EVALUATION OF HOUSEHOLD DECISION MAKING ASSOCIATED WITH SHIFT FROM PASTORAL TO AGRO-PASTORAL FARMING SYSTEMS IN TRANSMARA WEST DISTRICT- KENYA

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DECLARATION AND RECOMMENDATION

Declaration

I declare that this is my original work and to the best of my knowledge has not been presented for publication there before.

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DEDICATION

I dedicate this work to my late dad, Mr. Charles Nyamira and Mrs. Abigael Magembe,

besides my brothers and sisters who are aspiring scientists.

ACKNOWLEDGEMENT

ABSTRACT

The shift from pastoral to agro-pastoral farming system is on-going among the Maasai community in Trans-Mara West district of Kenya. This community has had a long time history in pastoral livelihoods, but are increasingly engaged in the shift, in spite of the Kenyan Government effort to set up co-operative societies for marketing livestock and livestock related products. Essentially, these co-operatives are supposed to trigger extensive expansion in livestock production which in turn could have implication on natural resource conservation. Despite this effort, pastoralists in the area are not sufficiently responsive as evidenced by the ongoing gradual shift. The push and pull factors between the pastoral and agro-pastoral livelihoods necessitates clarity. The shift in livelihoods could be following a rational and economic decision with impacts on the diversity of livestock and crops but empirical evidence is lacking to ascertain this assumption. Evaluating household decision making associated with the shift, may explain the rationale of observed behavior and inform development strategies for such areas. Specific objectives of the study were to compare differences between pastoral and agro-pastoral based livelihoods for: - socio-economic characteristics of practicing households, diversity in crops and livestock enterprises, economic benefits of the farming systems and to determine the factors associated with the shift. Stratified proportionate random sampling procedure was used to get the appropriate sample. Data were collected from a sample of 130 households through interview schedule. Data was subjected to chi square and t-test statistics while diversity of crops and livestock was based on Shannon index. An economic evaluation model was used to compare economic benefits while Heckman two-step model was used to determine the factors associated with the shift to agro-pastoral farming. The findings indicated that agro-pastoral households were older farmers with declining farm size, stronger in social capital and more inclined to diversification of livelihoods. They had better access to credit facilities and extension services. Shannon index of diversity for crops was 0.3 units higher in agro-pastoral farming where unit net economic benefits were 0.02 times greater. The shift from pastoral to agro-pastoral livelihoods was enhanced by more frequent group meetings and farmer trainings, declining land sizes, longer distance to watering points, shorter distance to market and more income from off-farm sources of incomes. The agro-pastorals choice to allocate higher proportion of land for crop production compared to livestock production was enhanced by more distance to watering points, low off-farm incomes, private land ownership, larger family, male dominance, more extension services, shorter distance to the market, less years of crop farming and little interaction with the neighbors.

vi

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

A.F.C	Agricultural Finance Corporation
A.S.A.L's	Arid and semi-arid lands
CAPRi	Collective action and property rights
CBS	Central Bureau of Statistics
COMESA	Common Market for East and Southern Africa
DAO	District Agricultural Office
FAO	Food Agricultural Organisation
FSM ltd	Fineline Systems and Management limited company
IFPRI	International Food Policy Research Institute
ILRI	International Livestock Research Institute
IUCN	International Union For Conservation of Nature
Ksh	Kenya Shillings
LUCID	Land use change impacts and dynamics
MODNKAAL	Ministry of state for development of Northern Kenya and other arid lands
MOFAP	Ministry of Finance and Planning
MOSPALRM	Ministry of special programmes for arid land and resource management
Msc	Master of science
PARIMA	Pastoral Risk Management
SPSS	Statistical Package for Social Scientists
TLU's	Tropical Livestock Units
WISP	World Initiative for Sustainable Pastoralism

CHAPTER ONE
INTRODUCTION

1.1 Introduction

Globally, pastoralism is characterised by keeping large herds of indigenous breeds. In Kenya almost 8 million people depend on pastoral livelihoods (Adeel and Uriel, 2005). Pastoralists own over 70% of Kenyan national livestock herd valued at over US$ 1.55 billion (Fineline systems and Management Company, 2010). These people live in the arid and semi arid lands (ASALS) characterised by high rainfall variability and with recurring droughts which impact on rangeland productivity. In some ASALS, where rangelands receive reliable rainfall pattern which can support crop production, pastoral households have responded by introducing commercial crop production. Consequently, the response has been associated with gradual shift from pastoral livelihoods to agro-pastoral land use systems (Gumbo and Maitima, 2007; Mwang'ombe et al., 2009).

This kind of shift in livelihoods is ongoing in TransMara West district among traditionally pastoral Maasai community, who have had a strong attachment to livestock keeping. In the district, integration of crops and livestock systems has led to competition for land resource between livestock and crops. Adding to land pressure is higher growth rates of population and in-migration to pastoral lands (Coast et al., 2001; Coast et al., 2006; Tangus, 2004; Akinwumi et al., 1996). In pastoral land use, land ownership remains communal, unlike in agro-pastoral land use where, land ownership is private, which may be used for ranching and crop enterprises.

In Kenya, agro-pastoral land use systems have been on increase (Gumbo and Maitima, 2007; Mwang'ombe et al., 2009), but the drivers behind those land use system have not been well understood. Increased conversion of fertile range lands to commercial cultivation in TransMara West district has led to competition for land resource between livestock and crops. Remaining rangelands have been increasingly privatized through sub-division and allocation of rights for ranching and farming enterprises. Moreover, high rates of population growth and in-migration have added to both real and perceived pressures on pastoral lands (Coast et al., 2001; Coast et al., 2006; Tangus, 2004; Akinwumi et al., 1996).

Access to extensive land offering potential for grazing and water resources promote mobility in pastoral production system. Therefore, changes restricting access to these grazing resources increase pastoral vulnerability to drought and loss of livestock assets, which pose threat to sustainability of pastoral-based livelihoods (Coast et al., 2006; Mwangi, 2005). Faced with such threats, many pastoral communities have responded with diversification of livelihoods to agro-pastoralism (Binsbergen and Watson, 2008; Galvin, 2009; Freeman et al.,

2008). The Maasai community in TransMara West district is not exceptional even though the drives behind the shift have not been well understood.

To mitigate some sustainability threats to pastoral livelihoods, the Kenyan government in partnership with the private sector promoted integration of pastoral economy into market economy (Morton and Meadows, 2000; Mochabo *et al.,* 2006). This has been through setting up of co-operative societies in the TransMara district to open ready market for livestock and livestock products trading in order to accommodate financial and social capital. Availability of ready market could be associated with steady incomes and high turnover for pastorals, however, this development strategy has however not been able to support sustainable pastoralism, evidenced by ongoing gradual shift to agro-pastoral based livelihoods (Morton and Meadows, 2000; Mochabo *et al.,* 2006). The shift in livelihoods is pre-sumed to be associated with trade-offs in terms of socio-economic characteristics, diversity of crops and livestock and economic benefits which had to be evaluated.

There is a large body of literature on trade-offs between livelihoods and environment, Ayantunde *et al*. (2008); Freeman *et al*. (2007); Freeman *et al*. (2008); Gerber *et al*. (2009) and Herrero *et al*. (2006), however, these researches did not evaluate characteristic differences in household, institutional and farm features, diversity in crops and livestock and the economic benefits associated with the shift from pro-conservation land use pastoral system to less conservation agro-pastoral system (Griffiths, 2007). This knowledge could inform better understanding of household decision making and trade-offs in the shift from livestock based livelihood assets to livestock-crop integration in a community with known strong cultural attachment to livestock.

1.2 Statement of the Problem

In the TransMara West district in Narok County, the Kenyan Government has been providing incentives to the pastoralists in the quest of developing a sustainable livestock market. These incentives have been in the form of development of co-operative societies for marketing livestock and livestock related products. Essentially, these co-operatives are supposed to trigger extensive expansion in livestock production which in turn could have implication on natural resource conservation. Despite these incentives, pastoralists in the area are not sufficiently responsive. This is evidenced by ongoing gradual shift to agro-pastoral based livelihoods, among a community with traditionally strong cultural attachment to livestock assets and pro-conservation practices. The push and pull factors between the pastoral and agro-pastoral livelihoods necessitates clarity. The shift in livelihoods could be following a

rational and economic decision with impacts on the diversity of livestock and crops but empirical evidence is lacking to ascertain this assumption. Evaluating household decision making and quantifying the trade-offs associated with the shift to agro-pastoral livelihoods may explain the rationale of the observed behavior and inform development strategies for such areas.

1.3 The General Objective

The general objective of this study was to evaluate household decision making process and quantify the trade-off associated with the shift from pastoral to agro-pastoral farming system among Maasai community of TransMara West district in Narok County.

1.3.1 Specific objectives

i.   To compare the differences in socio-economic characteristics between pastoral and agro-pastoral households.

ii. To compare the differences in diversity of crops and livestock assets between pastoral and agro-pastoral households.

iii. To compare the differences in economic benefits associated with pastoral and agro-pastoral farming systems.

iv. To determine factors associated with the shift from pastoral to agro-pastoral farming systems in TransMara West District of Narok County.

1.4 Research Questions

The research questions answered by this study were:

i.   Are there differences in socio-economic characteristics between pastoral and agro-pastoral households in TransMara West District of Narok County?

ii. Are there differences in diversity of crops and livestock assets between pastoral and agro-pastoral households in TransMara West District of Narok County?

iii. Are there differences in economic benefits between pastoral and agro-pastoral farming in TransMara West District of Narok County?

iv. Which factors have been associated with the shift from pastoral to agro-pastoral based livelihoods in TransMara West District of Narok County?

1.5 Justification

Various researches have shown that pastoral economies are under pressure from various internal and external drivers. These pressures are unlikely to diminish and may increase due to

climate variability, sedentary settlement, population increase, change in land policies and the need for social changes that demand income diversification and entry into the cash economy. Therefore, this study targeted to generate imperative information that will elucidate the nature of the shift from pastoralism to agro-pastoralism within particular localities of Maasai community. Information generated by the study will guide policy making process in line with the achievement of vision 2030.

From the study, comparison of socio-economic characteristics between pastoral and agro-pastoral households will form a basis for decision making by farmers. Further, information generated will assist in planning, allocation and distribution of Government resources.

Quantification of crop and livestock diversity will provide insight into household choices in engaging in crop and livestock enterprises. Moreover, crop livestock diversity will act as a framework for further mapping on agro-biodiversity distribution by interested parties such as IUCN.

Comparative quantification of economic benefits associated with the shift from pastoralism to agro-pastoralism will provide insight into the rationale underlying household decision making in farming systems. Determination of the key determinants influencing the shift will enhance better understanding of the household decision making process.

Besides, this study contributes to a pool of knowledge on the shift from pastoralism to agro-pastoralism by the Maasai community. Further, this study will play a major role in bringing into the light what is happening among the Maasai to the attention of Kenyan Government, donors, NGOs, economists and conservationists, just as it has in bringing outside knowledge to the attention of the Maasai. Furthermore, there is no other study that has been done on evaluation of household decision making associated with the shift from pastoral to agro-pastoral farming systems in the area.

1.6 Scope and Limitations of the Study

Only the Maasai community of TransMara West district was covered since they practice both pastoral and agro-pastoral farming systems. Given the fact that the researcher did not know the vernacular language, data collection was done in English. The data collected was for the period 2009 since through observation, this was the period when the shift was prominent. The sample size was arrived at based on 1999 population census since the 2009 population census statistics were not yet published. The Maasai who did not keep livestock but practiced crop cultivation in the area were excluded. This was because of financial constraints

and time frame within which the study was to be completed. Besides, the fact that not all farmers kept records made the study to rely on estimates.

1.7 Definition of Terms

A household- Is a group of individuals living in the same house, eating together and contributing to income. It includes unmarried sons and daughters living away from home. Non-relatives such as employees who reside in the households will be excluded as members.

Agro-pastoralism- Is a land use system in which the Maasai of TransMara district grows crops and integrates it with pastoralism

Diversity- Crop and livestock enterprise variety in numbers and types. It excludes breeds**.**

Farming system- Can be used interchangeably with household livelihoods.

Livelihood- Capabilities, assets and access that jointly determine the living gained by an individual household.

Livestock- It includes cattle, shoats, donkey, pigs, bees and poultry.

Pastoralism- Is a land use system in which the Maasai of TransMara district rear livestock.

Small scale farmer- Is a farmer with less than 40 acres of land (DAO's office TransMara West District)**.**

Trade-off- What pastoralists are willing to give up or gain by becoming agro-pastoralists in terms of socio-economic characteristics, diversity and economic benefits.

Decision- Choice made by households of either remaining pastoralists or shifting to become agro-pastoralists

Decision making- The process of making a choice

Livestock assets- The view of livestock as physical asset (provider of meat, milk, honey) and financial asset (livestock can be sold to earn money).

