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Effects of Capital Assets on Livelihood-Based Outcomes from Livestock Production among Youth in the Semi-Arid Lands of Kenya

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Abstract

The purpose of this study was to analyse the effects of human, natural, financial, social and physical capital assets on livelihood-based outcomes from livestock production among youth households in the semi-arid lands of Kenya and their policy implications for improved youth livelihoods. The Sustainable Livelihoods Framework was used for the study. An ordinal logistic regression model was used for analysis. Primary data from the Kenya Integrated Household Budget Survey (KIHBS) of 2006 originally obtained by interviews of household heads was utilized. Data representing proxies for human, social, natural, financial and physical capital assets were identified using literature on sustainable livelihoods approach and matched to variables in the main KIHBS 2005/06 report. The variables were measured appropriately; human capital as the total number of years of the highest level of education of a youth household head, social capital as the sum of value of food gifts to a household, natural capital as household agricultural holding size in acres, physical capital as value in shillings of the main household agriculture implements, and financial capital as expenditures on chemicals used in livestock production. Age of youth was measured in years (15-34 years). The dependent variable, livelihood outcome was measured as income from sale of all livestock from a youth household in 2005. The dependent variable, livelihood outcome, was regressed on the five proxy variables and age of youth household heads using ordered logistic regression. The dependent variable, livelihood outcome (livestock income) was coded into three categorical variables and analysed as a continuous variable. Agricultural holding size, financial capital and age were statistically significantly positively associated with livelihood outcome among youth. Food gift, household physical capital and education had no significant effects on livelihood outcome from livestock production among the youth. Policies facilitating youth knowledge, skills and capabilities to increase livelihood outcome from livestock production, cultural mind-set changes that can facilitate youth access to land and land ownership, increasing credit support and promoting market access and innovations in land potential such as irrigation, and targeting expanded participation of youth in livestock production value chains are more likely to improve livelihood outcome for youth. This would require parallel improvements in agricultural input supply, market information development and communication infrastructure.

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1. Introduction

1.1 Background

Youth¹ in Sub-Saharan Africa (SSA) comprises over 20 per cent of the total population (UNFPA, 2014). The proportion of the elderly (60 years and over) was only about 16 per cent by 2015. The proportion of the total youth population and youth urban population in the SSA are expected to more than double by 2050 (AGRA, 2015). As the youth leave farming because of unemployment due to reduced productivity and the image of agriculture associated with poverty and traditionalism, their aging parents in rural areas are also retiring from farming. Due to high birth rates, high urban migration and low formal employment creation, unemployment especially of the youth has become a major challenge (AGRA, 2015; UNFPA, 2014). Agriculture represents the best opportunity to address youth unemployment since the sector already employs a most (65%) of rural people in SSA. It is also a major contributor to overall economic growth, generating about 30 per cent of GDP in most countries (AGRA, 2015).

The youth ‘demographic bulge’² can be used to increase productivity in agriculture and address food security, poverty, underemployment³ and unemployment⁴ through agricultural transformation⁵ using agribusiness⁶. The youth challenges in agriculture in Africa, including Kenya, comprise lack of equitable access to; land and land rights, investment capital, policy decisions, education and vocational skills and productive technologies. The other challenges include access to markets, and socio-cultural constraints related to gender, age, education and property ownership. These challenges need to be addressed for youth to remain in agriculture. It can be done through policy, and by ensuring that agriculture is productive, profitable, dynamic and natural resources sustainably managed. The multiple opportunities in the agri-food value chains, including production,

1 Various organizations and governments define the term “youth” differently. For example, the United Nations Development Programme (UNDP) defines youth as individuals in age group 18-35 years (UNFPA, 2015). In Kenya, the National Youth Policy of 2007 defines the youth as individuals in the 15-30 age bracket (Government of Kenya, 2007) while the Kenya Constitution of 2010 defines them as 18-35 year olds. This paper merged the two definitions to expand the sample size. Thus, “youth” is herein defined as persons aged between 15 and 34 years.

2 Youth demographic bulge is defined as a peak in the share of youth in the population (AGRA, 2015).

3 Underemployment means employment at less than desired hours (World Bank, 2016; NESC, 2010).

4 Unemployment occurs to individuals when they are of working age, are searching for work at prevailing wage rate but cannot find work (World Bank, 2016; KIPPRA, 2012).

5 Agricultural transformation is the process in which any farm changes from highly diversified agricultural enterprises and subsistence production towards specialized farms integrated into a market system (Huffman and Evenson, 2001).

6 Agribusiness is a commercial transaction which is based on the value chains for different agricultural services and inter-linked agricultural activities including input production and distribution, products assembly, processing, storage, transportation and marketing (AGRA, 2015).

processing, transportation, marketing and financial and insurance services represent a huge potential for sustainable livelihood outcomes and employment (AGRA, 2015). Livelihoods are a means to gaining a living or a set of the resources used and the activities undertaken to secure a living. A livelihood outcome is a state of living such as increased income or well-being brought about by activities and use of resources (Scoones, 2009). They are sustainable when realized and are resilient to long-term changes in policy, institutions and other external factors. Better livelihood outcomes for youth in agriculture can be achieved by better understanding of the relationship of the five (5) capital assets and livelihood outcome.

In Kenya, a continuous decline in agricultural productivity occurred after the 1970s until early 2000 (average growth at 3.5%, 1.3% and 2.4%, respectively, in the 1980s, 1990s, 2000s). Growth was negative in the early 2000s after which significant productivity growth was achieved. Specifically, unemployment of youth at a rate of 20 per cent has disproportionately affected youth households who are in the age range of 15-34 years (UNDP, 2013). As a result of the decline, a number of macroeconomic policies and strategies were devised after 1970s through to 2000s to address the interrelated problems of economic growth, high population growth, food insecurity, climate change, poverty and unemployment (UNEP, 2015; Odhiambo et al., 2004; Gerdin, 2002). The Vision 2030, the development blueprint for Kenya, addresses the livelihoods and unemployment situation of the youth. It has assigned to agricultural sector a contribution of 10 per cent to overall economic growth through competitiveness in knowledge utilization and innovation in agriculture. The Agricultural Sector Development Strategy (ASDS) through the Medium Term Plans (MTPII) (2010-2017) aims to “promote sustainable development of the livestock sector by creating a favourable policy and legal framework and provide services that increase productivity, value addition and income for the livestock farmers” (Government of Kenya, 2012a). Youth who are men and women are specifically targeted by MTPII for equitable participation and inclusive growth in the agriculture sector. Youth make up 67 per cent of the Kenyan labour force (KIPPRA, 2012), are at the most productive stage of life, have better education than adults, are innovative and can therefore greatly contribute to goals of the policies.

Since agricultural productivity decline has led to food insecurity, poverty, and unemployment in general and specifically in the rural areas, the rate of rural to urban migration for the youth has been relatively high (UNEP, 2015). Unemployment in Kenya is partly attributed to the declining livelihoods from agriculture because of low adoption of innovations, reducing farm sizes and low soil fertility, among others, since agriculture is the main source of livelihoods. Because employment opportunities in urban areas are not matched with labour

supply (KIPPRA, 2012; Odhiambo et al., 2004), youth unemployment has increased over the years. The unemployment rate for youth in semi-arid lands (SALs) who comprise 39 per cent of SALs' population (Appendix 1) and many of whom can be expected to have households is modest overall and higher in some cases such as in the Coastal region than the national average of 11 per cent (KIPPRA, 2012). Addressing unemployment and poor livelihood outcomes from livestock production is therefore urgently needed in SALs. Unemployment in general is a challenge because the most productive labour force from youth is wasted. Youth unemployment situation is far worse in the SALs due to a development strategy since 1963 that mainly focused on the high potential areas (Government of Kenya, 2012b). This can also be attributed to lack of infrastructures, harsh agro-climatic conditions that reduce agricultural production potential, insecurity and reduced opportunities for sustainable livelihoods in general. Besides youth unemployment is underemployment, which means employment at less than 40 formal employment hours in a week. A high proportion of the youth is affected by underemployment, is underpaid and is a majority (78% of total employment) in vulnerable jobs (KIPPRA, 2012; NESC, 2010). Additionally, youth have a greater share of the employed working excessive hours in a week and have real average wages falling.

A relatively large number of youth in the SALs migrate to urban areas after leaving school because of the harsh socio-economic conditions (Government of Kenya, 2012c). The conditions are characterized by in-access to land and other resources. Elderly individuals mainly own livestock resources. Although the proportion of youth households owning cattle, sheep and goats in SALs areas may not be substantial, the youth play a major role in raising livestock while elders make most value chain decisions. Because modes of agricultural production in SALs respond to economic incentives since farmers can produce surplus commodities for sale to purchase other goods, youth can be expected to make rational economic decisions in livestock production when constraints to the system are known and addressed by policy and other means.

Arid and semi-arid lands (ASALs) account for about 80 per cent of the total land area in Kenya while 16 per cent of the land mass is arable land used for agricultural production (Government of Kenya, 2010b; Aklilu, 2008). ASAL is defined as an area in which more than 30 per cent of the total land area has a moisture index which is less than 50 per cent (Omiti and Irungu, 2002). Semi-arid lands (SALs) alone account for 15 per cent of Kenya's total land area (Orodho, 2006; United Nations University, 1981). The SALs belong to agro-climatic zone V with a mean annual rainfall range of 450-900 mm (Orodho, 2006). Arid-lands (ALs) mainly differ from semi-arid lands in Kenya in a higher degree of aridity,

low infrastructure availability and cultural dimensions. However, the two regions are similar in livelihood strategies used except that pastoralism dominates in the ALs (Government of Kenya, 2012b, c).

SALs support 24 per cent of the human population (9.4 million). In addition, it supports a modest livestock population at 34, 27, 25, 33, and 59 per cent, respectively of cattle, sheep, goats, chicken, and beehives of the total for Kenya (Appendix 2) (Behnke and Muthami, 2011). A large proportion of wildlife populations in Kenya also inhabit the SALs. Arid lands and SALs are important for food security and economic growth. Mixed-farming is practiced in the SALs comprising of rain-fed and irrigated agriculture, livestock production, small-scale businesses based on dry land products, tourism activities and some agro-pastoralism in Narok, Kajiado, Trans Mara, West Pokot and parts of Laikipia counties. Additionally, the contribution to local and national economies from the marketed production of timber, fuel wood, fruits, charcoal, gums, fruits, honey and herbal medicines in the SALs is substantial (Government of Kenya, 2010a, 2012b). At least a half of the 70 per cent of the marketed beef and 43 per cent of agricultural GDP is derived from the SALs and ALs (Behnke and Muthami, 2011; Kahi and Wasike, 2006). SALs only differ from the nation in access to water, human development index and poverty rates (Appendix 3) (Government of Kenya, 2012a). It has the highest number of students travelling to school a longer distance (0-5 km) and only better than ALs (Appendix 3 and 4)(Government of Kenya, 2010c).

