DETERMINANTS OF INFORMATION COMMUNICATION TECHNOLOGIES USAGE IN AGRICULTURAL VALUE CHAINS BY RURAL YOUTH IN BUSIA COUNTY, KENYA

BY

PAULINE NDINDI KATUNYO

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Department of Agricultural Economics

Faculty of Agriculture

University of Nairobi

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DECLARATION

This thesis is my original work and has not been submitted to any university or institution for any award.

Pauline Ndindi Katunyo

Reg. No A56/82205/2015

Signature……..Date……

This thesis has been submitted with our approval as university supervisors.

Dr. David Jakinda Otieno

Department of Agricultural Economics, University of Nairobi

Signature……. Date……

Prof. Willis Oluoch-Kosura

Department of Agricultural Economics, University of Nairobi

Signature…….Date…….

Dr. Julius Juma Okello

International Potato Centre (CIP), Uganda

Signature……. Date…….

RESEARCH PAPER

The following paper has been written from this thesis.

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DEDICATION

With lots of love, I dedicate this work to my late parents, Geoffrey and Colletah who have always and will continue to be a source of great inspiration in my life.

I dedicate it to my wonderful siblings and friends who believed in me and supported me morally and financially throughout my study and made this work possible.

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ABSTRACT

The youth represent one of the productive resources of every country. In Kenya, the youth constitute 80% of total population, but face significant challenges in the labor market. About 55% of Kenyan youth are unemployed, making it one of the highest youth unemployment rates in the world. The use of information communication technologies (ICTs) in agricultural value chains provides an opportunity for improving the profitability of agriculture-related activities to ensure sustainable livelihoods. However, the extent of youth's participation in the application of ICTs in agricultural value chains is yet to be documented. This study sought to fill this knowledge gap by characterizing youth participation in agricultural value chains and analyzing the extent to which they use various forms of ICTs. Primary data were obtained through face-to-face interviews of a random sample of 213 youth in Busia County. The data were analyzed using descriptive statistics, binary logit and poisson regression models. Descriptive analysis was used to characterize youth participation in agricultural value chains. A binary logit regression model was applied to analyze factors influencing youth's use of ICTs in agriculture. Poisson regression model was used to examine the extent of ICT usage in agricultural value chain stages. The findings showed that usage of ICTs by most youth for agricultural transactions is concentrated in the cereals, horticulture and livestock value chains. The youth mostly preferred using ICTs at the marketing level of the agricultural chain activities. The study also found that youth's usage of ICTs in agriculture is influenced by access to extension, group membership, transport cost to the market and number of ICT tools owned. Age, marital status, transport cost, distance to market, number of agricultural value chains, land size and access to extension services significantly affected the extent of ICT usage by the youth in the agricultural value chains. These findings offer useful insights on the best points along the agricultural value chains where ICTs can be

more effectively deployed and the specific capacity of the youth can be built to enhance their application of ICTs tools in agricultural transactions. The findings suggest the need to incorporate agricultural information packages on social media platforms. Further, introducing training programs tailored to build capacity in understanding specific value chains will be important in helping youth use ICTs appropriate for different enterprises and value chain stages.

Key words: ICTs, youth, agricultural value chains, Kenya.

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ACRONYMS

AGRA	Alliance for a Green Revolution in Africa
AVCs	Agricultural Value Chains
BPO	Business Process Outsourcing
CIDP	County Integrated Development Plan
CTA	Technical Centre for Agricultural and Rural Cooperation
EPRC	Economic Policy Research Centre (Uganda)
FAO	Food and Agriculture Organization of the United Nations
ICTs	Information Communication Technologies
IDRC	International Development Research Centre
IFAD	International Fund for Agricultural Development
IFPRI	International Food Policy Research Institute
IICD	International Institution for Communication and Development
ILO	International Labor Organization
ITU	International Telecommunication Union
KIPPRA	Kenya Institute for Public Policy Research and Analysis
KNBS	Kenya National Bureau of Statistics
NBRM	Negative Binomial Regression Model
NGO	Non-Governmental Organizations
PRM	Poisson Regression Model
SSA	Sub-Saharan Africa
UN	United Nations
UNDP	United Nations Development Programme
USAID	United States Agency for International Development
VIF	Variance Inflation Factor
ZIP	Zero Inflated Poisson

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background of the Study

Development policy documents in Sub-Saharan Africa (SSA) emphasize the critical role of young people in economic transformation. For instance, the fourth commitment of the Malabo declaration (*inclusive agricultural growth and transformation*) pledges to create job opportunities for at least 30% of the youth in agricultural value chains (African Union Commission, 2014). Youth have been defined widely and differently. For most African countries it captures the change between end of childhood and entry into adulthood; from being dependent on others to being independent through paid formal or informal employment or self-employment, and a period in which one has reached maturity. Some of the transition challenges however, extend into the late 20's or even beyond, due to prolonged job search (International Development Research Centre - IDRC, 2015).

The age bracket commonly used by the United Nations (UN) agencies to define youth is between 15 and 24 years. However, the African Union and the Technical Centre for Agricultural and Rural Cooperation (CTA) consider youth as individuals between 15 and 35 years of age (African Union, 2006; CTA, 2014; United Nations Development Programme, 2014). The constitution of Kenya defines the youth as persons in the 18 to 35 years' age bracket (Republic of Kenya, 2010), which is the definition adopted in the current study.

Young men and women have a crucial role in the prosperity of SSA because they constitute the bulk of the workforce estimated to be more than half of Africa's population (African Union

Commission, 2011). About 62% of the total labor force in SSA is employed in agricultural enterprises (World Bank, 2017; FAO, 2018). The agricultural sector offers opportunities for young people to be employed as producers and suppliers of food in order to keep pace with the increasing domestic demand for food (World Bank, 2013). Innovative uses of Information Communication Technologies (ICTs) present opportunities by providing linkages along the agricultural value chains as an alternative source of employment for young people (Sanginga et al., 2015).

About 70% of the unemployed youth in SSA form the rural population, which relies on agriculture as the primary means of livelihood (African Union Commission, 2011). In Africa, the youth comprise 67% of the total population (FAO, 2018) and over 40% of the total unemployed people (International Telecommunication Union, 2015). Figure 1 shows the distribution of youth employment in Africa, by location and gender.

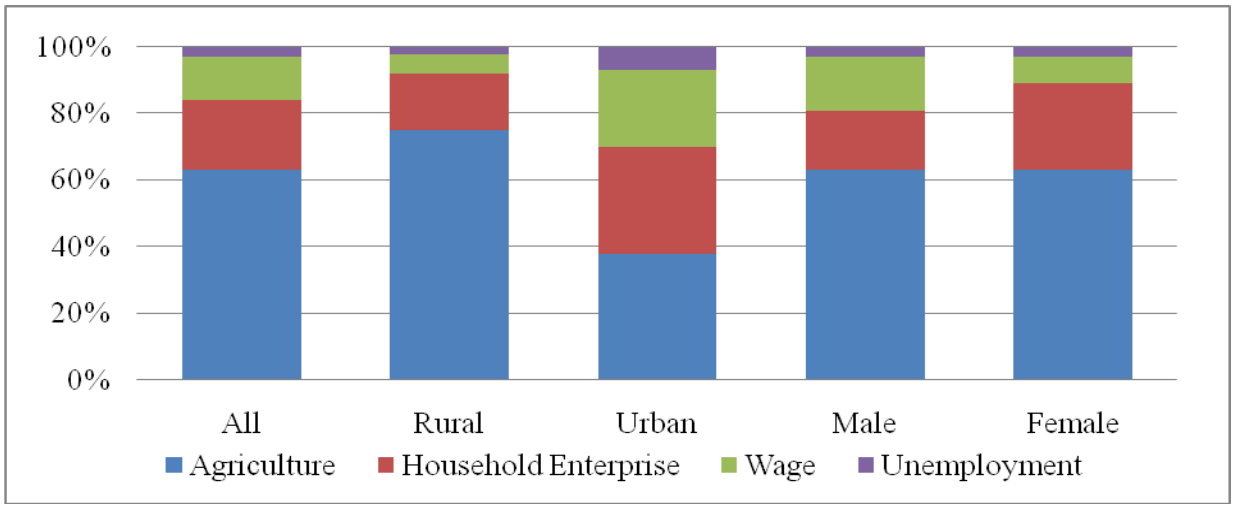

Figure 1: Nature of Youth Employment in Africa

Source: World Bank (2013).

It is estimated that more than three-quarters of the Kenyan population is below 35 years and that the youth constitute 64% of the unemployed persons in Kenya, majority of who reside in rural areas (Kenya National Bureau of Statistics, 2010a; Republic of Kenya, 2017). The median age in Kenya is estimated to be 19 years and the population that is below 15 years of age is about 43% (Kenya Institute for Public Policy Research and Analysis - KIPPRA, 2015).

In the year 2006, the government of Kenya developed two national agendas; the Kenya National Youth Policy and National ICT Policy that were expected to address issues of youth employment. However, these policy documents mainly focused on formal and non-agricultural sectors as the key pathways to prosperity. Subsequently, the government-initiated programs targeting the youth and women such as Youth Enterprise Development Fund (YEDF) and *UWEZO* fund. However, there are few instances, of beneficiary youth investing the funds from *UWEZO* and *YEDF* into farming (Kemunto, 2014). For example, a study by Olima (2016) showed that only 39% of the *UWEZO* fund received by youth was invested in agriculture. Furthermore, the funds offered by the government are not enough for the large number of unemployed youth (Muiya, 2014).

The Kenyan youth population presents an opportunity for the country's economy if well integrated in relevant growth sectors. Literature shows that a well designed agricultural sector can provide employment opportunities along the entire value chain (United States Agency for International Development - USAID, 2016), including; supplying inputs, incorporating new farming methods that use ICTs, commodity markets, processing, transport, marketing and retailing (Alliance for a Green Revolution in Africa - AGRA, 2015). Agriculture can therefore,

provide employment opportunities that can lift youth out of poverty and curb rural-urban migration and the socio-economic ills such as insecurity and drug abuse that come with it.

The persistent trend of youth migration from rural to urban areas is driven by the quest for better income-earning opportunities in the non-agricultural sectors. Most youth consider agriculture to be a form of drudgery and an unprofitable venture (Bezu and Holden, 2014; Afande et al., 2015). They associate agriculture with the aged, illiterate rural people, lacking skills needed for alternative occupation (Food and Agriculture Organization - FAO, 2012). Majority of the youth don't find growing traditional crops or rearing the usual domestic animals interesting. Instead, their target is niche markets where products move quickly (Irungu et al., 2015). For agriculture to be attractive to the youth, it will have to be more profitable, competitive, dynamic and appealing (Brooks et al., 2013). The application of ICTs can potentially transform the image of agriculture from that of drudgery to a '*cool*' sector that youth covet to participate in for learning, skill development and employment. The youth can access, re-package and disseminate extension information through ICT platforms using the internet, phones and computers and thus, sustain their livelihoods better.

The rising demand for ICT solutions in African agricultural value chains is an additional incentive for youth participation in agricultural activities since they tend to easily grasp new technologies (Mtega et al., 2014; Oluwatayo, 2014). The advent of modern ICTs especially mobile-phone technology and the internet has changed the way information is shared and the speed of communication (Conway, 2012). Modern ICT tools, especially the internet and mobile phone services, have reduced the cost of accessing information and enhanced the timely

provision of information in different sectors of African economies, including agriculture (Juma, 2011; AGRA, 2015).

The youth have the capacity to innovate and the propensity to take higher entrepreneurial risks involving trying out new and sometimes expensive applications (Hamilton et al., 2015). For instance, the social media Facebook site '*Mkulima Young Champions'*, commonly used by Kenyan youth features young educated champion farmers and has become a leading platform for a digital initiative to change youths' perception about agriculture. Such platforms aim to project farming in Kenya as a profitable 21st century career path (Macharia, 2013).

Creating awareness on the significance of ICTs in agricultural value chains is essential to challenge the notion that ICTs are more relevant in other sectors than the agricultural sector. Non-Governmental Organizations (NGOs) such as the International Institution for Communication and Development (IICD) have successfully linked farmer organizations to local service providers, ICT advisors and research institutes to provide information such as market prices and production information. This has been achieved through establishment and equipping of ICT hubs in villages and local market centers where farmers can easily access them (IICD, 2013). These centers are open to farmers and community members to provide training on good farming practices and market information. Youths' capacity to offer similar services has a huge potential but little has been documented about it.

Agriculture is a major livelihood activity in Busia County, with about 71% of the population being involved in family farms (County Integrated Development Plan, 2018). According to Busia County development plan, areas that have been given priority in investment include promotion of palm oil production by availing seedlings, processing of palm oil, improving marketing of

cotton, promotion of horticultural crops and promotion of electronic extension. The electronic extension platform would make it easier for farmers to keep proper farm records and even promote post-harvest management technology. Agriculture remains the most viable option that can spur the county's economic growth. The priority investment areas form a blue print that youth can integrate ICT tools in, such as in dissemination and use of electronic extension in production, post harvest handling, marketing, and keeping farm records. However, youth participation in these opportunities in Busia County has not been empirically studied and thus this study sought to fill this knowledge gap.

1.2 Statement of the Research Problem

A large population of unemployed youth in Africa, estimated to be about 12 million enters the job market every year with most of them looking for formal sector jobs (AGRA, 2015). The formal sector, however, is unable to create sufficient employment opportunities for the large number of young entrants. The current level of youth unemployment rate in Kenya is about 35% and is worsened by rural-urban migration (Republic of Kenya, 2017). The migration pattern does not match the rate of new job creation and thus the problem of unemployment and eventually underdevelopment persists (Economic Policy Research Centre, 2013).

According to Oucho et al. (2014), rural youth migration (to urban areas) in Western Kenya is estimated at 62.5% for males and 25% for females aged 15 to 29 years. Some of these youthful migrants have left untapped agricultural opportunities in the rural areas and migrated to the cities where they rarely get suitable employment opportunities due to lack of requisite skills and employment opportunities. Consequently, they end up being exposed to a wide range of social

ills (such as theft, drug abuse and violence), depriving rural communities of their most energetic and best-educated members (Sanginga et al., 2015).

Youth face difficulties in receiving timely information, reaching the markets on time and also face high transaction costs along the value chains (Republic of Kenya, 2017; AGRA, 2015). Modern ICT tools can possibly solve this problem through efficient transfer of timely agricultural information to reduce transaction costs (FAO, 2013).

Even though the use of ICTs is generally increasing, there is slackness in the agricultural sector especially by farmers to adopt and incorporate various forms of ICTs into their day to day farming activities and thus they are not able to achieve their full potential in productivity (Sideridis et al., 2010). Modern ICTs have largely been used in other sectors, but there is limited empirical evidence on their integration in the agriculture sector. Exceptions include Levi (2015), Nyaga (2015) and Ogutu et al. (2014) that show application of ICTs in agriculture in general. There is also a dearth of empirical evidence on where the youth are using ICTs, the extent of use and the points along the value chain where young farmers use ICT for agricultural transactions.

Youth participation in agriculture using ICTs presents a way of changing the migration and unemployment trend (IICD, 2013). Several studies show ICT usage in agriculture increases income, presents new lucrative opportunities and has positive impact on productivity (Krone et al., 2016; Ogutu et al., 2014; Mwakaje, 2010). Since youth have a high affinity for modern technology, ICTs offer a unique solution of connecting young farmers to opportunities in agricultural value chains. This can attract and retain the youth in rural areas in agriculture. Therefore, knowing the points along the value chain where youth are involved and the factors that determine ICT usage at those levels is useful yet undocumented.

Other studies have noted that youth prefer certain value chains to others, particularly the high value and short period ventures (FAO, 2014; Irungu et al., 2015). However, empirical data is scanty on how youth can integrate ICTs in agricultural enterprises particularly in Kenya. This study therefore analyzed the determinants of ICT usage in agricultural value chains among young farmers in western Kenya.

1.3 Objectives of the Study

The main objective of this study was to analyze determinants of youth participation in integrating ICTs along agricultural value chains in western Kenya.