CHAPTER TWO
LITERATURE REVIEW

2.1 Pastoralism in Kenya

The Maasai community have a long time history in pastoralism, and in Kenya they are known as an indigenous group of people who comprise of pastoralist and semi-nomadic livestock herders. The Kenyan Maasai are ranked after the Somalis to be the second biggest group of pastoralists and among the pastoralists of Southern Kenya, are the Maasai of Transmara West district. As per the 1999 population census the district had a population of 170,592 persons with an inter-censal growth rate of 2.6. With such a growth rate in human population, there's a likelihood that pastoralists traditional dietary habits will change from eating meat, milk and blood to vegetables to cope up with drivers of pastoral pressures. Even though the change in their lifestyle is expected, research has shown that under conditions of good rainfall, the profitability of pastoral operations in terms of incomes alone is much more than those of crop farmers (Herero *et-al*., 2006; Gumbo and Maitima, 2007; Mwang'ombe *et al*., 2009)). This acts as an incentive and a framework upon which we need pastoral activities in our Kenyan economy.

Pastoralism creates and maintains ecosystem health and stability when practiced effectively. It is responsible for a range of ecosystem goods and services, which are enjoyed far beyond the boundaries of the pastoral system itself (WISP, 2008; Homewood *et al*., 2009; WISP, 2006). Based on the new understanding that pastoralism is a multiple use system, rangeland ecology and social science research over the last two decades has re-examined the way dry land livestock keepers actively manage uncertainty in their natural environment. These researches have highlighted the importance of pastoral mobility to sustainable natural resource management in dry lands. It has been suggested that land degradation is rooted in policies that prevent pastoral mobility. Where mobility and customary institutions for natural resource governance are intact, dry lands tend to be in good health (Niamir-Fuller, 1999; Scoones, 1994).

Pastoralists usually view their animals as a store of wealth and value. This is associated with weak banking institutions in pastoral lands. Traditionally, the term pastoralism encompassed shoats, cattle and donkey, but currently it has been observed that most of the households in pastoral land adopt poultry as part of livestock. Poultry production was not part of the Maasai culture, neither was it part of their diet (WIBD, 2005; BurnSilver *et al*., 2009).

2.2 Trade-off Assessment

The concept of trade-off has been applied in wetland conservation (Burlando and Dahlberg, 2005), marine ecosystems and range lands. In agricultural economics, the term trade-off is derived from the notion that benefits from different agricultural enterprises do not fall simultaneous. So in case income from one enterprise falls, it will be compensated by rising income of another enterprise. It is therefore, a risk management strategy a farmer employs to increase and stabilize farm incomes. Enterprise diversification provides an opportunity to exploit potential complementary relationships between enterprises through improved utilization of scarce resources (Meuwissen, 2001). The term trade-off is derived from the principle of "opportunity cost". Trade-off analysis applies this principle to derive information about sustainability of production systems by quantifying the interrelationship among indicators implied by bio-physical process and economic behavior of farmers (Cruz *et al*., 2006; Antle *et al*., 2004). In this study the term trade-off was used to show what pastoralists are willing to give up or to gain by becoming agro-pastoralists in terms of diversity, socio-economic characteristics and economic benefits. The trade-off was measured by variations in socio-economic characteristics, diversity and net economic benefits associated with the shift from pastoralism to agro-pastoralism.

Campbell *et al*. (2000), using simulation model realized that pastoral systems give higher economic returns than other systems in Zimbabwe. Similarly, (Barret, 1992), using replacement cost method realized that gross revenue from communal cattle was higher than that of commercial cattle implying that high stocking rates and herd diversification make economic sense. This study sought to establish whether crop and livestock enterprise diversification in TransMara West district made economic sense.

According to Lasco *et al*., (2006), it is possible for farmers to obtain higher yield and income as a result of adaptation options such as the use of appropriate crop varieties. However, the study sought to quantify economic benefits associated with adoption of crop cultivation in pastoral lands.

Akinwumi *et al*. (1996) assessed crop and livestock enterprise trade-off using multi objective problem function. The results showed that a livestock farmer cannot engage in crop production without losing some income from livestock. This study aimed at finding what was happening in TransMara West district when pastoralists engage in agro-pastoralism in terms of diversity and economic benefits.

2.3 Determinants of Crop and Livestock Diversity in Kenya

In the available literature on agro-biodiversity, (Momsen and Oakley, 2004) documented on the interrelationships between gender, agro-biodiversity, the use and preferences for improved and local crop varieties using the number, types, and varieties of crops grown in the fields and home gardens. The preference to grow a variety of crops in TransMara District of Narok County was determined.

Kariuki *et al*. (2007) identified the dominant crop livestock diversification patterns in relation to income and manure use in Rift valley community of Kenya using principal component analysis. It was realised that households who kept improved cattle and grew fruits were found to earn higher incomes. Besides, factors such as education, family size, participation in farmer groups and access to training centres were key in adoption of crop-livestock diversification patterns. However, this study sought to know the contribution of these factors towards the ongoing shift.

William and Yanda, (2010), noted that pastoralists were diversifying into crop production to supplement food shortages during drought season. It was also realized that most of the pastoralists kept cattle for prestige and wealth reasons. Shoats were kept for medicinal purposes, income generation and food security. Besides, donkeys were kept for carrying luggage. Further, inaccessibility to credit facilities accelerated adoption of crop cultivation. However, this study intended to validate whether these diversities were kept and which diversity/ livestock type was most preferred over the other in TransMara District. Besides, access to credit facilities was a variable to be investigated whether it influenced the shift from pastoralism to agro-pastoralism.

2.4 Factors Influencing the Shift from Pastoralism to Agro-pastoralism

Diversification often involves a change along one or more of the following dimensions; an expansion of the set of income sources, a change in the key sources of income, and/or a change in location (Homewood *et al*., 2009). Formal ownership of livestock in a household unit is vested within the male household head (WIBD, 2005). The male household head therefore makes decisions on disposal or acquisition of additional livestock. This has increased women and children's vulnerability to poverty and food insecurity. Freeman, (2008) had shown that women are likely to diversify more than males.

Several studies have been conducted to assess farmer's decision making towards participation in diversification. The decision of an individual to participate is binary/dichotomous dependent variable in nature (participate or not participate), which is

influenced by some explanatory variables. Akinwumi *et al*. (1996) observed that in areas where agro-pastoralism is emerging, the perceived nature of the trade-off between crop and livestock enterprises strongly influences ones decision to adopt agro-pastoralism or remain in pastoralism and this was to be empirically ascertained in TransMara district.

According to WIBD (2005), a greater percentage of critical resources such as livestock were owned by men and boys in Ethiopia. This left women with little ownership of cattle thus they tended to diversify more to crop cultivation than men. Simtowe (2009), in Malawi noted also that female households are more likely to diversify, besides access to credit. These studies acted as a framework upon which the contribution of gender and access to credit in the on-going shift were investigated in Transmara West district.

Arunga *et al*. (2009); Coast, (2002); Little, (2001), observed that farm household characteristics such as gender, livestock assets (TLUs), education level of the household head and extent of diversification were significant in determining household incomes. Kariuki *et al*. (2007) also noted that households with better access to knowledge on new ideas and varieties, market and infrastructure are more likely to choose high-return livelihood portfolios. Besides, the extent of engagement in particular farm activities, acres devoted to particular crop types as well as livestock holdings by animal types are indicators of heterogeneity among households in choosing livelihood diversification strategies. The influence of these factors (gender, access to knowledge and ideas, market and financial infrastructure, farm size) in the shift was determined.

According to Ellis (1998), assets both facilitate and are facilitated by diversification. Those pastoralists who are observed to hold more assets in terms of livestock are pulled into other alternative income sources. They are usually capable, for example to enrol their kids in school. Therefore, they are able to attain high paying positions of employment, which in turn improves the living standards of the whole family through remittances (Coast, 2002). On the other hand, those who are not well endowed with assets are pushed away from pastoralist production. They seek manual and unskilled jobs and are most dependent on the natural resources for their livelihoods. These 'former' pastoralists will however revert back to pastoral production when they have accumulated enough finances to be able to purchase livestock. In this study, the significance of herd sizes to the shift from pastoralism to agro-pastoralism was investigated.

2.5 Quantification of Benefits associated with Pastoralism and Agro-pastoralism

According to the study done by Tshering (2002) in Honduras, farm profitability is the difference between gross income and operating costs. It was realized that the difference in yield for the traditional and modern farmers was statistically not significant. Further, a sensitivity analysis on enterprise gross margin indicated that, gross margins were more sensitive to yield and price changes for traditional farmers as compared to modern farmers. Nevertheless, profitability in TransMara district was considered as one of the economic benefits associated with the shift which required to be quantified.

Akinwumi *et al*. (1996) using farm budgeting procedure examined the profitability of both crop and livestock enterprises under different systems of management and it was realised that agro-pastoralists had higher gross margin than crop farmers. The study had taken into consideration the fixed costs besides taxes paid on land which was not considered in TransMara West district. This is because some households had land title deeds whereas others used communal lands for grazing.

Ajani *et al*. (2008) conducted a study on livelihood and rural wealth distribution among farm households in Western Kenya and it was realised that majority of the households owned chicken followed by cattle and shoats. Further, total revenue model was used to evaluate annual household wealth. Wealth included revenue from crops, livestock, farm machineries and income from rent. In this study wealth included the sum of net benefits associated with various reasons for farming.

WISP (2008), used total economic value to quantify benefits associated with pastoralism. This method took into consideration both direct and indirect benefits. However, this study considered only the direct/tangible benefits. Mdoe and Mnenwa (2008) assessed the economic value of pastoralism in Tanzania using the same method (Total economic value) and it was observed that goat products fetched more returns as compared to cattle following a one year sales values. However, the study revealed that agro-pastoralism exhibited more net benefits compared to pastoralism in Transmara West district.

2.6 Theoretical Framework

2.6.1 Livelihood Diversification Theory

The theory holds that people undergoing diversification alter their activities, location, social identity, aspirations and primary sources of income (Homewood *et al*., 2009). These separate and twinned processes do not take place in any particular sequence and more often they overlap. The theory holds for households living mainly from herding and to some extent

diversifying into other alternative sources of income (Freeman, 2008; Arunga *et al.*, 2009). Changing of social identity and aspirations of pastoralists, involves change of attitude to western education and perception to women roles (WIBD, 2005). On the other hand, change of pastoral activities implies limited mobility (Lesorogol, 2008; Campbell, 2000) thus catalysing intensive land usage. The theory is pegged on the fact that sedentarization occur due to push factors (pastoral exclusion in terms of prime grazing lands and watering points) and pull factors (access to education, health and social services). Moreover, poverty, loss of opportunities and means to pursue those opportunities accelerates sedentarization (Coast *et al.*, 2006).

2.6.2 Random Utility and Choice Theory

This theory states that preferences are not directly observable, but can be discovered through behaviour observation. It is assumed that preferences remain unchanged as behaviour is observed. Ones preference to shift from pastoralism to agro-pastoralism cannot be observed but the behaviour associated with this shift can be observed such that, a decision maker i must choose from a set of mutually exclusive alternatives, n = 1…... n. The decision maker i obtain utility U_{in} from each choice made. Given a set of alternatives as stated above (n=1…, n) a rational individual will chose an alternative that provides the highest utility. The model is constructed on the premise that the decision maker chooses the choice that maximizes utility. The random utility function is expressed below as given by (Simtowe, 2009)

$U_{in} = V_{in} + \varepsilon_{in} \ \forall n$…………………….. ………….. (i)

Where; V_{in} is the deterministic component which can be calculated based on observed characteristics and ε_{in} is the unobserved random or stochastic error component. The error component is never observed which makes it difficult to have enough information that would allow one to predict a specific individual's choice at each occasion. Regression models can be used to make predictions about the patterns of choices over many individuals and many choice occasions. The probability of a decision maker *i* choosing alternative *k* among *n* alternatives is expressed as follows;

$P_{ik} = Pr \ (U_{in} > U_{ik} \ \forall \ n \neq k$

$Pr \ (V_{ik} + \varepsilon_{ik} > V_{in} + \varepsilon_{in} \ \forall \ n \neq k$ ……………………………… (ii)

The utility specified above under a random utility modeling framework can be extended as follows:

$V_{ik} + \varepsilon_{ik} = \lambda_{ik} \beta + \varepsilon_{ik}$ ……………………………………… (iii)

Where; λ is a vector of characteristics which influence the choice of a livelihood strategy, β is the coefficient vector and as stated earlier ε_{ik} is the term for random disturbances with an extreme value distribution. The estimation of equation (ii) is based on the assumption that each of the random components "*in*" in the utilities is distributed independently.

2.7 Conceptual Framework

The conceptual framework in Figure 1 outlines the conceptualized interrelationships in the study, the key variables involved and how they were interrelated. The reasoning was that, some households choose to shift to agro-pastoralism while others choose not. The decision to shift to agro-pastoralism was assumed to be determined by a number of factors: household factors (education, age, gender, household size), financial (off-farm income, crop and livestock incomes) physical and institutional factors (distance to watering points, distance to market, crop and livestock diversity, land tenure, farmer trainings and extension services, credit access and group membership).