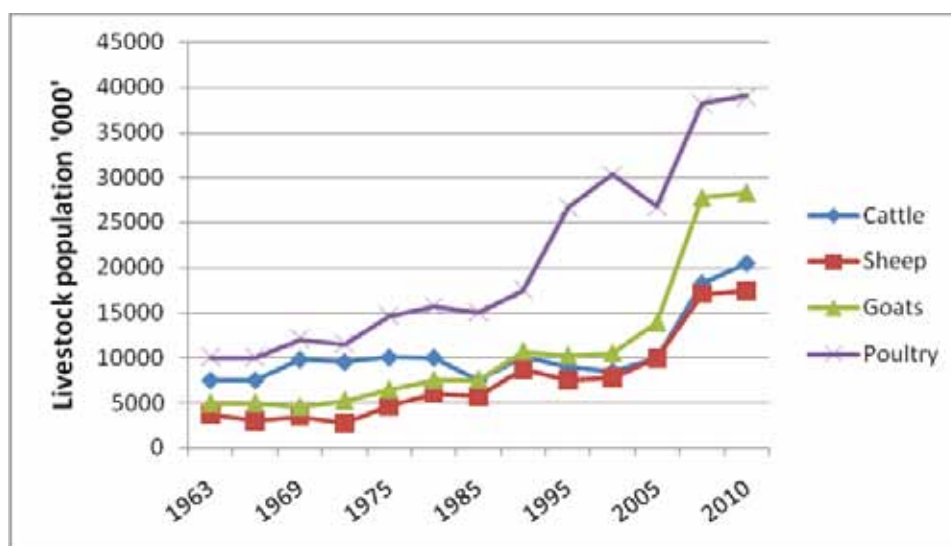
The substantial population of cattle and sheep and goats in the SALs play important roles in household food security and incomes. The livestock provides income, traction for cultivation, manure for crops and social functions. They are the main sources of livelihoods. The trend of estimated livestock population for Kenya is presented in Figure 1. Although livestock numbers were increasing since 1963 through to 2005, livestock production per livestock unit and livelihoods has been declining (Behnke and Muthami, 2011). Livestock population in 2009 is presented in Appendix 2. The main problems in the livestock industry in the SALs have been low livestock productivity, budgetary constraints for infrastructure development and research and extension services, erratic weather patterns that affect the quality and quantity of livestock feeds, and prevalence of trans-boundary and zoonotic diseases and pests. The other problems have concerned insecurity due to inter-clan conflicts and competition for pastures and watering points, inadequate market infrastructure, poor access to local and international markets, and inadequate technical capacity for control of diseases (Aklilu, 2008; Otieno et al., 2008).

The rapidly increasing population in the SALs and the rest of the country and climate change have led to increased settlements in the SALs. Fragile lands

are used for agricultural production. The ecological integrity of the SALs has declined due to increased cultivation, tree felling for wood fuel, and livestock overstocking among other extractive resource utilization methods. Poverty has been exacerbated. The current livelihoods cannot be sustained from the patterns of resource use in the SALs. One viable strategy for improving the livelihoods is to enhance the productivity of capital assets and other resources (human, physical, social, natural, financial capital, livestock, land, pastures and trees) (Scoones, 2009; Ngugi and Nyariki, 2005). Scoones et al. (2009) define capital assets as material and social resources which can be used as means of living. In SALs, no insights regarding the role of capital assets on livelihood outcomes exist to the best of our knowledge. Enhancing livelihood outcomes requires such knowledge.

After liberalization of the economy in the 1990s, the government and stakeholders undertook to implement programmes to address some of the problems regarding market infrastructure, disease and pest control through improvements in stock market routes. These were done by construction of livestock holding grounds and making livestock value chains disease free zones. However, the problems still remain (Behnke and Muthami, 2001). Therefore, the government and stakeholders need to address the livestock sub-sector issues in the ASALs to enhance agricultural productivity in these areas. This study seeks to provide insights regarding the role of capital assets (human, physical, social, natural and financial) on livelihood outcomes among youth in the SALs. The research problem, objectives and rationale are first identified. This is followed by literature review, the methodology used and findings. Conclusions are then made.

Figure 1: Trend for national livestock population, 1963-2010



Source: Republic of Kenya, 2012

1.2 Problem Statement

The specific effects of the five (5) capital assets known to influence livelihoods and that are expected to impact livelihood outcomes among the youth in livestock production are not known about in the SALs. Specifically, literature review reveals that no study was undertaken at a higher level of aggregation such as at SALs level to analyze influence of the five (5) capital assets on livelihood outcomes among youth in livestock production. Some of the studies found in literature in Kenya were conducted in some few former SALs districts. In addition, not the whole array of the five capital assets or their proxies was analysed in the few former districts. Moreover, some of the capital assets were statistically significant in relation to the dependent variable used, which ranged from income to livelihood strategies while others such as social capital were not significant. Further, some of the capital assets were significantly related to farmer income or combinations of farming strategies in one research site while not necessarily statistically significantly associated with income or livelihood strategies in other sites. In essence, the livelihood outcome among youth in livestock production in SALs was not analysed in relation to the five capital assets specifically. Therefore, the effects of the five capital assets on livelihood outcomes among youth in livestock production in the SALs are not known. This study aims to reduce that knowledge gap.

The problem for research is also framed from a policy perspective. First, the Vision 2030 and MTP II aim at a knowledge and innovation-based agriculture to contribute to better livelihood outcomes for youth and women who have been less targeted in agricultural development before the MTPs. This can most likely be realized from youth participation in livelihoods involving livestock production and a role in the livestock value chains in the case of SALs since the youth are, on average, more educated compared to the elderly and can easily adopt agricultural innovations than adults. Yet, youth in the SALs are migrating to urban areas after graduating from school at a relatively higher rate than youth in the high and medium potential areas, leaving the elderly mainly realizing livelihoods from livestock production (Government of Kenya, 2012a, c). This is due to poor livelihood outcomes and consequent high unemployment rate for youth in the SALs that is disproportionate compared to that of youth in the medium and high potential areas of the country (KIPPRA, 2012; Government of Kenya, 2012a, c). Youth migration and unemployment represent livelihood outcomes resulting from poor agricultural/livestock productivity. This is a problem since knowledge and innovation-based agriculture of the Vision 2030 cannot be realized without knowledge of the relationship between the five (5) capital assets and livestock livelihood outcomes among youth in SALs. Second, because the main opportunity for economic growth and sustenance of the Youth in the SALs

is livestock production, a low livelihood outcome from livestock production is a problem since the goal of the Vision 2030 of better livelihood outcome for youth is not being realized for youth in SALs. Third, the poverty reduction policy and healthy socio-economic growth domiciled in the Vision 2030, the Agricultural Sector Development Strategy (Government of Kenya, 2010a) and the Kenya Constitution 2010 provision for citizen rights to food and nutrition security and equity in development cannot be realized if the youth in SALs are not facilitated to participate in economic development. The only and most promising livelihood outcomes for youth in the SALs is in livestock production, which is best understood by the youth and, in the environment, youth have the best knowledge about. All the policy goals mentioned above can mainly be realized when the five capital assets youth are endowed with can be understood and interventions targeted in relation to their livelihood outcomes.

1.3 Objectives and Research Questions

1.3.1 Objectives

The study proposes to analyse the effects of the five (5) capital assets on livelihood outcome among youth in livestock production in all SALs sub-counties in Kenya. The research seeks to achieve the following specific objectives:

1. Determine the effects of the five capital assets (human, natural, physical, financial, and social capital) on livelihood outcomes among youth in livestock production (cattle, goats, and sheep and chicken, etc.) in the SALs.
2. Suggest policy options for intervening on the five (5) capital assets to influence livelihood outcomes among youth in livestock production based on the findings.

1.3.2 Research questions

The following research questions will guide the study:

1. What are the effects of the five (5) capital assets on livelihood outcomes among youth in livestock production in the SALs?
2. What policy options can be suggested to influence the five (5) capital assets to positively impact livelihood outcome among youth in livestock production based on the findings?

1.4 Justification

Analysis of the effects of the 5 capital assets on sustainable livelihood outcomes among the Youth in relation to livestock production in the SALs will be gained through this study. The nature of the relationship between livelihood outcome among youth and each capital asset will provide insights on how policy options can be used to intervene in each relationship. The relationship between the capital assets among youth and livelihood outcome can then be influenced in a manner that enhances positively livelihood outcome in livestock production among youth. The magnitude of the effects of the capital assets on livelihood outcome will also allow the researcher to assess the most important capital assets that need to be emphasized by policy interventions to ensure optimal livelihood outcomes are realized among the youth. This way, the study can address livelihood outcome among youth in livestock production by affording insights on what interventions in policy can be undertaken to positively influence livelihood outcome based on study findings. Insights from the study can help address growth in agricultural production, poverty reduction, urban migration, unemployment and underemployment among others. This is the case since agriculture has a greater potential for employment creation in the rural areas compared to other economic sectors. In short, knowledge insights gained from the study could be useful in formulating policy options that can be adopted and implemented by the National and County Governments to reduce youth unemployment in SALs that is inhabited by 24 percent of the national population. Further, the sectoral Medium Term Plan II (MTP II) of Vision 2030 (2013-2017) programmes aims at making agriculture productive, commercially viable and competitive globally by making the sector contribute to the economy at a growth rate of 10 percent annually. The programme aims at creating equitable opportunities for youth and women participation in the sector through increased innovation and participation in value addition. Insights from this study can therefore be used to adapt MTP II programmes by the National, County Governments and other development players to address SALs youth needs in terms credit, land and technology access, and participation in policy processes to make them more relevant to youth in the SALs.

2. Literature Review

2.1 Theoretical Literature

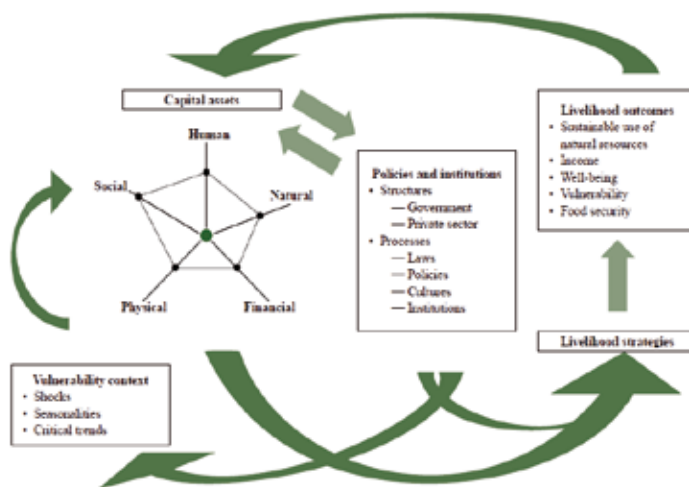
Neo-liberal theory of sustainable livelihoods framework

This literature review elaborates on the Sustainable Livelihoods Framework or Approach (Chambers, 1995, cited in Scoones, 2009). People in the rural or urban areas, their goals for sustainable livelihoods and the livelihood strategies they adopt to achieve them are diverse (Berdegúe and Escobar, 2001; Ngugi and Rakodi, 2002; Tonner, 2003; Nyariki, 2005; Mango et al., 2009;). A livelihood is made up of capabilities, assets, and activities needed to reach a status of living (Serrat, 2010). The assets include human, physical, natural, financial and social capital (asset pentagon or 5C's). A livelihood comprises a complex web of activities and interactions across boundaries of different sectors of the economy. Livelihood outcomes such as a state of well-being vary and may depend on how different strategies affect livelihood pathways. Realization of a livelihood involves coping, adaptation, improvement, diversification and transformation. Analyses at the individual unit can aggregate to complex livelihood strategies and pathways at household, village or area level, such as a district or region. A livelihood is sustainable when it can cope with and recover from stresses and shocks. It can maintain or enhance its capabilities and assets while not negatively affecting the natural resource base on which it is based (Chambers and Conway, 1992, cited in Scoones, 2009).