The following specific objectives were pursued:

i. To characterize youth participation in agricultural value chains.
ii. To analyze factors that influence youth's use of ICTs in agriculture.
iii. To analyze determinants of the intensity of ICT use in agricultural value chain stages among youth.

1.4 Research Hypotheses

i. Youth participation in production is significantly higher than in other levels of agricultural value chains.
ii. Access to extension and transport cost to the market do not significantly influence youths' decisions to use ICTs in agriculture.

iii. Socio-economic variables (age, marital status) and institutional factors (distance to market, number of AVCs) do not influence youths' intensity of using ICTs in agricultural value chains.

1.5 Justification of the Study

Characterizing youth participation in agriculture provides insights that can enable policy makers to identify what enterprises youth prefer to participate in. Further, identification of the stages of the agricultural value chains in which youth participate in can provide insights that can enable stakeholders/development agencies to focus on priority activities. This can enable youth to exploit areas of benefit along the value chain in line with the Kenya Youth in Agribusiness Strategic Plan 2017-2021, which aims at providing new opportunities for youth in agriculture and its value chains (Republic of Kenya, 2017).

Analysis of factors that influence youth's use of ICTs in agriculture provides insights that can enable both national and county governments to know what kind of support is needed to implement youth-specific initiatives in agribusiness. This is in tandem with *article 6.2.12* strategic objective 6 of Kenya's Ministry of Agriculture, Livestock and Fisheries Strategic Plan for 2013-2017, which seeks to increase youth investment in agriculture by promoting new farming technologies. The ICTs can transform rural agriculture as well as empower small and marginalized farmers especially women and youth to access relevant information.

Analyzing determinants of the intensity of ICT use in agricultural value chain stages among youth provides information that can be beneficial to policy makers to be able to develop policies on relevant ICTs that are needed to help boost youth participation in agriculture. This can help address the African Union Agenda 2063 *aspiration 1* number 13; which seeks to strategically

modernize agriculture and increase its productivity using technology innovation so to make it profitable and attractive to youth (African Union Commission, 2015). The Kenya youth in Agribusiness Strategy also identifies ICTs as a gateway to promote youth participation in agriculture.

The findings of this study can inform African countries on how youth can profitably apply ICTs in agriculture. The application of ICTs to modernize the face of agriculture can possibly contribute to changing the trend of youth fleeing agriculture. This can help in the implementation of the Malabo Declaration of 2014 (commitment number 4) by providing possible avenues to increase youth participation in agricultural value chains, increase agricultural productivity, improve food security and creating decent employment opportunities for themselves. Further, this study contributes to the attainment of Sustainable Development Goal 8 which focuses on promoting sustainable economic growth, decent work, full and productive employment (UNDP, 2015). This study also provides insights for policy makers in Busia County to develop appropriate youth-focused policies for agricultural development and thus enable the attainment of the aspirations in *section 4.4.5* of the Busia County 2018-2022 Integrated Development Plan, which prioritizes investment in youth, women and other vulnerable groups with the aim of increasing growth and development.

1.6 Study Area

The study was carried out in Busia County in Western Kenya. The County borders three other counties: Bungoma to the north, Kakamega to the east and Siaya to the south-west. Busia County covers an area of 1,694.5 km^2 (Republic of Kenya, 2016). The latest population count stands at 743,946 according to Kenya's 2009 census. The age distribution is as follows: 0-14 years (47.9%), 15-64 years (48.4%) and those above 65 years at 3.7% (KNBS, 2010b). The region receives an annual rainfall of between 760mm and 2000 mm, and the temperatures range between 14°C and 30°C. It is dominated by farmers who practice mixed farming for both subsistence and commercial purposes. Most parts of the county have relatively good soil quality with a high potential for agriculture making it suitable for both food and cash crops. The crops grown include tobacco, cotton, maize, coffee, sugarcane, horticultural crops (such as fruits and vegetables), pasture, potatoes, sweet potatoes, yams and bananas (CIDP, 2018).

The population of the study consisted of youths in the county. The total youth population aged between 18-35 years is 194,981 (Republic of Kenya, 2014). The study site is adjacent to Bungoma County where pilot ICT projects were established in recent years focusing on smallholder farmers, links between the introduction and use of ICTs in farming and the interest of youth in farming and value chain development (Okello et al., 2010; IICD, 2013). Five farmer-ICT-hubs open to farmers and community members were set up near places frequently visited by farmers. The hubs provide training on good farming practices and market information. This provides an opportunity to understand how such ICT pilot projects influence youth involvement in agriculture through spill-over effects. Figure 2 presents the map of Busia County.

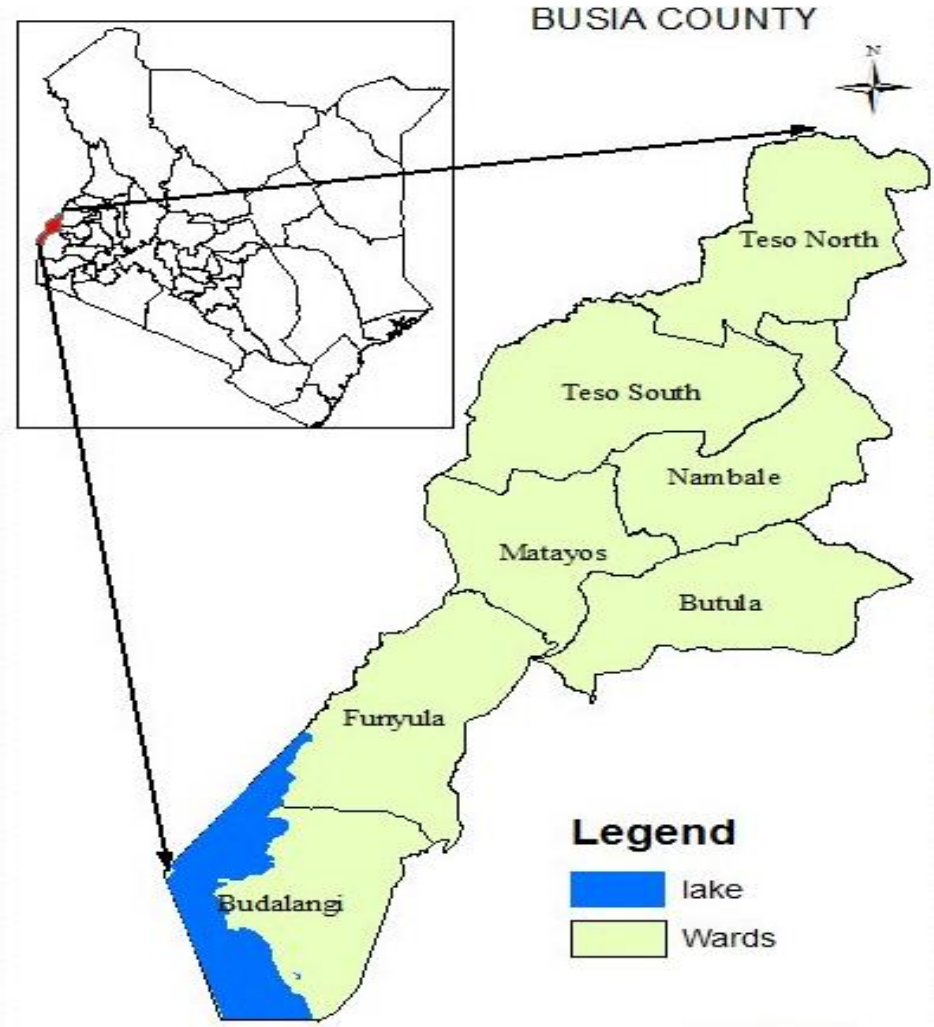

Figure 2: Map of Busia County

Source: Mulefu et al. (2016).

1.7 Organization of the Thesis

This thesis is structured into five chapters. Chapter one provides the introduction, which is organized into background information, statement of the problem, objectives and justification of the study. Chapter two covers a review of literature on trends of youth involvement in agriculture as well as use of ICTs in agriculture. Chapter three presents the conceptual, theoretical and empirical frameworks. Sampling, data collection procedures, data sources and methods of data analysis are also described in the chapter. In chapter four, the results are presented in graphs, tables and discussed. Relevant conclusions are presented and suggestions for policy interventions are offered in chapter five.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Overview of ICTs and Agriculture

2.1.1 Trends in the use of ICTs in Agricultural Value Chains

During the last two decades, the growth of the ICT sector has driven global development in an exceptional way (for instance, in e-commerce, online marketing and mobile money transfers). The ICT sector has experienced tremendous progress compared to other infrastructure sectors in Africa. This is attributed to technological progress and falling costs of access to ICTs. The sector has grown from less than 1 billion mobile cellular subscriptions in the year 2000 to more than 7 billion in 2015 worldwide. By the end of 2015, over 3 billion people were using the internet; two-thirds of them being from developing countries (ITU, 2015). The global internet penetration in developing countries grew from 7.7% in 2005 to 45.3% at the end of 2018 (ITU, 2018). Internet penetration rates are higher for men than for women globally. The worldwide internet user gender gap grew from 11% in 2013 to 12% in 2017 with Africa registering the largest gender gap of over 25% (ITU, 2017).

In Kenya, e-services, e-commerce, e-agriculture, business process outsourcing (BPO), internet website design, mobile-based agricultural support, applications development, market research and mobile technologies are some of the avenues for growth of the ICT sector (International Youth Foundation, 2013). The application of ICTs in agriculture is increasingly important. This is because there has been a significant development in improving communication and decision-making in rural areas through application of new technologies. *E*-agriculture is a field that focuses on the enhancement of agricultural and rural development through improved information

and communication processes (Zahedi, 2012). It refers to the use of ICTs and their applications in the domain of agriculture (FAO, 2015). One of the defining characteristics of participation in agricultural value chains is the control over information. All stakeholders of the agricultural industry need information and knowledge about the value chains to manage them efficiently. Therefore, integrating ICTs into Kenya's extension system has the potential to overcome the constraints on the public extension system (Mafre and Nordehn, 2013).

In Kenya, mobile subscriptions grew by 6.2% from the preceding quarter to stand at 49.5 million by December 2018. Figure 3 shows the trends in mobile subscriptions[1] and mobile penetration[2] levels.

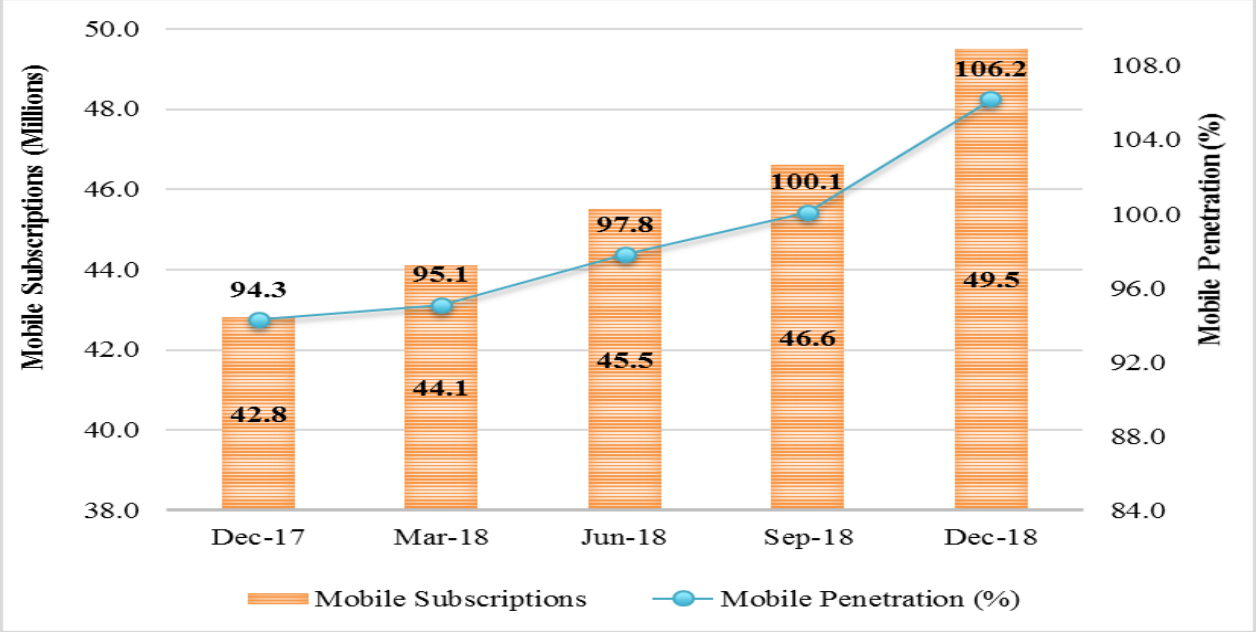

Figure 3: Mobile Subscriptions

Source: Communications Authority of Kenya (2018).

[1]Mobile subscriptions- refer to number of subscriptions to a public mobile phone service using cellular technology. This includes postpaid subscriptions and prepaid active accounts (that have been used within the last 3 months). It applies to all mobile subscriptions that offer voice communications.

[2] Mobile penetration- refers to the number of active mobile phone users usually measured using number of SIM connections per 100 persons within a certain country. The value can be above 100% because users can have multiple SIM-cards/multiple phones (Omae et al., 2015).

Similarly, internet subscriptions increased by 4.3% from 29.6 million to reach 30.8 million data/internet subscriptions in September 2017. The number of data/internet users also grew by 12.5% from 45.4 million users to 51.1 million users translating to internet penetration levels of 112.7% as at September 2017 (Communications Authority of Kenya, 2018). Even though the rate of internet usage continues to increase, use of data/internet to carry out agricultural activities still lags behind. The trend in internet penetration and internet users is as illustrated in Figure 4.

There is great potential in harnessing ICTs for disseminating agricultural information. A number of studies have suggested that ICTs could play an important role in agricultural development. For example, Irungu et al. (2015) noted that ICTs play a significant role in enhancing agricultural production and growth through enhanced sharing of knowledge and experience through utilizing telecenters, social media and other ICT-driven communication tools.

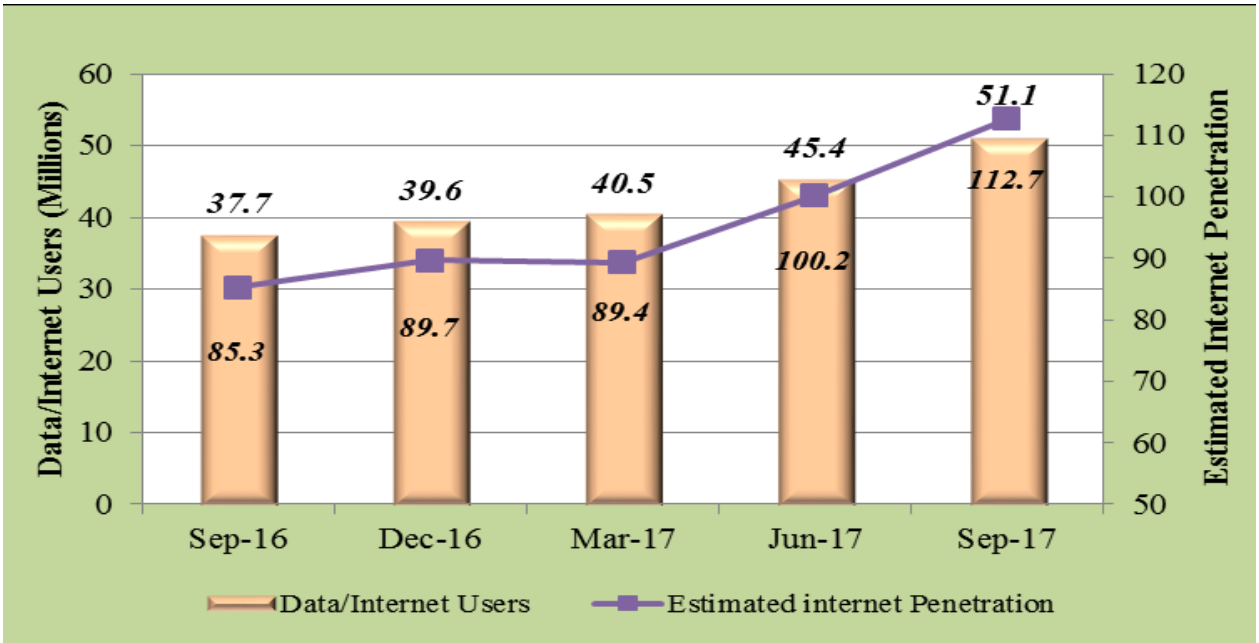

Figure 4: Trends in estimated Number of Internet Users and Internet Penetration

Source: Communications Authority of Kenya (2017).