For example, gender of household head may influence the ability of the household to own assets such as livestock and power to make major decisions regarding agricultural production. So, depending on who makes decisions, a household can decide to remain pastoral or become agro-pastoral. Off-farm income enunciates the choice and ability to shift to agro-pastoralism, but the decision whether to shift or not lies within an individual. Group involvement ensures accessibility to credit, equipment and collective marketing which is more effective than individual marketing, thus depending on whether a household belongs to a group or not will determine his/her decision to shift to agro-pastoralism. Land tenure also could influence the shift given that households with private land ownership tenure system can easily prove direct ownership unlike communal land ownership, for which there is no direct claim to land by the individual households.

Finally, the decision made (to shift to agro-pastoralism or not) determines household livelihoods. These livelihoods (pastoralism and agro-pastoralism) are associated with trade-offs in terms of socio-economic characteristics, crop and livestock diversity besides economic benefits which were investigated.

Institutional factors	**Physical factors**	**Household factors**	**Financial factors**
• Title deed	• crop and livestock diversity	• Education	• Off farm-Income
• Credit access	• Farm size	• Gender	• Income from crops
• Farmer trainings and extension service	• distance to water points	• Age	• Income from livestock
• Group membership	• distance to markets	• Household size	

Household decision making

Pastoralism
- Socio-economic characteristics
- Diversity in livestock
- Economic benefits

← – – – Trade-off – – – →

Agro-pastoralism
- Socio-economic characteristics
- Diversity in livestock and crops
- Economic benefits

Figure 1: Conceptual framework
Source: Own conceptualization (2011)

CHAPTER THREE
METHODOLOGY

3.1 Study Area

This study of the shift from pastoral to agro-pastoral farming was conducted in TransMara West District of Narok County. The area was selected for exemplifying the ongoing shift in livelihoods among a community with traditionally strong cultural attachment to livestock assets and pro-conservation practices. It is an area where government support to development of livestock market opportunities have been less successful in sustaining livestock based livelihoods. To mitigate some sustainability threats to pastoral livelihoods, the Kenyan government in partnership with the private sector promoted integration of pastoral economy into market economy by setting up co-operative societies to open ready market for trading of livestock and livestock products (Morton and Meadows, 2000; Mochabo *et al.,* 2006).

The district lies on the south-western part of Rift Valley Province between Latitude 0° 50' and 1° 50' South and Longitude 34° 35' and 35° 14'. The topography of TransMara West district comprises three major categories:- the highlands which lie between 2,200m and 2,500m above sea level, the plateau which rises from 1524 to 2200m above sea level and the lowland which lie below 1524m above sea level. The lowland receives 1000mm of rainfall per year.

The district has seven divisions covering an area of about 2,846.40 square kilometers with an estimated population of 170,591 (1999 census), growing at a rate of 2.23% and has a population density of 60 people per square Kilometer (MOFAP, 1999) with an estimated poverty index of about 40% (MOFAP, 1999).

The study area is estimated to have 14517 households (in the eight locations of interest) with an average household size of 5 people (MOFAP, 1999). Settlement patterns in the district correspond to land use, land tenure and urbanization. Settlement is sparse where large stocks of livestock are reared, but comparatively denser in areas where crop farming is practiced and small stocks of livestock reared.

3.2 Sample Size

The needed sample size was calculated from the approach of Anderson *et al*. (2007):

$$n = \frac{(z_{\alpha/2})^2 \, p * q}{E^2}$$

Where;

n = Sample size,

Z= confidence level (95% in this case)

$z_{\alpha/2} = 1.96$

P^* = proportion of the population

$q = 1 - p^*$,

E= allowable error

In computing n, $P^* = x / N$

Where x is the population (households) involved in pastoralism and agro-pastoralism, N is the total population (households) in the eight locations in Kirindoni and Lolgorian divisions. From consultation with the extension service providers in the area and according to the DAO's office, x was determined to be 1228 and N to be 14517 (MOFAP, 1999). The proportion (p^*) ($x/N = 1228/14517$) is thus 0.08459. With the desired margin of error (E) set at 0.05, the sample size needed was estimated at 119 from

$$n = 0.08459 * 0.91541 * \left[\frac{1.96}{0.05}\right]^2 = 118.9 \approx 119$$

An additional 11 respondents were included to cater for non and invalid responses that are common with cross sectional survey interview administration. Consequently, a sample size of 130 respondents was used.

3.3 Sampling Procedure

The study used stratified proportionate random sampling procedure. Within TransMara district, the divisions were stratified according to agro-ecological zones. Kirindoni and Lolgorian divisions were selected because of having prominent pastoral and agro-pastoral farming households within the same agro-ecological zone. 8 locations among the two divisions were randomly selected. The locations were further stratified into two namely: - pure pastoralism and a mixture of pure pastoralism and agro-pastoralism. Lastly, random selection of the respondents within the locations was made proportionate to the population of each location to obtain the required sample size. The needed proportionate sample in a location was computed from the households in a location divided by sum of all households in eight locations them multiplied by the needed sample estimate of 130 households, as illustrated in Table 1.

Table 1: Distribution of questionnaires among respondents

Locations	Households (n)	Sample proportion obtained (n)
Kimintet	985	9
Oldonyo orok	1007	9
Moyoi	1084	10
Emurua dikirr	1268	11
Olorien	1447	13
Angata	1574	14
Emarti	3446	31
Murkan	3706	33
Total	14517	130

3.4 Data Collection

Data collection used interview schedule. Both large scale and small scale farmers were contacted. For those farmers who did not keep records, recall method was relied upon to get information.

Secondary data such as the number of households in the area, various crops grown in the area, and the total population per location was collected from the Divisional and District Agricultural extension offices and the District development office in TransMara West district. Data for objective one included household age, household size, gender, education level, frequency of group meetings, farmer trainings, distance to watering points and market, extension services and income from other sources of incomes.

Data for objective two included, crops and livestock assets (in numbers and types and classes) and land sizes (acreages). The livestock unit's used in the study was sourced from the District agricultural extension office.

Data requirements for objective three included livestock live weights, inputs and outputs quantities and prices, labour requirement, sources of credit in the area and interest rates charged, inventory of crop and livestock assets at the beginning and end of the year of survey. Because most farmers did not keep records, therefore a recall on month to month approach, field observation and field estimation was used to reduce the limitation of memory recall.

Data collected for objective four included:-household characteristics (Age, family size, off-farm sources of incomes, gender and education level), institutional factors (land tenure system, access to credit, group meetings), physical factors (distance to market and watering points, asset owned) and farm factors (herd size, farm size).

3.5 Specification of the Empirical Models

3.5.1 Comparative analysis of socio-economic characteristics

Data in scale measurements with normal distribution was subjected to t-test statistic. Nominal and count data were tested for statistical differences using Chi-Square test (Allahyar *et al.,* 2010; Allahyar *et al.,* 2011).

3.5.2 Comparative determination of diversity in livestock and crop assets

Chi-square and t- tests statistics were run to detect any statistical difference in diversity of crops and livestock assets between pastoral and agro-pastoral systems. Diversity was computed using Shannon index in order to account for both species dominance and evenness (Gizawa, 2006). This is unlike other indices such as Margalef index which only measures species richness. The Shannon index was used to show diversity distribution pattern to which monetary value was attached (Kaitibie *et al*., 2007):-

$$\text{Crop diversity (CPD)} = -\sum_{i=1}^{n} \propto_i \text{In} \propto_i \quad \text{.. (i)}$$

Where: Cd ≥ 0, $\propto_{i\,=}$ area share occupied by the ith crop enterprise in A_i.

$$\text{Livestock diversity (LVD)} = -\sum_{i=1}^{n} \theta_i \text{In} \theta_i \quad \text{………………………….. (ii)}$$

Where: θ_i =share of the Total Livestock Unit ($TLu_i / \sum_{i=1}^{n} TLu_i$), $TLu \geq 0$

TLu_i=the total livestock unit up to the ith livestock type. The livestock types include cows, goats, sheep, donkey and poultry.

The index ranges from 0 to 1 whereby a diversity index of 1 means high diversity whereas 0 means no diversity. The outcome of the indices was subjected to t test statistics to make inferences on crops and livestock diversity between pastoral and agro- pastoral systems (Donnermeyer *et al*., 2002; Perfecto *et al.,* 1994).

3.5.3. Quantifying economic benefits

An economic evaluation model based on the approach of Ayalew *et al*., (2003a, b) was adopted to compute the economic benefits from physical capital, financing and security/insurance.

Valuing physical benefits from livestock and crops (crop sales)

The sum of monetary values of meat, milk, and honey and eggs production gave the gross output of the kth herd.

$$G_k = YM_k + MM_k + MH_k + ME_k \dots\dots\dots\dots\dots\dots\dots\dots \text{ (i)}$$

Where; G_k = Monetary gross output of the kth herd,

YM_k = Sum of monetary values of net meat production,

MM_k = Sum of monetary values of net milk production,

MH_k = Sum of monetary values of net honey production and

ME_k = Sum of monetary values of net egg production.

The value of livestock kept for meat production was calculated as follows;

$$Y_K = FS_k - IS_k + S_k - P_k + OT_k - IT_k + C_k \dots\dots\dots\dots\dots\dots\dots \text{ (ii)}$$

Where; Y_K = Monetary net production of livestock in (kgs) of the kth herd,

FS_k = body weight of livestock in (kgs) of the kth herd at the end of the year,

IS_k = body weight of livestock in (kgs) of the kth herd at the start of the year,

S_K = body weight of livestock in (kgs) of the kth herd sold out during the year,

P_k = body weight of livestock in (kgs) of the kth herd purchased during the year,

OT_k = body weight of livestock in (kgs) of the kth herd transferred out during the year,

IT_k = body weight of livestock in (kgs) of the kth herd transferred in during the year,

C_k = body weight of livestock in (kgs) of the kth herd slaughtered during the year.

Total value added of the kth herd will be obtained by deducting total purchased inputs (l_{kj}) from gross output in monetary value (G_K) as follows

$$VA_K = G_K - \sum l_{kj} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots \text{ (iii)}$$

Gross margin analysis was used to get the physical economic benefits from crops. This analysis has been adopted by (Ajani *et al*., 2008; Abubakar *et al*., 2007; Cairo *et al*., 2009) and is stated as follows:-

$$GM = \sum_{i=1}^{n} (PyiYi - PxiXi) \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots \text{ (iv)}$$

Where: Yi = quantity of product (s)

Pyi = unit price of the product(s).

Xi = quantity of inputs (s)

Pxi = Unit price of the input(s)

i=1……n

Σ = Sigma

Valuing financing benefits from livestock and crops

Livestock and crops helps to adjust the consumption and savings of the household's income over time by balancing the current cash needs against anticipated cash needs of the future. The financing benefits associated with livestock were estimated based on the value embodied in the herd and the opportunity of using the animals for the specific purpose at the desired time without having to pay in the form of interest rate. Thus benefits for financing (F_{KL}) of the kth herd were determined as follows

$$F_{KL} = OM_K \times f \text{.. (v)}$$

Where; OM_K=Monetary value of stock outflow ($C_K+S_K+OT_K$) and financing factor (f). f represents interest rates based on the opportunity cost of borrowing credit in the locality.

C_k= body weight of livestock in (kgs) of the kth herd slaughtered during the year.

S_K= body weight of livestock in (kgs) of the kth herd sold out during the year

OT_k= body weight of livestock in (kgs) of the kth herd transferred out during the year.

It was assumed that some households might require liquid cash to pay school fees, medical bills and even for re-investment, thus there's a likelihood that they sell or lease out crops in the field to get cash. These financing benefits associated with crops (F_{KC}) were arrived as follows:-

$$F_{KC} = OM_K \times f \text{.................................... (vi)}$$

Where: OM_K=Monetary value of crops sold while in the field and f will be interest rates for credit in the area which was based on the opportunity cost of borrowing credit. The opportunity cost of credit was sought from the available credit service providers (A.F.C., Kenya commercial bank and Co-operative bank). Informal credit institutions were at reach by farmers, however, formal credit was common. There was insufficient evidence to apply estimates of interest rates from the informal credit market, as most farmers did not know the interest rates (Figure 3). The observed rate of 10% charged by AFC, which is the major credit provider in the area, was used. AFC charged this rate (Kibaara, 2006) for short to medium term credit cash during the study period. A chi-square test was applied to determine whether there were differences in interest rate awareness and credit provision between pastoral and agro-pastoral households.

Valuing insurance /security benefits from livestock and crops

It was assumed that all livestock and crops were available to provide household security through liquidation at any time if need arises. On this assumption, the Security benefits from livestock (SKL) were based on the value of sum weights of all livestock herds as follows:-

$$S_{KL}=W_{KL} \times S \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\text{(vii)}$$

Where W_K=Monetary value of weighted current stock of kth herd and S = insurance factor of the study area based on opportunity cost of insurance.

