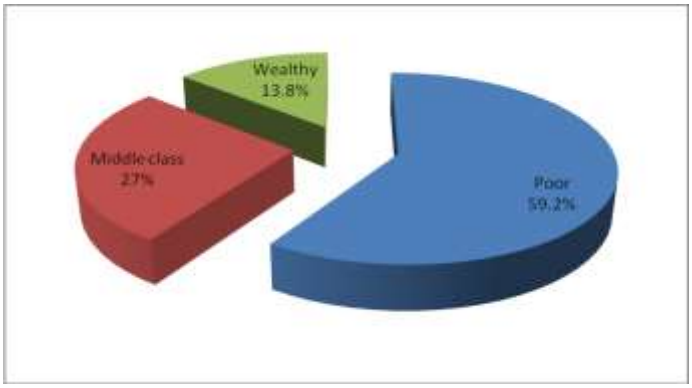

Figure 4.1: Household distribution by wealth categories in Solio resettlement scheme

Source: Survey data

The mean distance of the households to the nearest town was 10.1Km, where this distance ranged from 3Km to 18 Km and this was the same for distance to the nearest market. The mean distance to an agricultural field office was 9.7Km where it ranged from 0.5Km to 22Km. The average distance to a tarmac road was 7.7Km, which ranged between 1.5Km-15Km.

Boreholes were the main source of water in the scheme. The average time taken to walk to the borehole by the households in the area was 15.1 minutes, while the time taken to walk to the borehole ranged from 1-75 minutes. There was no statistical difference by gender on the time taken to walk to a water source (p=0.836). The scheme had one hospital while some households

used hospitals outside the scheme. The average time taken to walk to the nearest hospital was 61.8 minutes and it ranged from 5 to 180 minutes. Female-headed households took more time to walk to the nearest hospital with a mean of 65.9 minutes as compared to male-headed households which took 59.5 minutes. The difference of means was statistically significant (p=0.038). The average time taken to walk to an electricity hook up point in the scheme was 13.3 minutes and it ranged from 0-75 minutes, where only 7.1% of the households had electricity connection in their homesteads. There was no statistical difference by gender (p=0.942). Distances to services and social amenities were not statistically different by gender.

At the time of the survey, each household had on average cultivated 0.7ha (or 38.9%) of land from the total landholding of 1.8ha. The cultivated land ranged from 0.1ha to 1.8ha. Much of the land was under livestock production, because it was left fallow and used as grazing land. The size of land cultivated was not statistically different by gender because the difference of means was not statistically significant (p=0.192).

Table 4.1: Summary of socio-economic and demographic characteristics in Solio resettlement scheme, Kenya

Variable	Pooled sample					Gender difference				
	n	Mean	Std. Dev	Min	Max	Gender	n	Mean	Std.Dev	Mean difference
Household head characteristics										
						Male	126	45.8	12.9	-17.6*
Age in years	196	52.1	14.7	24	93	Female	70	63.4	10.4	
						Male	126	7.9	3.0	2.7***
Education in years	196	6.9	3.6	0	17	Female	70	5.2	4.1	
Household characteristics										
						Male	126	5.7	2.4	-1.6*
Number of household members	196	6.2	2.7	1	14	Female	70	7.2	3.0	
						Male	126	2.0	1.6	0.6
Number of dependents	196	1.8	1.7	0	8	Female	70	1.5	1.7	
						Male	126	16.0	11.3	6.2**
Wealth in wealth index	196	13.7	11.0	0	59.9	Female	70	9.8	9.2	
Distance to services and social amenities										
						Male	126	10.1	3.1	0.1
Distance to town in KMs	196	10.1	3.0	3	18	Female	70	10.0	3.0	
						Male	126	9.7	3.5	-0.0
Distance to agricultural field office in KMS	196	9.7	3.6	0.5	22	Female	70	9.7	3.8	
						Male	126	10.1	3.1	0.2
Distance to market in KMs	196	10.0	3	3	18	Female	70	10.0	3.0	
						Male	126	7.6	3.3	-0.2
Distance to a tarmac road in KMs	196	7.7	3.3	1.5	15	Female	70	7.9	3.3	
						Male	126	13.0	12.1	-6.0
Distance to a water source in walking minutes	196	15.1	13.0	1	75	Female	70	19.0	13.8	
						Male	126	59.5	33.1	-6.5**
Distance to a hospital in walking minutes	196	61.8	34.9	5	180	Female	70	65.9	37.7	
Distance to electricity hookup point in walking minutes	196	13.3	12.5	0	75	Male	126	12.6	11.6	-1.9
						Female	70	14.5	13.9	
						Male	126	0.8	0.5	0.2
Cultivated land in hectares	196	0.7	0.5	0.1	1.8	Female	70	0.6	0.4	

Source: Survey data (t-test level of significance *=10%, **=5% and ***=1%)

4.1.2 Discussion

A majority (69.4%) of the household heads were above 45 years old. Information gathered during the (FGD) with the residents revealed that most of the young people had migrated to towns when a census of the displaced households was carried out in Nyeri County in 2008. However, the young people who did not migrate had started having households of their own during the time of the survey. Female household heads were found to be statistically older than male household heads and this could negatively affect the number of livelihood activities they could be involved in, as supply of labour for off-farm activities is higher for younger household heads than for older household heads (Woldenhanna and Oskam, 2001).

The household heads had a less than 8 years of formal education on average. This can be explained by the fact that most of the residents had been internally displaced for many years and lived as squatters. Hence, many of them did not have access to education. The literacy levels were lower for female household heads and this could negatively affect their ability to secure better employment in the non-farm sector. This is because educated people have skills that are relevant in areas outside of farm work (Adi, 2007).

There was poor access to social amenities and services in the scheme, though there was little difference by gender which was not statistically significant apart from distance to a hospital. It took some households up to one hour and a quarter to walk to the borehole to fetch water especially in Mukandamia, Tetu and Mathingira villages whose boreholes were located on the periphery of the villages. The FGD revealed that the situation was made worse in instances where a pump in a given borehole broke down or there was power outage which made the residents walk for several hours to the neighboring villages to fetch water. Nonetheless, this had

opened an opportunity to some young men who supplied water using donkey carts to residents who were far from the boreholes.

The scheme did not have all-weather roads. This could negatively affect some livelihood strategies due to the challenges poor roads bring. For instance, their produce may not get to the market on time nor could farmers access farm inputs easily during the rainy season. Most of the households were also far from towns which could be sources of employment to the residents. Markets were located in those towns and that is why their distances were the same as per the results above.

Electricity transformers were located near the boreholes in the scheme and therefore only a few people near the boreholes were connected to the electricity grid. A majority (92.9%) of the households were not connected. Lack of electricity could negatively affect the number of livelihood strategies available to the households, because availability of electricity enables and promote households to engage in non-farm self-employment (Zerai and Gebreegziabher, 2011).

4.2 Household livelihood strategies in Solio resettlement scheme

4.2.1 Main livelihood strategies reported

The main livelihood activities that households engaged in are shown in Table 4.2. Almost all the households (99.5%) were involved in crop farming. There was no statistical difference by gender on participation in crop farming (P=0.179).