The capital assets an individual or household possesses determine the livelihood strategies the household embraces, which in turn determine livelihood outcomes. In determining the livelihood strategies, capital assets interact with the policies and the institutional environment in which the sustainable livelihoods are situated. This structures the livelihood outcomes for the household (Figure 2). People deploy livelihood strategies to improve well-being, food security, and increasing incomes and minimizing vulnerability (Serrat, 2010; de Janvry and Sadoulet, 2000 cited in Berdegúe and Escobar, 2001).

Due to the differentiations in rural household assets, the regions in which the people reside, the income generating opportunities and the contexts structuring people's decisions, rural and/or SALs poverty can be quite heterogeneous. The contexts are made up of markets, droughts, institutions, power structures, policies and policy organizations, and trends such as demographic growth and environmental changes. Thus, understanding the relationships among the assets, the contexts in which sustainable livelihoods are taking place, the livelihood strategies adopted by a household and its outcomes can be understood (Figure 2).

Figure 2: The sustainable livelihoods framework



Source: Adapted from Serrat, 2010

The mainstream theory on sustainable livelihoods approaches have drawn mainly on neo-liberal economic foundations. The neo-liberal perspective of livelihoods focused on household economics. However, this theoretical perspective has been criticized for not analysing the wider concerns about complex livelihoods, environmental dynamics and poverty (Petersen and Pedersen, 2010). In particular, the earlier sustainable livelihoods approaches concentrated on macro neo-liberal concerns about employment and not the local context (micro-level), role of politics and power relations, and governance in livelihood outcomes (Scoones, 2009). Scoones (2009) advocated for a meta-theory for sustainable livelihoods for understanding the impact of knowledge, politics, scale and dynamics on livelihood outcomes. Before, the theoretical relevance of the meta-theory is elaborated, the livelihoods approach evolution is briefly described.

Evolution of theory of sustainable livelihoods framework

In the 1960s or so, studies of collaboration of ecologists, anthropologists, agriculturalists and economists studying changing rural systems at an institute in Zambia, although not labelled as livelihoods approaches, contributed to the current theoretical understandings of sustainable livelihoods approach or analysis. The analyses were integrative, locally embedded, cross-sectoral and based on a deep field engagement and action-oriented in relation to improving rural livelihoods (Scoones, 2009). However, in the era after World War II, policy advice was dominated by professional economists framing development discourse using

predictive models of supply and demand, inputs and outputs by applying micro-economics and macroeconomics. Livelihoods analysis thus linked economics with natural, medical and engineering sciences. However, some studies undertaken in this era including village studies, impacts of the Green Revolution in India, the actor-oriented approach of the Wageningen University and studies of contested patterns of livelihoods in Nigeria constituted meta-theory on livelihoods analyses.

Other studies contributed to the theoretical development of sustainable livelihoods approach in the 1980s. These included household and farming systems and agro-ecosystems analyses. The studies aimed at getting at integrated systems perspective on farm problems. The methods commonly used for field engagement included rapid and participatory rural approaches (Chambers, 2008). Also, studies on livelihood and environmental change, dynamic or changes in ecologies, history and longitudinal change, gender, social differentiation and cultural contexts were performed by geographers, socio-economists and social anthropologists. The studies underlined livelihoods under stress and coping strategies and livelihood adaptation. Yet, more studies were undertaken on intersections of structural, political and ecological dynamics. These emphasized the complex realities of diverse livelihoods linked to macro-structural issues. Finally, the environment and development movement of the 1980s-90s linked and focused on poverty reduction and development with longer-term environmental shocks and stresses, emphasizing the concept of sustainability in Agenda 21. The sustainable development agenda was concerned with livelihoods priorities of local people, in relation to environmental issues of climate change, biodiversity and desertification. The same issues were explored in cross-disciplinary research on socio-ecological systems, resilience and sustainability science (Clarke and Dickson, 2003).

The above studies from various disciplinary perspectives have offered diverse insights into the complex interaction between rural livelihoods and environmental, economic, political and cultural processes but were not labelled livelihoods approaches until Chambers and Conway defined the concept in 1992 (Scoones, 2009). The neo-liberal paradigm of predictive models was challenged by the researches of the Department for International Development (DfID)(UK), among others, in the 1990s-2000s. The Sustainable Livelihoods Framework (SLF) developed from economists linked inputs (capitals or assets) with outputs (livelihood strategies) to outcomes (poverty, employment which are connected to well-being and sustainability). However, the economic perspective focusing on assets has not gone beyond the instrumental goal of poverty reduction. Such studies have only analyzed inputs-outputs-outcome elements of the SLF, which are amenable to quantitative analysis (Figure 2). The sociological explanation of links between livelihoods and outcomes in the SLF has indicated how and why

diverse assets connect to strategies and outcomes through mediation of socio-cultural and political processes. The latter require qualitative understandings of power, politics and institutions.

A meta-theory of sustainable livelihoods framework

The SLF emphasizing economic perspective has been criticized in the 1990s-2000s for emphasizing the local context but not processes of economic globalization, politics and governance as they determine resource access, the challenges of long-term environmental sustainability (climate change) and major shifts in rural economies (agrarian change). The framing of the traditional SLF meant a shift of research and policy focus from the contextual, multi-disciplinary and cross-sectoral approach of livelihoods perspective to predictive macro-economic models. For example, sustainability in the SLF has meant coping with immediate shocks and stresses but not long-term trends. This could only mean that adaptation can address poverty marginally at the present but cannot fundamentally transform it in the future (Scoones, 2009). Scoones (2009) therefore proposed a better understanding of the complex, dynamic contexts and diversity by proposing analyses of the roles of knowledge, politics, scale and dynamics in sustainable livelihoods.

Because knowledge production occurs through value systems, politics of what is knowledge and what is not, assumptions and these are reinforced by educational and training institutions, there is need to create opportunities to make multiple framings of knowledge explicit. Political choices in livelihoods analyses can then be made and the framings of livelihoods and normative commitments for action cannot then be dominated by specific institutions such as has occurred for the World Bank in livelihoods analyses (Scoones, 2009). As regards politics, Scoones (2009) proposed that livelihood analyses must unpack the contextual specificity of livelihoods in terms of understanding how power and politics determine livelihoods. Understanding social relations helps to identify how political spaces are opened or closed and result into the distribution of property, types of work and division of labour, income distribution and time-space changes in consumption and accumulation. Analysis of the role of politics in livelihoods outcomes must take into account the nature of the state, the influence of private capital and terms of trade, colonialism and globalization among other wider structural forces.

One of the failures of livelihoods approaches has been failure to address wider global processes and their impacts on livelihoods at the local level (Petersen and Pedersen, 2010). Thus, ground has been ceded to macroeconomics, which cannot adequately inform local-level complexities (Scoones, 2009; Murray, 2002,

cited in Tonner, 2003). Multi-sited, comparative, scaled studies that link local-level analysis to wider processes of change such as globalization can achieve the requirement of scale analysis in livelihoods approaches. Scale analysis links the micro to the macro and vice versa. The mentioned studies have used a variety of methods including examination of networks, linkages, connections, flows and chains across scales while rooted in place and context. Such approaches need to clarify how specific forms of globalization and their processes of production and exchange from colonialism to the present era of neo-liberal economics generate both processes of opportunity and marginalization. Livelihoods analysis thus needs to illustrate the multiple experiences of globalization and indicate the implications of multiple transformations and diverse livelihood pathways.

Analysis of long-term dynamic change in livelihoods perspectives has been weak. The concept 'sustainable' or 'sustainability' in livelihoods implies stability, durability, resilience, and robustness in livelihoods in the face of external shocks and internal stresses (Morse et al., 2009). It has not been made explicit what shocks or stresses are as drivers of livelihoods, how sustainability is measured and how the livelihoods of posterity are integrated into the SLF analyses. The SLF mainly gave attention to vulnerability analysis and short term coping and adaptation. In short, the SLF gave little attention to systemic transformations due to long-term secular changes such as climate change or trade. Specific drivers of change operate in long-term livelihood change. Thus, sustainability and resilience cannot always emerge from local adaptation when conditions of extreme vulnerability such as climate change prevail. More dramatic changes of livelihoods may have to occur in response to long-term changes (Scoones, 2009). Although climate change has been included in livelihoods analysis, this has not addressed the inter-relationships between vulnerability and resilience (Nelson et al., 2007, cited in Scoones, 2009). A critical analysis of long-term change and the above inter-relationships can facilitate a conceptualization of different pathways to livelihoods to be envisaged and interventions to be applied to enhance livelihoods (Morse et al., 2009). Studies on analysis of resilience of socio-ecological systems can shed light on how sustainable the livelihood pathways generated from analysis of long-term change are. Studies on the relationships between socio-economic and technological systems can also suggest how sustainable the livelihood pathways suggested could be (Geels and Schot, 2007, cited in Scoones, 2009).

Morse et al. (2009) emphasized the points already made about the theoretical framework of the SLF. The researchers reiterated the need for focus on the household in SLA, the importance of evidence in SLF process and intervention (policy), people-centeredness of the SLF and its dependence on involvement of the people and acceptance of involvement of multiple sectors in analysis and intervention (Rakodi, 2002). The other aspects of the SLF include the setting of

objective of intervention after SLF analysis and that change happens in the long-term and livelihoods are dynamic and not static.

Practices and applications of sustainable livelihoods framework

Further critiques mainly bordering on practical usefulness of SLF and its application have been made by other researchers. These are: that SLF conducts quantitative cataloguing of data and information but people about which SLF exercises are performed are invisible (Toner, 2003); each of the five pentagon group of assets contains many elements, and are therefore not directly comparable (Maqueen, 2001, cited in Toner, 2003) and how and which ones are to be measured is not clear; trust is important for an SLF exercise yet most of the questions being asked about assets are very sensitive and the data collected could be distorted; and the problem of representation still exists with SLF approaches as with all participatory methods because different actors are involved in the various arrows in Figure 2 and those participating in the SLF are not the same ones that can use the information to bring about change, making SLF exercises an end in themselves. Also, defining and measuring capital assets is problematic and a mechanistic relationship between policy and institutional environment in livelihood choices is assuming rational choice model and ignoring the complexities involved. SLF's concern with mainly formal institutions is also narrow, ignoring community and familial structures and norms and their role in evolution of new institutions (Toner, 2003). In addition, analyses of vulnerability such as shocks and trends do not appreciate the difficulty of predictability of outcomes of such analyses and there is much complexity in SLF analyses that require decisions about interpretation and presentation (Morse et al., 2009).

The empirical literature addressing the use of the SLF theory and practice is now presented.