The insurance benefits from crops were based on the assumption that households keep crop produce in store for quite some time before converting them into liquid cash. Thus crop insurance benefits were computed as:-

$$S_{KC}=W_{KC} \times S \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\text{(viii)}$$

Where: $S_{KC} =$ Security benefit from crops, W_{KC}=Monetary value of unsold crop produce in store and S = insurance factor of the study area based on opportunity cost of insurance, however, an opportunity cost of insurance did not exist in the area, as insurance services were inaccessible to the farmers. This concurred with findings of Ayalew *et al.,* (2003b), Bebe *et al.,* (2002), Obare *et al.,* (2003) and Kosgey *et al.,* (2004a). However, in relation to index based insurance whose aim is to protect farmers against weather relate losses such as livestock mortality, Mude (2010) proposed a premium of 3.25% e chargeable on the monetary value of livestock insured in the ASAL areas. This is applicable only when the predicted mortality rate is greater than 15%, implying that if the predicted mortality rate is below the strike point (15%), farmers are never compensated. So, an insurance factor of 3.25% was used in this study.

Net benefits

The net benefits from raising livestock were given as the sum of value added VA_K, benefit from financing (F_K) plus benefit from insurance (S_K).

$$NB_{KL}=VA_K+F_{KL}+S_{KL}\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\text{(ix)}$$

The net benefits from crops were given as the sum of gross margin (GM) associated with crops, benefit from financing (F_K) plus benefit from insurance (S_K).

$$NB_{KC}=GM+F_{KC}+S_{KC}\ldots\ldots\ldots\ldots\ldots\ldots\ldots\text{(x)}$$

Unit net benefit for agro-pastoralists was the combination of unit net benefits from crops and livestock, whereas for pastoralists were unit net benefits from livestock. It is worth noting that the contribution of skins to gross benefits was negligible because a small proportion

of animals were slaughtered at home that solely contributed to skins sold by the farmers, an observation already made in pastoral herds by Kosgey *et al.,* (2004a).

Unit net benefit

It was assumed that for a household to get a certain level of output which is associated with different economic benefits, they used factors of production (land, labour and capital). In this case land was treated as a fixed input. Both hired and family labour were considered and assumed to have equal productivity. Also all farmers were assumed to have same production technology. Prices which were used prevailed during that production season for each of the enterprises.

Thus these factors of production were accounted for in order to get the appropriate productivity measure. The per unit net benefit was arrived at by dividing the total net benefits by the average price of hiring in/lending out land in the area (Ayalew *et al.*, 2003b). The obtained unit benefit values were subjected to t- test for any statistical difference in net economic benefits between the pastoral and agro-pastoral households in their livelihood sources. This is because a t-test has been used to compare statistical mean differences between two independent samples (Anderson *et al.*, 2007).

3.5.4. Determination of factors associated with the shift from pastoral to agro-pastoral livelihoods

Literature is rich on quantification of income diversification using econometric models such as censored Tobit model (Karugia *et al.*, 2006), OLS (Babatunde and Qaim, 2007), Generalized linear regression analysis (BurnSilver *et al.*, 2009) and Multinomial logit.

Heckman two stage and double hurdle models (Matshe and Young, 2004; Lansink *et al.*, 2000) have been used to determine the factors influencing ones decision to participate in diversification and the extent of participation. However, in this study a Heckman two- step model was used. This is because the model works well when normality assumption is upheld, moreover, it provides guidance on which variables to be included in the first and second steps respectively (Obayelu *et al.*, 2009). The two step procedure was chosen for estimation so as to correct the sample selectivity bias as per Heckman (1979). Both participation and extent equations were estimated simultaneously. The variables included in the model were age, farmer training, gender, off-farm income, education level, herd size, individual land tenure, frequency of group meetings, distance to market, extension services, household size, land size, distance to watering points, experience in crop farming, neighbour influence and credit access.

Marginal effects of variables were arrived at after post estimation of selection equation. The marginal effects were used for interpretation, since coefficients of both selection equation and outcome have no direct interpretation. The reason is that they are just values that maximize the likelihood function. Marginal effects have direct interpretation (Heckman, 1979). Therefore, this objective was modelled as two separate decisions: - i) Whether or not to shift to agro-pastoralism (ii) the extent of the shift.

The reason for separation was that these decisions are twofold. First, due to social or psychological drives, the individual may prefer not to engage in agro-pastoralism. Second, an individual may be a potential diversifier but for certain levels of relevant variables, decide not to diversify. The former represents abstention, the latter a corner solution. Heckman (1979) proposed a two-step procedure which only involves the estimation of a standard probit and a linear regression model. The two equations for the two steps were specified as follows:

Selection equation (Probit)

Participation decision $= \beta_0 + \beta_1*(agehh)_i + \beta_2*(off\text{-}farminc)_i + \beta_3*(educlevel)_i +$
$\beta_4*(totherd)_i + \beta_5*(hhsize)_i + \beta_6*(owntd)_i + \beta_7*(freqmet)_i + \beta_8*(dstmkt)_i +$
$\beta_9*(noconta)_i + \beta_{10}*(dstwater)_i + \beta_{11}*(crdtaces)_i + \beta_{12}*(traintim)_i +$
$\beta_{13}*(genderhh)_i + \beta_{14}*(farmsize)$…..…...............................$+ \varepsilon_1$ (i)

Outcome equation (Simple OLS)

Proportion of land allocated to crop production $= \beta_0 + \beta_1*(agehh)_i + \beta_2*(off\text{-}farminc)_i + \beta_3*$
$(educlevel)_i + \beta_4*(totherd)_i + \beta_5*(hhsize)_i + \beta_6*(owntd)_i + \beta_7*(freqmet)_i +$
$\beta_8*(dstmkt)_i + \beta_9*(noconta)_i + \beta_{10}*(farmsize)_i + \beta_{11}*(dstwater)_i +$
$\beta_{12}*(crdtaces)_i + \beta_{13}*(traintim)_i + \beta_{14}*(genderhh)_i + \beta_{15}*(ninfl) +$
$\beta_{16}*(cropfayr)_i$.$+ \varepsilon_2$ (ii)

Table 2 below presents the variables fitted with this model

Table 2: Description of variables and expected signs

Variable	Full definition	Description of the variables	Expected Sign
Part	Participation decision	Dependent variable for selection equation. (Dummy)	None
Lsize	Land size	Dependent variable for outcome equation (Proportion of land allocated to crop and livestock enterprises)	None
dstmkt	Distance to the market	Time taken (hours) to the nearest market	+
agehh	Age in years	Household head age (Years)	+/-
dstwater	Distance to watering point	Time taken (hours) to the nearest watering point	+
genderhh	Gender	Sex of the household head (Dummy)	+/-
noconta	Extension services	Number of contacts with extension officers	+
owntd	Land title deed	Possession of land title deed by a household	+
freqmet	Frequency of meetings	Frequency of group meetings by a household (Numbers)	+/-
cropfayr	Experience	Number of years in crop farming	+
ninfl	Neighbourhood influence	Neighbourhood influence to an household	+/-
off-farminc	Off-farm income	Income from off-farm income sources	+
crdtaces	Credit access	Households access to credit services	+/-
totherd	Total herd size	Households number of livestock	+/-
farmsize	Total farm size	Household farm size in acres	+/-
traintim	Farmer training	Number of times attended by a household	+
wealthpe	Wealth perception	Household perception towards livestock as a source of wealth (Dummy)	+/-
educlevel	Education level	Farmer's level of education	+
hhsize	Household size	The size of households sampled	+

Source: Survey data, 2010

CHAPTER FOUR
RESULTS AND DISCUSSIONS

This chapter presents the findings for each of the research questions that guided this study. These were comparisons between pastoral and agro-pastoral households for their socio-economic characteristics, diversity of their crop and livestock enterprises and the economic benefits derived from their farming. The last section present the factors identified to be associated which the shift from pastoral to agro-pastoral farming systems in TransMara West district of Kenya.

4.1 Comparison of socio-economic characteristics between pastoral and agro-pastoral households

Table 3 presents the socio-economic characteristics of the sampled households. The agro-pastoral households were older (P<0.05) with larger family, smaller farm size and were having more frequent group meetings and extension services compared to pastoral households. Agro-pastoral households do live sedentary life with strong social capital (Abele *et al.,* 2009) which they derive from group meetings. For these households (agro-pastoral), land ownership is important for farming and a larger family is essential for provision of the needed farm labour (Rana *et al.* (2000). In sedentary farming, the need to apply production technologies in farming is higher for increasing productivity and value of agricultural production, which explains greater interaction with the extension services, as previously noted by Onemolease and Alakpa (2009).

Table 3: Comparison of socio-economic characteristics of Pastoral and Agro-pastoral households using t-test

Characteristics	Pastoral households (n=53)	Agro-pastoral households (n=77)	t-test
Age (Years)	41	44	1.991**
Household size (n)	6	7	2.172**
Off-farm income (Ksh.)	4109.17	5893.72	2.066**
Farm size (Acreage)	48.67	34.14	2.037**
TLU's units	101	102	0.084
Farmer trainings (n)	1	2	4.389***
Group meetings (n)	0.8	1.8	3.562***
Number of extension visits per year (n)	0.7	1.6	3.593***
Distance to market (Hrs)	1	2	-1.633
Time taken to reach water points (Hrs)	0.8	1.6	4.011***

Means are significant at: ** 0.05; *** 0.001, probability levels

Compared to pastoral households, the agro-pastoral household had higher off-farm income (P<0.05), which can be associated with diversification of livelihoods portfolios (Liyama, 2006). In this sample, farmlands were smaller (P<0.05) for agro-pastoral households though livestock units kept were not different (P>0.05). A possible explanation for this observation is that agro-pastoral households have embraced private land ownership tenure system and can prove direct ownership unlike the pastoral households still practicing communal land ownership, for which there is no direct claim to land by the individual households.

Access to watering points was better (P<0.05) for pastoral household because water is important for their livestock, though access to market was not different (P>0.05) between agro-pastoral and pastoral households. The common water sources in the area included seasonal rivers and water pans constructed in the pastoral areas for livestock.

Table 4 shows household and institutional characteristics of the pastoral and agro-pastoral households. The Chi-Square tests showed a significant difference (P<0.05) in education levels, but over 75% of household heads had not attained post primary education, while 26% to 34% had no formal education among either pastoral or agro-pastoral households. This low education levels could be attributed to the tradition of young Maasai males engaging

in fulltime livestock herding, because livestock is a key source of wealth as indicated by the majority of respondents (over 80% in Table 4) and the community's strong cultural attachment to livestock. Moreover, provision of education facilities in the area could be constrained by poor infrastructure and non-sedentary life style (Coast, 2002).

Table 4: Comparison of socio-economic characteristics between pastoral with agro-pastoral households using chi-square test

Characteristic	Frequency (%) of pastoral households	Frequency (%) of agro-pastoral households	Chi-Square test value
Gender			
Male	88.7	94.8	1.75**
Female	11.3	5.2	1.66**
Education level			
None	34.0	26.0	2.33**
Primary	45.5	50.9	0.58**
Secondary	11.3	22.1	3.57
Tertiary	3.8	3.9	0.00
University	0.0	2.6	1.40**
Credit access			
Yes	22.6	48.1	8.63**
No	77.4	51.9	8.63**
Livestock is source of wealth			
Agreeing	80.1	84.4	0.49**
Neutral	17.0	13. 0	0.74**
Disagreeing	1.9	2.6	0.70

Means significant at: ** 0.05 probability level.

Gender distribution indicated dominance of the males in both pastoral and agro-pastoral households, though females were fewer ($P<0.05$) in the agro-pastoralist households. Some studies have suggested that gender is an important parameter in livelihood diversification (WIBD, 2005; Freeman, 2008; Simtowe, 2009), which could apply to this sample population.

Household that had accessed credit were over 2 times higher ($P<0.05$) among agro-pastoral compared to pastoral households. This provides evidence of a difference in an

institutional factor to link with the shift to agro-pastoralism. In the area, majority of households sourced credits from Agricultural Finance Corporation (AFC) and a few from Kenya Commercial bank, Cooperative Bank and local money lenders (Figure 5).