Livestock keeping was practiced by a majority of the households as well as wage agricultural labour, where 87.2% and 74.5% of the households were involved in these activities respectively. The gender differences were 7.4 and 9.8 respectively and were statistically significant (p

=0.007). These results show that male-headed households participated more in livestock-keeping as compared to female-headed ones.

Supply of agricultural and non-agricultural labour was practiced by 74.5% and 42.3% respectively of the households while 28.6% of the households were involved in business in the scheme. The differences by gender for these strategies were 28.3, 9.8 and 21.3 respectively and were statistically significant (p=0.000, p=0.002 and p=0.000). Male-headed households therefore participated more in these livelihood strategies.

Among the interviewed households, 27.6% got remittances from family members who lived and worked outside the scheme. The gender difference was 18.0 and statistically significant (p=0.000). Male-headed households therefore participated more in this strategy.

Salaried employment had the lowest number of households involved in it, where only 2.6% of the 196 households reported it. The Pearson chi-square showed no significant difference in the level of participation in salaried employment between the male-and female-headed households (p=0.458).

These results show that women were disadvantaged in accessing high remunerative livelihood strategies such as business, livestock keeping, supply of agricultural and non-agricultural labour. This therefore means that efforts needed to be put in place so as to enable women access opportunities in the non-farm sector.

Table 4.2: Livelihood strategies identified in Solio resettlement scheme

Livelihood strategy	Gender	n	Participants	Non-participants	Gender difference
	Male	126	116	55	
Livestock keeping	Female	70	10	15	7.4***
	Male	126	126	0	
Crop farming	Female	70	69	1	1.8
	Male	126	103	23	
Sale of agricultural labour	Female	70	43	27	9.8***
Sale of non-agricultural	Male	126	71	55	
labour	Female	70	12	58	28.3***
	Male	126	4	122	
Salaried employment	Female	70	1	69	0.6
	Male	126	50	76	
Business	Female	70	6	64	21.3***
	Male	126	22	104	
Remittances	Female	70	32	38	18.0***

Pearson chi-square test level of significance *=10%, **=5% and ***=1%

Source: Survey data

The livelihood strategies are presented in Figure 4.2 in terms of their dominance in respect to the number of households that identified the given strategy as their dominant livelihood strategy:

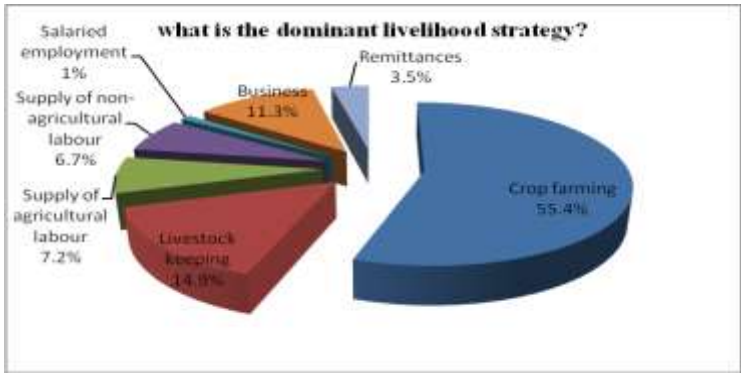

Figure 4.2: Households' choice of dominant livelihood strategy in Solio resettlement scheme

Source: Survey data

Household distribution among the identified livelihoods by wealth status in Solio is presented in Table 4.3. Poor households participated more in crop farming as a dominant strategy as compared to other households in the scheme as 61.1% of the households in this category reported crop farming as their dominant strategy. Livestock keeping was the second livelihood strategy to crop farming for the poor households comprising of 11.2% of the poor households. About 9.5% of the poor households participated in some form of business in the scheme. Sale of agricultural and non-agricultural labour among the poor households had equal proportions representing 6% of these households respectively. Poor households relied more on remittances from family members working and living away from the scheme than the middle class and the wealthy, representing 5.2% of the households that considered remittances a dominant livelihood strategy. Among the poor households only one percent considered salaried employment a dominant livelihood strategy.

Middle class households in the scheme had the largest proportion that considered livestock keeping and sale of non-agricultural labour their dominant livelihood strategy, comprising of 20.8% and 11.3% respectively. However, crop farming was the most dominant livelihood strategy for the middle class as reported by 49.1% of the middle class households. About 11.3% of these households considered business as their dominant strategy, while 7.5% of the middle class households reported sale of agricultural labour their dominant livelihood strategy.

The wealthy households had the largest proportion that considered business, sale of agricultural labour and salaried employment their dominant livelihood strategies in the scheme, comprising of 18.5%, 11.1% and 7.4% of these households respectively. However, crop farming was the most dominant strategy as 40.7% of these households reported. The wealthy households also had

a high proportion (18.6%) of the households considering livestock keeping as their dominant livelihood strategy in the scheme.

Table 4.3: Dominant livelihood strategy by wealth category in Solio resettlement scheme

Wealth category	Livelihood strategy						
	Crop Farming	Livestock Keeping	Business	Agricultural Labour	Non-Agricultural Labour	Remittance	Salaried Employment
Poor	61.1%	11.2%	9.5%	6.0%	6.0%	5.2%	1.0%
Middle Class	49.1%	20.8%	11.3%	7.5%	11.3%	0%	0%
Wealthy	40.7%	18.6%	18.5%	11.1%	0%	3.7%	7.4%

Source: Survey data

4.2.2 Description of the livelihood strategies in Solio resettlement scheme

(a) Crop farming

Crop farming was the most dominant livelihood strategy for 55.38% of households in Solio resettlement scheme. The poor households considered this their dominant livelihood strategy since they faced entry barriers into more remunerative strategies such as business (Barrett et al., 2001). There was no statistical difference between male-headed and female-headed households. This was due to relaxing of the land constraint by the government, by giving each household 1.8ha. The main crops grown in the area included Irish potatoes, beans, sweet potatoes, maize, sorghum, wheat, pumpkins and onions.

Households in the scheme had chosen crop farming as the dominant livelihood strategy, mainly for household food production. Nonetheless, crop production faced many constraints in the semiarid region; hence many households did not produce enough food for the household consumption throughout the year.

During the FGD, a number of constraints to crop production were identified as follows:

(i) The land was virgin and had a hard pan hence it could not be opened up by hand but by tractor. Although the government had provided a tractor in the resettlement scheme, the farmers had to fuel it. Due to high levels of poverty, many of the residents had not been able to open up most of the land as they could not afford to fuel the tractor.

(ii) Rainfall in the area was erratic and poorly distributed, hence most households grew short season crops. Crops like maize dried up before they matured because the rainfall season lasted for only a short period. The land had very few trees and was on the lee-ward side of Mt Kenya with high dry winds. The wind increased the level of transpiration coupled with frost in the morning which burned crops lead to losses.