2.2 Empirical Literature

Livelihood and livelihood diversification and household capital assets

Barret et al. (2001) analyzed the effects of household endowments and characteristics on the choices and diversification of four livelihood strategies adopted by rice farming households which raised livestock within West Africa Rice Development Association (WARDA) in Côte d'Ivoire. The four livelihood strategies included full time farmer, farmer and off-farm worker, farmer and skilled non-farm worker, and farmer, off-farm and skilled non-farm worker (mixed strategy). The change in livelihood strategies among the four livelihood

diversification options used longitudinal data in 1993 and 1995 period when massive exchange rate devaluation between the local currency and a foreign currency occurred. Similarly, the researchers analyzed the effects of Food for Work (FFW) programme that involved distribution of food to households in exchange for labour provision to local road construction works in the ASAL Baringo County in Kenya. Livestock production is a major livelihood strategy in the region, although crop production is undertaken marginally. The goal of the study was to assess the impact of FFW programme on livelihoods of the beneficiaries. Data was collected from 308 randomly stratified farm households in ten sub-locations in the arid-to semi-arid region.

Overall, both livelihood studies in Côte d'Ivoire and Kenya indicated that livelihood diversification behaviours and outcomes are influenced by liquidity and skills constraints to household activity choice (Barret et al., 2001). The constraints are related to *ex ante* endowments or capital assets, which limit access of poorer populations to livelihood strategies that are more income rewarding and less risky. For the WARDA case study, a multinomial logit regression and chi-square analysis indicated that the likelihood of a household being in the more income rewarding full farmer and farmer and non-skilled farmer livelihood strategies was determined by increasing total land, livestock owned and secondary school completion. The most important factor in livelihood choice in 1995 was past livelihood strategy. Age was not an important factor in livelihood choices among the capital assets. Participation in non-farm activity decreased with distance from town. For the Kenya study, FFW participants acquired higher income than did non-participants except for the second income quartile. Also, the difference in the above incomes between the two groups was more than transfers due to FFW indicating that value was added to the diversified household activities. This showed that participants in FFW moved into higher income rewarding livelihood strategies associated with improved crop production, improved management of livestock, and increased participation in skilled non-farm activities.

Perret et al. (2005) investigated livelihood diversification and factors responsible for diversification among 237 households in two communities located in semi-arid regions in South Africa. A total of nine livelihood typologies emerged, with main types of livelihoods ranging from incomes from pension, childhood allowances, self-employment, crop-farming, livestock keeping, remittances and health allowance, among others. The study concluded that there was departure from agriculture as a major source of livelihoods from the past and that some specialization rather than a portfolio of livelihoods had emerged among the households contrary to literature. Further, the factors important in determining livelihoods comprised gender (women headed households had poorer livelihoods), number of adult family members, skills, experience in life (age) and income.

Interestingly, households with livelihoods from agriculture (crop and livestock farming) were either salaried or had income from self-employment.

Iiyama (2006) used the SLF to analyze the livelihood diversification patterns and linked them to livelihood well-being (degree of poverty) and environmental resource use among 177 households in Rokocho sub-location in Kerio River Basin, in Keiyo District. Sampling of households was based on a census. Data was collected through interviews of household members during 2006. The main livelihood patterns identified through cluster analysis consisted of crop activities (drought resistant sorghum, millet, staple foods such as maize beans, fruits and commercial crops such as wheat), livestock livelihoods (indigenous cattle, sheep goats, or exotic animals), off-farm activities (business, casual labour and remittance) and land rental. The proportion (percent) contribution of a livelihood typology was used for their identification. Livelihood patterns (household activity incomes) were estimated by their determinants that comprised household characteristics or capital assets (age, gender, years of education, years in farmer group, adult equivalent, livestock equivalent units, and acres of traditional, fruits and commercial crop, etc). The effects of a particular livelihood diversification pattern on poverty (total income) and resource use were estimated from livelihood patterns (dummed proportion of income generated for a livelihood typology) and household variables. An OLS model and logistic regression models were used for the above estimations, respectively. Four dummy variables represented the five livelihood patterns mentioned with a moderate staple crop livelihood used for control in the OLS. Percent households involved in terracing, planting napier grass and tree planting were used similarly to present income from a livelihood pattern.

Households (34%) with young uneducated heads or fewer livestock were unlikely to practice farming activities but got involved in off-farm income activities (78% income). For households (12%) that specialized in traditional livestock (73% income), minute distance to a training centre and the number of traditional animals were significantly positive, but land acreage with drought-resistant crops and fruits were significantly negative. Households with livelihood pattern with staple crop (11%) including casual off-farm and traditional livestock (59% income) had dummy (whether migrated from away), minute distance to a training centre, number of exotic animals significantly negative while areas with staple crop was significantly positive. The fourth cluster, the crop-livestock integrated livelihood pattern (fruits and exotic animals) (19% households, 32% income from fruits) had the number of exotic animals significantly positive and years of education of household head negative. The livelihood pattern specialized in regular off-farm activities (24% households, 71% income from off-farm) had years of education of

the head significantly positive while areas with staple crop and minute distance to a service centre significantly negative.

The significant variables for the estimated effects of particular livestock livelihood patterns and household variables (capital assets) on total gross income were age and education years of the head, participation years in farmer groups, adult equivalent (positive), and specialization in casual off-farm dummy variable (negative). Specialization in traditional livestock livelihood was negative though not significant, meaning that it was associated with low-return activities. Finally, for the effects of livelihood patterns and household characteristics on terracing, tree planting and napier planting, households integrating fruits and exotic animals were more likely to conserve the environment. The above cluster took more measures on environmental conservation than households whose livelihoods were based on regular off-farm activities that were likely to be full time employed or in business. Among the households, gender affected terracing and napier planting. Education increased the probability to plant napier. The researchers concluded (citing other studies) that differentiation between households in livelihood diversification in Africa has deepened. Other researchers have confirmed the existence of diversification in livelihood strategies (Tsegaye, 2013; Alemu, 2012; Mango et al., 2009; Rakodi, 2014). Livelihood patterns based on natural resource exploitation exhibit less diversification, lead to low returns to income, low investment in natural resource management and a vicious cycle of poverty compared to more diversified high income return livelihoods (Iiyama, 2006).

Further, Iiyama et al. (2007) found that education, participation in farmers' groups, access to training centre, and family size (human capital) had significant association with dominant crop-livestock diversification livelihood patterns. The study used multiple regression and was conducted in Keiyo District, Kenya.

Household assets, policy and the institutional environment and household income

Freeman et al. (2004) studied livelihood status for households from ten villages in 2001 and 2002 in the then Bomet and Suba districts, respectively, in Rift Valley and Nyanza regions of Kenya. The study using SLF analyzed the asset status of the rural households, income generating activities undertaken by the households, and the social and institutional environment within which livelihood strategies were realized in agriculture and livestock activities. The micro-level findings were reflected on to the poverty reduction and/or agricultural productivity enhancement macro-level policy adopted by the Kenya government at least from 2003. The latter guided recommendations for agricultural and rural development

policy for addressing poverty reduction in the studied villages. The researchers had villagers in the ten villages rank wealth participatory in terms of livelihood assets such as land and livestock-owned, implements (mainly agricultural), how permanent the household house was, whether labour was hired or not, level of education, whether household was food secure all year round or not and household participation in non-farm activities (trading, shop-keeping, etc). Rapid Rural Appraisal and Participatory Rural Appraisal methods were used for quantitative and qualitative data collection.

The above study found mean land acreage increase across income quartiles except for Suba District fishing villages where households involved in artisanal fishing with lower land acreage were found in the top income quartiles. Similar findings were found for livestock holdings (cattle goats, sheep and chickens) measured as livestock equivalent units. Fishing households were an exception to the rule in that fishing households achieved highest incomes with relatively fewer livestock units due to income from fishing. The status of the five assets including land (natural capital), livestock (natural capital), labour (economic capital), implements (physical capital) and years of education (human capital) were assessed for the income tercile for all households in the study sample. The top and middle income thirds of households only differed on implements in average ownership of the five assets. The last income third of the households had the least ownership of all assets except the number of working adults. This case study illustrated a clear relationship between the level of asset ownership and income or livelihood outcomes, and the upper quartile position of income that livestock allows owners to take. The multiple roles of livestock as a substitute asset in its ability to be converted to land and other assets and vice versa were illustrated by the study. When fishing in Suba District was assumed as an agricultural activity, then 46 per cent and 54 per cent of household income, respectively, were derived from agriculture and livestock farming and non-farm activities. Further, the income portfolios for livestock farming alone was at least 33 per cent for the bottom income quartile while it was a mere 4 per cent for the top quartile income households for the whole sample. For analysis of the institutional and social context in which livelihoods were realized, qualitative data was collected from individual and group interviews. The study found that the greatest threat to livelihood activities in the two districts was from both formal and informal taxation by local level authorities.

Finally, in South Africa, Alemu (2012) used stochastic dominance test and multinomial logistic regression to model the effects of age, labour endowment, education, and community access to basic infrastructure on household livelihood outcomes. The study found that households that generated income from wage employment from farm and non-farm activities had better livelihoods than did households without wage employment.

Household assets and poverty

Kristjanson et al. (2005) modelled spatial correlates of poverty incidence in the semi-arid Kajiado District using as independent variables proxies of the five assets in the SLF. The researchers used participatory methods with the locals and practicing researchers to identify 40 proxy variables for human capital, social capital, natural capital, physical capital and financial (economic) capital. The variables were all spatially referenced. Poverty incidence as a measure of livelihood well-being in each of the 105 sub-locations used for research was estimated as the proportion of the population in a sub-location falling below the poverty line (Ksh 1,239 per adult equivalent per month or US\$ 0.55 per day). A loglinear Poisson regression model that assumed a linear relationship between poverty incidence and the predictor variables was used. A set of three predictor models were fitted using Akaike Information Criterion (AICc). A 96 per cent confidence set on models encompassed the three models, meaning that the three models would be selected as the best 96 per cent of the time. The proxy variables retained in the three best models that excluded social capital were vegetation index (natural capital), livestock density (financial capital), road density, distance to a major town (physical capital), access to education facilities and access to security (human capital). Independent variables that were highly correlated at 0.5 to the included variables were excluded from model fitting. Thus, pasture potential, livestock density, road density and security access were negatively related to poverty incidence as expected. However, access to education facilities was positively associated with poverty incidence unintuitively because more education facilities were located in poorer areas without enough time lapses to produce expected positive effects (Kristjanson et al. (2005). The researchers noted that livelihoods were diversified into both agro-pastoralism and none agro-pastoralism activities and many livelihood strategies were dependent on livestock. Vista (2005) found a similar relationship between poverty incidence and spatial variables of access to road infrastructure, water and markets and elevation, slope, soil and government policies in the Philippines.

Household assets, livelihood vulnerability and practices and applications of sustainable livelihoods framework

Morse et al. (2009) used SLF to analyze two households each in two villages in Igalaland in southern Nigeria. The goal was to analyze the pentagon 5 assets and vulnerability to provide evidence to support or not support an assumption that an ongoing Catholic credit programme could be re-designed to have all credit used for a stated purpose. Re-modelling the credit could better impact the livelihoods of

farmers in different contexts of agricultural production if supported by the study. The study also assessed the methodology of SLF. The research was a case study of two villages. The methods used included interviews using semi-structured questionnaires, informal discussions, field mapping and observations and participation in activities. One major finding was the difference in vulnerability for credit between the two villages. One village was found to have greater dependency on credit than the other. The village judged to have less dependency on credit for agricultural production had more diverse livelihoods than the other. The researchers noted how difficult it would be to make a conclusion regarding sustainability of livelihoods between the two villages, noting that if a major change occurred on credit sources for the village which needed it most, then that did not mean that livelihoods could not be sustainable or less sustainable because farmers could always find other sources of credit to maintain or better their livelihoods.