4.2 Comparison of the diversity of crops and livestock

Figure 2 presents the frequencies of pastoral and agro-pastoral households compared for diversity in livestock and crops assets. Chi square tests of the frequencies show dominance of poultry and goats in ($P<0.05$) agro-pastoral households while other livestock species dominated ($P<0.05$) in the pastoral households.
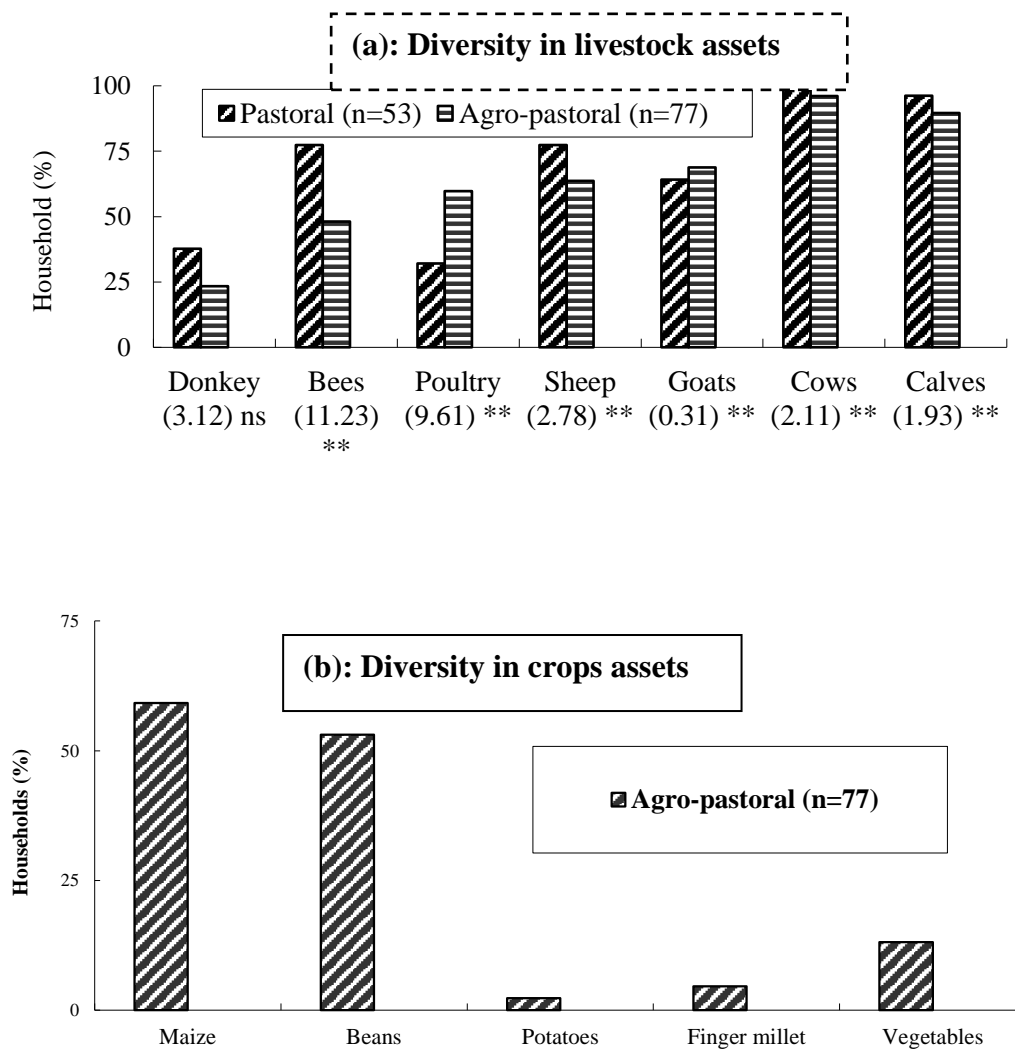
Figure 2: Frequency of pastoral and agro-pastoral households compared for diversity in livestock (a) and crops (b) assets (in brackets are Chi-Square values with ** P<0.05, ns P>0.05)

The result reflects that and crop assets were solely associated with agro-pastoral livelihoods. Crop diversity was biased to maize and beans in over half of the households (Figure 2b) because these are food crops contributing to food self-sufficiency at the household level.

Pastoralists specialized on livestock production for their livelihood assets, reflected by total exclusion of crops. The Shannon index computed for diversity of crops and livestock in pastoral and agro-pastoral farming are presented in Table 5. The result reflects greater diversity in livestock assets in both pastoral and agro-pastoral farming while crop diversification is restricted to agro-pastoral farming. A Shannon index of 0 meant no diversity and was associated with specialization in farming, in this case livestock in pastoral farming. On the other hand an index of 1 meant high diversity. Livestock diversity index was not different (P>0.01) between pastoral and agro-pastoral farming (0.37 verses 0.36). The diversity in crops among agro-pastoral farmers was (0.30), though the levels reflect less diversification, which can be attributed to preference for growing of maize and beans (Fratkin and Mearns, 2003). The results indicate that the shift from pastoral to agro-pastoral livelihoods has no adverse impact on livestock diversity while it promotes diversity in crops.

Table 5: Shannon index for diversity of crops and livestock in pastoral and agro-pastoral farming systems

Variable	Pastoral farming system (n=53)	Agro-pastoral farming system (n=77)	t-test
Livestock diversity index	0.37 ± 0.13	0.36 ± 0.13	0.61
Crop diversity index	0.00 ± 0.00	0.30 ± 0.08	0.00

4.3 Comparison of interest rate awareness, sources of credit, limiting production factors and land prices among pastoral and agro-pastoral households

Economic benefits were arrived at by summing gross benefits, insurance and financing benefits in the farming systems. Moreover, the economic benefits were derived out of factors of production which had to be taken into consideration. To get financing benefits, interest rate for borrowing credit, household's awareness of the interest rates and various sources of credit were investigated. Figure 3 presents a comparison of pastoral and agro-pastoral household's awareness of the interest rates charged for the credit by various lending institutions.
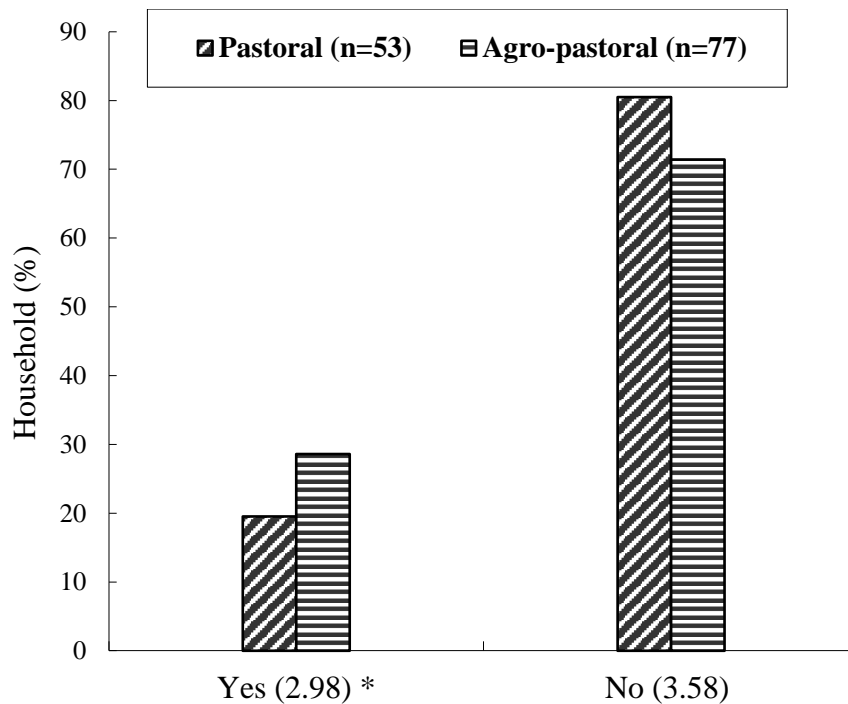
Figure 3: Awareness of interest rates among the pastoral and agro-pastoral households (in brackets are chi square values with *P<0.01

About two thirds (81% and 71%) of the households did not know the interest rates charged. Lack of awareness of interest rates charged by credit lending institutions might relate to low uptake of credit, low attendance in training and extension access (Table 3). Moreover, the practice of borrowing credit from informal lending institutions (local money lenders) (Figure 4) could have contributed to low levels of awareness. Credit access was higher (P<0.05) among the agro-pastoralists. Of the four credit lending institutions, A.F.C was the major provider of credit, probably because of its low interest rate which might have attracted many farmers (Jayne and Nyoro, 1999).
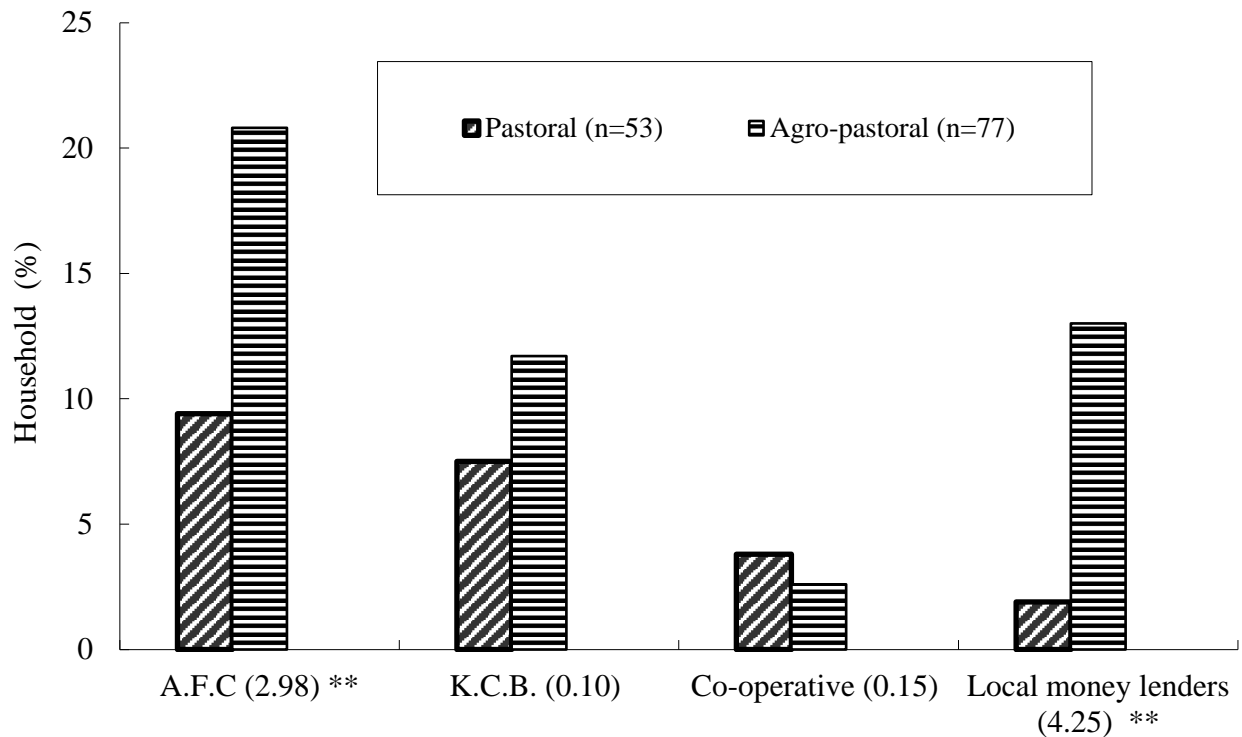
Figure 4: Household preferences for credit sources by pastoral and agro-pastorals (in brackets are Chi square values with **P<0.05)

Asked about limiting factors of production, the respondents indicated, in order of importance, land, labour and financial capital (Figure 5). Land and financial capital were more (P<0.05) limiting for the agro-pastoral households while labour was more limiting for the pastoral households. Among the factors of production, land turned out to be limiting for both pastoralists and agro-pastoralists. The results imply that shift to agro-pastoral farming was associated with smaller farm holdings and greater need for financial capital. Land limitation for agro-pastoral farming could be explained by the decision by the Kenyan government to privatize land in the rangelands (Griffiths, 2007), consequently leading to subdivision and allocation of rights for ranching and farming. This policy created pressure on pastoral lands (Coast *et al.,* 2001; Coast *et al.,* 2006; Thornton, 2010) which has been accelerated further by the, high rates of population growth and in-migration in the area.
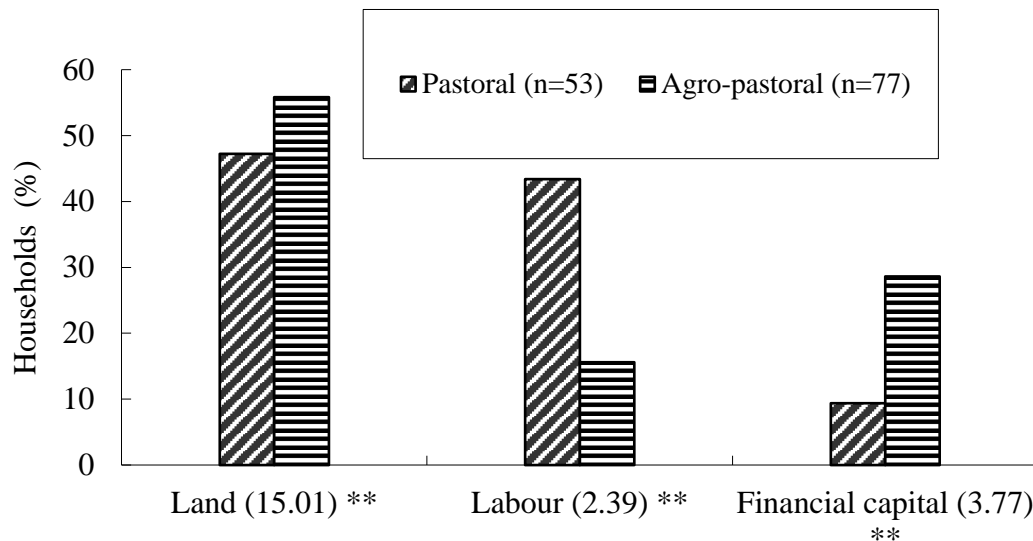
Figure 5: Limiting factor of production among pastoral and agro-pastoral households (in brackets are Chi square values with **P<0.05)

4.3.1 The average price of renting in and out land

To arrive at the unit net benefits, the average price of renting in and out the most limiting factor of production (land) was taken into consideration. The results indicated that the average price of renting in and out land was not different (Ksh. 2118.5) between pastoral and agro-pastoral farming systems. This was because the buying and selling price of land was not dependent on the farming systems (Herrero *et al*., 2006; Akerman, 2009). Moreover, it might happen that there existed a competitive market, where by the land prices were determined by the prevailing market forces, making both buyers and sellers be price takers.