(iii) Crops in the field were also destroyed by pests and wild animals. Porcupines (*Hystricomorph hystricidae*) destroyed Irish potatoes as well as sweet potatoes. Zebras and Thompsons gazelles fed on the crops in main fields hence making it difficult for some farmers to harvest anything in the main fields. Elephants were also a great threat to crop production especially in Mukandamia village, which lies on the migration corridor of the elephants from Mt Kenya to the Aberdares forest. The invasion by wild animals raised the level of human-wildlife conflict.

(iv) Irish potatoes acted both as a food and cash crop in the area. Harvesting periods was months of January, June and July, when brokers from outside the resettlement scheme came to purchase from the farmers. These brokers enabled the farmers to market their potatoes. However the brokers controlled the market by dictating the price of the potatoes. The brokers also packaged the potatoes in un-standardized sacks that weighed up to 160kgs, which was way above the standard 130kgs sack for potatoes. The brokers doubled up as an opportunity as well as a

challenge to the poorly organized farmers, who sold their potatoes from the main field individually.

The farmers in the study area mostly used fertilizer for potatoes production, where 42.4% of the farmers reported to be using fertilizer. Diammonium phosphate was used for planting while foliar spray was used thereafter.

(b) Livestock keeping

Livestock keeping was the second livelihood strategy after crop farming in the resettlement scheme, with 14.9% of the households considering it as their dominant livelihood strategy. Male-headed households participated more in this strategy since they were wealthier than female-headed counterparts (as seen in Table 4.2) and therefore had the initial capital required to purchase livestock and therefore participate in this strategy.

The tropical livestock units (TLU) were computed using the following weights: cattle=0.5, goats=0.1, sheep=0.1, chicken=0.01, for SSA (Njuki et al., 2011). Livestock holding in the scheme had been increasing since resettlement as seen in Table 4.4. The TLU increased from 0.2 in 2009 when the households came to Solio to 0.7 at the time of the interview in 2013; this amounted to a 250% increase in household livestock holding. This increase was due to the abundance of grass in the open fields which had led to an increase in cattle, goats and sheep. Unlike crop farming, livestock rearing had fewer challenges, since the area being a grass land savannah had enough pasture throughout the year. Most households engaged in livestock rearing where 87.2% of the households were involved in one or the other livestock rearing.

Table 4.4: Households livestock holding in Solio resettlement scheme

	Pooled sample					Gender difference				
Variable	n	Mean	Std. Dev	Min	Max	Gender	n	Mean	Std. Dev	Mean difference
						Male	123	0.2	0.7	-0.2**
Cattle 2009	192	0.3	1.2	0	14	Female	69	0.4	1.9	
						Male	126	0.8	1.6	0.4**
Cattle 2013	196	0.7	1.5	0	9	Female	70	0.4	1.3	
						Male	126	0.4	1.0	0.2***
Goats 2009	195	0.3	0.9	0	5	Female	69	0.1	0.6	
						Male	126	1.8	4.9	1.2***
Goats 2013	196	1.3	4.0	0	50	Female	70	0.6	1.2	
						Male	126	0.5	1.7	-0.3
Sheep 2009	196	0.6	3.2	0	40	Female	70	0.9	4.9	
						Male	126	2.0	3.8	0.8***
Sheep 2013	196	1.7	3.4	0	23	Female	70	1.2	2.5	
						Male	126	1.6	3.5	0.8**
Chicken 2009	194	1.3	3.2	0	30	Female	68	0.8	2.5	
						Male	126	5.6	5.2	1.8
Chicken 2013	196	5.0	5.2	0	27	Female	70	3.7	5.0	
						Male	123	0.2	0.4	-0.1**
TLU 2009	189	0.2	0.9	0	11	Female	66	0.3	1.4	
						Male	126	0.9	1.1	0.4***
TLU 2013	196	0.7	1.0	0	5.5	Female	70	0.4	0.8	

t-test level of significance *=10%, **=5% and ***=1%

Source: Survey data

The mean number of cattle increased from 0.3 to 0.7 per household from 2009 to 2013, which was 133.3% increase. In 2009, women-headed households had more cattle than male-headed households as the difference of means was -0.2 and statistically significant (p=0.024). At the time of the survey in 2013 male-headed households had more cattle than female-headed households as the difference of means was 0.4 and statistically significant (p=0.040).

The mean number of goats had increased from 0.3 to 1.3 goats per household between 2009 and 2013, which was 333.3% increase. Male-headed households had more goats than their female-headed counterparts both in 2009 and 2013. The differences of means during the two periods were 0.2 and 1.2 respectively, and were statistically significant (p=0.002 and p=0.008).

The mean number of sheep had increased from 0.6 to 1.7 sheep per household between 2009 and 2013, which was 183.3% increase. There was no statistical difference in the number of sheep owned by gender in 2009 (p=0.133). However, in 2009 male-headed households had more sheep than their female counterparts with a mean difference of 0.8 which was statistically significant (p=0.005).

Chicken rearing also increased from a mean of 1.3 to 5.0 chickens per household between 2009 and 2013. In 2009 male-headed households had more chicken than female-headed with statistically significant differences (p=0.017). There was no difference between female and male-headed households on chicken ownership at the time of the survey (p=0.324).

In 2009, female-headed households had significantly higher TLU than their male-headed counterparts (p=0.045). However, in 2013 male-headed households had significantly higher TLU than their female-headed counterparts (p=0.003).

The middle class had the highest proportion that considered livestock keeping their dominant strategy; this could be due to the fact that they could purchase goats, sheep and chicken since they were more affordable as compared to cattle. This results are consistent with other finding in literature because generally literature shows that the small stock is often the first step in the rung out of poverty (Kristjanson et al., 2004).

Livestock rearing was constrained by the absence of surface water within the resettlement scheme, as each village had one watering point at the borehole. This may lead to spread of contagious diseases (such as foot and mouth, lumpy skin disease, contagious bovine pleuropneumonia in cattle, and contagious caprine pleuropneumonia, contagious echthema in goats) if an outbreak were to occur. This situation was made worse by the fact that, wealthy outsiders had leased land within the resettlement scheme, and were keeping large herds of cattle, thereby increasing competition for pasture and water. The absence of any government veterinarian in the study area, and lack of a cattle dip also made livestock production a risky venture.

(c) Business

There were many forms of small businesses in the area which supported a number of households. About 11% of the households considered businesses their dominant livelihood strategy, where 28.6% of the households interviewed were involved in some form of business. Male-headed and wealthy households participated more in businesses than their female counterparts. This could be because they were wealthier and better educated hence making it easier for them to overcome entry barriers as well as have better business management skills (Reardon and Taylor, 1996; Reardon, 1997; Woldenhanna and Oskam, 2001).

The main businesses that households engaged in were small kiosks, vegetable sales, small hotels, bars, wood fuel sales, clothes sales and technical skill based businesses. The kiosks sold household goods within the scheme. Women were involved in sourcing vegetables and fruits outside the scheme which they sold in the scheme, mostly near the boreholes where many people frequented during the day. There were also small hotels which were also concentrated near the boreholes as well as small bars. A few individuals especially in Tetu and Mathingira villages were involved in making local brews for sale.