The researchers also concluded that representativeness of households/participants in relation to generalization of findings can be problematic in SLF because diversity always exists among households. The researchers noted the importance of trust in externally-led SLF analysis by participants. This determines the quality of data and information participants provide. Emphasis on a more accurate assessment of capital asset provides better information for improving livelihood sustainability. However, care has to be taken not to lessen the importance of people. Inclusion of the local community in SLF should be emphasized (Petersen and Pedersen, 2010; Rakodi, 2002). This leads to increased motivation, commitment and empowerment of the locals. The SLF can help a community learn and exchange information on how they can take opportunities that may come. However, it is important that such a view recognizes policy, other contexts and constraints that may be at work. Scoones (2009) made a similar emphasis regarding analysis for livelihoods. Finally, Morse et al. (2009) concluded based on this study that an SLF analysis could be judged to be successful based on a trade off of quality of work with costs and any final change which follows an SLF.

2.3 Synthesis of Literature Review

This study therefore adopts a theoretical perspective that the asset pentagon (5Cs) determines strategies used to realize livelihoods and livelihood outcomes for individuals, groups and community subject to the macro factors (institutions, policies and power relations and scale (local context), among others. The study also embraces integration of the local context at the household and district level with the macro-context at the regional level comprising of semi-arid districts in Kenya. Although the micro-level and macro-level contexts are assumed to be integrated in terms of analyses at the household, district and regional levels, policy

and environmental contexts are not modelled in the study. The semi-arid lands straddle eastern, western, northern and southern Kenya in general. The study however, does not analyse livelihoods over time since KIHBS is a one time cross-sectional study. Therefore, dimensions of livelihoods such as coping, resilience, and sustainability are not addressed since these can only be measured over time.

Given, the literature reviewed, one of the gaps in knowledge identified for research is in regard to factors that determine livelihoods in livestock in semi-arid areas as an aggregated region in relation to age. The effects of age have also been mixed up in the studies that have been conducted at lower levels of aggregation. Analysis of the effects of age on livestock livelihoods can allow policy options to be determined to enhance the livelihoods for the youth who have the greatest unemployment especially in the marginal areas of Kenya.

3. Methodology

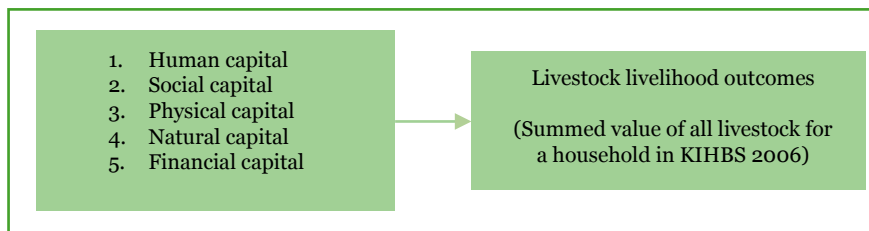
3.1 Conceptual Framework

Sustainable livelihoods theoretical perspective was used to derive the conceptual framework. The theory proposes that individuals (household heads) choose different strategies to achieve different livelihoods depending on the assets (social, financial, natural, physical, social and human capital) and the context or external factors (institutions, policies and economic factors) that they interact with in their environment (Figure 2). The asset profiles of the households and the contexts in which the assets are applied to achieve sustainable livelihoods determine the livelihood outcomes. In this study, the individuals are youth household heads in SALs.

However, practically, the effects of the external environment such as policies, politics, power relations and economic factors may not be empirically measured when the relationship between assets and livelihood outcome is modelled (Scoones, 2009). The conceptual model in this study therefore assumed the existence of the intervening variables mentioned above, especially given that the intervening variables to assets and livelihood outcomes could not be measured for cross-sectional data that was used in the analysis. The model used is presented in Figure 3.

Figure 3: Model of the 5 Capital assets and livestock livelihoods outcomes

The conceptual model made several assumptions one of which is that variations in livestock livelihood outcomes did not occur because of the one summed livestock value used in the regression model but in reality the outcomes are expected to differ for households in income magnitudes and specializations in livestock livelihoods.



3.2 Analytical Framework

An ordinal logistic regression model was therefore adopted for the relationship between proxy variables for the five capital assets (5Cs) including age and a proxy variable for livestock income representing livelihood outcome (proxy of summed value of livestock sales in 2006 for youth household heads in SALs) (Government of Kenya, 2006). The estimation model was based on the conceptual

framework for livelihoods adopted for the study (Figure 3). The model estimates the probability (odds) of an individual household being in a higher category of three ordinal categories of livestock income (livelihood outcome) compared to an individual in the middle and lower livestock income categories when a specific capital asset instantaneously changes or increases by one unit when all the other capital assets are held constant. Thus, the effects of age on livestock livelihood outcome and those of the factors that determine livestock livelihood outcomes for the youth and their magnitude and directions are rendered. However, the distances between adjacent levels of livelihood outcome categories are not known. The ordered logistic regression model is represented in the logit form (Liu and Koirala, 2012) below. The null hypothesis tested in the model is that there is no relationship between livestock livelihood outcome (livestock income proxy) and each of the independent variables in the model.

$$\begin{aligned}
 \text{(i) } \ln(Y'_j) &= \text{Logit}[\pi(x)] \\
 &= \mathbf{h} \left(\frac{\pi(x)}{1 - \pi(x)} \right) \\
 &= \alpha_j + (-\beta_1 X_1 - \beta_2 X_2 - \dots - \beta_p X_p)
 \end{aligned}$$

Where $\pi_j(x) = \pi(Y \leq j | x_1, x_2, \dots, x_p)$ is the probability of being at or below category j , given a set of predictors, $j=1, 2, \dots, J-1$, α_j are the cut off points, and $\beta_1, \beta_2, \dots, \beta_p$ are logit coefficients for the independent variables namely Human capital, Natural capital, Social capital, Financial capital, Physical capital and Age. Y is the dependent variable in three categories (low, moderate, high), Y'_j is the latent variable of cut points between boundaries of the dependent variable.

The dependent variable livestock income was livestock sold (total value of cattle, sheep, goats, chicken, pigs, etc sold) by youth household in the last 12 months. The proxy variables for the independent variables are as follows: Human capital = total years of the highest level of education of household head; Natural capital = total agricultural holding size in acres; Social capital (gift) = sum of value in Kenya shillings of food received from others, including the Government in 2006; Financial capital = sum of expenditure in Kenya shillings in agricultural chemicals for livestock by a household; Physical asset value (PAV) = sum of value of major implements for agriculture in 2006; and age = age of youth household head in years (15-34 years). Age was included to test how the degree of youthfulness also affects livelihood outcome among youth as is expected.

Ordinal or logistic regression analysis was selected for data analysis because the theory on livelihoods acknowledges a linear relationship between capital assets and livelihood outcomes. However, because the dependent variable is

highly positively skewed and not normally distributed, probability measures for predicting the likelihood of a household being at a higher or lower category compared to other households in other categories would be better determined from ordinal regression and not linear regression. A log linear transformation of the continuous dependent variable showed very low association between the dependent continuous variable and independent variables. Therefore, a probabilistic model was adopted. Second, the requirement of interval data for ordinal logistic regression analysis was satisfied by the availability from KIHBS of independent variables as interval data. Data for education which was in grade levels was easily converted to level of education in years. Since qualitative data for the sub-sample of households in the semi-arid lands used for analysis was not available, mixed method could not be used to add richness to the analyses.

Data analysis

An ordered logistic regression (OLR) model was estimated for livelihood outcome from livestock production by estimating log-odds (ordered log-odds or logits) of a predictor variable for being in the highest category of livelihood outcome from livestock production compared to the middle and lowest livelihood outcome categories given that all the other independent variables were held constant at mean values. The dependent variable (livestock income) was ordered into three categories of livelihood outcome from livestock production with an ordinal scale (category 1 = Ksh 0; category 2= Ksh 1 to 3999; category 3 = Ksh 4000 to 100,000). An assumption was made that the levels of livelihood outcome from livestock production had a natural ordering from low to high, but the distances between adjacent levels are not known. Before data analysis, because livestock income values were highly positively skewed from descriptive statistics, Shapiro-Wilk Test for normality and tests of homoscedasticity and heteroscedasticity were conducted, respectively (Appendix 5 and 6). The normality test confirmed that the interval data was highly positively skewed at over + 13 standard z values. The Breusch-Pagan/Cook-Weisberg test for homoscedasticity/heteroscedasticity confirmed, respectively, lack of constant variance of residual errors and lack of independence of the errors from earlier independent variable values (Appendix 6) (Chi square value 463.14 and a probability > Chi square 0.0000). Therefore 1.5 per cent of outlier data was deleted to exclude maximum values of the dependent variable (livelihood outcome) that were too skewed. The three categories, respectively, comprised of 45, 24 and 26 per cent proportions of youth household heads. The categories are not overly unrepresentative of the values that they represent since no particular category is even twice as much as the others. Second, the population of values in categories 2 and 3 are basically equal. A requirement

for category in statistics is that the proportions represented should be as much as possible about equal, and this general requirement is satisfied here since a category with the lowest number of values has 70 values. This is not a small number in statistical analysis. A multi-collinearity test for independent variables also showed inter-correlations below 0.70 and no serious multicollinearity among the variables (Appendix 7).

The model was estimated using STATA version 13 into likelihood Chi square ratios, ordered log-odds (coefficients or logits), standard errors, standardized values (z-tests) and associated *p*-values and pseudo R squared. The latter was not interpreted as the normal adjusted R squared in OLS regression. The other outputs are cut points for boundaries between the three categorical response variables. The null hypothesis tested in the model is that no relationship exists between livestock livelihood outcome and any capital asset (The model coefficients are not different from zero). Type I error (α) level was set a priori at 0.05.

Model post-estimation for parallel regression assumption or proportional odds assumption was performed using *omodel* and Brant tests (Liu, 2012). The assumption posits that the regression coefficients or relationship between all pairs of response variable groups is the same. Therefore only one regression model is necessary to describe each pair of outcome groups. The null hypothesis of the tests is that there is no difference in the coefficients between models describing the relationship between each pair of response outcome groups. Both model fit tests use likelihood ratio tests. Results for *omodel* test and Brant test are tabulated (Appendix 8 and 9). Both tests allow the null hypothesis not to be rejected when the probability of the Chi square ratio is different from $p < 0.05$. When such a result is obtained with each test, then the test indicates that the proportional odds assumption is not violated.