However, the flow of information on agricultural production, information sharing and marketing to youth has been hindered by under-utilization of ICTs (Njenga et al., 2012). Similarly, Chavula (2014) points out that poor performance of the agricultural sector is due to underutilization of improved agricultural technologies and the low usage of ICTs, particularly the internet for executing activities with a significant contribution to agricultural production and growth. Many farmers are yet to have proper access and usage of the internet. African governments ought to promote internet usage in agricultural activities in order to reach a critical mass of intended beneficiaries. This will enable the sector to exploit unique opportunities that come with internet usage thereby contributing to increased agricultural production in Africa. In order to increase outreach and use of ICTs in agriculture, there is need to engage youth in disseminating agricultural information (Kobe, 2014).

2.1.2 Trends of Youth Involvement in Agriculture

The youth constitute one of the greatest assets that any country can have particularly for supporting the development of the agricultural sector. They are regarded as the future leaders and constitute the most productive group of people in a society since they are energetic, resourceful, resilient and perseverant (Naamwintome and Bagson, 2013). The youth in rural areas provide an opportunity for generating the farming entrepreneurs (Chikezie et al., 2012). Njeru and Mwangi (2015) observe that because most farmers are not young, they are reluctant to take risks, they are less venturous and more averse to innovations. This makes it difficult to transform the agricultural sector to produce enough food to supply the awaiting population by 2030 (Akpan, 2015).

Even though farming has potential benefits in terms of employment opportunities, food and income provision, there is limited youth participation in the agricultural sector in many developing countries (Bezu and Holden, 2014; Afande et al., 2015). This is due to the unattractive and labor-intensive nature of the agricultural sector; it is also due to its inefficiency, risks, costs as well as the fact that youths have limited control over resources such as capital and land (Naamwintome and Bagson, 2013). Therefore, numerous incentives created by agricultural agencies, NGO's and the government remain untapped because of the inadequate involvement of youth in agriculture (Akpan, 2015).

According to the International Youth Foundation (2013), the most promising source of quality youth employment in Kenya is the ICT sector. Incorporating ICTs such as the internet, mobile phones, computers, and GPS can motivate the youth to view agriculture as a career opportunity. This is because the majority of youthful farmers are familiar with modern ICTs, with most having access to smart phones and the internet. This gives them access to information about the animals they rear, the crops they grow, market information and farming trends (Irungu et al., 2015).

A number of studies show that youth in rural areas are mostly involved in working in family establishments or family farming (CTA, 2014; ILO, 2015). Most of the youth engaged in agriculture are vulnerably employed as own-account workers and contributing family workers with little or no income accruing to them (EPRC, 2013). They provide family labor for farming activities such as weeding, harvesting and spraying. There is potential that youth can play an important role as intermediaries in disseminating information, knowledge and skills acquired.

They can also bring new technology and innovation, which enhance agricultural productivity (CTA, 2014).

The emerging trend in Kenya shows that well-educated and skillful youth and more so university graduates have opted to engage in agriculture to sustain their livelihoods. They are not interested in farming indigenous crops and animals but instead they target niche markets to start business enterprises of fast-moving farm produce. They are not afraid of getting their hands dirty with soil since farming is encouraging and earns them a respectable income (Irungu et al., 2015). The youth also prefer short-term agricultural training courses to the long-term courses (International Youth Foundation, 2013). Indeed, the IFAD (2012), noted that niche markets and high valued agricultural products present opportunities to young farmers especially women as the returns generated over a short period of time acts as an incentive for the youth to venture in.

Youth are the best agents for the anticipated change in the poor image of the agricultural sector. Motivating them to participate in agriculture as a career opportunity will require innovative interventions. In order to absorb the youth into the sector, agriculture has to compete with other sectors in a profitable manner (IFPRI, 2016). Such transformation will require the promotion and development of agricultural value chains in a way that provides attractive off-farm job opportunities to the youth. If properly harnessed, these agricultural value chains can possibly be the main employer of the youth.

2.2 A Review of Knowledge Gaps on Youth and ICTs in Agricultural Value Chains

Generally, considerable research has been done on youth participation in, and their perception of agriculture (Issa et al., 2014; Njeru et al., 2015; Akpan et al., 2015). Some studies have also focused on the use of ICTs for agriculture and rural development as a way of uplifting the livelihoods of the rural poor (Hassan et al., 2008; Syiem and Raj, 2015; Levi, 2015). This includes the use of ICT tools for linking farmers to agricultural research knowledge and extension services (Fu and Akter, 2009; Sanga et al., 2013; Akuku et al., 2014; Nyaga, 2015). Other studies have analyzed the application of ICT tools in market information systems. Such studies have evaluated the impact of ICTs on farm productivity for smallholder rural farmers (Mwakaje, 2010; Okello et al., 2010; Ogutu et al., 2014). Although these studies focused on either youth participation in agriculture or the use of ICTs among farmers, they did not analyze the extent of youth integration of ICTs in agriculture.

For instance, Hassan et al. (2012) did a study on determinants of youth perception towards the ICT contribution to their agro-based productivity in Malaysia. In their study, the main tools owned and used by the Malaysian youth were mobile phones, television and radio. Television was the most frequently used tool to obtain agricultural information compared to mobile phones. The youth perceived ICT tools as effective extension channels that can help them get timely agricultural information. This study therefore built on Hassan et al. (2012) study by going beyond perceptions and focusing on determinants of use of ICTs in agricultural value chains by youth.

Irungu et al. (2015) assessed the role of ICTs in attracting Kenyan youth into profitable agriculture. Their results showed that most youth acquired information from the internet; hence

internet was the best platform to market and promote agriculture to the youth. Other tools used were Microsoft office and spreadsheets for record keeping. Although the study highlighted various aspects of youth, ICT and agriculture; it did not assess usage of ICT by youth along the value chains. The current study contributes to literature by investigating the linkage between youth participation in agricultural value chains using ICTs and the intensity with which the ICT tools are used in various levels of the agricultural value chains.

Kobe (2014) analyzed the effect of ICT on increasing production of pigeon pea in Kenya among the youth. The study showed that use of ICT increases youth participation in agriculture. Results from the descriptive statistics showed that mobile phone was the most commonly used ICT tool followed by radio and television. The mobile phone was the main tool used to access information from the internet. However, only 5% of the youth used it to search for agricultural-related information whereas 95% used it for social connections. Although the study focused on various aspects of ICT, youth and pigeon pea production, the underlying reasons for youth's decision to engage in this particular sector were not assessed. The current study filled this gap by investigating the determinants of youth participation in agriculture using ICTs. The current study also considered other agricultural enterprises of interest to the youth.

2.3 A Review of Approaches for Measuring Participation and Intensity of Participation

Previous studies on participation and intensity of participation typically employed a Tobit model, Heckman sample selection model or Craig's double hurdle model (for example, Alene et al., 2008; Oluwatayo et al., 2014; Huang et al., 2015; Gicheha et al., 2015; and Olarinde et al., 2016). The Tobit model originally formulated by Tobin (1958) is used to analyze the relationship between a non-negative censored dependent variable and independent variables. However, the

model has a setback of assuming that the independent variables have a similar effect on both the probabilities and degree of participation (Woodridge, 2010). Another limitation of the Tobit model is that it treats non-participants as if they chose not to participate, when they may be lacking access to ICTs such as phone, radio and internet in this case. To relax the first assumption, some past studies (Sebatta et al., 2014; Martey et al., 2014; Kiwanuka and Machethe, 2016), used a two-step model; the Heckman sample selection model (Heckman, 1979) and Double hurdle model by Craigs (1971). These models allow for separation of a household's decision to participate or not, and the extent of participation (intensity decision); by introducing an assumption that each decision is determined by a different set of explanatory variables (Green, 2000). The application of appropriate regression models depends largely on the nature of the dependent variable. Though these methods have been widely used, they are inappropriate for this study because the dependent variable is a count data variable. Therefore, count regression model was appropriate to assess the intensity of use of ICT tools in agricultural value chains.

In determining factors that influence participation decisions, probit and logit models have been commonly used. These are statistical models in which the probability of a dichotomous outcome (participate or not) is associated with a set of independent variables that are hypothesized to influence the outcome (Kirui et al., 2010). Agwu et al. (2014), for instance, used a probit model to assess the determinants of agricultural labor participation by youth in Nigeria. Akpan et al. (2015) used a binary logit regression model to analyze determinants of youth decision to participate in agriculture in Southern Nigeria. Wawire et al. (2017) also applied a logit to evaluate determinants of use of mobile phones by farmers in Kenya. The logit model is preferred over probit, because of its comparative mathematical simplicity arising from a closed mathematical form (Gujarati, 2004).

This study applied a binary logit to assess determinants of ICT use in agriculture among youth. The current study improved on previous studies by only including youths who used ICT tools in agriculture and not in general. Additionally, number of ICT tools owned and number of agricultural value chains was included so as to provide flexibility in making policy recommendations. This is because it allows researchers to formulate specific policies, and not generalize their interventions. For this case, policy makers can differentiate policies as per the different number of ICT tools owned.

In the analysis of intensity of events from count data, the key regression models that are used include the Poisson Regression Model (PRM), the Negative Binomial Regression Model (NBRM), the Zero-Inflated Poisson (ZIP) and the Zero-Inflated Negative Binomial (ZINB) (Winkelmann and Zimmermann, 1995; Wooldridge, 2002; Greene, 2008; Okello et al., 2012). The PRM and NBRM models are applicable in studies where response variables have a non-negative integer with no excess zero counts than would be expected.

Several studies have used the Poisson regression model to measure the intensity of ICT use. For instance, Kirui et al. (2012) used the Poisson model to examine intensity of use of mobile phone-based money transfer services among farm households in Kenya. Okello et al. (2014) applied a Poisson model to analyze the intensity of use of ICT-based market information services by smallholder farmers. Wawire et al. (2017) applied the same method to assess the intensity of use of ICT tools by farmers to access information from the Kenya Agricultural Commodity Exchange. The model has also been applied in different fields of agriculture (see for example, Akpan et al., 2015; Pedzisa et al., 2015).

The negative binomial model is used where Poisson fails due to under-dispersion or over-dispersion of variance (that renders estimates of Poisson biased and inefficient). The negative binomial corrects for over-dispersion and under-dispersion in the data, that is, when the variance is greater than or less than conditional mean (Patemoster and Brame, 1997; Osgood, 2000). Negative binomial regression has found application in various studies (for example, Paxton et al., 2011; Mensah-Bonsu et al., 2011) to examine the intensity of technology adoption in agriculture.

The ZIP and ZINB are specifically used to account for cases with frequent zero counts (when there are more zeros than would be expected, in either, Poisson or Negative binomial models) (Lambert, 1992; Hall, 2000; Kirui et al., 2010; Huiming et al., 2012; and Okello et al., 2012). For example, when analyzing the number of technologies adopted by a farmer, the decision of not adopting a technology should be put into consideration in order to cater for the effect of excess zeros. This is because it takes into account the people who did not use any ICT technology. Mutuma (2016) used a zero inflated Poisson to examine the intensity of use of inoculants on soybean production. Other studies that have applied a zero inflated Poisson include Lohr and Park (2002); Lambert (2007); Sileshi (2008) and; Harper (2011).

This study expected the response variables to have only few zero counts since the study assumed that each young person interviewed, engaged in at least one agricultural value chain level using ICTs. Therefore, only the Poisson and Negative Binomial models were considered. The agricultural value chain levels/stages considered included: production, marketing, processing, finance access, extension services and transportation. Building on earlier work by Okello et al. (2012&2014) and Wawire et al. (2017), this study applied a Poisson model to examine frequency of use (intensity) of ICTs in agricultural value chain stages by youth.

CHAPTER THREE

3.0 METHODOLOGY

3.1 Conceptual Framework

Timely dissemination of agricultural information is increasingly important in the development of the agricultural sector. Use of ICT as an extension channel is crucial to address farmers' needs that include production techniques, market information, financing opportunities and use of new technologies. This study therefore aimed at analyzing youths' use of ICTs in agricultural value chains. The study was based on the diffusion of innovation theory developed by Rogers (1962), which explains why farmers choose to adopt (use) new technologies, the time needed and the rates of adoption, which depend on the innovation itself and the characteristics of the users. In this study diffusion is viewed as a process by which ICTs (innovations) are communicated through certain channels over time among young farmers.

From the conceptual framework shown in Figure 5, the stages of agricultural value chain that a youth engages in using ICTs was determined by farmer specific characteristics such as age and gender, farm specific characteristics such as land size and distance to the market, and capital endowment characteristics. The decision to participate results in a change in the perception of youth towards farming, increase agricultural productivity, and also serve as an avenue for income generation for the youth. Therefore, beneficiaries are likely to continue engaging in agricultural activities and attract more youth to participate.

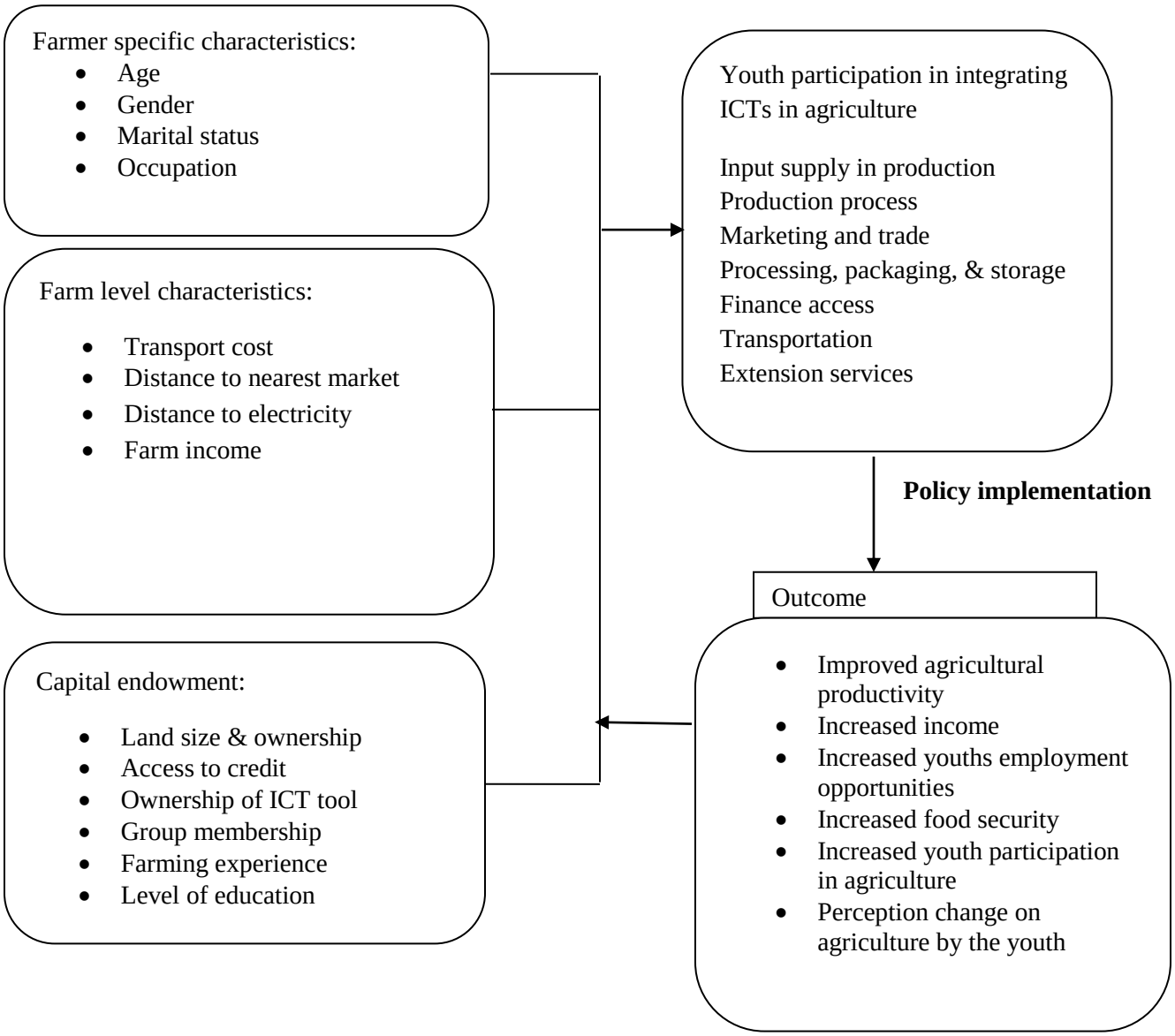

Figure 5: Relationship between Socio-economic Variables and Use of ICTs in Agriculture

Source: Author's conceptualization (2017).