Due to lack of trees within the scheme, wood fuel presented a business opportunity for some residents who supplied charcoal, firewood and sawdust for cooking and heating especially during cold seasons. They also supplied wood for home construction as well as for fencing. Some of the residents operated tree nurseries where they sold seedlings to the residents.

Transport business also earned a number of households some income. Motor cycles were the most common and reliable means of transport in the scheme. A few well up families that had small vehicles they used to transport people to the neighboring towns. Households that owned donkeys transported farm yields from the farms to the stores at home as well as fetching water for the households that were far from the boreholes which they sold at KShs 10 per 20 litre jerry can.

During the harvesting season, hawkers sold second hand clothes in the scheme taking advantage of periods when the residents had income from sale of potatoes. There were a few small businesses that were dominated by individuals who possessed some technical skills who made items and goods and offered services from their trade for sale but at very small scales within the scheme and a few outside the scheme.

Among the interviewed households, 28.1% of the heads possessed some type of technical skill as presented in Table 4.5. The main skills were carpentry, masonry, driving, mechanics and tailoring were the most popular technical skills in that order.

Table 4.5: Technical skills identified in Solio resettlement scheme

Type of skill	Frequency	Percent
None	141	71.9%
Carpentry	18	9.2%
Masonry	7	3.6%
Driving	6	3.1%
Mechanics	5	2.6%
Tailoring	5	2.6%
Weaving	3	1.5%
Cobbler	2	1.0%
Painting	2	1.0%
Hair dressing	2	1.0%
Plumber	1	0.5%
Barber	1	0.5%
Welding	1	0.5%
Tinsmith	1	0.5%
Black Smith	1	0.5%
Total	196	100%

Source: Survey data

(d) Agricultural labour supply

Among the interviewed households, 7.2% considered wage agricultural labour their dominant livelihood strategy. The wealthy households had a higher proportion (11.3%) of households that considered agricultural labour their dominant livelihood strategy. This could be due to the fact that they could afford to buy some implements that are used like hand hoes, knapsack sprayer among others. Overall 74.5% of the households reported to have engaged in this livelihood strategy at some point in the year. Male-headed households participated more in this strategy

(see Table 4.2). The wage rate per day was KShs 200, where a work day was from 8:00am to 1:00pm. The wage rate was equal for men and women were constant throughout the year.

Agricultural labour included land preparation, planting, weeding, harvesting and herding. Apart from herding which went on throughout the year, the others were seasonal. Planting was done in March and April for the first season, while in the second season, it was done in September. Weeding was done in April and May for the first season while for the second season it was done in October. First season harvesting occurred between June and July while second season harvesting was done between December and January. Wage agricultural labour was mainly supplied to well established farms outside the resettlement scheme.

Herding labour was exclusively consumed within the resettlement scheme. There were two types of herders in the study area. In the first category, herders were hired by wealthy outsiders who had leased land within the scheme and had large herds of cattle, goats and sheep. The second category was the community herders who charged KShs 200 per head of cattle and KShs 50 per head of goat or sheep per month respectively.

Contrary to findings by Rahut and Scharf (2012) in the Himalayas, wealthy households participated more in sale of agricultural labour as compared to other categories. This could be due to the fact that some of the activities where agricultural labour was sold required an individual to have some implements (e.g., hoe, fork jembe, and wheelbarrow) that the wealthy could more easily purchase these implements compared poor and middle class households.

(e) Non-agricultural labour

Supply of non-agricultural labour was dominated by male-headed households, due to its nature and mostly those who possessed some technical skills. People who possessed carpentry,

masonry, welding, tinsmith, plumbing, painting and driving were hired for their specific skills. Overall 6.7% of interviewed households reported sale of non-agricultural labour as their dominant livelihood strategy. This strategy required some investment especially where a skill was needed, hence the poor could not easily participate in it.

Non-agricultural labour supply was highly seasonal. Some young men (below 35 years) were hired as "*matatu*" (public service vehicle) conductors and drivers in neighboring towns while others were hired as motorcycle riders within the resettlement scheme. Motorcycles were the most common and reliable means of transport in the scheme. The wage rate per day for non-agricultural labour ranged between KShs 250 – KShs 750 per day depending on the skill. Carpenters and masons were paid higher than conductors, drivers, and motorcycle riders at KShs 500 – KShs 750 per day. This meant that skilled labour fetched up to three times more than unskilled labour. Among the interviewed household heads, 42.4% reported to be engaged in some non-agricultural waged labour at some point in the year.

(f) Remittances

Remittances from urban areas or from people working outside the scheme were a key livelihood strategy especially among old people (above 55years). About 4% of households in Solio resettlement considered remittances their dominant livelihood strategy. Male-headed households participated more in this strategy than female-headed ones. The poor had the largest proportion (5.2%) of households that depended on remittances. The households in Solio received Kshs 1,546 per month on average. About 28% of the households interviewed participated in this strategy.

(g) Salaried employment

Salaried employment was available only to one percent of the households. These included teachers, chiefs, assistant chiefs, police officers, doctors, nurses, hospital clerks, borehole operators and a few people employed by private companies. There was no significant difference by gender on participation in this strategy (X^2=0.6; p=0.458).

4.2.3 Number of livelihood strategies reported

Figure 4.3 shows the distribution of the number of livelihood strategies that households in Solio resettlement scheme were involved in. Most (38.8%) of the households were involved in three livelihood strategies only, which was the smallest set of livelihood strategies reported. Another 31.6% were involved in four strategies. Households involved in five livelihood strategies accounted for 18.4%, while those involved in two and six livelihood strategies accounted only for 10.2% and 1.0% respectively.

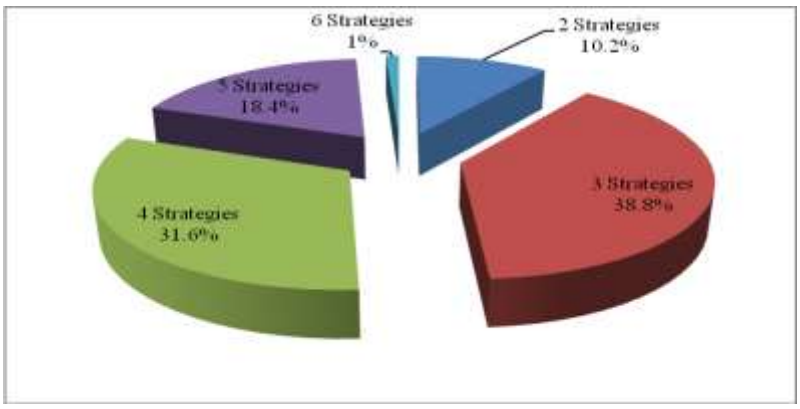

Figure4.3: Frequency of the number of livelihood strategies reported in Solio resettlement scheme

Source: Survey data

The proportion of households by wealth class that adopted a given number of livelihood strategies in Solio resettlement scheme is presented in Table 4.6. Most of the poor households adopted two and three livelihood strategies accounting for 13.8% and 44.8% respectively. Therefore they had the highest proportion of households participating in few livelihood strategies. The middle class had the highest proportion of households participating in five strategies (35.8%), while most of these households participated in three and four livelihood strategies accounting for 32.1% and 24.5% of middle class households' respectively. Wealthy households had the highest proportion of households participating in six livelihood activities (3.7%), while none of the households in this category participated in less than three livelihood activities. Wealthy households had the highest proportion of households participating in four livelihood strategies, accounting to 51.9% of the wealthy households. The results are consistent with literature where wealth positively influences livelihood diversification (Ellis, 2000; Barrett et al., 2001; and Berhanu et al., 2007).