4.3.1 Comparison of Economic Benefits (Revenues, costs and net benefits estimates)

Table 6 gives revenues, costs and net benefits associated with pastoral and agro-pastoral farming. The net benefits were arrived at by subtracting costs from gross incomes to get net incomes/profits. Further net incomes were added to financing and insurance benefits (obtained from equations (v) and (vi) to obtain the net benefits. The net benefits were more than twice higher for agro-pastorals as compared to pastoral (Ksh. 323306.04 verses Ksh.133890). Agro-pastoral farming enjoyed benefits from both crops and livestock, unlike pastoral farming where benefits were solely from livestock. Honey formed a substantial source of income in pastoral farming, about four times higher (P<0.05) than in agro-pastoral farming system. The reason is that bee keeping was a dominant activity among pastoralists (Figure 2a).

31

Table 6: Average revenues, costs, financing, insurance and net benefits from pastoral and agro-pastoral farming

Variable	Pastoral (n=53)	Agro-pastoral (n=77)	t-test statistic
Total gross income (Ksh)	162485.00	442933.70	
Revenues (Ksh)			
Egg sales	776.60	3031.30	1.95
Honey sales	70452.83	28352.60	-3.03**
Livestock sales	43154.57	43259.00	0.10
Milk sales	48101.00	145450.00	-1.06***
Crop sales		222840.80	3.25***
Total costs (Ksh)	53368.21	146694.70	
Livestock costs			
Treatment cost	3117.74	2560.39	-1.08
Transport cost	564.15	333.13	-1.04
Drug costs	3154.06	2939.81	-0.34
Labour cost	46532.26	27054.61	-2.12**
Crop costs			
Labour costs	0.00	77058.70	2.35**
Transport cost	0.00	468.18	4.70**
Input cost	0.00	36279.94	2.98**
Net income (Ksh)	109116.80	296238.40	
Financing benefits (Ksh)			
Livestock	23546.34	20626.75	-0.46
Crops	-	1919.48	1.81
Insurance benefits (Ksh)			
Livestock	1226.87	3854.84	1.70
Crops	-	666.51	4.31***
Net benefits (Ksh)	133890.00	323306.04	2.70**

*** P<0.001, ** P<0.05

Labour costs were 1.7 times higher for pastoral farming compared to agro-pastoral farming, a result inconsistent with several earlier observations (Adewumi *et al.,* 2009; Kristjanson *et al.,* 2002; Akinwumi *et al.,* 1996). It should be noted that livestock herding is a shared responsibility between family and hired labour on communal grazing lands, which when far away requires payments for labour services of trekking livestock. Pastoral herds are moved from place to place to access natural salt licks (Ndumu *et al.,* 2008; Karbo, 2007). Akinwumi *et al.,* 1996, also supports the fact that as more people shift into agro-pastoralism through increased cropping, access to natural grazing land becomes limited due to fencing. So, more labour would be required to tether the animals carefully, thus increasing labour costs.

Milk sales earned about three times more (P<0.01) revenues in agro-pastoral than in pastoral farming. The difference could be associated with better access to milk markets in market centres within proximity of agro-pastoral homes (Table 9) and consumption of most milk produced by the pastoral households.
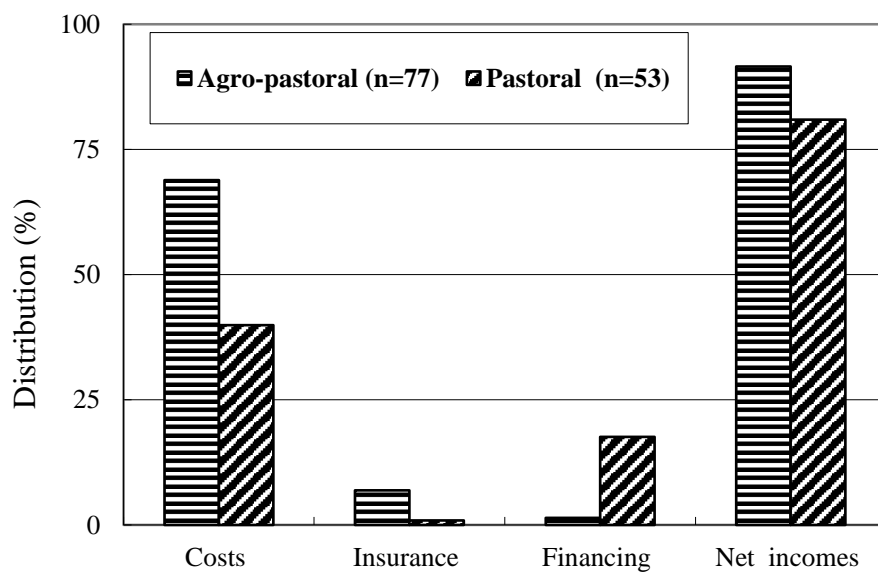
Figure 6: Distribution (%) of costs and benefits of insurance, financing and net incomes from pastoral and agro-pastoral farming

The percent distribution of the economic benefits (Figure 6) indicates that financing and insurance roles of crop and livestock were important part of economic benefits with financing benefits higher (17.6%) in pastoral while insurance higher (6.9%) in agro-pastoral farming. Financing benefits is liquidation of crops and livestock assets to finance cash needs requiring lump sum of money like school fees and even buys food for the household. Insurance

33

benefits is liquidation of crops and livestock assets to meet emergency cash needs such paying medical bills or settling legal court case (Kosgey *et al*., 2004a; Awuor, 2003; COMESA, 2009).

Unit net benefits were arrived at after dividing net benefits by the monetary value of the most limiting factor of production in the area, which was land. Further a t-test was done to test for statistical difference in unit net benefits between pastoralists and agro-pastoralists. The results are presented in Table 7, indicating that agro-pastoral attained about 2.4 times more unit net benefits (Ksh 152.61/ha/year) compared to pastoralism (Ksh 63.20/ha/year). The reason could be that, farmers had realized that they could not achieve self-sufficiency through livestock production alone so as a response they tended to diversify to crop production so as to provide a variety of food for their families (Fratkin and Mearns, 2003; Miyuki, 2006; Adewumi *et al.,* 2009).

Table 7: Unit net benefit results

Farming system	Mean (Ksh)	Standard deviation	t-test
Pastoral households (n=53)	63.20	121.29	2.70***
Agro-pastoral households(n=77)	152.61	219.30	

*** means significance at 1 % probability level

4.4 Factors Influencing the Shift from Pastoral to Agro-pastoral livelihood

4.4.1 Heckman Two-Step procedure

Heckman two-step procedure was used to determine the factors influencing the shift from pastoral to agro-pastoral farming and the extent of the shift. The results of selection equation and outcome equation are presented in table 8 and 9 respectively.

Table 8: Heckman Two-step selection equation results for dependent variable -participation in the shift from pastoral to agro-pastoral farming

Variables	Coefficient	Std. Error.	p>|z|	Marginal effects dy/dx
agehh	0.001	0.011	0.921	-0.000
crdtaces	0.439	0.278	0.115	0.159
off-farminc	-0.752	0.307	0.014**	-0.259
farmsize	-0.008	0.004	0.041**	0.003
educlevel	0.201	0.179	0.261	0.068
owntd	0.475	0.373	0.203	0.164
totherd	-0.000	0.002	0.916	0.000
freqmet	0.248	0.114	0.030**	0.087
dstmkt	-0.308	0.120	0.010**	-0.113
noconta	0.169	0.130	0.196	0.060
hhsize	0.085	0.062	0.171	0.030
dstwater	0.677	0.221	0.002*	0.243
traintim	0.289	0.154	0.061***	0.105
genderhh	-0.154	0.452	0.734	-0.054
mills lambda	0.160	0.777	0.039**	0.056

dy/dx = Marginal effects. * Means significant at 10%, ** significant at 5% and *** significant at 1%

The Inverse Mills Ratio (IMR/Lambda) term was significant and positively signed (Table 8), which suggest that the error term in the selection equation is positively correlated. This implies that unobserved factors that make participation in the shift to agro-pastoral farming are more likely to be associated with higher score on the dependent variable. Six factors: off-farm income, farm size, frequency of group meetings, distance to the market, distance to the watering points and farmer training were significantly associated with household decision to participate in the shift to agro-pastoral farming.

Off-farm income sources significantly and negatively affected participation in the shift to agro-pastoral farming. Increasing incomes from off-farm sources would decrease shifting to agro-pastoral farming by 75%. This could be attributed to the possibility that as income increases, households pursue other opportunities (investing in fixed assets such as building, rental houses in town, buying motor vehicles and re-investing in business) but they would not

completely exit from pastoralism because of strong cultural attattchment to livestock in the area (Little, 2001; Bekure and Leeuw, 1991; Mochabo *et al.,* 2006).

Declining land sizes increased the shift to agro-pastoral farming by 0.8%, implying that farmers with less land sizes could shift to agro-pastoral farming as compared to those with more land sizes. The reason could be that, farmers could not achieve self-sufficiency through livestock production alone so as a response they tended to diversify to crop production so as to provide a variety of food for their families (Fratkin and Mearns, 2003; Liyama, 2006; Adewumi *et al.,* 2009). An increase in time taken to reach the nearest market decreased the shift to agro-pastoral farming by 30.8%. The result was consistent with findings from previous agricultural market studies such as (Abele et al., 2009). The finding reinforces the argument that poor market access for households located in remote areas encourages pastoral livelihoods Studies from market chain analysis such as (Gebregziabher, 2010) indicate that households located far from the market, incurred high transportation and other related costs. Incurring high amount of transportation and other related costs due to long distance to market will discourage them from participation in the shift.

An increase in time taken to reach the nearest watering point increased agro-pastoral farming by 67.7%. This implied that households located further from the water points were more likely to shift to agro-pastoralism than those living closer to the water sources. The reason is that near water sources, natural salt licks are found (Ndumu *et al.,* 2008; Galvin, 1992) which promotes the health of the animals, thus most pastoralists prefer grazing their livestock near water sources. Moreover, availability of salt licks saves farmers the cost of buying mineral licks for their livestock (Karbo, 2007).

Training of the household head was also significant with a positive sign. Almost 29 % of the observed variation in the shift from pastoral to agro-pastoral farming could be explained by the number of trainings. An additional training session of the household head increased participation by 29%. Moreover, frequency of group meetings showed up as significant and positive in terms of explaining variation in the shift across farmers, increasing the explanatory power of the model to 25%. Frequent meetings enhance access and exchange of new ideas and knowledge. Both household training and frequent group meetings increased participation in the shift since well educated farmers tend to be more receptive to new technologies (Kosgey *et al.,* 2004b; Kariuki *et al.,* 2007).

Table 9: Heckman Two-step outcome equation results (OLS results)

Extent of the shift- Dependent variable

Variables	Coefficient	Std. Err.	p>|z|	Marginal effects dy/dx
agehh	-0.000	0.002	0.978	-0.000
cropfayr	-0.058	0.026	0.027**	-0.059
crdtaces	0.037	0.041	0.358	0.038
off farminc	-0.093	0.056	0.098***	-0.093
farmsize	-0.000	0.000	0.984	-0.000
educlevel	0.014	0.024	0.547	0.015
owntd	0.120	0.051	0.020**	0.121
totherd	-0.00	0.000	0.739	-0.000
freqmet	-0.018	0.016	0.255	-0.018
dstmkt	-0.071	0.024	0.004*	-0.071
noconta	0.077	0.019	0.000*	0.077
hhsize	0.016	0.009	0.064***	0.017
dstwater	0.082	0.035	0.020**	0.082
ninfl	-0.121	0.037	0.001*	-0.122
traintim	0.017	0.022	0.437	0.018
genderhh	0.225	0.084	0.007*	0.226

dy/dx = Marginal effects * Means significant at 10%, ** significance at 5% and *** significance at 1%

Table 9 shows the results of Heckman two-step outcome equation. The extent of the shift was determined as the proportion of land allocated to crop production divided by total farm/land size. Variables determined to have significant association with the extent of the shift included: experience in crop production, other sources of income, land ownership with title deeds, household size, gender, neighbour influence, extension services, distance to the market, distance to the watering points and farmer training.