Socio-demographic characteristics such as age of a farmer positively influence youth participation in agriculture (Akpan, 2015). However, it has a negative effect on use of ICT tools

since younger farmers with higher level of education have a higher likelihood of using ICTs (Okello, 2014). Marital status is hypothesized to negatively influence the adoption and use of ICTs among youth since married youth reduces their decision to participate (Akpan, 2015). This is because decision making in a family does not solely rely on one person, but is often collective.

Farm-level characteristics such as distance to electricity, transport cost and distance to the output market captures travel time and associated costs that influence use of ICT tools to acquire information. Transport cost and distance to the market is likely to positively influence use of ICT tools since farmers who live far from markets are more likely to use ICTs tools to reduce transaction costs. Distance to electricity is likely to negatively influence use of ICT tools such as computers and mobile phones for agricultural purposes as they rely on electricity for charging (Okello et al., 2012).

Institutional factors such as group membership, access to credit and extension services are likely to have a positive effect on youth participation in agriculture using ICTs (Nyaga, 2015). These factors enhance a system through collective action, networking, investment in agriculture and adoption of new technologies.

3.2 Theoretical Framework

The decision by a youth to use ICTs in agriculture or not is a binary choice, which was considered under the general framework of utility or profit maximization (Pryanishnikov and Katarina, 2003). This study was based on random utility theory, which assumes that individuals will choose an alternative that yields maximum utility (McFadden, 1974; Greene, 2002). Suppose that an individual *i* has two alternatives to represent perceived utilities of youth's use of

ICTs in agriculture and non-use choices *a* and *b*, respectively. The utility that individual *i* derives from alternative ***a*,** labeled U_{ia} is assumed to be the maximum utility obtained.

Following this theory, the utility derived from the choice of alternative ***a*** can be expressed as a sum of two parts: (i) deterministic part V_{ia}, which is a function of observable attributes of the utility function, and (ii) random stochastic error term ε_{ia} (Thurstone, 1927).

$$U_{ia} = V_{ia} + \varepsilon_{ia} \quad (1)$$

where V_{ia} represents the deterministic part and ε_{ia} the stochastic error term. The random stochastic error term is assumed to be independently and identically distributed (IID) (Greene, 2000). Since utility cannot be observed, we alternatively observe the attributes of explanatory variables that influence the perceived desirability of each choice. Therefore, the choice process is measured in terms of the probability that a given alternative with the highest utility is chosen. A youth will choose alternative a(to use ICTs in agriculture), denoted by *Y*=1, if;

$$U_{ia} > U_{ib} \quad (2)$$

The probability that an individual will choose alternative a over alternative b could be defined as (Greene, 2002):

$$P(a) = P[U_{ia} > MaxU_{ib}] = P[V_{ia} + \varepsilon_{ia} > MaxV_{ib} + \varepsilon_{ib}] \forall b \neq a \quad (3)$$

3.3 Sampling Procedure

The target population for this study comprised young farmers who were at least 18 years old and below 35 years old, in Busia County. A multistage sampling technique was used as it is cost effective and facilitates the collection of data from geographically dispersed groups when face-to-face contact is required (Sudman, 1976). First, Busia County was purposively selected based on its high youth population estimated to be 194,981 (Republic of Kenya, 2014). It's uniqueness in terms of its potentiality in agriculture and its position as a cross-border centre for agricultural products also made it a proper fit for this study. In addition, the current context in which farmers in western Kenya operates is characterized by a strong urban demand for an increasingly diverse range of products and crops (IICD, 2013).

In the second stage, 3 sub-counties; Budalangi, Matayos and Samia were selected from the total of 7 sub-counties due to the diversity of the locations being either peri-urban, rural or both to obtain a representative sample of the population of youth in the county. This was followed by random selection of a total of five wards from the selected sub-counties. Using the probability proportionate to size sampling method, one ward from Budalangi and two wards each from Matayos and Samia sub-counties were selected. Lastly, respondents were selected randomly from the villages with the help of sub-county agricultural officers; the officers provided a list of different youth groups which were randomly sampled. This method is preferred because it gives every member of a population an equal chance of being selected (Moser and Kalton, 1971).

Previous studies on ICTs and agriculture, (for instance, Kituyi-Kwake and Adigun, 2008; Mwakaje, 2010; Levi, 2015) used a sample size of between 200 and 240 respondents to analyze the effectiveness, use and access of ICTs among rural smallholder farmers for dissemination of

agricultural information and market access. For this study, the sample size was determined based on Cochran (1963:75) formula (equation 4) and the sample size of previous similar studies (Israel, 1992).

$$n = \frac{Z^2 \times p(1-p)}{e^2} \quad (4)$$

where; *n* is the required sample size, *Z* is the confidence level at 95%, p is the estimated proportion of an attribute that is present in the population, (for this case p= 0.4 as this would yield maximum sample size) and *e* is the margin of error at 0.06.

Therefore, as shown in equation 5 below;

$$n = \frac{1.96^2 \times 0.4(1-0.4)}{0.06^2} = 256 \quad (5)$$

A total of 256 respondents were recruited for interviews but only 213 were successfully interviewed due to prevailing field challenges during the survey including; budget constraints, incomplete questionnaires, while others declined to respond or could not be reached leading to a non-response rate of 17%. The 213 farmers were distributed proportionate to size of each sub-county's population. Budalangi, Samia and Matayos have a population of 66723, 93500 and 111345, respectively (CIDP, 2013). Therefore, the sample was distributed as follows: 24.4% from Budalangi, 33.8% from Samia and the rest from Matayos.

3.4 Data Collection

Primary survey methods were used to obtain information on the extent of and determinants of youth participation in integrating ICTs in agriculture. The study employed questionnaires, interview, observations and focus group discussion (FGD). The FGD was used so as to validate questionnaires and composition of the target sample in terms of preferred agricultural value chains and ICT tools utilized by youth. The FGD was held to obtain key insights on trends of youth engagement in farming, main agricultural enterprises mainly practiced, activities in agricultural value chains and ICT use patterns. Participants consisted of 21 young farmers (15 male and 6 female). More to this, 5 of the members were leaders of 5 different youth groups that participated in farming and 1 County agricultural extension officer. The target sample was based on the kind of agricultural enterprises they participated in and their region of residence (location).

The data was collected by use of semi-structured questionnaires. As noted by Freeman and De (2002) and Babbie (2004) semi-structured questionnaires are a useful mode of obtaining information regarding opinions and behavior of individuals. The questionnaires were administered through face-to-face interview which are preferred since the interviewer can probe for explanations of responses for clarity (Jackle et al., 2006; De Leeuw, 1992). This was used to obtain data on farmer-specific characteristics, farm-level variables, capital/asset endowments, ICTs used by young farmers and location-specific characteristics. Village elders were engaged in locating the respondents during data collection.

3.5 Empirical Analysis

The data was coded and entered in SPSS and Microsoft Excel software. Descriptive and econometric methods were employed in the analysis using SPSS version 20 and STATA version 14. The specific analytical methods for each objective are described below.

3.5.1 Characterizing Youth Participation in Agricultural Value Chains

This first objective, namely, characterizing youth participation in agricultural value chains, was addressed using descriptive statistics. The results were computed by use of means and standard deviations for continuous variables; and percentages (proportions) for categorical variables. Cross tabulations and analysis of variance (ANOVA) measures were also used in establishing statistical differences between various categories of youth profiles. The results are presented in graphs, tables and pie charts in chapter four.

3.5.2 Factors Influencing Youth Participation in Agriculture Using ICT Tools

Youth's decision to use ICTs in agriculture was estimated using a binary logit model. Youth decision to use ICTs in farming is a binary dependent variable, which assumes a value of 1 if a youthful farmer uses ICT tools for agriculture and 0 otherwise. Following Maddala (2001), the probability P that a young farmer uses ICT tools for farming is given by:

$$P = e^{z}/1+e^{Y} \quad (6)$$

Central to the use of logistic regression is the logit transformation of p given by Y

$$Y= ln\ (p/1-p) \quad (7)$$

where;

$$Y = X\beta + \varepsilon \quad (8)$$

Where; Y is a latent variable that takes the value of 1 if the young farmer uses ICTs for farming and 0 otherwise, β is a vector of regression parameters, X is a vector of explanatory variables and ε is the stochastic term assumed to have a logistic distribution.

The empirical equation that was estimated to assess youth's decision to use ICT tools for farming is given by Equation (9).

Use of ICT tools = *f (gender, marital status, transport cost, distance to electricity, extension, credit, ICT ownership, group membership) +e* (9)

These variables were measured as shown in Table 1.

Table 1: The expected signs of variables included in the binary logit model

Variable	Description	Expected Sign
Gender	1 = Male; 0 = Female	+
Marital Status	1 = Married; 0 = Otherwise	+
Extension access	1 = Yes; 0 = Otherwise (within 12 months)	+
Credit access	1 = Yes; 0 = Otherwise (within 12 months)	+
Group membership	1 = Yes; 0 = No	+
Distance to electricity	Kilometers	-
Transport cost	Kenya Shillings	+
ICT ownership	Number of ICT tools owned	+

Source: Survey Data (2017).

3.5.3 Assessing Intensity of ICT Use in Agricultural Value Chains by Youth

The intensity of use of ICTs in agricultural activities was proxied by frequency of use of ICT tools in agricultural value chains (number of times a youth uses ICT tools per week at any stage of the value chain). The number of times a youth uses ICT tools per week assumes integer values of discrete nature and is therefore a non-negative count variable (Woodridge, 2002). This study therefore used a count data model to analyze the intensity of use of ICTs for agricultural purposes. Count data are non-normal and hence are not well estimated by OLS regression (Maddala, 2001).

Among the count data models, the Poisson regression model (PRM) is usually the first step for most count data analyses (Areal et al., 2008). The PRM is an improvement over the OLS and other linear models (Greene, 2003). The model assumes that the dependent variable y_i given vector of predictor variables X_i has a Poisson distribution. The probability density function of y_i given *Xi* is completely determined by;

The conditional mean $E(y_i|x_i = \lambda_i)$ and its equi-dispersion $Var(y_i|x_i) = \lambda_i$ (10)

Its density function of PRM is given by (Greene, 2003; Greene, 2008):

$$f(y_i|x_i) = \frac{e^{-\lambda(x)}\lambda_i(x)^y}{\Gamma(1+y_i)} \quad (11)$$

where; $\lambda_i = \exp(\alpha + X'\beta)$ and $y_i = 0,1,\ldots,i$ is the number of times a youth uses ICT tools per week, X = a vector of explanatory variables and $\propto$ and β are the parameters to be estimated (Greene, 2008).

Following Wooldridge (2002) and Greene (2008) the expected number of events y_i (number of times of ICT use) is given as:

$$E\ (y_i|x_i) = \ \mathrm{Var}[y_i|x_i] = \ \lambda_i = \mathrm{Exp}\ (\alpha + X'\beta) \text{for i} = 1,2, \dots, n \quad (12)$$

The implicit functional form of the PRM for estimating the intensity of ICT use in agricultural value chains is specified as follows:

Number of times of ICT tools use = *f (age, gender, occupation, transport cost, distance to electricity, farm income, access to credit, extension, ownership of land, literacy, farming experience, own ICT tool, group membership) +e* (13)

These variables were measured as shown in Table 2.

Table 2: The expected signs of variables included in the Poisson regression model

Variable	Description	Expected Sign
Age	Years	-
Gender	1 = Male; 0 = Female	+
Marital Status	1 = Married; 0 = Otherwise	+
Occupation	1 = Farming as the main occupation; 0 = Otherwise	+
Education	Years of formal education	+
Transport Cost	Kenya Shillings	+
Distance to market	Kilometers	+
Distance to electricity	Kilometers	_
Income	Kenya Shillings (Monthly)	+
Agricultural Value Chains	Number of AVC stages a youth participates in	+
Group membership	1 = Yes; 0 = No	+
Total land size	Acres	+
Credit access	1 = Yes; 0 = Otherwise (within 12 months)	+
Extension access	1 = Yes; 0 = Otherwise (within 12 months)	+

Source: Survey Data (2017).

3.6 Description of Variables Included in the Model and their Expected Signs

Age: the age of the respondent was hypothesized to have an inverse relationship with ICT usage, because younger people are more likely to be enthusiastic about new technologies and therefore better able to use ICTs (Okello, 2012). This indicates that young farmers are more exposed to modern technology and tend to benefit more from ICTs (Nyaga, 2012). Youths participate in different stages of value chain. Muhoma (2014) established that majority of youth participate in production, transportation and trading levels of milk value chain. In a study conducted in Machakos on youth participation in agricultural value chains Kising'u (2016), found that most youth participated in input delivery and production levels of the value chains. Age is a continuous variable and was measured in years.

Gender: was measured as a dummy variable, 1 representing male youth and 0 for female youth. The effect of gender on use of ICTs was predicted to be positive. Young men have a comparative advantage in participating in high profit ventures that require high investment, because they have more or stronger property rights compared to female youth. Women lag behind on information access due to lack of asset ownership (FAO, 2011). Therefore, young men have a higher access to information on new technologies and are expected to use ICT tools more than their female counterparts.

Formal Education: is an important determinant of the ability of users to properly comprehend new knowledge. It was hypothesized that the more educated a farmer is the more likely it is that they have knowledge about usage of ICT tools to acquire and disseminate agricultural information, hence a positive relationship. Young literate farmers are more likely to make direct phone calls to buyers or surf the internet to search for new markets or to understand the current

market trends (Nyaga, 2015). The level of formal education was captured as the number of years spent in school.

Farm Income: income was hypothesized to positively influence the use of ICTs in agricultural value chain development. This is because individuals with higher level of income are likely to have a higher purchasing ability of ICT tools (Syiem and Raj, 2015). Also, farmers who are financially more-endowed are able to adopt new technologies much more quickly and are more likely to increase use of ICTs for agricultural purposes than their counterparts (Wawire, 2013; Kirui, 2012). Income was captured as earnings per month in Kenyan shillings. Income illustrates amount of money a farmer derives from both on farm and off-farm activities.

Access to credit: respondents were asked if they had accessed credit/loan over the last twelve months. The variable was coded as 1 if the respondent had access to credit and 0 otherwise. Lack of credit may restrain farmers from using innovations that require startup capital. Access to credit was predicted to have either a positive or negative influence. On one hand, access to credit is likely to positively influence the likelihood of a youth to participate in agriculture using ICTs. This is because the financial resources will enable young farmers to acquire ICT tools needed for agricultural activities. On the other hand, it may reduce participation in agricultural activities due to diversification of investment to non-agricultural investments. According to Afande et al. (2015) this can be explained by the risky nature of agriculture and the conditions attached to the credit facilities.