Table 4.6: Number of livelihood strategies by wealth category in Solio resettlement scheme

	Number of livelihood strategies				
Wealth Category	**2**	**3**	**4**	**5**	**6**
Poor	13.8%	44.8%	30.2%	10.2%	1%
Middle Class	7.5%	32.1%	24.5%	35.8%	0%
Wealthy	0%	25.9%	51.9%	18.5%	3.7%

Source: Survey data

4.2.4 Contribution of livelihood strategies to household income in Solio resettlement scheme

The contribution of different household income sources is presented in Table 4.7. Off-farm income was the largest contributor to household income accounting for 67.4% of annual household income. Off-farm income was significantly higher for male-headed households with a mean of Kshs 76,136 compared to a mean of Kshs 35,719 for female-headed ones (p=0.001). Crop income contributed 17.1% to annual household income and there was no statistical difference between female and male headed households (p=0.877).

Livestock sales contributed 9.5% of household income on average where male headed households had a higher mean of Kshs 10,465 as compared to female headed households that had a mean of 5,464.3Kshs from this income source. The gender difference was Kshs 5,001 and was statistically significant (p=0.018). Livestock products and byproduct sales contributed 6.0% of household income. However, there was no significant difference between-male and female-headed households (p=0.523). These products and byproducts included milk, eggs, manure and hides and skins. The average annual total income was KShs 93,377 per households. The mean income was statistically significant by gender with male-headed households having higher incomes (p=0.014).

Table 4.7: Contribution of different income sources to total annual household income in shillings in Solio resettlement scheme

	Pooled sample						Gender difference			
Variable	**n**	**Mean**	**Std. Dev**	**Min**	**Max**	**% contribution**	**Gender**	**n**	**Mean**	**Std.Dev**	**Mean difference**
							Male	126	76,136.1	117,636.3	
Off-farm income	196	61,701.4	99,046.2	0	1,095,740	67.4%	Female	70	35,719.0	39,869.8	40,417***
							Male	119	16,300.6	19,255.0	
Crops income	187	15,680.7	18,005.2	0	149,771	17.1%	Female	68	14.495.9	15,656.6	1,705
							Male	126	10,465.60	20,343.60	
Livestock sales	196	8,679.40	18,884.50	0	150,000	9.50%	Female	70	5,464.30	15,549.40	5,001**
Livestock							Male	126	5,199.40	13,030.40	
products	196	5,444.40	19,014.80	0	216,000	6.00%	Female	70	5,885.40	26,719.00	-685
TOTAL							Male	119	111,434.50	132,760.20	
INCOME	187	93,377.20	113,323.50	13,876	1,156,324	100%	Female	68	61,777.00	54,931.00	49,658**

t-test level of significance *=10%, **=5% and ***=1%)

Source: Survey data

4.2.5 Discussion of livelihood strategies in Solio

The environmental and resource endowment constraints that a household faces determine the set of livelihood strategies it chooses to engage in (Ellis, 2000; Adi, 2007). This is evidenced by the findings of this study in seeking to answer the first objective which was to identify and describe the livelihood strategies of resettled households in Solio resettlement scheme.

The resettlement scheme provided opportunities for the residents by relaxing the land constraint the households faced initially. However, it also brought in a number of environmental constraints that the resettled people did not face. The scheme is situated in savannah grassland with very few scattered trees. The area does not have any surface water and the residents depended on water from boreholes sunk by the government. The area had low tree cover and vast open grasslands and being between Mt Kenya and Aberdares ranges, it faces strong winds as well as frost in the morning. The households also faced financial and physical resource constraints as well as poorly developed physical infrastructure like roads, watering points, irrigation facility, markets among others all that would enhance some livelihood activities (Barrett et al., 2001).

Livestock keeping especially cattle, sheep and goats was enhanced by the fact that most of the land was not opened up for crop farming and therefore there was abundant pasture in the open fields. Despite this, there were barriers to entry into this livelihood strategy. These included the income levels of most of the households did not allow them to have enough capital to purchase livestock especially among female-headed households. This is because they had lower incomes than male-headed households. This corroborates previous literature that low incomes impede acquisition of livestock necessary to diversify out of crop agriculture (Dercon, 1998; McPeak and Barrett, 2001). In most rural areas in SSA countries, owning more livestock is considered being wealthy and gives a household high social status and is positively related to livelihood

diversification (Barret et al., 2001; Gebru and Beyene, 2012). Hence, the female-headed households were poorer than their male-headed counterparts which may have made it more difficult for them to acquire livestock and therefore diversify their livelihoods.

Low levels of education among the resettled people coupled with the age of most of the household heads especially among female-headed households explain the low number of people participating in salaried employment. Entry to the agricultural labor market in the area had low entry barriers, mainly limited to age, compared to other strategies such as salaried employment that required more education and possession of a technical skill. Non-agricultural labour market was easy to enter for young male-headed households that possessed some technical skills compared to those that possessed none. This is due to the fact that when agrarian economies are open for off-farm work, the young are the first to take them up, because they are more educated and more energetic and may not have an agrarian ethic (Woldenhanna and Oskam, 2001). The findings of the current study are therefore consistent with literature.

Agriculture was the most dominant livelihood strategy in terms of crop and livestock production. Most of the households were involved in three to four livelihood strategies as reported by 70.4% of the households. This shows high homogeneity among the households with respect to livelihood diversification. This could be explained by the fact that a majority of the households came to Solio at around the same time and they had the same background as squatters who were resource-poor for many years. They also did not have the opportunity to acquire education as well as wealth, which led to them adopting almost similar livelihood strategies for survival in a new environment. However, the level of diversification was not the same for all households

faced by the same environmental constraints as evidenced by these results, where 19.4% of the households were highly diversified being involved in more than four livelihood strategies. Previous literature has found agriculture to be the dominant livelihood strategy in African rural households even with the advent rural livelihood diversification (Ellis, 2000, Reardon et al., 2000 and Barrett et al., 2005). The results of the current study are consistent with literature where agriculture still remains the most dominant livelihood strategy.

Total income was composed of both real income and fungible income. Fungible income was defined as the substitution of goods for money that would have had to be earned to acquire those goods (Bettina and Hasan, 2001). This is because by growing their own food, households produced food for own consumption or for sale; consequently real and fungible income was generated. This was meant to give a real estimation of household incomes. Off-farm income was a major contributor to total household income accounting for 67.4% of average household income. Male-headed households had higher off-farm income as compared to female-headed counterparts. Previous literature has found that men and women have different access to assets, resources and opportunities in many African rural areas, in addition women have lower education due to discriminatory access to education as children and therefore they typically have a narrower range of labour markets (Ellis, 2000). Access to assets, resources and opportunities as well as level of education may be the reasons why male-headed households had higher off-farm income compared to female-headed households, because the results found that male household heads were more educated than female household heads. The high contribution of off-farm income to farm income in the resettlement scheme was due to the constraints facing agriculture especially crop farming as identified earlier. The results are inconsistent with literature that indicates off-farm income in SSA agricultural households contributes between 30 and 50 percent

to the total household income (Reardon, 1997; World bank, 2008; Zerai and Gebreegziabher, 2011).