3.3 Data Sources and Measurement

The data used for this study is primary data collected in the Kenya Integrated Household Budget Survey (KIHBS) (Government of Kenya, 2006). A summary of the methodological approach used in the KIHBS survey is briefly documented here followed by the methods used for data analysis in this particular study. The KIHBS 2006 survey was the first survey to collect a comprehensive set of socio-economic indicators required to measure, monitor, and analyze the progress made in improving the standards of living of Kenyans in line with the Economic Recovery Strategy (ERS) (Government of Kenya, 2012) and the Millennium Development Goals. The KIHBS data and information comprise these data: demographics; child health and anthropometry; housing, water, sanitation and energy use; transfers;

income; credit and recent shocks to household welfare; food consumption and expenditures, expenditures on non-food items and durable goods; agricultural holdings, activities and outputs; livestock; labour; and household enterprises. Measures related to expenditures on non-food items and the latter measures acted as proxies for the five capital assets used in this study.

All the needed variables were referenced by the unique household identification numbers. The variables were collapsed, merged and saved into one file for the study. The variables were then labelled appropriately for easy recognition of the variables as already described.

4. Results and Discussion

4.1 Descriptive Data

Descriptive data for youth was analyzed for a total of 927 household heads with a gender composition of 75.40 per cent males and 24.60 per cent females. Data was analyzed into frequencies, means, range and standard deviations for the SALs. The results are presented in Table 1. The mean values for the independent and dependent variables shown in the table are relatively low as can be expected of the SALs which have relatively lower agricultural potential and productivity. The mean value for physical assets indicates the limitation that exists for the realization of livelihoods in agriculture in SALs in general due to low asset endowments. The value specifically demonstrates limitation for livelihoods in livestock production where normally limited assets are employed in agricultural production due to the low climatic potential for agriculture. The data showed that a lot of variance occurs for all variables in youth households. This was especially the case for livestock income (livelihood outcome), gifts and physical asset value. The households were headed on average by a relatively older youth at the age of 28 years in 2006. The zero value for livestock income meant that youth household got no income from livestock in 2005/6 but not necessarily having no livestock. The same was true for “Gift” (food received), physical asset (agriculture implements), financial capital and agricultural holding size.

Table 1: Frequencies, means, standard deviation and range values for livelihood outcome and capital assets among youth

Variable (units)	N	Mean in 2005	Std Deviation	Min	Max
Livestock income (Ksh.)	686	6,976.62	28,704.15	0	437,200
Gift (Ksh.)	531	5,431.56	14,216.76	0	180,000
Physical asset value (Ksh.)	913	249.67	3,559.49	0	100,000
Agricultural holding size (acre)	927	1.44	4.10	0	98
Financial capital (Ksh.)	927	112.81	1,285.31	0	33,600
Age (years)	927	28.38	3.99	16	34
Household size	927	3.83	2.12	1	14

Note: N = number of observations

Source: Author's own compilation from KIHBS (2006) data

4.2 Capital Assets Affecting Livelihood Outcome from Livestock Production among Youth

The estimation model was analysed by regressing the ordinal dependent variable (livelihood outcome from livestock) on independent continuous variables comprising gift (social capital, sum of all food received by household in 2006), physical asset value PAV (physical capital value of implements used in agriculture), agricultural holding size in acres (natural capital), sum of expenditure on chemicals used in livestock production (financial capital), education in years (human capital) and age in years (human capital). An important assumption of ordered logistic regression is that the relationship between each pair of outcome groups such as the lowest category of livelihood outcome and all other livelihood outcome categories and the second category and all other higher livelihood outcome categories, respectively, is the same. The dependent variable is ordered naturally and continuous (Liu and Agresti, 2005). Results are shown (Table 2 and 3). Overall model summary indicates that with a likelihood Chi square ratio of 55.45 and a p -value <0.0001 , the model is statistically significant as a whole compared to the null model without predictors. The pseudo R squared is modest at 10.5 per cent (Table 2).

Results for estimate of the dependent variable are now briefly described. The only predictor variables having effects on the response variable at $p < 0.05$ are agricultural holding size (natural capital), expenditure on chemicals used in livestock production (financial capital) and age of household head (natural capital) (Table 3). The relationships are positive and statistically significant. Agricultural holding size has the greatest effect on livelihood outcome followed, respectively, by age among youth and financial capital taking into account the magnitude of log-odds or coefficients. For a one unit increase in agricultural holding size, we would expect for a youth household an increase of 0.19 log-odds of being in a higher level of livelihood outcome given that all the other variables in the model are held constant at their mean values. A one year increase in age between 16 and 34 years is expected to result in 0.09 log-odds for a household of being in the higher livelihood outcome category compared to being in the middle and lower categories of livelihood outcomes when all other variables are held constant. Similarly, a one unit increase in the value of financial capital is expected to lead to an increase in log-odds of 0.0014 (Ksh 100 expenditure increase in chemicals used in livestock production leads to an increase in log-odds of 0.14) for a household of being in the higher livelihood outcome compared to the lower and middle level livelihood outcomes given that all other variables are held constant at their mean values. Finally, the cut points of 3.31 and 4.50 indicate where the latent variable is cut to make the three dependent variable categories. A log-linear regression of the

independent variables against livelihood outcome indicated a “lower” adjusted variance explained compared to the ordinal logistic regression model (Appendix 10). See further discussion below.

Although SALs are low in agro-climatic potential, increased holding size is expected to positively influence livestock livelihood outcome due to increased pasture availability or acreage for crop residues used for livestock feeds. However, since the limited average holding size of only 1.44 acres (Table 1) was available for a household head, not much can be hoped for in improving the livelihood outcomes of youth from farm-size as land availability in the SALs is generally limited.

Table 2: Model summary of ordered logistic regression of livelihood outcome on gift, physical asset, agricultural size, financial capital, education and age among youth

Ordered Logistic Regression	Number of Observations = 291
	LR Chi ² (6) = 55.45
	Prob > Chi ² = 0.0000
Log likelihood = -235.29519	Pseudo R ² = 0.1054

Table 3: Model of logistic regression of livelihood outcome on agricultural holding size, gift, financial capital, physical asset, education and age of household head

Livestock livelihood outcome	Coeff. squares	SE	z	P> z
Agricultural holding size (acre)	0.1910375	0.0465549	4.10	0.000
Physical asset value (Ksh)	-0.0000337	0.0001017	-0.33	0.740
Financial (Ksh)	0.0014689	0.000634	2.32	0.020
Gift (Ksh)	-0.0000243	0.0000174	-1.40	0.162
Education (years)	-0.0039899	0.0286803	-0.14	0.889
Age (years)	0.0883992	0.0346824	2.55	0.011
/Cut1	3.307958	1.038406		
/Cut2	4.47621	1.054201		

Note: Cut1 and Cut2 are cut points which define boundaries which separate the three levels of the response variable

Source: Author's own compilation from analysis

This is so since land pressure is already a problem in semi-arid lands and land potential is also marginal. Increasing the potential of land size in semi-arid areas through technological innovations in the form of moisture conservation, early

maturing and productive seed varieties, and productive and adapted livestock would be among the options for productivity enhancement for agriculture. Financial assets represent capital such as oxen ploughs or tangible production technologies which can enhance production through increases in livestock output. Age is expected to be positively associated with livelihood outcome. In essence, age category influences social networks, which increase better chances for the adult to realize capital accumulation including, knowledge and skills for livestock production, market access for capital and livestock products and in selling off animals. Aged individuals will likely have a family life cycle that will provide more able-bodied labour for the family. These are in addition to cultural advantages of age which allow better inheritance of family wealth such as land and livestock, and access to resources in general compared to youth.

All capital assets are theoretically expected to be positively associated with livelihood outcome from livestock production. The lack of statistically significant association between the dependent variable and education, social capital (gift) and physical asset can be explained. All the above relationships were unexpected. It is possible that in each case of the independent variable, the construct used for each variable in the survey was not necessarily the best measure for it.

Marginal effects for the relationship between the dependent variable and independent variables were estimated in terms of change in odds for a standard deviation change in the independent variable. The estimation was also made in terms of per cent change in odds associated with standard deviation change in the independent variable. The results are shown in Appendix 11 and 12. From Appendix 11, a change in livelihood outcome odds of 1.211 occurs when there is a unit increase in agricultural holding size. For a unit increase in financial capital, there is a change in odds of 1 for livelihood outcome. The changes in livelihood outcome odds for standard deviation increases in agricultural holding size, financial capital and age were, respectively, 3.459, 2.102 and 1.409. Finally, a change in livelihood outcome odds of 1.092 is associated with a unit increase in age of a household head. The greatest effect on livelihood outcome for youth is therefore achieved from farm size, followed, respectively, by financial capital and age. Similarly, in Appendix 12, 21 per cent change in livelihood outcome odds occurs when there is a unit increase in agricultural holding size. For a unit increase in financial capital, there is only 0.1 per cent increase in odds of livelihood outcome. Finally, there is 9.2 per cent increase in odds for livelihood outcome for a unit increase in age. In terms of percent change, there is a 246 per cent change in odds of livelihood outcome for a standard deviation increase in agricultural holding size. A standard deviation in financial capital is associated with a 110 per cent change in livelihood outcome while a similar change in age is associated with 41 per cent change in odds of a youth household head being in a higher livelihood outcome category.

The findings of this study are now put into perspective in relation to past studies. Similar to findings in this study, the research of Barret et al. (2001) found land acreage, livestock equivalents (financial or natural capital)(Perret et al., 2006; Freeman et al., 2004) and secondary education positively associated with household incomes for livelihoods in Côte d’Ivoire and Kenya. The findings of Freeman et al. (2004) regarding the relationship between capital assets and livelihoods in ten villages in Bomet and Suba districts in Kenya agree with this study. The exceptions to the above study were physical assets and social capital. Specifically, Freeman et al. research found that land acreage and livestock holdings (cattle, sheep, goats, and chickens, etc) increased across income quartiles for the households. The result of a lack of relationship with the dependent variable for physical asset value in this study may be explained from the fact that very limited physical capital (implements) is utilized in semi-arid lands perhaps because of the extensive nature of production where land holding size is the main capital for investments in livestock production. The study of Barret et al. (2004) and Freeman et al. (2004) did not include an indicator for social capital.

Kristjansson et al. (2005) found a linear relationship between poverty incidence (proportion of the population in a sub-location falling below the poverty line (US\$ 0.55 per adult equivalent per day) and spatial correlates of poverty (vegetation index, natural capital; livestock index, financial capital; road density and distance to a major town, physical capital; access to education facilities and access to security, human capital). Only social capital predictor was not associated with poverty incidence.

In comparison to this study, Perret et al. (2005) found factors determining livelihoods in households in two communities in South Africa to comprise gender, number of adult household members, skills, age and income. Apart from gender, the independent variables could represent natural/human capital, education, age, and economic/financial capital in this study. Iiyama (2006) estimated the effects of particular livestock livelihood patterns and household characteristics (capital assets) on livestock livelihood among a census of households in Keiyo District in Kenya. The study found a positive association between the dependent variable (livestock livelihood) and age, years of education of household head, years of participation in farmer groups, household adult equivalent (human capital). The above variables are self explanatory in comparison to the variables in this particular research. Years of participation in the above study could represent social capital. However, there was a negative relationship with specialization in off-farm activities. The study also found either positive or negative relationships among acreage of some crops, years of education of household head and distance to service centres, and specific types of livelihoods ranging from mainly staple crop farming to specialization in mainly traditional livestock keeping. Finally, Morse et al. (2009) found that a village

with better credit (financial capital) endowment in Southern Nigeria had better livelihoods in agriculture including livestock production than did a village with a poor endowment for credit. The researchers concluded that credit, which is a form of financial or social capital, like in this study, can determine agricultural livelihoods subject to context.