Access to extension services: extension is a vital determinant of farmers' access to information about new technologies. Extension services were expected to have a positive impact on the use of ICTs. Increase in extension services is likely to increase flow of information about new

technologies and hence increase hours spent in agricultural activities by youth (Akpan et al., 2015). This variable was measured by asking if the respondent received/ had access to extension services over the last one year (coded as 1) and zero otherwise.

Distance to nearest source of electricity: was expected to have an inverse relationship on the extent of use of ICT tools especially those that require use of electric power. The farther the source of electricity is likely to reduce the use of ICT tools. A study by Okello et al. (2012) showed a negative effect to the use of mobile phones for agricultural related transactions as they require charging. The study concluded that improved electricity connectivity in rural areas would result in increased use of mobile phones for agricultural purposes. This is a continuous variable and was captured in kilometers to show the distance from farmer's house to the nearest source of electricity.

Group membership: this was coded as a dummy where, 1 represents member of a development group and 0 otherwise. Group membership was hypothesized to have a positive effect on use of ICT tools. Belonging to a development group is likely to increase social participation, better dissemination of information and it enables better access to stable and reliable markets through collective action (Nyaga, 2015).

Land size: was predicted to have a positive effect since increase in land size increases the probability of a youth participating in multiple agricultural ventures hence high output (Agwu, 2014). Therefore, this will motivate the youth to use ICT-based agricultural technologies and tools to access market information and sell their output. Youth accessed land in different means such as; inherited land, purchased, leased, gift and borrowed land. Land size was measured in acres.

Ownership of an ICT tool: such as mobile phones, computer, radio, television are likely to positively influence use in agriculture since these tools enables access to agriculture-based information. According to Okello et al. (2014) ownership of mobile phone increases the chances of a farmer to use ICT-based market information services. Therefore, the current study expected a positive significant relationship since farmers who own one or more ICT tools are likely to engage in agricultural value chain activities using ICTs compared to their counterparts. This variable was captured by asking if the respondent owns any ICT tool and zero otherwise. It was also captured by counting the number of ICT tools a respondent owned.

3.7 Model Diagnostics

3.7.1 Equi-dispersion

Equi-dispersion is one key precondition for fitting a Poisson distribution. It requires that the variance of the dependent variable to be equal to its mean. The Pearson's chi-square ratio of the goodness-of-fit test approved of Poisson distribution as the best fit for the data.

3.7.2 Multicollinearity

Multicollinearity was tested using Variance Inflation Factors (VIFs) for independent variables included in the Poisson model. According to (Gujarati, 2004) if the VIF exceeds 10 then it demonstrates evidence of correlation among explanatory variables. The mean VIF was 1.40 with the explanatory variables having a VIF of between 1.15 and 1.80. Results showed that there is no linear relationship between the explanatory variables hence they were included in the model (see appendix 3).

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

4.1 Socio-economic Characteristics of Youth

Table 3 presents the general characteristics of youth who participated in agriculture for this study. Out of the 213 respondents interviewed, 58% were male. Perhaps, this is an artefact of the sampling design, but largely conforms to the general population structure in Busia County.

Table 3: Socio-economic characteristics of youth farmers

Variable	Statistic (n = 213)
Gender (% of male)	57.7
Marital status (% of married)	70.9
Group membership (% of farmers)	75.5
Average age (years)	28.0 (6)
Average education (number of years of formal schooling completed)	9.7 (3.1)
Access to credit (% of farmers)	62.9
Access to extension (% of farmers)	89.2
Completed primary school and above (% of farmers)	84.8
Average land size (acres)	1.59 (1.46)
Average monthly income (Kshs)	9640.0 (9902.0)
Main occupation (% farming)	77.0
Ownership of at least 1 ICT tool (% of farmers)	95.3

*Note: standard deviations for mean values are in parentheses.

Source: Survey Data (2017).

The average age of the respondents was 28 years. This means that most youth in the study area are in an economically active age and can be productive in carrying out agricultural activities. The average number of years of formal schooling was about 10 years with about 85% having attained primary and secondary school education. This indicates that most youth are educated and are more receptive to adopting new technologies (Akpan, 2015). More than 90% of the

youth owned or had access to at least one ICT tool, with most of them owning phones and radios. This is because youth are the major users of ICTs (Samsuddin et al., 2016; International Telecommunication Union, 2017).

Majority (70%) of the respondents were married with the rest being single. This is because married youth have more family responsibilities therefore engage in farming activities more to provide for their families' socio-economic needs (Kimaro et al., 2015). The average farming experience was 4 years, indicating less participation of young farmers in agriculture. This means that most youth in the study area have not been engaged in agriculture for a long time. This is not a surprise considering the limited access to land and credit facilities to start up a farming business. Therefore, by the time they acquire these important productive assets, they are old. This explains why the average age of a Kenyan farmer is about 60 years (Republic of Kenya, 2012).

The average land size accessed by youth was about 1.6 acres with most land acquired through inheritance and leasing as shown in Figure 6. This is much lower than the average house hold farm size in the county, which is 2.34 hectares (CIDP, 2013). This shows that lack of land is a major obstacle to youth participation in agriculture (Naamwintome and Bagson, 2013). It is difficult for youth to acquire land for agricultural purposes as compared to the elderly. Results show that 67% of those who owned land had no title deeds. Majority of youth use land without exclusive ownership rights since they depend on family land or leasing for a season. This conforms with the observation of Kangai and Mburu (2012) that land scarcity continues to impede youth from engaging in agriculture.

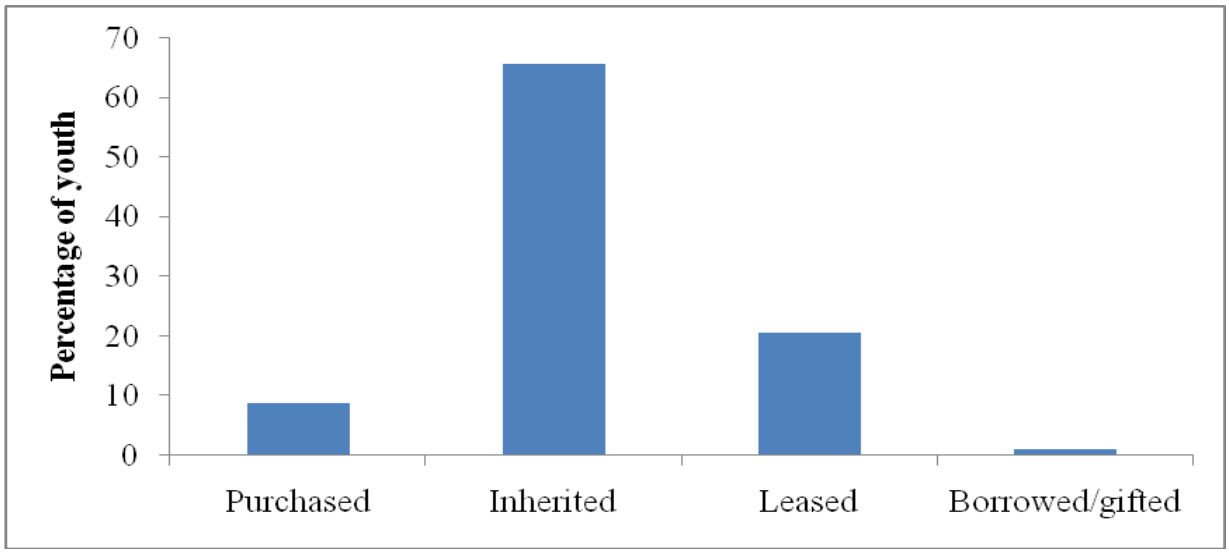

Figure 6: Ownership of Land by Youth in Busia County

Source: Survey Data (2017).

4.2 Institutional Services

4.2.1 Group Membership

Three quarters of the sampled youth were members of social organizations; implying that the social capital formation among youth was high in the study area. The average years of group membership was about 3.6 years with majority of them belonging to youth groups. Figure 7 shows the main functions of the groups. An interesting observation is that the primary motivation for belonging to a group is that the groups mainly help the youth to market their produce. This is because youth increase their bargaining power through involvement in groups. Group membership also facilitates agricultural trainings and provision of credit. Most financial institutions are reluctant to offer loans to young people because they have no collateral (Republic of Kenya, 2012). Therefore, being a group member gives them easier access to credit services.

Mobile phone was the most used ICT tool by youth in groups, for communication and price negotiations.

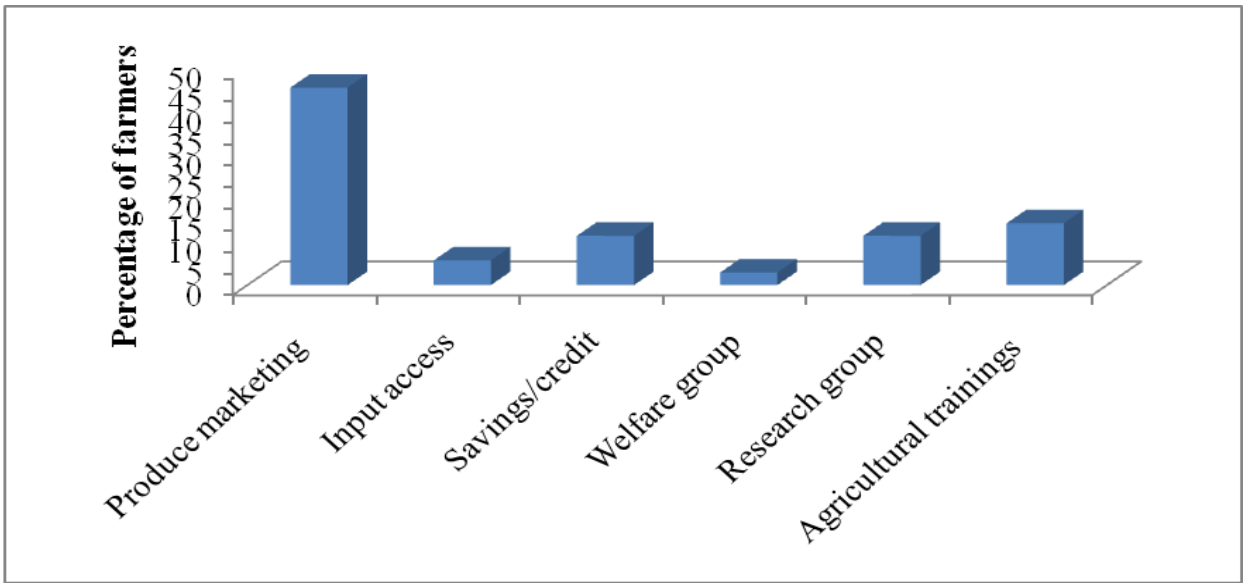

Figure 7: Main Function of Group

Source: Survey Data (2017).

4.2.2 Access to Extension Services

As shown earlier in Table 3, more than 85% of respondents had access to extension services within the last 12 months. About three quarters of the youth obtained knowledge trainings mainly from farmer to farmer extension source (Figure 8). This was followed by radio and TV, while the rest received extension from government, NGOs, input dealers and farmer cooperatives. The youth gained useful information on crop and livestock husbandry especially on improved seeds and breeds. This implies that young people are the best tools to disseminate agricultural information and new technologies in rural areas. Since they can be used as contact

farmers to share ICT information to other beneficiaries and enable them tackle farming challenges they face. Access to extension may spur youth participation in agriculture.

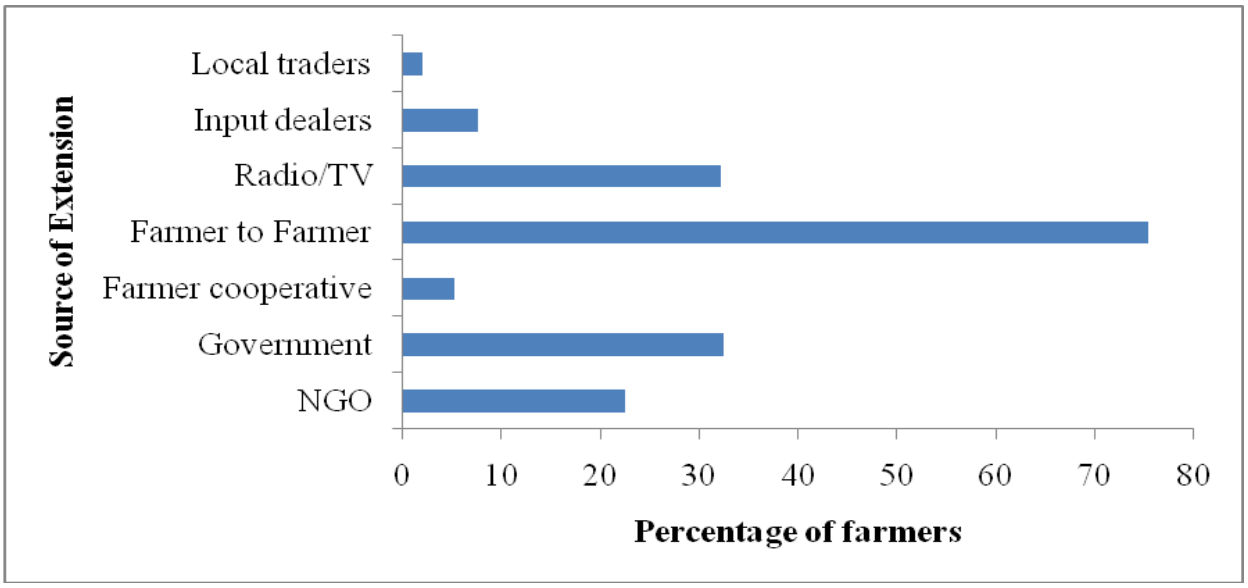

Figure 8: Sources of Extension

Source: Survey Data (2017).

4.2.3 Access to Credit

Results showed that close to 63% of the sampled youth had access to credit. The major source of credit was from friends and relatives (Figure 9). This result is similar to the findings of AGRA (2015) and FAO (2014), which revealed that many youths venturing in agriculture acquire financial services from informal sources such as friends and family support are the common sources of finance for youth in agriculture.

Other youth also accessed credit from youth groups and mobile money. Youth mainly used the credit borrowed to purchase inputs followed by improving their crops and livestock production. Less than 7% accessed credit from commercial banks and micro finances. This could be

attributed to the fact that young people in the rural areas are unemployed and are often hesitant to taking loans as they are afraid, they may not be able to pay back. Youth willing to venture into agricultural activities are faced with inadequate access to financial services due to lack of the required collateral such as land to obtain the loans (Republic of Kenya, 2012). Hence, they are not favored by financial institutions in the distribution of credit services (Herbal 2010). Kangai et al. (2011) also pointed out that youth attribute low agricultural productivity to lack of access to credit.

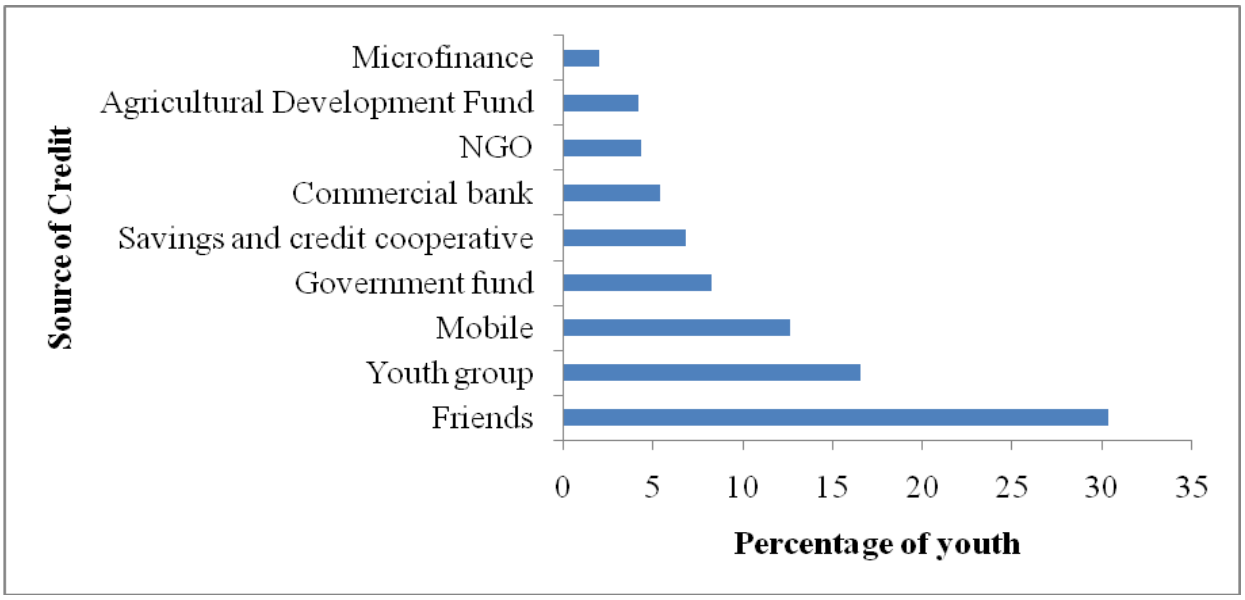

Figure 9: Sources of Credit

Source: Survey Data (2017).