4.3 Factors influencing the choice of livelihood strategies in Solio resettlement scheme

Table 4.8 shows the factors influencing the number of livelihood strategies chosen by households in Solio resettlement scheme. A negative binomial regression model (equation 3.9) was fitted into the data, where four of the ten variables were statistically significant.

Table 4.8: Negative binomial regression results for the factors influencing the choice of livelihood strategies in Solio resettlement scheme

Variable	Coef.	Std. Err.	Z	P>|Z|
Age of the household head (AGE)	0.0427	0.0092	4.62	0.000***
Age of the household head squared (AGE^2)	-0.0004	0.0001	-3.97	0.000***
Gender of the household head (GENDER)	0.0805	0.1021	0.79	0.430
Household head education in years (EDUCATION)	0.0088	0.0124	0.71	0.477
Possession of technical skills (SKILLS)	0.2241	0.0831	2.70	0.007***
Dependents in the household (DEPENDENTS)	-0.0189	0.0243	-0.78	0.437
Membership to a group (MEMBERSHIP)	0.0350	0.0821	0.43	0.670
Wealth in wealth index(WEALTH)	0.0744	0.0527	1.41	0.158
Time to a water source (DWATER)	-0.0062	0.0034	-1.82	0.069*
Distance to town in KMs (DTOWN)	0.0117	0.0121	0.97	0.331
Observations	196			
Wald $chi^2(10)$	1221.39			
prob>chi^2	0.0000			
Log likelihood	-324.39			
Lnalpha	-18.66713			
Alpha	7.82e-09			

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

Source: Survey data

The age of the household head and possession of a technical skill by the household head positively influenced the number of livelihood strategies chosen by a given household. While time taken to a water source negatively influenced the set of livelihood strategies chosen by a given household.

Contrary to the *a priori* expectation, as the age of a household head increased the number of livelihood strategies adopted by that household increased and was significant (p=0.000). However, the number of livelihood strategies adopted by the households increased as the age of the household head increased up to some point, whereas the household head gets older the number of livelihood strategies the households engaged in started decreasing. This is evidenced by the negative and statistically significant age squared variable (p=0.000).

A household with a head who possessed a technical skill engaged in more livelihood strategies than households headed by a head that possessed no skill. This is evidenced by the positive and statistically significant at one percent level of significance "SKILLS" variable.

Time to a water source variable was statistically significant at 10% level of significance. This meant that, households that were near water sources (boreholes in this case) engaged in more livelihood strategies than those located farther from the water point. Contrary to expectations, number of dependents, distance to town, a household being male-headed, more educated, a member of a group and increase in wealth did not influence the number of livelihood strategies adopted by a household.

4.3.1 Discussion of factors influencing the number of livelihood strategies adopted in Solio

Age of the household head was positive and statistically significant, meaning that young household heads had less diversified livelihoods than older households. These results were inconsistent with most of the available literature that suggests that younger household heads have more diversified livelihoods than older household heads (Bryceson, 2000; Adi, 2007; Berhanu et al., 2007; Zerai and Gebreezghiabher, 2011). However, these results were consistent with findings by Khatun and Roy (2012), who found that age was positively related to the number of livelihood diversification strategies adopted by households in west Bengal. Karugia et al., (2006) also found a positive relationship between age and off-farm earnings in western Kenya, meaning older household heads had more diversified livelihoods than their younger counterparts. They attributed this to the fact that elderly household heads may have had more resource endowment saved over time compared to younger counterparts, which would enable them to engage in high return livelihood strategies, e.g., businesses or even possess productive assets that the young did not have. Khatun and Roy (2012) also indicate that experience increases with age; hence, experienced farmers have more prospects of getting jobs off-farm. This would enable them to participate in more livelihood strategies compared to younger household heads. Nonetheless, as the household head advanced in age the number of livelihood strategies adopted reduced which is evidenced by the negative and statistically significant age squared variable. This could be attributed to the fact that as one advances in age they become less productive.

Technical skills are used to acquire non-farm wages and at times salaries or even enable one to start a skill-related business such as tailoring, welding and carpentry among others. This explains why household heads that possessed technical skills had more livelihood strategies, since they could easily participate in livelihood strategies that others were barred from due to their lack of

technical skills. These finding were consistent with literature as similar results were found in Eastern Tigray, Ethiopia (Zerai and Gebreegziabher, 2011). The economic potential of rural Africa and the future welfare of its residents is crucially dependent on the infusion of marketable skills through innovative informal and formal training especially for children and youth (Adi, 2007). This is due to the fact that rural livelihood hangs on the precarious balancing of agricultural and non-agricultural sources of income.

Due to the large number of people who visited the boreholes to fetch water, small-scale businesses like shops, hotels, and vegetable and fruit sellers and tree nurseries were found/ set up near and around the water points. The boreholes acted as central meeting points in the villages and even public transport bays had developed around them. This is in spite of the fact that commercial plots were sited elsewhere in the scheme especially in Rehema, Baraka and Bahati villages. Livestock watering points were also at the boreholes, where each village had one watering point. Water availability determines the available labour hours for livelihood diversification. Literature indicates that this may be due to the fact that water availability is directly correlated with health of the people and poor health reduces agricultural productivity and availability of labour for livelihood diversification away from agriculture (World Bank, 2008). Also, a household that spends a lot of time fetching water will have less time to participate in other productive activities because basic infrastructure like water supply has an important role in the development of a region, and therefore could dictate the availability of some livelihood strategies e.g. fish farming (Khatun and Roy 2012). Therefore these could be the reasons why households that spent less time to the water source had more diversified livelihoods.

Most of the variables in the model were not statistically significant (Table 4.8). This was because there was high homogeneity of the variables among the households, as the majority came to Solio at around the same time.

Chapter 5: Summary, Conclusions and Recommendations

5.1 Summary

This study examined the determinants of a household's choice of livelihood strategies in Solio resettlement scheme in central Kenya. The specific objectives of the study were: first, to identify and describe the livelihood strategies of resettled households in Solio resettlement scheme. Secondly, to assess the factors that influence the number of livelihood strategies chosen by households in Solio resettlement scheme. The study utilized primary household data collected in Solio through focus group discussion as well as semi-structured questionnaires. One hundred and ninety six households were randomly selected from 3,082 potential households in Solio resettlement scheme. Descriptive statistics were used to characterize the livelihood strategies in the scheme. A negative binomial regression was employed to assess the factors that influenced the number of livelihood strategies chosen.