Finally, model fit statistics from various indices were estimated to assess the reasonableness of the models in terms of fitness in representing the relationship between the dependent variable and independent variables. Results for various fit statistics are reported in Appendix 13. The fit statistics cannot be interpreted as a “percentage of explained variation” in the least squares’ R squared sense. This is the case since the values for the indices shown in the table are based on chi-square units and not linear distances like in least squares cases. The indices for the relationship between the dependent and independent variables range from a minimum of 0.075 to a maximum of 0.422. Literature indicates that McKelvey and Zavoina’s indices are highly correlated to the least squares adjusted R-squared. Literature also indicates that Cragg-Uhler/Nagelkerke index is very conservative. Based on the above, it may be reasonably concluded that the fitness indices for the fitted **logistic** regression model likely ranges between 0.208 and 0.422. The model has reasonable fitness.

5. Conclusions and Policy Recommendations

5.1 Conclusions

The following conclusions are made based on the research findings.

Factors affecting livestock livelihoods for youth

Agricultural holding size

Increasing landholding size for a youth household head in semi-arid lands leads to an increase in livestock livelihood. However, increased landholding size may not be relied on for long-term improvement of livelihoods for youth. This is because the average holding size of 1.44 acres does not amount to much land because semi-arid lands are marginal in potential. Therefore, given the significance of the land endowments for the youth and policies, there is need for cultural mind-set changes that can facilitate youth access to land and land ownership. This can promote better livelihood outcomes in livestock production among youth in the SALs.

Financial capital

Increase in expenditures in agricultural chemicals for livestock leads to an increase in livelihood outcome. Improvement in livelihood can be enhanced by increasing access to chemical inputs, affordability and efficient utilization of inputs.

Age

As the age of a youth household head increased, livelihood outcome from livestock production increased. This means that the relatively lower potential of the younger youth compared to the older ones to impact livelihood outcome need to be enhanced to give the much younger youth a greater potential to generate better livelihood outcome. A policy targeting building on livestock knowledge and skills of the younger youth on livestock production is necessary. There is also need to target the younger youth in accessing support services such as credit, inputs and market access to help them compensate for their lower potential in other capital assets which older youth and adults are expected to possess on average.

5.2 Policy Recommendations

The following policy recommendations are derived from the conclusions already made.

1. Agricultural holding size. Youth are socially and culturally disadvantaged in relation to land access, purchase, inheritance and ownership. Both the national and county governments need to devise educational and social and cultural sensitization to change mind-set of adults to prevent discrimination of access, purchase, ownership and inheritance of land based on gender and age of individuals.
2. Financial capital. Credit for use in livestock production can be created to support the youth. This would most likely succeed when modelled on community-based credit systems in which traditional trust and peer pressure for collective mobilization and refund of credit for revolving are critical. Such capital would have greater impact when combined with a policy supporting marketing, information and communication structures to create motivation for increased production beyond household consumption.
3. Age. Programmes in research and extension and support services in marketing should target the younger youth especially to develop their potential in areas of knowledge, skills, social networks and access to other resources which is limited by age.

5.3 Limitations and Areas for Further Research

The following limitations and areas for further research were identified. The limitation could make these research findings not valid.

1. The variables used as indicators for the five (5) capital assets in the SLF were not researched to be the most appropriate for representing the capital assets before the survey was conducted. Instead, the researcher selected them from the survey data without prior knowledge as to how appropriate they were as indicators of the capital assets. They may not be the best indicators for capital assets.
2. Use of a single value to represent livelihood outcome for livestock production may not have estimated the actual value because a holistic and participatory appraisal of the range of livelihoods was not measured by the survey.
3. The dimensions of livelihoods such as coping, resilience, and sustainability are not addressed since these can only be measured over time but the data

used was cross-sectional data. The effects on livestock livelihood outcome are not therefore analyzed over time and not contextualized.

4. There is need for investigation on the interaction effects of capital assets on livelihood outcome for the youth.
5. There is a need to include other forms of infrastructure such as roads in future research.
6. To address the costs and need for a more comprehensive data for analysis of livelihood outcomes on dimensions of sustainable livelihoods such as coping, resilience, and sustainability, power structures and livelihoods, environmental changes and livelihoods among others, participatory data collection methods (focus group discussions, participatory learning and evaluation, etc), historical records and transect methods should be used longitudinally. Livelihood outcomes would then be analysed relatively cheaply and longitudinally over time. Such methods can be combined with econometric models to bring out comprehensive understandings of livelihood outcomes over space and time and from power structures, globalization and poverty influences.

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Appendices

Appendix 1: Proportion of youth in semi-arid districts and the total population in Kenya

County	Age in Years				Share of Youth (%)
	0-14	Youth 15-35	36+	Total	
NAIROBI	946,770	1,597,220	572,880	3,116,870	51.24
NYANDARUA	257,100	199,840	138,790	595,730	33.55
NYERI	231,650	247,410	207,890	686,950	36.02
KIRINYAGA	175,230	201,440	150,530	527,200	38.21
MURANG'A	348,050	316,070	277,230	941,350	33.58
KIAMBU	566,640	674,630	385,880	1,627,150	41.46
MOMBASA	310,560	439,640	175,330	925,530	47.5
KWALE**	303,460	219,370	120,720	643,550	34.09
KILIFI**	514,970	377,030	205,020	1,097,020	34.37
TANA RIVER*	123,950	76,210	39,990	240,150	31.73
LAMU**	43,610	37,380	21,220	102,210	36.57
TAITA TAVETA**	107,950	97,960	71,960	277,870	35.25
MARSABIT*	134,980	98,210	54,480	287,670	34.14
ISIOLO*	62,670	49,910	26,970	139,550	35.76
MERU*	542,260	502,170	308,580	1,353,010	37.12
THARAKA NITHI**	141,690	127,220	93,570	362,480	35.1
EMBU*	195,540	187,220	135,810	518,570	36.1
KITUI**	467,940	318,480	217,920	1,004,340	31.71
MACHAKOS**	426,180	397,140	265,020	1,088,340	36.49
MAKUENI**	383,650	290,210	203,870	877,730	33.06
GARISSA*	296,980	221,320	98,910	617,210	35.86
WAJIR*	340,350	211,760	103,830	655,940	32.28
MANDERA	551,000	317,940	157,720	1,026,660	30.97
SIAYA	374,510	276,040	184,290	834,840	33.07
KISUMU	419,200	365,930	175,570	960,700	38.09
MIGORI	453,380	317,340	144,940	915,660	34.66
HOMA BAY	458,220	329,020	170,970	958,210	34.34
KISII	516,660	408,180	220,800	1,145,640	35.63
NYAMIRA	261,480	215,240	120,070	596,790	36.07
TURKANA*	390,990	317,410	143,240	851,640	37.27
WEST POKOT**	270,730	165,730	77,870	514,330	32.22
SAMBURU*	111,050	73,410	35,970	220,430	33.3
TRANS NZOIA	385,010	290,800	143,740	819,550	35.48
BARINGO*	267,150	184,710	97,410	549,270	33.63
UASIN GISHU	369,120	353,460	159,670	882,250	40.06
ELGEYO MARAKWET*	170,980	127,260	70,470	368,710	34.51
NANDI	335,210	271,580	143,990	750,780	36.17
LAIKIPIA**	170,300	140,880	89,040	400,220	35.2
NAKURU	676,350	615,830	309,040	1,601,220	38.46
NAROK**	427,240	288,130	128,030	843,400	34.16
KAJIADO**	284,600	278,020	120,400	683,020	40.7
KERICHO	257,970	222,460	108,070	588,500	37.8
BOMET**	412,960	322,230	157,960	893,150	36.08
KAKAMEGA	774,510	553,590	329,420	1,657,520	33.4
VIHIGA	245,890	170,750	137,440	554,080	30.82
BUNGOMA	662,130	465,850	242,490	1,370,470	33.99
BUSIA	354,710	246,070	136,860	737,640	33.36
SEMI-ARID LANDS	3,529,100	3,059,780	1,614,640	7,894,510	38.76
Total	16,523,530	14,205,700	7,681,870	38,411,100	36.98

Note: * = Arid District; ** = Semi-arid District (Semi-Arid Land); some of the semi-arid districts were sub-divided and the number of districts in the above table does not represent all semi-arid districts as shown in Appendix 1.

Source: Government of Kenya, Kenya Integrated Household Budget Survey, 2009

Appendix 2: Kenya livestock population: ASAL, arid, semi-arid and highlands as head in 2009 and proportion in 2009 census

	National MLD 2008 estimates	National 2009 population census	ASAL ¹	Arid	Semi-arid	Highlands
Cattle	13,522,500 77%	17,467,774 100%	12,155,974 70%	6,281,354 36%	5,874,620 34%	5,311,800 30%
Sheep	9,907,300 58%	17,129,606 100%	14,954,925 87%	10,246,527 60%	4,708,398 27%	2,174,681 13%
Goats	14,478,300 52%	27,740,153 100%	25,250,865 91%	18,230,633 66%	7,020,232 25%	2,489,288 9%
Camels	1,132,500 38%	2,971,111 100%	2,968,670 100%	2,924,742 98%	43,928 1%	2,441 0%
Donkeys	786,800 43%	1,832,519 100%	1,616,522 88%	1,126,103 61%	490,419 27%	215,997 12%
pigs	330,020 98.6%	334,689 100%	82,500 25%	1,438 1%	81,062 24%	252,189 75%
Bee hives		1,842,496 100%	1,371,101 74%	286,564 16%	1,084,537 59%	471,395 26%
Chicken indigenous	29,615,000 93%	25,756,487 ² 81%	10,258,066 32%	1,063,276 3%	9,194,790 29%	15,498,421 49%
Chicken commercial		6,071,042 19%	1,523,983 5%	131,811 0%	1,392,172 4%	4,547,059 14%

Source: Adapted from Behnke and Muthami (2011)

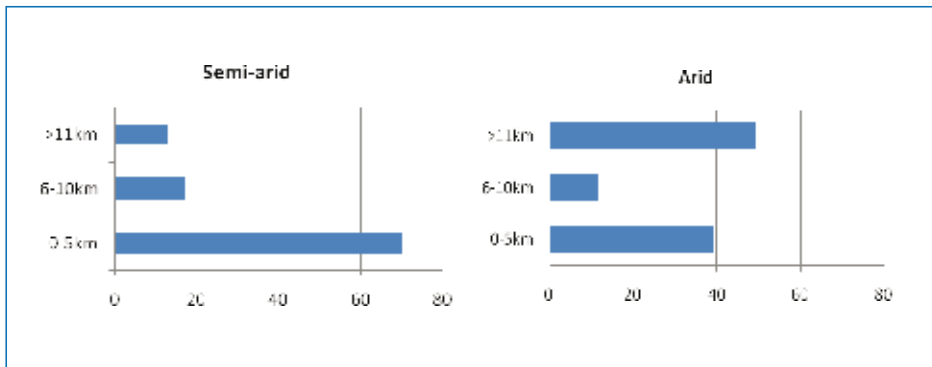
Appendix 3: Human poverty index and human development index for semi-arid districts in 2009 in Kenya