4.3 Nature of Agricultural Enterprises Preferred by Youth

The types and nature of agricultural value chains that youth participated in are shown in Figure 10. The results show that majority of the youth were more concentrated in the cereal value chain (95%), followed by horticulture (75%) and livestock value chains (62%). This could be due to

the fact that cereal crops form the major staple food in the study area. Furthermore, a large number of the farmers produce for both food and for sale. Increased demand for cereals has resulted to increased investment to its production.

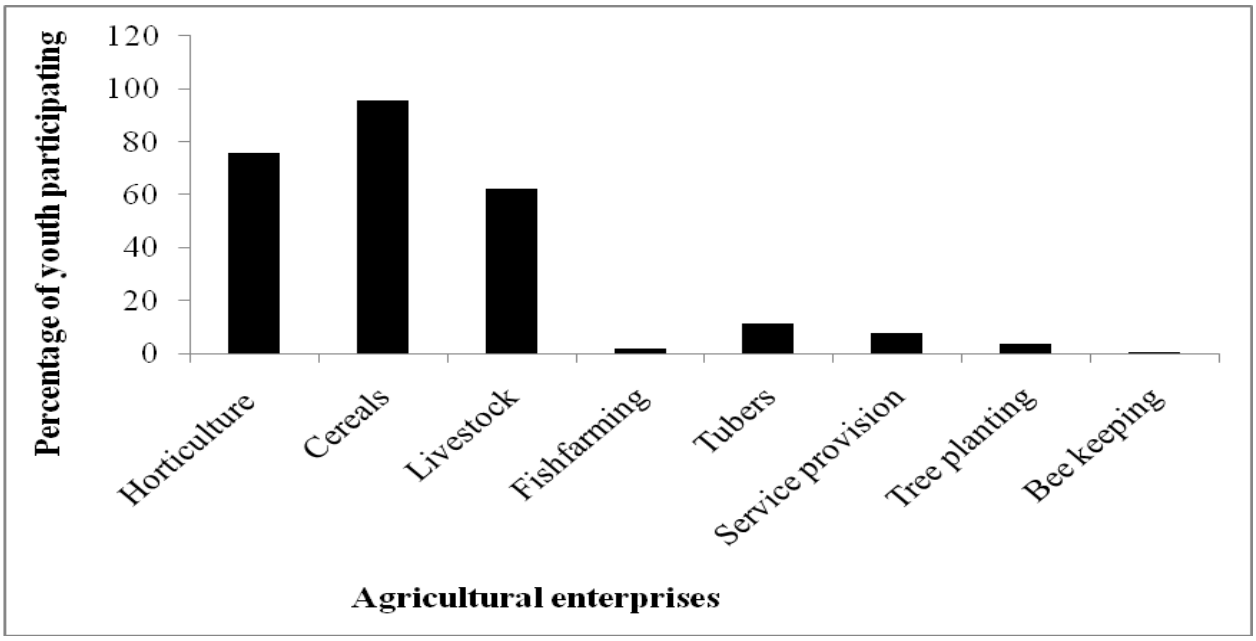

Figure 10: Youth Participation in Agricultural Enterprises

Source: Survey Data (2017).

Close to three quarters of the respondents were involved in the horticultural value chain as the young farmers are entrepreneurial and they prefer venturing in high-valued and short season agricultural enterprises that enable to make quick profit. A study by Poulton and Kanyinga (2014) confirm that youth mainly dominate the horticulture value chain. Kangai and Mburu (2012) also found that youth favored horticulture more than other farm-level enterprises. Majority of youth who are in the livestock value chain are concentrated in poultry production because of ready market and short production periods.

Only about 11% of the respondents engaged in growing root and tuber crops. This could be attributed to the fact that root and tuber crops require value-addition for them to fetch good market price; which needs capital. In addition, explanation from focus group discussion showed that youth consider the venture unprofitable due to the need to upgrade existing processing and product development technologies.

Furthermore, Figure 11 shows that across all enterprises' respondents participated more in production, marketing and input supply stages of agricultural value chains; with an exception of service provision where a large number participated in the provision of extension services. This means that their main way of participation was through providing labor. This observation is similar to those of Kimaro et al. (2015) and Afande et al. (2015) that youth are involved in agriculture by supply of labor at local and family farms.

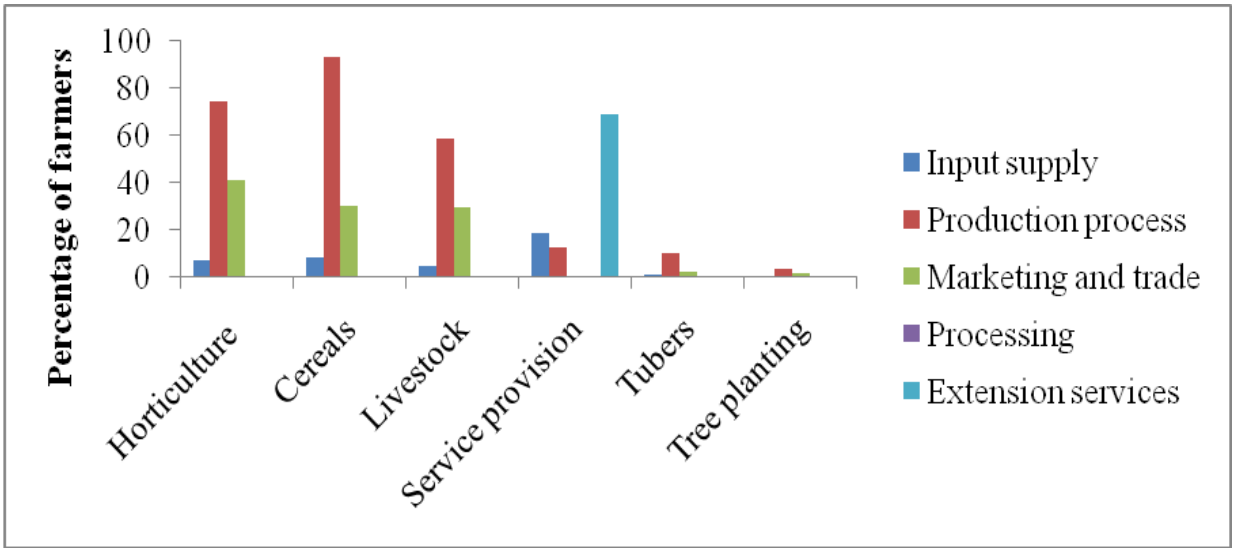

Figure 11: Stages of Agricultural Value Chains Activities

Source: Survey Data (2017).

In conformity with observations by EPRC (2013), the results show that most youth participate in agriculture through provision of labor across all enterprises as shown in Figure 12 below.

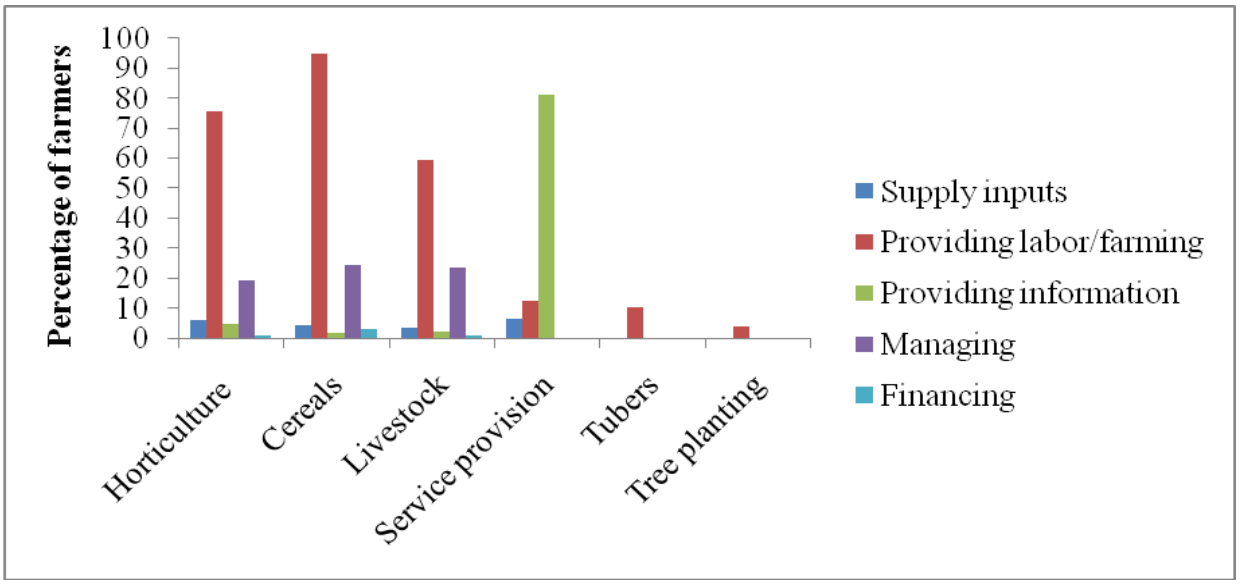

Figure 12: Ways of Youth Participation in Agriculture

Source: Survey Data (2017).

4.4 ICT Use in Agricultural Chain Activities

Results in Figure 13 shows the main differences in the use of ICTs for other purposes compared to the use for agricultural purposes. This finding indicates that generally use of ICT for non-agricultural purposes is higher while there is slackness in use for agricultural purposes by youth. This conforms to findings by Chavula (2014) that indicate low usage of ICTs for agricultural purposes.

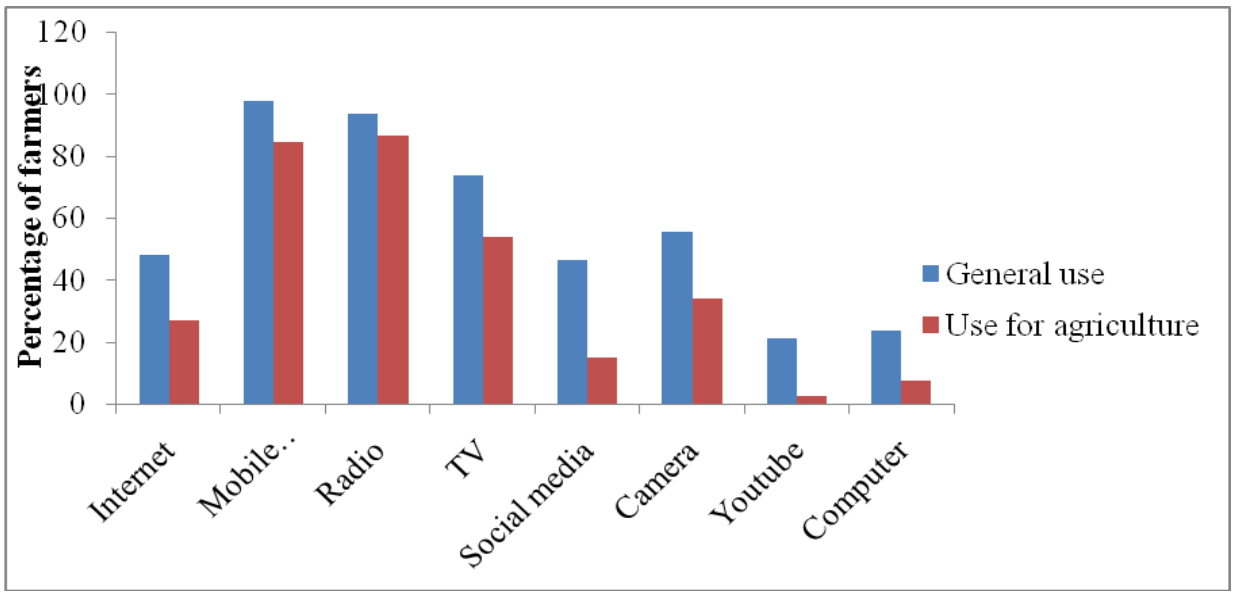

Figure 13: Distribution of use of ICT Tools and Services

Source: Survey Data (2017).

Of the total sample, more than 90% preferred using ICTs mostly for marketing as shown in Figure 14. This is because youth are entrepreneurial and are more focused on higher returns thus would want innovations that reduce transaction costs, are convenient and enable them to get accurate information (Kimaro et al., 2015). The drudgery nature of agriculture is minimized at the marketing stage using ICTs (Maru et al., 2018). Chalwe (2011) also noted that younger people engaged more than older people in marketing of beans in Zambia.

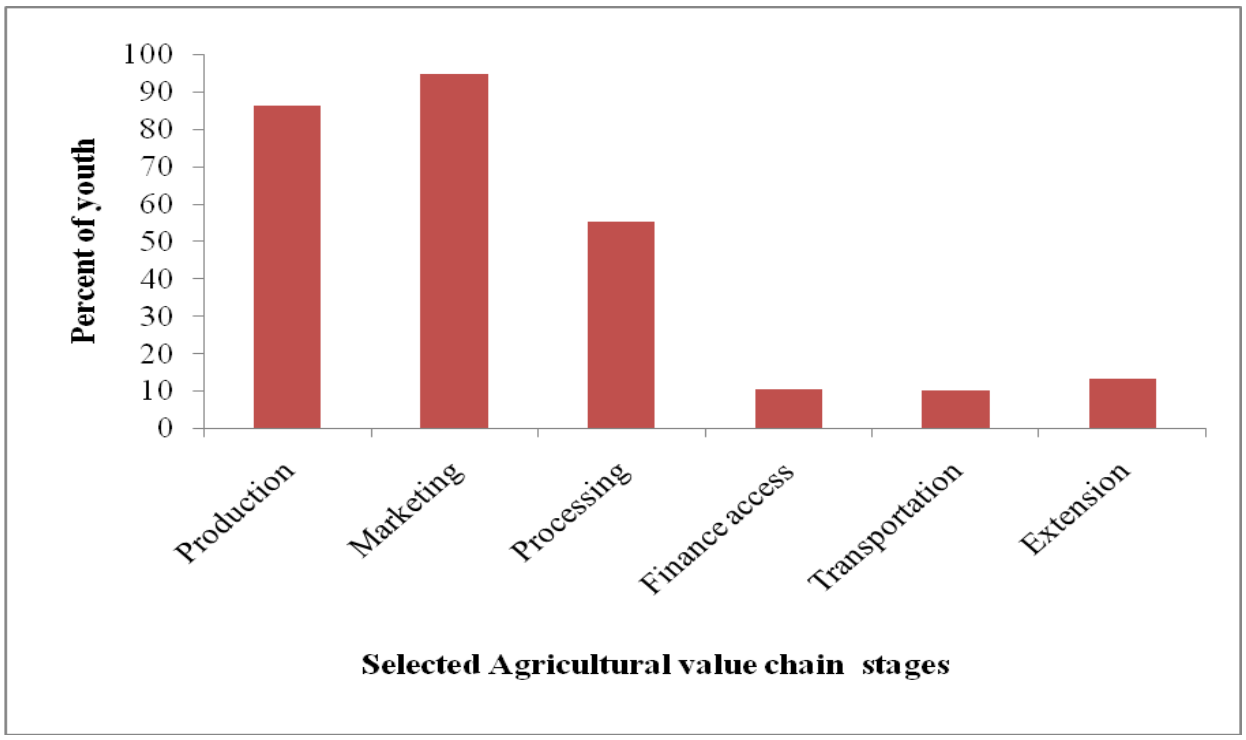

Figure 14: Use of ICTs in Selected Agricultural Value Chain Stages

Source: Survey Data (2017).