Seven main livelihood strategies were identified and described. These were: crop farming, livestock keeping, sale of agricultural labour, sale of non-agricultural labour, small businesses, salaried employment and remittances. Majority (55.4%) of the households reported crop farming as their dominant livelihood strategy. Over 60% of the poor households depended more on this strategy for food production. Livestock population was found to have increased by 250% since resettlement in 2009, which could be attributed to abundance of pasture in the main fields. On average, households allocated 0.7ha to crop production, leaving 1.1ha for livestock production. Male-headed households had more livestock than female-headed counterparts; wealthier households participated more in livestock keeping. Salaried employment had the least number of participants and was practiced by 2.6% of the households. In addition, only one percent of the

196 households considered it their dominant livelihood strategy. This was probably due to the low level of education among the household heads of 6.9 years on average.

Most (67.4%) of the household income came from off-farm sources which included supply of agricultural and non-agricultural labour, businesses, remittances and salaried employment. Male-headed households earned significantly more off-farm income compared to female-headed households. Wealthier households had a comparative advantage in getting off-farm income due to the fact that they faced less entry barriers into the more remunerative non-farm activities like business compared to poor households. The high contribution of off-farm income to total household income was due to environmental and infrastructural constraints that faced the farm sector in the scheme, which included pests, harsh climatic conditions, and bad roads among others.

The econometric model found four variables statistically significant out of the ten fitted. Age of the household head positively and significantly influenced the number of livelihood strategies chosen by a given household ($p=0.000$). This means that older household heads had more diversified livelihoods compared to younger household heads. Possession of a technical skill positively and significantly influenced the number of livelihood strategies a household adopted ($p=0.007$). Time taken to a water source negatively and significantly influenced the number of livelihood strategies chosen by a given household, implying that households that took more time to walk to a water source participated in fewer livelihood strategies than those that took lesser time to walk to the water points. This could be due to the fact that they spent most of the time fetching water hence had limited time to engage in many productive activities as well as the fact

that households near the boreholes could engage in more activities like business as people congregated around the boreholes.

5.2 Conclusions

Resettled households diversify their livelihoods so as to make it easier for them to reconstruct their livelihoods. A large proportion of the household income of the immigrant households is derived from off-farm sources, due to the numerous environmental and infrastructural challenges that face their farm sector, leading to its poor performance as the households adapt to new environments.

Possession of technical skills is important for resettled households, since it makes it easy for them to access off-farm wage employment as well as establishing businesses that are related to the skill. This enables such households to diversify their livelihoods and easily reconstruct their livelihoods in the new environment.

5.3 Recommendations

a) The econometric model revealed that younger household heads in the resettlement scheme participate in fewer livelihood strategies than older household heads. In addition the study found that having a technical skill makes an individual participate in more livelihood strategies as compared to those that had none. Such an individual earned up to three times more wages for sale of non-agricultural labour. Therefore, programs and projects aimed at targeting the youth in resettlement schemes who are disadvantaged in accessing resources necessary for them to diversify their livelihoods should be explored. This could be achieved through the construction of a vocational training facility in Solio resettlement scheme, to impart the youth with technical skills. Funding for such a

vocational training facility could come through the county government, constituency development fund (CDF) or development partners. This will create opportunities for residents' children to get technical and business skills, which will ultimately lead to diversified livelihoods.

b) The study found that households that took less time to walk to a water source were more diversified compared to those that took more time to walk to a water source. Therefore to address the issue of water as a major constraint, it would be prudent to introduce piped water to the households in Solio resettlement scheme. This will reduce the time taken by households looking for this vital resource, therefore increasing the time spent on productive activities. In addition the residents could consider water harvesting when there are rains from their roofs for domestic use as well as harvesting runoff for irrigation purposes.

5.4 Areas for further research

There is need to compare the determinants of choice of alternative livelihood diversification strategies in resettlement schemes vs typical rural livelihoods. The current study was limited to a resettlement scheme with unique constraints unlike normal villages which are used to their environments. This will enable policy makers to distinguish between policies, programs and projects that work best in each of the two contexts depending on the determinants of livelihood diversification, towards eradicating rural poverty, unemployment and food insecurity.

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Annex 1: Focus group guide

History of the residents	
Where did the residents of the village come from?	
What lead to your internal displacement?	
What activities were you involved in before displacement?	
What do you do now? And what are the constraints faced?	
Is there a seasonal pattern of the activities mentioned above	
Which crops are grown in the area	
Which crops are produced for sale	
Which livestock is reared in the area	

Annex 2: Questionnaire

Determinants of livelihood diversification

SURVEY INSTRUMENT FOR SOLIO HOUSEHOLDS

Introduction

This study is meant to collect information about the livelihood strategies undertaken by households in Solio settlement scheme since resettlement. All responses obtained from the research will be treated with utmost confidentiality and will be reported in general terms.

Do you consent to participate in this research? [1=yes 0=no] ☐ if no move to the next household.

Section 1: Identification

Name of interviewer ……

Questionnaire number ……Date of interview……/……/……..

Name of respondent …….

Phone number…….

Village……

Section 2: Household head characteristics

Relation of respondent with household head	1=household head 2=spouse 3=grown up child(>18 years) 4=relative 5=others (specify)	
Sex of household head	1=male 0=female	
Age of the house hold head (years)		
Education of HH in years		
Does the HH possess any special skills e.g. masonry, tailoring, carpentry, mechanics, wiring, phone repair, welding, tinsmith, black smith etc	1=yes 0=no if yes specify the Skill…… …… …… …….	

Section 3: Household characteristics

Household size		Males= Females=
Number of males	>18 years	
Number of females	>18 years	
Number of other dependents		
Number of household members living away out of Solio		

Section 4: Distance to services and social amenities

	Issue	km	walking minutes	cost
1	Distance to the nearest town			
2	Distance to the nearest input source (fertilizer, concentrates, seeds)			
3	Distance to agricultural field office			
4	Distance to the nearest Bank			
5	Distance to nearest market			
6	Distance to the tarmac road			
7	Distance to the water source			
8	Distance to the nearest hospital			
9	Distance to the nearest electricity hook up			
10	Distance to the nearest primary school			
11	Distance to the nearest secondary school			

	Number
12 Number of contacts with extension services in the last 12 months	

Section 5: Livelihood strategies

5.1 What are your income sources?

Livelihood strategy	**1 if participates 2 if doesn't participate**
1=Livestock keeping	
2=Crop farming	
2=Waged agricultural labour	
3=Waged non-agricultural labour	
4=Salaried skilled non-agricultural labour	
5=Salaried skilled agricultural labour	
6=Petty business	
7=Remittances	
Others specify	

5.2 Which are your three main livelihood strategies in the order of importance?

Livelihood strategy	**List the strategies in order of importance e.g. (1,6,7)**
1= Livestock keeping 2=Crop farming 2= waged agricultural labour 3= waged non-agricultural labour 4= salaried non-agricultural labour 5= salaried agricultural labour 6= petty business 7= remittances 8= others specify……	

5.3 What are the reasons for you response above?

……
……
……
……
……
……
……..