Years of crop farming experience had a significant negative effect on proportion of land allocated to crop cultivation. The intensity of crop production decreased by about 6% for every extra year of farming experience a household gained. The reason could be that, as one grows old the energy to work on the farm declines since crop farming is labour intensive (Adewumi

et al., 2009). Also, it might happen that due to strong cultural attatchment to livestock in the area, over time older farmers revert back to livestock production (Akinwumi *et al.,* 1996). Research by Kristjanson *et al.,* (2002) showed that diversification into cropping appeared to be a quite tenuous option, with many households not getting a harvest even in a year considered to be a 'good rainfall year'. Similarly, there is a possibility of farmers reverting back to pastoral production over time if returns from crop farming are low.

Income from off-farm sources significantly and negatively affected the proportion of land allocated to crop production. As incomes from off-farm sources increase, the proportion of land allocated to crop production decreases by about 9%. This result differs from what Lynn (2010) observed. The difference in observations could be attributed to the fact that as income increases, farmers can be able to use the money in buying a variety of foods rather than growing the crops. Pastoralists are known to sell livestock so as to buy food, clothing, pay medical bills and even school fees and in response they tend to adopt crop farming to supplement livestock incomes. Therefore, with increase in other sources of incomes, sell of livestock is limited and by so doing livestock units tend to increase. Over time, most farmers would have more livestock, implying more land will be allocated to livestock production compared to crop production (Boone *et al.,* 2003; Markakis, 2004; Bebe *et al.,* 2002; Deluca *et al.,* 2010).

Land ownership with title deed showed up as positive and significant, along with household size. So, larger household sizes together with land title deeds appear to have an advantage when it comes to the proportion of land allocated to crop production. Private land ownership with title deeds gives farmers a right to use the land (security of tenure) thus creates an incentive for the farmers to make necessary investments in their land which are long term and even riskier (Rana *et al*., 2000).

A larger household size increased the probability of allocating more land share to crop production by 2%. Larger household sizes have been found to be associated with extra expenses (food, school fees and medical bills), thus households will allocate more land for crop production so as to cater for such expenses instead of selling livestock. Also due to change in dietary habits (from milk and blood) more land is allocated to crop production so as to get a variety of foods (Markakis, 2004; Deluca *et al.,* 2010)

Extension service was measured by the number of household head contacts with extension officers and it proved significant with a positive sign. It was realized that 8% of the observed variation in the extent of the shift from pastoralism to agro-pastoralism could be explained by the number of contacts. An additional visit of the household head by the officers increased the extent by 8%. Extension agents supply farmers with important information and

skills on production, management and even marketing. The availability of relevant and adequate information reduces the risk associated with crop production. The reduction in the risk therefore provides an incentive to the farmers to expand production of a particular crop. According to Onemolease and Alakpa (2009), farmers in contact with extension agents are two times more likely to increase adoption of crop-related innovations than those with no contact.

Distance to the market significantly and negatively affected the proportion of land allocated for crop production. An increase in time taken to reach the nearest market reduced the probability of allocating more land for crop production by 7%. This implies that increased distance to the market favors pastoralism in the area. This would be attributed to the fact that by moving further from town, a household is able to occupy less crowded pastures for livestock and there is much space for resting of livestock(during the day for lactating livestock, and at night for non-lactating ones) (Doss and McPeak, 2005).

Distance to the nearest water source was significant and positively correlated with extent of the shift. Increase in time taken to reach the nearest watering point say by one hour increased the proportion of land allocated for crop production by 8%. Research by (Herrero *et al.,* 2006), has shown that households located closer to water points earn more returns from livestock as compared to households further from watering points. Thus, it might happen that households located further from water sources get demotivated by little returns (less milk, blood and little income from sales) from livestock and in response they allocate more land for crop production. In addition, following the Kenyan government decision to privatize land in the area, it is difficult to access water given that already other farmers have fenced their land (Mwang'ombe *et al.,* 2009; Griffiths, 2007; Semambo *et al.,* 2009).

Gender of the head of the household had a significant impact on the proportion of land allocated to crops positively. There was a lower likelihood for female-headed households to allocate land for crop production compared to male-headed households (Deluca *et al.,* 2010). The results indicated that if the household head is a male the probability of allocating more land for crop production increased by 22.58 %. A plausible explanation for this could be that female headed households are resource constrained given that they do not own critical resources such as land and livestock. Moreover, they have no power to make decisions on resource use as noted by (WIBD, 2005).

Influence from the neighborhood significantly and negatively affected the extent of the shift. As farmers interacted more with their neighbours, the probability of allocating more land for crop production declined by 12.17%. In this context, the neighbourhood comprised of other communities found in the area such as the Kisii, Luo and the Kipsigis. On the other hand, the

Maasai themselves formed part of the neighbourhood based on different Maasai clans. So, depending on who formed the neighbourhood, farmers could decide to allocate more or less land towards crop production. A plausible explanation for this result is that the Maasai community have a long time history in livestock production. Besides, they have a strong cultural attatchment to livestock (Mageka and Osero, 2007; WISP, 2008) hence they were likely to allocate much land to livestock production as compared to crop production. Langyintuo and Mulugetta (2005) argues that as farmers interact more with their neighbours and outside world, they become more able to assess the relevance of new technologies, and ideas thus they exercise a choice.

CHAPTER FIVE
CONCLUSION AND POLICY IMPLICATIONS

5.1 Conclusions

The aim of the study was to compare socio-economic characteristics of pastoral and agro-pastoral households, determine and compare crop and livestock enterprise diversity, quantify and compare economic benefits besides determine factors influencing the decision to shift and the extent of the shift from pastoralism to agro-pastoralism.

From the study, it was found that some households shifted to agro-pastoralism out of necessity, whereas others shifted by choice. For some of these households, the shift was a means to reduce risk, while for others it was a reflection of changing cultural, dietary habits and social norms.

Agro-pastoral and pastoral households exhibited differences in their socio-economic characteristics. Agro-pastoral households were older farmers with declining farm size, stronger in social capital and more inclined to diversification of livelihoods and increasing agricultural productivity. They accessed credit facilities better together with extension services but education levels remained low even with the shift from pastoral to agro-pastoral livelihoods. Low education levels in the area could be attributed to poor infrastructure and much time spent by young men in herding besides past history of incessant movements on their parts before the Kenyan Government prohibited cross-border movements.

Even though no difference was exhibited between pastoral and agro-pastoral households for livestock diversity, diversity in crops was biased towards food crops of maize and beans. Enterprise diversification was high reflecting farmers attempt to achieve self-sufficiency through integration of livestock with crops production. Diversification was important so as to meet certain objectives, however, household objectives vary. Moreover, following frequent land subdivisions, land is limiting. Therefore, it would happen that households were constrained by the fact that they did not know the suitable enterprise combination which would suit their objective. Thus, there is need to improve provision of extension services and increase farmer trainings so that farmers can be sensitized on enterprise combinations which will maximize their objectives given the available resource constraints at the same time conserving the environment.

Engaging in agro-pastoralism was more beneficial economically compared to engaging in pastoral livelihood. This is because agro-pastoralism exhibited greater unit net benefits which were associated with more enterprise diversity. Therefore, it was empirically justified that the shift made economic sense. The unit net benefits were derived from factors of

production land being one of them. It was evident that land turned out to be the most limiting factor of production. Therefore, as much as farmers will be willing to shift to agro-pastoralism, already they are constrained by land. Thus, educational campaigns, workshops and seminars on land use, planning and management should be encouraged in the area.

Households would be better off with the shift from pastoral to agro-pastoral livelihoods, given that this shift is enhanced by more frequent group meetings and farmer trainings, shorter distance to market and more income from off-farm sources of incomes. Declining land sizes and longer distance to watering points forms the rationale of the observed behavior changes among households.

The agro-pastorals choice to allocate higher proportion of land for crop production compared to livestock production was enhanced by more distance to watering points, low off-farm incomes, private land ownership, larger family, male dominance, more extension services, shorter distance to the market, less years of crop farming and little interaction with the neighbors.

5.2 Policy Implications

Even though the shift is economically viable, there is need for the Government and other development partners to encourage farmers to practice environmental friendly agriculture in the area. Most studies have revealed that, optimal pathways for crop-livestock integration have achieved the best utilization of locally available resources without much reliance on external inputs through recycling of crop/animal residuals. Thus if this can be encouraged in the area then the shift might lead to environmental conservation.

Distance to watering points was found to be key in influencing the shift, however, as much as most farmers have shifted, still culture inhibits complete exit from pastoralism, thus there's need for a policy to address water problems in the area (given that farmers took 1-2 hours before they could reach the nearest water source), through targeted training programs that will enhance the knowledge of farmers on water harvesting technology. Moreover, the Government should drill more boreholes in strategic points to assist households during the dry season.

5.3 Suggestions for Further Research

Given high crop-livestock enterprise diversity in the area, the study recommends further research on optimal crop-livestock integration pattern that will yield maximum returns,

and manageable herd sizes that could be kept by households so as to improve their living standards.

Estimation of economic benefits was challenging. It would happen that farmers are less attracted to borrow loans from formal financial institutions when transaction and transport costs are taken into account by these institutions. Likewise the insurance premiums might be high given the fragile environmental conditions that pastoralists live in. Therefore, this study recommends further comprehensive research on ways in which farmers can cope with future uncertain financial requirements besides relevant alternative insurance options in the area.

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APPENDIX 1: QUESTIONNAIRE

HOUSEHOLD NUMBER --------------------------------

Topic: Evaluating household decision making and quantifying trade- offs associated with the shift from pastoral to agro -pastoral farming systems in TransMara West District- Kenya

Introduction

Hallo, am…………………………………………… am part of research team from Egerton university conducting a study on " Evaluation of household decision making and quantifying trade- off between pastoral and agro pastoral farming systems in TransMara West District Kenya." You are therefore requested to provide accurate information being sought in this questionnaire. Your participation is voluntary and you are also assured that the information you provide will be treated with confidentiality and used for sole purpose of research. Your support to the research is highly appreciated in advance. For more information or clarification, you can contact the project manager through 0725719013. The information required is for the period January- December, 2009. Thank you.

<u>Questionnaire identification</u>

Name of enumerator _____

Division _____Location_____

Sub- location _____village _____

Farm household number ____   Date _____ Starting time _____Ending time _____

SECTION A: HOUSEHOLD PROFILE

(1.0) Please indicate the following details on household members for the year (Jan-Dec 09)

HH Memb. No.	First Name	Relation to HH Head	Year of birth	Gender M= 1 F = 0	Marital status	No. of months lived at home	Highest Education level reached (years of schooling)	Involvement in any income generating activity 1=Yes 2=No(go to next member	If yes, which income generating activity	Months involved in the activity last year	Estimated monthly range of income from the activity
1											
2											
3											
4											
5											
6											
7											
8											
9											

Relation to head codes

1=Head, 2=Child, 3=Spouse 4=grand child, 5=cousin, 6=aunt/uncle, 7= niece/nephew, 8= brother /sister in law, 9=others (specify)

Marital status codes

1=monogamous, 2=single, 3=widow(er), 4=divorced, 5= separated 6=polygamous 7=others (specify)

Highest education level

0=none   1=Primary school   2=Secondary school   3= Tertiary/college   4= University
5=others (specify)

Income generating activities: 1=Formal employment 2=informal employment (farm)
3=Non-farm income 4=Business 5=other (specify)

Estimated incomes: 1=<5000, 2=5001-10,000, 3=10001-15000, 4=15001-20,000,
5=20001-25000, 6=25001-50000 7=>50,000

(1.1) Do you own land? *1=Yes; 0=No*   **---------------**

    (A) If **Yes**, in **1.1** above, under which form?----------- ------------ --------------

    1=Communal, 2=Ownership with title deed, 3= Ownership without title deed,
    4=Rented, 5=owned by parent/relative, 6=other (specify) --------------

    (B) Please indicate the following with regard to total land under your control

	Owned	**Rented in**	**Rented out**	**Communal**	**Other(specify)**
Land size in hectares					
	Food crops	**Livestock**	**Pasture**	**Land under no use**	**Other(specify)**
Land use in hectares					

    (C) What is the rate of renting in and out land? (Ksh/acre/year)   --------   **-----------**

(1.2) What are your main objectives of farming? Rank them in the table provided below from
1-4, where *(1=most important, 2= slightly important, 3= important 4= least important)*

Objective	**Rank**
Food supply	
Basic income/profit	
Social acceptability	
Prestige	

Store of wealth	
Others (specify)	

SECTION B: LIVESTOCK PRODUCTION

(1.3) Do you keep livestock?   *1=Yes 0=No*---------------

   (A) If Yes **in 1.3 above**, when did you venture into livestock production?   ----------

   (B) What economic activities were you doing before you ventured into livestock production----------   --------------   --------------

Activity done: 1= crop farmer   2=Formal employment   3= Tourist entertainer 4=other (specify) ------------

   (C) What are your reasons for venturing into livestock production? --------------