Results in Figure 15 illustrate that mobile phone, radio and TV are the most commonly used ICT tools in agriculture. The most used ICT tool across all the value chain stages was mobile phone. This is mainly because young people are the largest group using phones which is because of the ease and convenience in getting information on new production technologies, money transfer and communication (GSM Association, 2017). The finding concurs with that of Ogbeide and Ele (2015), who found that mobile phones were highly accessed and most frequent used by young farmers. Syiem and Raj (2015) also found that rural farmers in India used mobile phones more compared to other tools.

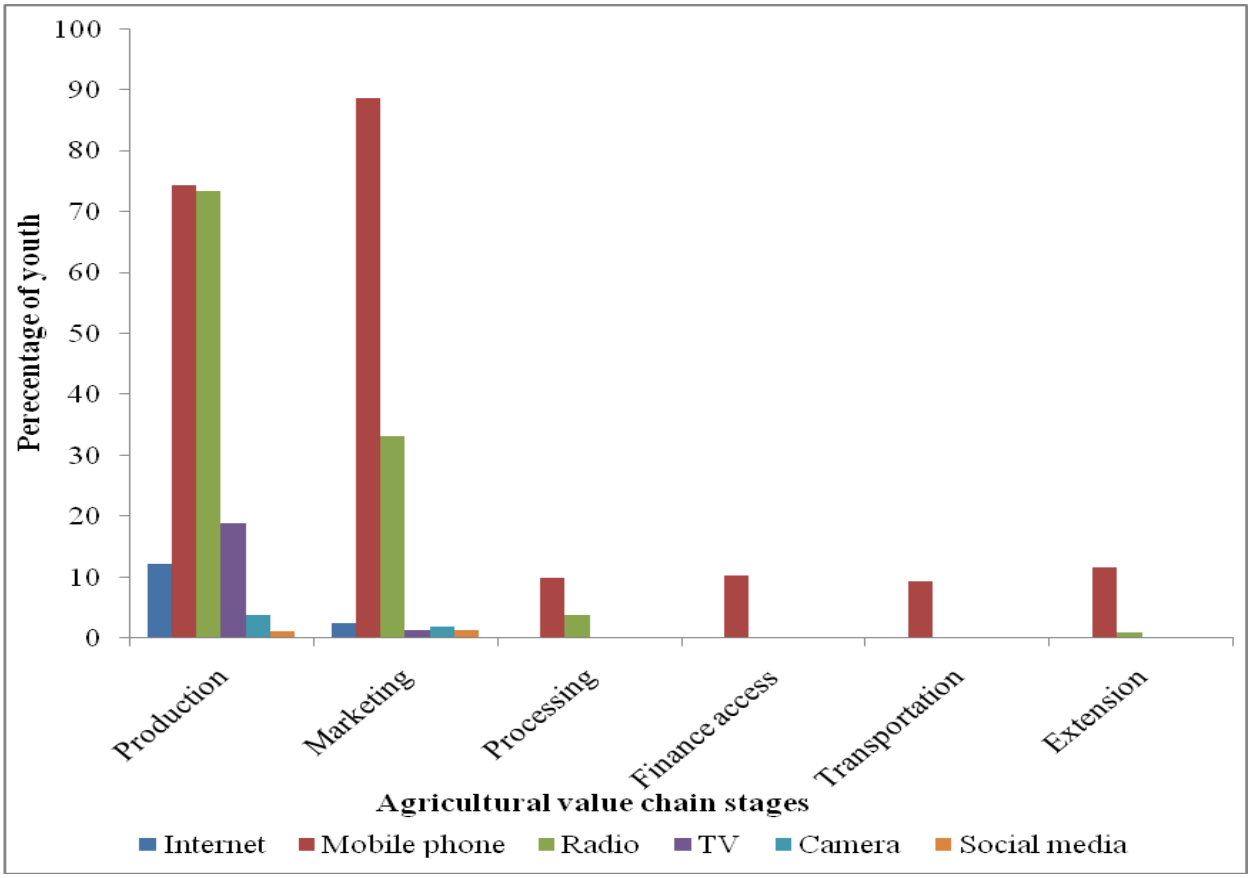

Figure 15: Tools Used in the Selected Agricultural Value Chain Stages

Source: Survey Data (2017).

Figure 16 shows the number of times the respondents used ICT tools per week for agricultural transactions. Results show that on average youth used ICTs twice or thrice a week, with majority using phones across all value chain stages. Interestingly the social media was used for about 5 to 6 times a week mainly for marketing of produce. This finding suggests that these online platforms (notably, *Facebook and WhatsApp*) boost marketing of farm products by youth compared to other platforms. A study by Irungu et al. (2015) also shows that Kenyan youth commonly used *Facebook* to advertise and sell their produce.

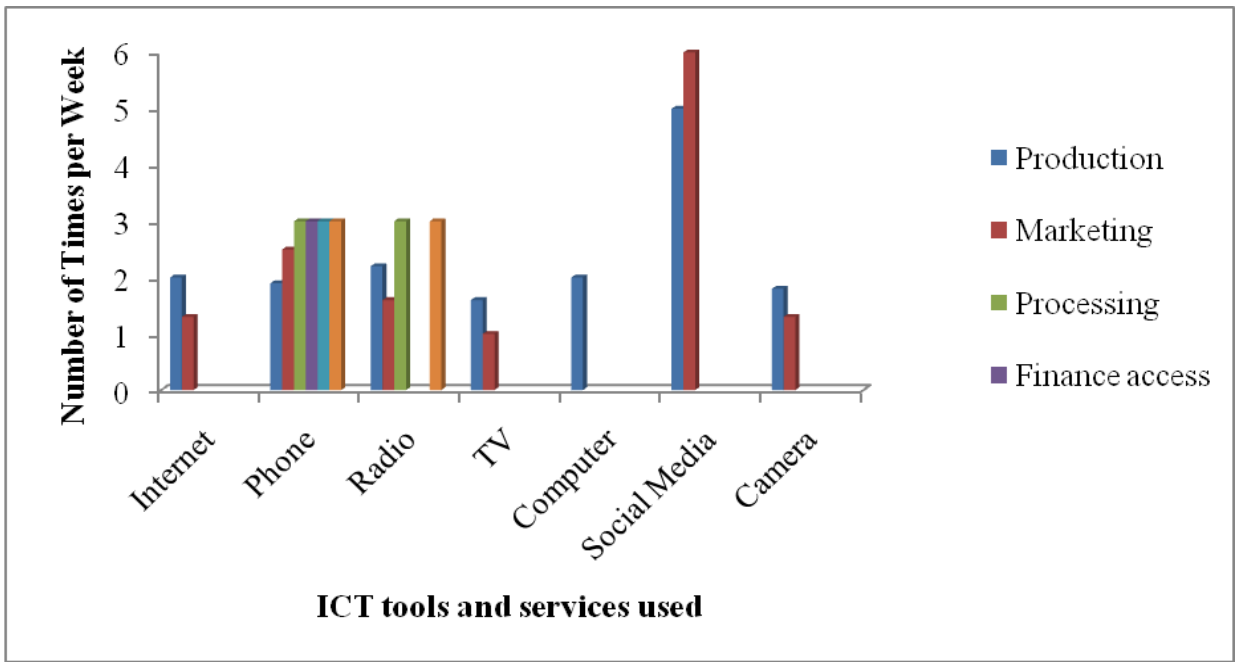

Figure 16: Frequency of Using ICT Tools and Services (Number of Times per Week)

Source: Survey Data (2017).

A two-sample t-test was conducted to compare mean differences between the income of users and non-users of ICTs for agriculture (Table 4). Results showed that the mean income of non-ICT users for agriculture was 6,676 Kenya shillings per month while that for ICT users was 9,755 Kenya shillings per month. This shows that ICTs play a role in increasing income among the youth who participated in agriculture using ICTs. These findings concur with previous studies such as Krone et al., 2016; Ogutu et al., 2014; Mwakaje, 2010 which showed that ICT usage in agriculture increased income and had a positive impact on productivity. Additionally, a probable explanation for these results is that farmers with higher income levels are more likely to purchase and adopt new technologies for agricultural purposes compared to their counterparts.

Table 4: Comparison of income based on ICT usage

Monthly income	ICT users in agriculture	Non-users	Pooled	t-statistic
Mean income (Kshs)	9755 (10134)	6676 (6197)	9508 (9901)	1.845*

Note *: Significant difference between users and non-users at 10%. Standard deviation in parentheses

Source: Survey Data (2017).

Results in Table 5 below highlight that farmers who used ICTs in agriculture had significantly 0.502 more acres of land as opposed to non-users in ICTs.

Table 5: Comparison of accessible land size based on ICT usage

	ICT users in agriculture	Non-users	Pooled	t-statistic
Average land size (acres)	1.370 (1.501)	0.868 (0.708)	1.330 (1.459)	2.482***

Note ***: Significant difference between ICT users for agriculture and non users at 1%. Standard deviation in parentheses

Source: Survey Data (2017).

A plausible explanation of this observation could be that farmers with larger land sizes are likely to diversify production and will need more information for production alternatives hence they use ICTs to acquire more diversified information and agricultural related innovations. Previous study by (Agwu, 2014) corroborates these findings by highlighting that larger piece of land increases the chance of a youth to venture in many agricultural enterprises.

A Fisher's exact test was carried out to evaluate the observed differences between use of ICTs for agriculture across the sub-counties (Table 6).

Table 6: Comparison of ICT use for agriculture across the sub-counties

ICT Use	Budalangi	Matayos	Samia	Total
No	4	5	8	17
Yes	63	68	65	194

Fisher's Exact $p = 0.541$

Source: Survey Data (2017).

Although results from Fisher's exact test suggest that there is no statistically significant difference in the proportion of ICT users across the sub-counties (Fisher's exact test; $p = 0.599$). It is important to note that the more peri-urban sub county (Matayos) which was closer to the boarder had a higher proportion of youths using ICTs in agriculture. This can probably be explained by the proximity of ICT infrastructural support in this area.

4.5 Challenges and Perceptions in Use of ICT in Agriculture

Results show that respondents who used ICTs for agricultural activities cited electricity shortage as the main challenge, followed by high cost of services and unaffordable (high) prices of ICTs, poor network, and lack of knowledge of how to use some of the ICTs tools, especially computers. On the other hand, respondents who did not use ICTs for agricultural purposes pointed out that unaffordable prices of ICT tools was their major reason for not using ICT tools. About 32% of them cited lack of knowledge to use ICT as shown in Figure 17.

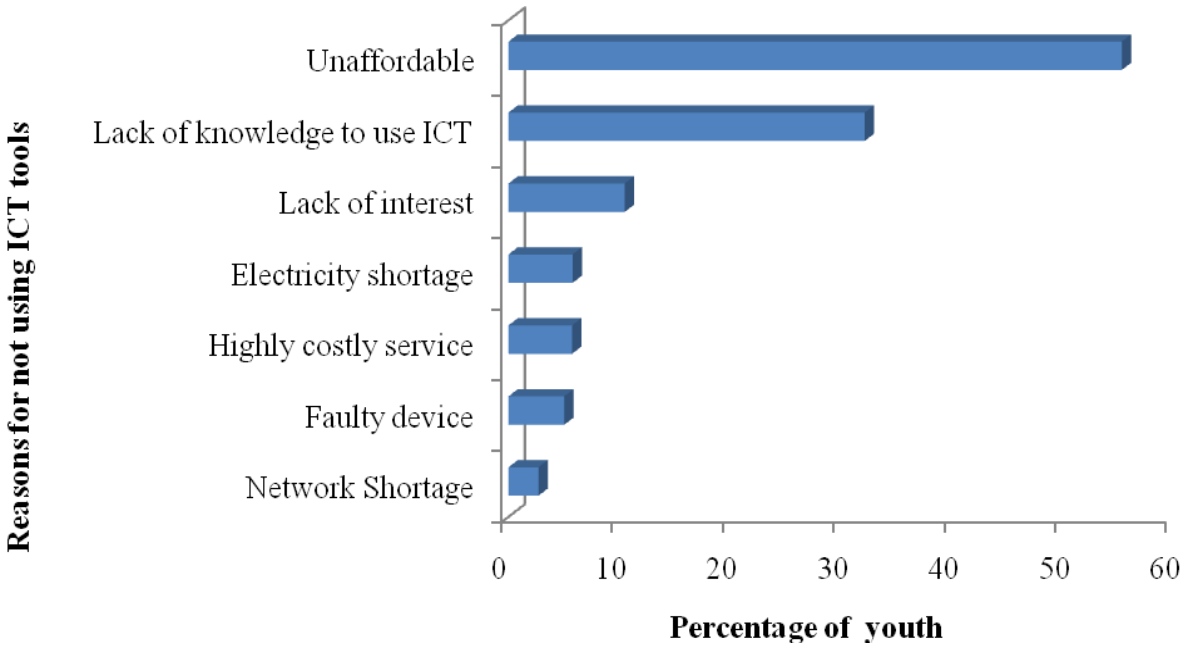

Figure 17: Reasons for not Using ICT Tools for Agriculture

Source: Survey Data (2017).

Table 7 shows the youths' perceptions on ICTs reliability, affordability, importance of information received from ICT tools. The results showed that majority of the respondents reported that computer and TV were the most expensive tools whereas radio, mobile phone and social media were the cheapest ICT tools to use in agriculture. More than three quarters of the

respondents noted that making ICTs more affordable would encourage youth to engage more in agricultural activities using ICT tools.

Mobile phone was considered the quickest way of getting agricultural information followed by radio and internet whereas camera was the slowest tool. Results also show that youth reported that use of ICTs could make agriculture a profitable business across all tools. This finding suggests that their attitude towards ICTs is positive.

Table 7: Perceptions on reliability, affordability and importance of information received from ICT tools

ICT tool / Perceptions	Internet	Mobile phone	Radio	TV	Computer	Social Media	Camera	YouTube
ICT prices are high (% agree)	66.4	45.3	38.6	80.6	92.8	41.5	71.1	60.6
If ICTs are affordable youth would engage in agricultural activities more (% agree)	78.2	82.5	80.7	86.2	85.1	76.5	88.2	83.1
Use of ICTs make agriculture a lucrative business (% agree)	92.9	94.3	95.3	92.9	92.7	88.4	94	91.5
Use of ICTs is the quickest way of getting agricultural information (% agree)	69	96.7	89.6	62.6	51.6	63.7	48.5	58.2

Source: Survey Data (2017).

Results of the focus group discussion show youth involvement in livestock and crop value chains along gender roles. Figure 18 illustrates how roles in the crop value chain are shared between male, female and both. Results show very few females participated in land identification; this

could be attributed to the fact that land ownership is low among women as they mostly depend on land owned by family/spouses (Musangi, 2017). Further, the results also agree to the fact that most young farmers still farm on land owned by parents.

Over 80% of processing is done by women as they are perceived to be keener and it is culturally considered to be a woman's task. Transportation to market is majorly men's role based on physical strength due to the bulky nature of agricultural produce. Decision making on use of money obtained from sale of produce is jointly done by men and women, although the decision may still be in the hands of men. A study by Pal and Haldar (2016) on role of women participation and decision making in farm activities also explains that women's involvement in decision making concerning money matters is low. This can be explained by the fact that control and access of resources is gendered towards men (Rubin et al., 2009).