Section 6: Socioeconomic characteristics

6.1 Land holding within the settlement scheme

Tenure	**Cultivated in acres**	**Fallow (e.g. for grazing)**
Own land		
Leased in		
Leased out land		
Borrowed out		
Borrowed land		
Total		

6.2 Do you have a title deed for the land you own? 1=yes 2=no

6.3 Marketing of crops harvested in the last season

a) kitchen garden

Crop type (***)	**production (kgs)**	**Qty sold (kgs)**	**price/ kg**	**total sales**	**consumed (kgs)**	**saved for seeds (kgs)**	**Given out (kgs) (Tithes, donations, wages in kind)**
Total							

b) Main field

Crop type (***)	**production (kgs)**	**Qty sold (kgs)**	**price/ kg**	**total sales**	**consumed (kgs)**	**saved for seeds (kgs)**	**Given out (kgs) (Tithes, donations, wages in kind)**
Total							

6.4 Livestock holding

Type	**Stock when you came to Solio**	**Value of stock**	**Stock now**	**Value of stock**
Bulls				
Cows				
Heifers				
Calves				
Goats				
Sheep				
Donkeys				
Pigs				
Chicken				
Ducks				
Guinea fowls				
Rabbits				
Geese				
Turkey				
Total				

6.5 Livestock production and marketing in the last 12 months

Type	Number owned currently	How many did you sell	Average selling price/ unit	**Total income**
Bulls				
Cows				
Heifers				
Calves				
Goats				
Sheep				
Donkeys				
Pigs				
Chicken				
Ducks				
Guinea fowls				
Rabbits				
Ducks				
Turkey				
Total				

Ask for the figures for the last 12 months

6.6 Asset endowment

Asset name	**Number currently owned**	**Year bought/built**	**Current value**
Bicycle			
Car			
Wheel barrow			
Store for farm produce			
Livestock kraal			
Radio			
Mobile phone			
Television			
Computer			
Water pump			
Chemical sprayer/pump			
Sofa seats			
Motor bike			
Tractor			
Ox plough			
Donkey cart			
Lorry			
Water tank			
Others specify……			
Total			

7. Social capital endowments. ***(Membership to a farmer/ development organization)***

Are you a member of any group	1= yes 0= no	
If yes specify the kind of a group	1= farmer group 2= women's group 3= faith based organization 4= community based organization 5=youth club 6= farmer cooperative 7= welfare organization 8=Savings and credit group 9= others specify……..	
Year you first joined / No of years		
Main function of the organization	1=produce marketing 2= input access 3= savings and credit 4=welfare 5= tree planting 6= faith based organization 7= others specify	

8. Household cash flow

8.1 In the last one year have you taken any credit facility? 1= yes 0= no ☐

b) If yes which kind of a credit facility

1= financial

2=in kind e.g. inputs specify…….

3= both financial and in kind (specify)……

c) Where did you get the credit facility from?

8.2 Total household income for the last 12 months

Income type	Did any household member earn from? No= 0, Yes = 1. *If no go to the next row*	Number of units worked (days, weeks, months, times,)	Average income/ unit		Total income
			Cash	In kind	
Agricultural labor					
Casual labor					
Salary					
Pension					
Rent					
Food aid					
Remittances/ Gifts					
Marriage/dowry					
Sale of wood or charcoal					
Sale of fruit					
Petty trade (shops, grocery)					
Transport					
Sale of crops					
Sale of crop residues					
Sale of animal fodder					
Livestock sale					
Milk sale					
Eggs sale					
Sale of other livestock products					
Rented out land					
Proceeds from machine hire					
Total					

Annex 3: Pair wise correlation matrix

```
. pwcorr AGE GENDER EDUCATION SKILLS WEALTH MEMBERSHIP DEPENDENTS DTOWN DWATER, sig
```

	AGE	GENDER	EDUCAT~N	SKILLS	WEALTH~X	MEMBER~P	DEPEND~S	DTOWN	DWATER
AGE	1.0000								
GENDER	-0.5753 0.0000	1.0000							
EDUCATION	-0.4696 0.0000	0.3548 0.0000	1.0000						
SKILLS	-0.2343 0.0010	0.2048 0.0040	0.1160 0.1054	1.0000					
WEALTHINDEX	-0.2682 0.0001	0.2682 0.0001	0.2681 0.0001	0.0456 0.5255	1.0000				
MEMBERSHIP	-0.1528 0.0325	0.1635 0.0220	0.0438 0.5419	0.1612 0.0240	0.0229 0.7502	1.0000			
DEPENDENTS	-0.1573 0.0277	0.1648 0.0210	0.0731 0.3084	-0.0483 0.5017	0.0933 0.1936	-0.0058 0.9354	1.0000		
DTOWN	-0.0144 0.8409	0.0078 0.9140	0.0563 0.4330	-0.0696 0.3326	-0.0858 0.2316	-0.0272 0.7047	0.0267 0.7107		
DWATER	0.3281 0.0000	-0.2228 0.0017	-0.2174 0.0022	-0.1814 0.0110	-0.1712 0.0164	-0.1947 0.0062	-0.0561 0.4344		

	DTOWN	DWATER
DTOWN	1.0000	
DWATER	0.0510 0.4778	1.0000

Source: Survey data

Annex 4: Variance inflation factor (VIF) analysis

Variable	VIF	1/VIF
AGE	1.82	0.54891
GENDER	1.6	0.62491
EDUCATION	1.33	0.75471
DWATER	1.18	0.84731
WEALTHCATEGORY	1.12	0.89632
SKILLS	1.11	0.90307
MEMBERSHIP	1.07	0.93024
DEPENDENTS	1.05	0.95627
DTOWN	1.02	0.97635
Mean VIF	1.26	

Source: Survey data

Annex 5: Breusch-Pagan/ Cook-Weisberg test for heteroskedasticity

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity

Ho: Constant variance

Variables: fitted values of LIVELIHOOD

chi2(1) = 0.79

Prob > chi2 = 0.3744

Source: Survey data

Annex 6: Poisson regression results

Variable	Coef.	Std. Err.	Z	P>|Z|
Age of the household head (AGE)	0.0441	0.0089	4.93	0.000***
Age of the hhh squared (AGE^2)	-0.0004	0.0001	-4.12	0.000***
Gender of the household head (GENDER)	0.0883	0.1013	0.87	0.383
Education of the hhh in years (EDUCATION)	0.0077	0.0124	0.62	0.535
Possession of technical skills (SKILLS)	0.2291	0.0830	2.76	0.006***
Dependents in the hh5 (DEPENDENTS)	-0.0202	0.0244	-0.83	0.407
Membership to a group (MEMBERSHIP)	0.0376	0.0822	0.46	0.648
Wealth in wealth categories(WEALTH)	0.0050	0.0036	1.40	0.160
Time taken to a water source (DWATER)	-0.0062	0.0034	-1.83	0.067*
Distance to town in KMs (DTOWN)	0.0122	0.0121	1.00	0.315
Observations	196			
Wald chi^2	1221.65			
prob>chi^2	0.0000			
Log likelihood	-324.402			
Chi^2 deviance	33.74577			
Prob>chi^2 (185)	1.000			
Pearson chi^2	35.21779			

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

Source: Survey data