District*	Life expectancy	Illiteracy rate	School enrolment	Households without access to safe water	Human Poverty Index	Human Development Index
Bomet	66.1	22.26	82.4	84.1	30.6	.6018
Kajiado	63.7	34.77	55.9	24.7	27.0	.5938
Kilifi	53.6	43.96	70.0	39.6	36.9	.5807
Kitui	57.1	37.65	72.5	83.5	46.4	.5133
Koibatek	66	29.68	79.4	55.0	29.3	.6023
Kwale	53.0	41.38	66.8	18.6	33.1	.4771
Laikipia	64.9	30.98	71.2	44.6	27.2	.6012
Lamu	56.0	32.49	78.4	69.0	39.7	.5512
Machakos	59.0	19.22	75.0	51.6	31.1	.5868
Makueni	57.2	22.41	77.8	57.1	33.3	.5584
Malindi	54.3	45.96	65.4	50.9	39.4	.4983
Mbeere	63.0	24.16	77.6	71.7	34.2	.5904
Mwingi	60.7	35.91	72.1	86.0	46.6	.5402
Narok	63.5	51.66	56.4	84.0	46.1	.5275
Taita Taveta	57.9	33.77	74.3	33.77	29.5	.5533
Tharaka	52.8	40.6	77.2	69.6	41.7	.4876
Transmara	58.9	49.27	62.3	74.3	45.4	.4847
West Pokot	58.3	50.53	59.1	77.3	44.0	.4655
Nation	56.6	29.23	70.5	43.0	29.1	.5608

Note: * = District as it existed in Kenya in 2006 before the Kenya Constitution 2010.

Source: Government of Kenya (2010c), Kenya National Human Development Report 2010c

Appendix 4: Distance to secondary school, proportion of students, semi-arid and arid lands



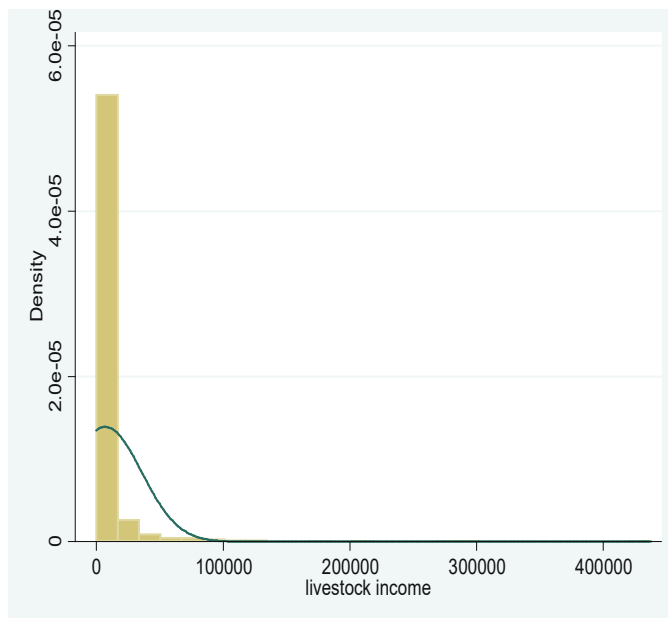
Source: Adapted from Government of Kenya (2012a)

Appendix 5: Shapiro-Wilk test of livestock livelihood outcome among youth households in Semi-Arid Lands in Kenya

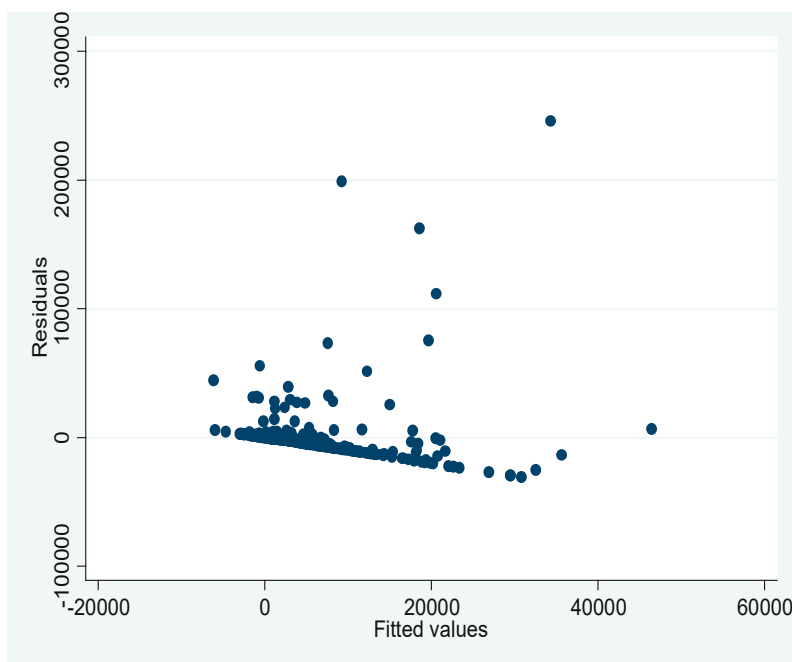
Variable	N	W	V	Z-Statistic	P-Value
Livestock income (Livestock livelihood outcome)	686	.33045	299.782	13.92	<.00001

Note: N = Number of observations; z-statistic= z-test score for b=0

Source: Own analysis



Appendix 6: Homoscedasticity/heteroscedasticity test for linear regression of livestock livelihood outcome on capital assets among youth in semi-arid lands in Kenya



Appendix 7: Multicollinearity test using a Matrix of Pearson correlation coefficients

	Livelihood outcome	Gift	Physical Asset Value	Agric_			
Holding	Financial	Age	Education				
Livelihood outcome	1.0000						
Gift	0.1280	1.0000					
Physical Asset Value	-0.0146	-0.0048	1.0000				
Agric_Holding	0.0611	-0.0843	-0.0187	1.0000			
Financial	0.1100	-0.0148	-0.0143	0.0253	1.0000		
Age	0.1055	-0.0064	-0.0956	-0.0132	-0.0234	1.0000	
Education	0.2150	0.2817	0.0311	-0.0135	0.0360	0.0310	1.0000

Source: Own compilation

Appendix 8: OModel test for logistic regression of livelihood outcome on agricultural holding size, gift, financial capital, physical asset, education, and age of household head

Livestock livelihood outcome	Coeff squares	SE	z	P> z
Agricultural holding size (acre)	0.1910375	0.0465549	4.10	0.000
Physical asset value (Ksh)	-0.0000337	0.0001017	-0.33	0.740
Financial (Ksh.)	0.0014689	0.000634	2.32	0.020
Gift (Ksh.)	-0.0000243	0.0000174	-1.40	0.162
Education (years)	-0.0039899	0.0286803	-0.14	0.889
Age (years)	0.0883992	0.0346824	2.55	0.011
/Cut1	3.307958	1.038406		
/Cut2	4.47621	1.054201		

Note: Approximate likelihood-ratio test of proportionality of odds across response categories:

$$Chi^2(6) = 3.55$$

$$Prob > chi^2 = 0.7371$$

Coeff= log-odds or coefficient; SE= standard error; z= z-score for test of b=0 ; P>|z|= p-value for z-test

Source: Own compilation from analysis

Appendix 9: Brant test of parallel regression assumption for logistic regression of livelihood outcome on agricultural holding size, gift, financial capital, physical asset, education and age of household head

Variables	Ch2	p>chi2	df
All	11.84	0.066	6
Agric_holding	2.04	0.153	1
PAV	0.52	0.469	1
financial	0.14	0.710	1
gift	5.51	0.019	1
education	0.02	0.887	1
age	0.04	0.841	1

Note: A significant test statistic provides evidence that the parallel regression assumption has been violated; Ch²= chi square value; p>ch²= probability of chi square ratio; df = degrees of freedom

Source: Own compilation

Appendix 10: Log-linear regression of livelihood outcome from livestock production on agricultural holding size, gift, financial capital, physical asset, education and age of household head

Livestock livelihood outcome	Coeff squares	SE	t	P> t
Agricultural holding size (acre)	0.1466619	0.0358902	4.09	0.000
Physical asset value (Ksh)	-0.0000349	0.0001073	-0.33	0.745
Financial (Ksh)	0.0014887	0.0004601	3.24	0.001
Gift (Ksh)	-0.0000247	0.00002064	-1.20	0.232
Education (years)	-0.0037764	0.0286803	0.08	0.940
Age (years)	0.1938403	0.0599126	3.24	0.001

Note: Coeff = coefficient; SE = standard error

Source: Own compilation

Appendix 11: Factor change in odds for increase in agricultural holding size, gift, financial capital, physical asset, education and age of household head

Variables	b	z	P> z	e ^b	e ^b StdX	SDofX
gift	-0.0000	-1.397	0.162	1.000	0.758	1.1e+04
PAV	-0.0000	-0.331	0.740	1.000	0.929	2177.475
agric_holding size	0.1910	4.103	0.000	1.211	3.459	6.497
financial	0.0015	2.549	0.020	1.001	2.102	505.884
education	-0.0040	-0.139	0.889	0.996	0.981	4.711
age	0.0884	0.887	0.011	1.092	1.409	3.882

Note: SD= standard deviation; b= raw coefficient; z= z-score for test of b=0; P>|Z|= p-value for z-test; e^b= exp (b) factor change in odds for unit increase in X; e^bStdX= EXP (B*SD of X) (change in odds for SD increase in X; SDofX = standard deviation of X)

Source: Own compilation

Appendix 12: Change in per cent odds for unit increase in agricultural holding size, gift, financial capital, physical asset, education and age of household head

Variables	b	z	P> z	%	%StdX	SDofX
gift	-0.0000	-1.397	0.162	-0.0	-24.2	1.1e+04
PAV	-0.0000	-0.331	0.740	-0.0	-7.91	2177.475
agric_holding size	0.1910	4.103	0.000	21.1	245.9	6.497
financial	0.0015	2.317	0.020	0.1	110.2	505.884
education	-0.0040	-0.139	0.889	-0.4	-1.9	4.711
age	0.0884	2.549	0.011	9.2	40.9	3.882

Note: b= raw coefficient; z= z-score for test of b=0; P>|Z|= p-value for z-test; e^b= exp (b) factor change in odds for unit increase in X; e^bStdX= EXP (B*SD of X) (change in odds for SD increase in X; SDofX = standard deviation of X

Source: Own compilation

Appendix 13: Fitness statistics for regression of livelihood outcome on agricultural holding size, gift, financial capital, physical capital, education and age of household head

Statistic	Ologit
Log-likelihood	
Model	-235.295
Intercept-only	-263.020
Chi-square	
Deviance (df=283)	470.590
LR (df=6)	55.450
p-value	0.00
R2	
McFadden	0.105
McFadden (adjusted)	0.075
McKelvey & Zavoina	0.422
Cox-Snell/ML	0.173
Cragg-Uhler/Nagekerke	0.208
Count	0.677
Count (adjusted)	0.105
IC	
AIC	486.590
AIC divided by N	1.672
BIC (df= 8)	515.977
Variance of	
e	3.290
y-star	5.693

Source: Own compilation

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