 Reasons: 1= culture 2=less input usage 3=lack of exposure to crop farming 4=lack of crop labour 5= other sources of incomes 6= accessibility to grazing lands 7=un limited access to the watering points 8= large herd sizes 9= lack of crop farming tools 10= Ready market 11=other(specify)--
----

   (D) What is your total herd size?   **-----------------**

E) Please fill in the following table concerning livestock production for the year 2009

Livestock type	Livestock class	Tick where appropriate (✓)	Number owned by Jan 2009	No. sold	Unit selling price	No. purchased	Purchase price	No. consumed	No. kept by others	No. Gained as gifts/dowry	No. lost	No. Kept for others	Number owned by Dec 2009
Cattle	Cows												
	Heifers												
	Bulls												
	Calves												
	Steers												
Goats	Dairy goats												
	Meat goats												
	Local Maasai sheep												
	Improved Maasai sheep												
	Dropper												
Poultry	Local birds												
Bees	Long stroth hives												

	Kenya top bar hive											
	Log hives											
Pigs										Pigs		
Donkey												
Rabbits										Rabbits		
Other(specify)												

INPUT USED IN LIVESTOCK PRODUCTION

(1.4) Please fill in the following table concerning labour use in livestock production

Livestock type	Activities	Labour type 1=Family 2=casual 3=permanent worker 4=other(specify)	Quantity(hours, days, months)	Unit cost/hr, day, month	Total(Ksh)
1					
2					
3					
4					
5					
6					
7					
8					
9					
Totals					

Activities: 1= Herding, 2=shed cleaning, 3=spraying, 4= dipping, 5= Harvesting honey 6= others (specify)

Livestock type: 1=Cattle, 2=Sheep, 3= Goats, 4=Donkeys, 5=Poultry, 6=Pigs, 7=bees, 8=Rabbits, 9= others (specify)

(1.5) How much did you spend on the following livestock inputs last year, please fill in the table below

Input no.	Livestock input type	Units	Price per unit	Total cost
1	**Drugs**			
2	**Treatment**			
3	**Other(specify)**			

Unit code: 1=Kgs, 2=Litres, 3=Numbers, 4=other (specify)

(1.6) Did you incur any transport cost on livestock inputs last year? *1=Yes 0= No*   -----------

(A) If **Yes** how much?   ---------------------------

LIVESTOCK OUTPUT

(1.7) Please fill in the following table concerning livestock output sales in Kshs for the year 2009.

Livestock product and their numbers		No. of months of production within the year	Unit of production	No. of times sales was made in a month	Average amount sold/month	Price per unit	Total value	Buyer type
1	Cow milk							
2	Goat milk							
3	Eggs							
4	Honey							
5	Hides and skin							
6	Other(specify) --------- --------- --------							

Unit codes: 1=Kgs, 2=Litres, 3=Trays, 4=Numbers, 5=other (specify).

Buyer type: 1=Coop society 2=K.C.C 3=Hawkers 4=Traders/private processors 5=Hotels/institution,

6=Consumer/neighbour/farmer 7=other (specify)

(1.8) Please indicate the problems you face in livestock production (List and rank them from *1=most serious 2= serious 3= least serious)*

Challenge no.	Challenge	Rank	Solution No.	Perceived possible solution
1			1	
2			2	
3			3	
4			4	

SECTION C: CROP PRODUCTION

(1.9) Do you grow crops besides being a pastoralist? *1=Yes, 0=No* **---------**

 (A) If **Yes in 1.9 above**, for how long have you been in crop farming? ------------

 Years: 1=less than 2 years, 2=2-6 years, 3=more than six years **--------**

(B) What economic activities were you doing before you ventured into crop production other than being a pastoralist? ----------------------------   -------------- --------------

Activity done: 1= Tourist entertainer   2=Formal employment   3=other (specify) ------------
----

(C) Why did you adopt crop farming? --------------------------------

Reasons: *1=Minimize risk 2= influence from neighbourhood   3=Change in dietary habits 4=profitable 5=Availability of other sources of incomes 6=limited access to grazing lands 7= limited access to the watering points 8= Declining herd sizes 9= Exposure to crop farming 10=other(specify)---*

 (D) Please fill in the table below by ticking which crops you grow, and state the estimate size in acres and the yield per acre.

Crop type	Tick where appropriate(✔)	Acres	Estimated yield	Units	Selling Price per unit	Total value	Buyer type
Maize							
Beans							
Sugarcane							
Tea							
Bananas							
Vegetables							
Potatoes							
Finger millet							
Others(specify)							

Unit codes: 1=90 kg bag 2=Debes 3=Tonnes 4 =50 kg bag 5 Bunches 6 =other (specify)

Buyer type: 1=N.C.P.B 2=Hawkers 3=Traders/private processors 4=Hotels/institutions
5=Consumer/neighbour/farmer 6=other (specify------------------------

(2.0) Do you sell or lease out crops while in the field (*1=Yes 0=No*)   -----------------

(2.1) if **Yes in 2.0 above,** Please fill in the table below concerning crops sold/leased

Crop type	Tick where appropriate(✔)	Estimated acreage	Reasons for leasing/selling	No. of out leases	No. of in leases	Units	Selling Price /unit	Total value
Maize(Green maize)								
Tea								
Vegetables								
Bananas								
Potatoes								

Others(specify)								

Reasons: 1=Ready cash 2=to get rid of more expenses 3=Influence from the neighbourhood 4= no store 5=others (specify)

Unit codes: 1=90 kg bag 2=Debes 3=Tonnes 4 =50 kg bag 5 Bunches 6 =other (specify)

(2.2) If **NO in 2.0 above,** give reasons? ---------------------------

Reason: 1=earns less income 2=nobody to buy 3=never tried it/no experience 4= other specify--------

(2.3) Do you keep crop produce in store for some time before selling? (*1=Yes 0=No*). ------

(A) If **Yes in 2.3 above,** Please fill in the table below concerning quantities stored

Crop type	Quantity in store as at Jan	Quantity sold during the year	Quantity purchased	Quantity in store as at Dec	Unit cost	Total(Ksh)
Maize						
Beans						
Finger millet						
Others(specify)						
Totals						

Quantity codes: 1=90 kg bag, 2=Debes, 3=Tonnes, 4=50 kg bag, 5=other (specify) ---------------

(B) If **No in 2.3** above, what are your reasons for not storing crops------------- **------------**

Reason: 1=no store   2=expensive   3=fear of price fluctuations   4= other specify--------

INPUT USED IN CROP PRODUCTION

(2.4) please indicate details on labour input used for crops last year in the table below
Using the following codings

Activities: 1=Clearing of land, 2=ploughing, 3=harrowing, 4=planting, 5=weeding, 6=spraying, 7=pruning, 8=harvesting, 9=transportation (from farm and to market), 10=threshing, 11=shelling, 12= others (specify) ------------------.

Crop type: *1* = Beans 2= Sugarcane 3= Tea 4= Bananas 5= Vegetables 6= Potatoes 7= Finger millet 8 = others (specify---

Crop type	Activities	No. of times the activities were done	Labour type: 1=Family 2=casual 3=permanent worker 4=oxen 5=Tractor 6= other(specify)	Quantity(hours , days, months)	Pay rate	Total(Ksh)
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
Totals						

(2.5) please fill in this table indicating details on input used for crops last year

Crop type	Input type	Quantity used	Units	Unit price	Total value (Kshs)
Maize					
Beans					
Sugarcane					
Tea					
Bananas					
Vegetables					
Potatoes					
Finger millet					
Others(specify)					

Units: 1=50Kg bag, 2=Kgs, 3=Litres, 4=Numbers, 5=others (specify)

Input: 1=Seeds, 2=fertilizers, 3=agrochemicals (herbicides, pesticides, and fungicides),

4=seedlings, 5=Manure,

6= others (specify)

(2.6) Did you incur any transport cost on crop inputs last year? *1=Yes 2= No* -----------

(A) If **Yes** how much?   ----------------------------

(2.7) Please indicate the challenges faced in crop production (List and rank them from

1=most serious, 2= serious 3= least serious)

Challenge no.	Challenge	Rank	Solution No.	Perceived possible solution
1			1	
2			2	
3			3	
4			4	
5			5	

SECTION D: INSTITUTIONAL, INFORMATION, EDUCATION AND TRAINING

(2.8) Did the household feel that there was need for extension services last year? *1=Yes 0=No*

(2.9) If **Yes in 2.8 above** fill in the details in the table below

Extension service provided 1=crop production 2=livestock production 3=others(specify)	Source 1=Government extension 2=Private 3=NGOs 4=University 5=Farmer groups 6= Co-operative 7=Other(specify)	No. of times the service was received	Payment made? 1=Yes 0=No	Cost per each time the service was received

(A) Did the household attend a farmer training last year? *1=Yes 0=No* **----**

(B) If **yes,** how many members?---------------------

(C) How many times did they attend?-------------- ----------------- ----------------

(D) What was the training about? **---------------** **---------------** **---------------**

Training : *1=Crop husbandry 2=Livestock husbandry 3= Finance 4=other (specify)*

(3.0) Do you have any other source of income apart from farming income? *1=Yes 0=No* **----**

(A) If **Yes in 3.0,** Please fill in the table below concerning other sources of income for the household

Source of income	No. of months the income was earned	Average monthly income	Total amount
Remittances			
Value of gifts received			

Land rented out			
Entertaining tourists at the park			
Income from buildings rented out			
Motor vehicle income rented out			
Employment income			
Hired out bulls and donkeys			
Others(specify)			

Estimated incomes: 1=<5000, 2=5001-10,000, 3=10001-15000, 4=15001-20,000, 5=20001-25000, 6=25001-50000 7=>50,000

(3.1) How long does it take to travel to the nearest market? **-----------------**

(A) How often do you interact with the market? --------------

Market interaction: 1=Once 2= twice 3=More than three times

(B.) Do you feel the market is adequate/ sufficient to absorb your produce? 1=Yes 0= No? ---

(C) If **Yes in B above** what are your reasons?--

(D) If **No in B above** what are your reasons ?--

(3.2) How long does it take to travel to the nearest watering point?   **-----------------**

(A) Do you think this **distance in 3.2 above** might have influenced you to grow crops?
1=Yes 0= No? ----

SECTION E: CREDIT ACCESS AND GROUP MEMBERSHIP

(3.3) Did the household feel that there was a need for credit? *1=Yes 0=No* ------------

(A) Did the household try to access credit last year? *1=Yes 0=No*   -------------

(C) If **Yes in 3.3A above**, fill in the table below

Credit source	Granted 1=yes 0=No	Credit type 1=money 2=in kind	Amount requested	Amount given	Purpose of credit	Repayment period	Do you know the Interest rate? *1=Yes 0=No* If yes what is the rate?	If not granted, give reasons

Source codes: 1=AFC, 2=commercial banks, 3=cooperative, 4=local money lenders, 5=others (specify)

Purpose codes: 1=School fees, 2=Household consumption, 3=Medication, 4=Livestock purchases, 5=crop farming, 6=other (specify) ----------

Repayment period: 1=annually 2=Semi annually 3=Quarterly 4=Fortnightly 5=Monthly 6=Weekly 7=other (specify) ----

Not granted reasons: 1=Lack of security 2=had another loan 3=defaulted previously 4=lack of enough savings 5=other (specify)

(C) If **No in 3.3A**, why didn't you try?---

(3.4) Is the household a member of a group? *1=Yes 0=No* ---------

(A) If **Yes in 3.4 above**, fill in the details in the table provided below

Type of group	No. of female members	No of male members	Year started	Group activities	Frequency of meetings per month	Saving per month	Premium paid incase of insurance group	Required collateral for loans

Type of group: 1=Self help group 2=cooperative society 3=Welfare group 4=Insurance group 5=other (specify)

Group activities: 1=Livestock farming 2= crop farming 3=Hedging against risk 4=other (specify)

SECTION F: HOUSEHOLD EXPENDITURE

(3.5) On average how much did you spend on the following items last year?

Food consumption ----------------------School fees---------------------Clothing --------------------------

House rent-------------------- Funerals---------- Medical care-------------- Dowry-------------------

Other (specify) ---

(3.6) is your farm income higher, same, less in 2009 as compared to 2008? Tick where appropriate

Farm income: Higher [   ]   same [   ]   less [   ]

(A) Give reasons for the status---

(3.7) Using the following rating scale (1=Agree 2=Neutral 3= Disagree) Please state your level of agreement with the following statement._____

'Wealth is related to the number of livestock that a person owns'.

(3.8) please rate your level of agreement with the following statement, using information in

(A1.) above_____

'If my household stops herding livestock our monetary household income would decrease'.

(3.9) Among this factors of production (1=land 2= labour 3=Financial capital) which factor do you consider as being limiting?

APPENDIX 2: LIVESTOCK UNIT CONVERSION FACTORS

Table 20: Livestock Unit Conversion Factors used to calculate the Economic Benefits

Animal classes	Indigenous stock Units	Estimated live weights(Kgs)
Cattle	0.67	167.5
Mature sheep and goats	0.13	32.5
Poultry	0.13	1.5
Donkey	0.48	120

Source: DAO, Office, 2010