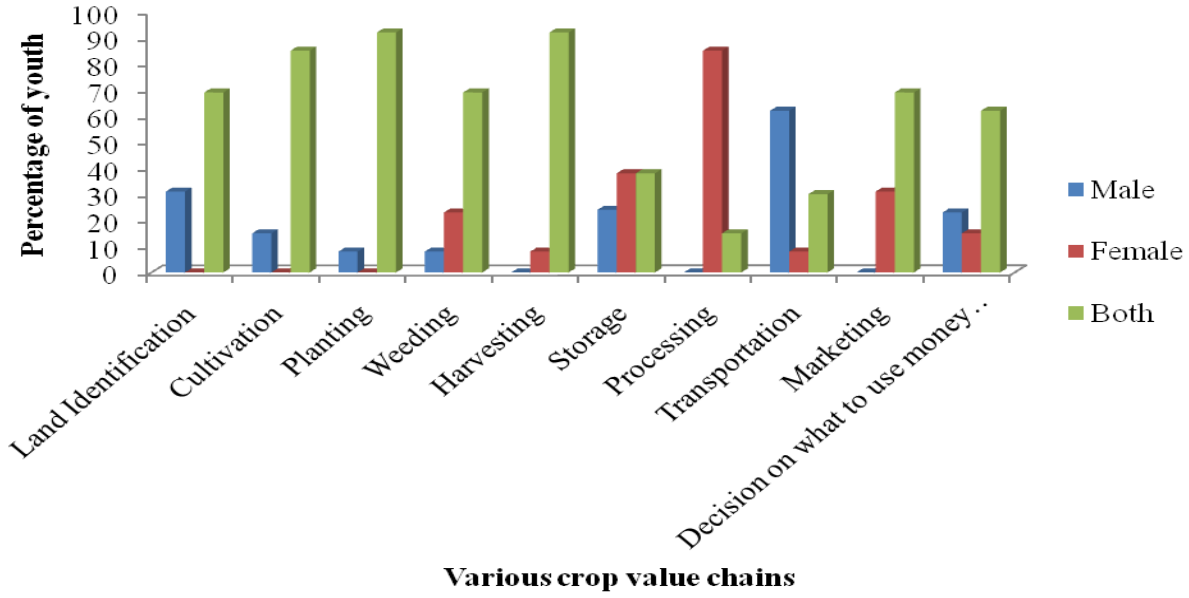

Figure 18: Youth Involvement in Crop Value Chains along Gender Roles

Source: Author's Focus Group Discussion Data (2017).

Figure 19 shows gender disparity in the livestock value chain. Male youth are more involved in ownership, buying, rearing, slaughtering and even selling of large animals/livestock, and women are majorly involved in small livestock/animals such as poultry across the value chain. This is probably because women tend to have less control over financial resources. The ownership of livestock has an effect on how and who makes decisions on these assets (Johnson et al., 2016). Debela (2016) found that gender difference is more pronounced in ownership of large animals. Large animals such as cows are assumed to have higher economic value hence mostly controlled by male. This is because women are constrained in access and ownership of resources, including, capital and land, than men (Njuki and Sanginga, 2013). Another reason could be that women give much preference to poultry than men do because of the ease of liquidation and they do not necessarily have to be land owners to rear chicken.

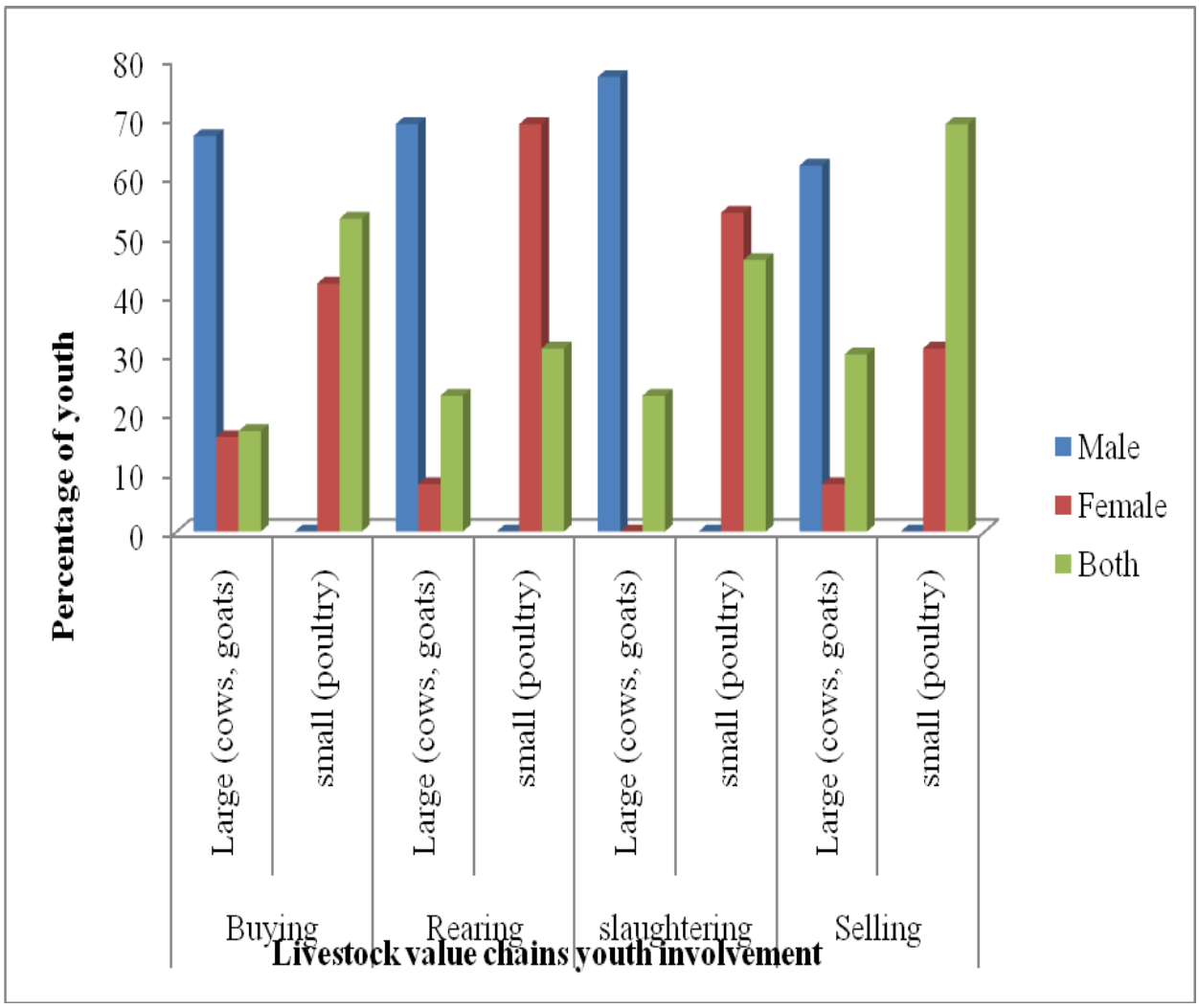

Figure 19: Youth Involvement in Livestock Value Chains

Source: Author's Focus Group Discussion Data (2017).

4.6 Determinants of Youth Participation in Agriculture Using ICT Tools

Youth's use of ICT tools for agriculture was estimated using a dichotomous (binary) choice variable of yes (if respondent uses ICT tools for agricultural purposes) or no (for non-use). Table 8 presents the estimates of the logit regression model output to determine the factors that influence the use of ICT tools for agriculture.

The model was checked for the equi-dispersion property and the results indicate the logit regression model was robust with good fit (Wald Chi^2 =40.75 *p*-value= 0.000). The second hypothesis of this study was that transport cost to the market and access to extension variables, have no significant effect on youth's decision to use ICTs in agriculture. Wald multiple exclusion test of the hypothesis is rejected at 5% level of significance (Wald Chi^2 (2) = 7.05, $Prob>Chi^2$= 0.0294).

Table 8: Factors influencing use of ICT tools for agriculture by youth

	Logit regression coefficients			**Marginal effects**	
Variable	**Coef.**	**Std.Err**	***p*-value**	**Coef.**	***p*-value**
Number of ICT ownership	0.81**	0.40	0.044	0.05	0.025
Transport cost to market	0.02*	0.01	0.094	0.01	0.090
Log of income	0.21	0.57	0.701	0.01	0.705
Extension	2.06***	0.81	0.011	0.11	0.018
Marital	0.73	1.04	0.480	0.04	0.468
Group membership	1.68***	0.57	0.003	0.10	0.011
Age	0.07	0.09	0.400	0.01	0.410
Distance to electricity	0.01	0.02	0.829	0.00	0.828
_cons	-7. 39	5.10	0.147		
Log likelihood = -30.73					
Pseudo R^2 = 0.305	**Wald Chi^2 = 40.75**		**Prob> Chi^2 = 0.0000**		

Note: *, **, * statistically significant at 1%, 5% and 10%, respectively**

Source: Survey Data (2017).

From the results in Table 8, the number of ICT tool ownership, access to extension services, group membership and cost to the market were significant in determining the decision to use ICT tools for agriculture. Holding other factors constant, an increase in the number of ICT tools owned increases the likelihood of using of ICTs for agriculture by about 5%. This implies that farmers owning more than one ICT tool are more likely to engage in agriculture because of the possibility to obtain more and diverse information for many aspects of farming and stability in information flow. Furthermore, youths owning mobile phones and radio, television or internet,

access agricultural related information more easily compared to their counterparts. This is similar to the results of Okello et al. (2014) which showed a positive significant relationship between ownership of mobile phones and use of ICT-based market information services.

Group membership was a positive and significant factor influencing participation in agriculture using ICT tools at 1% level. The results of the marginal effects show that belonging to a development group (such as, farming youth groups) increases the likelihood of using ICT tools for agriculture by 10%. Thus, youth belonging to groups acquire more information on use of ICTs and new technologies compared to non-members. This finding corroborates the findings of Wawire et al. (2017) where it was found that belonging to a farmer group positively influenced the probability of ICT use. This is because groups increase their social capital, ensure better information dissemination, higher bargaining power and better access to reliable markets (Nyaga, 2015).

A unit increase in access to extension services increases the likelihood of using ICT tools for agriculture by 0.11 units. This means that respondents who received extension services are expected to use ICTs more for agricultural purposes compared to those who didn't have access to extension. This could be explained by the fact that access to extension increases the flow of information on new technologies (Akpan, 2015).

An increase in the transport cost to the market increases the probability to use ICTs for agricultural purposes by 0.01 units. This implies that the higher the transport cost to the market, the more likely a youth will use ICTs. Young farmers located far from the market are more likely to use phones to seek market information on prices and mostly sell at farm gate to reduce on the

transaction costs. This finding concurs with Okello et al. (2012 and 2014) who found that increase in transport cost to local output markets increases the use of ICT tools.

4.7 Determinants of Intensity of Use of ICT Tools in Agricultural Value Chains

The Poisson regression model was estimated to examine the factors determining the extent to which young farmers use ICTs in agricultural value chains (Table 9). Wald multiple exclusion test of the hypothesis that socio-economic (age, marital) and institutional factors (distance to market, number of AVCs) have no joint effect on intensity of using ICTs in agricultural value chains by youth generated Wald chi^2 (4) =20.69, $Prob>Chi^2$ = 0.0004. The results, however, indicate that the level of significance is close to zero, therefore the hypothesis is rejected.

The coefficients of marginal effects of the Poisson regression model are interpreted as a unit change in the conditional mean if an explanatory variable change by one unit (Mensa-Bonsu et al., 2017; Cameron and Trivedi, 2013). Marginal effects were therefore used to explain the influence of each independent variable on the expected value of the extent of ICT use (Pedzisa et al., 2015).

From the findings, age, marital status, natural log of transport cost, natural log of distance to the market, land size, number of agricultural value chain stages (a youth participates in) and access to extension services significantly influence the intensity of ICT use in agricultural value chains.

Table 9: Determinants of the intensity of use of ICT tools by youth

	Poisson Regression coefficients			Marginal Effects		
Variable	**Coef.**	**Std. Err**	***p*-value**	**dy/dx**	**Std.Err**	***p*-value**
Age	-0.022*	0.011	0.060	-0.058*	0.031	0.062
Gender	-0.128	0.120	0.289	-0.339	0.320	0.290
Marital status	-0.362***	0.133	0.007	-0.964***	0.358	0.007
Occupation	0.088	0.142	0.535	0.234	0.378	0.536
Education (no. of years)	0.025	0.021	0.229	0.066	0.055	0.230
Lntransport cost	0.298***	0.107	0.005	0.793***	0.287	0.006
Lndistance to market	0.179**	0.081	0.028	0.476**	0.218	0.029
Lndistance to elec.	0.008	0.046	0.866	0.021	0.122	0.866
Lnincome	0.001	0.073	0.984	0.004	0.195	0.984
No. of AVCs	0.138***	0.045	0.002	0.368***	0.122	0.003
Group membership	-0.129	0.143	0.368	-0.344	0.382	0.368
Land size	0.090*	0.049	0.067	0.239*	0.131	0.068
Credit	0.021	0.129	0.869	0.057	0.344	0.869
Extension	0.458**	0.201	0.023	1.218**	0.538	0.024
-cons	-0.055	0.988	0.956			
Pseudo R^2 = 0.0742, LR Chi^2 (14) = 47.46, Prob> Chi^2 = 0.0000, Log likelihood = -295.9618						

Note: *, **, * statistically significant at 1%, 5% and 10%, respectively.**

Source: Survey Data (2017).

Age has a negative significant relationship to the extent of use of ICT tools. Increase in the age of the respondent by a year reduces the number of times ICT tools are used for agriculture by 5.8%, other factors held constant. This means that younger farmers are more receptive to new ideas and innovations compared to older ones. They are more likely to use ICT tools to seek information on production, marketing, access to extension and transportation services. The

inverse relationship is similar to the findings of past studies such as Okello et al. (2012) and Wawire et al. (2017).

Similarly, the results show that the extent of use of ICTs is inversely related to marital status. The expected number of times of ICT use for agricultural purposes is 96% higher among the single respondents than their married counterparts. This implies that the married respondents are less likely to use ICTs for agricultural purposes. This can be attributed to the fact that unmarried youths are risk takers (Umeh and Odom, 2011; Dadzie and Acquah, 2012) and are not afraid to invest their funds in modern agricultural technologies whereas their married counterparts prioritize food security and are therefore risk averse (Ndem and Osondu, 2018; Sumberg et al., 2012). This finding supports findings by Akpan (2015) which explained that decision making in a family does not solely rely on one party. Contrary to the findings by Nyamba and Mlozi (2012), that found that married people were more engaged in agricultural activities using mobile phones compared to their single counterparts.

Results also show that transport cost affects the intensity of use of ICTs for agricultural purposes. An increase in the natural log of transport cost is likely to increase use of ICT tools by about 79%. This is expected as the higher the transport cost the more likely a youth uses ICTs to make phone calls to trading partners or market produce online to reduce transaction costs. In addition, this finding explains the positive relationship between distance to the produce market and use of ICT tools in agricultural value chains. An increase in the natural log of distance to the market by a kilometer increases the use of ICT tools by 47.6%. This shows that young farmers', who reside far away from output markets, have a higher likelihood of using ICT tools to cut on large transport and transaction costs. This finding conforms with past studies (Okello et al., 2014)

which suggested that increase in transport cost to output markets increases use of ICT-based market information services.

The results also suggest that increase in the number of agricultural value chain stages a youth participates in, increases the intensity of use of ICT tools by 36.8% holding other factors constant. This is because young people are likely to be curious to seek information and use ICTs for communication and coordination of the value chain levels. Previous studies have shown that youth are involved in different levels of agricultural value chains including; input delivery, production, transportation and trading (Muhoma, 2014; Kising'u, 2016). Thus, young farmers participating in more than one agricultural value chain stage are likely to use ICT tools more frequently.

Land size also conditions the intensity of use of ICT tools for agricultural activities. Results of the marginal effects show that a unit increase in the size of land increases the expected number of times a youth uses ICTs for agriculture by 23.9%, *ceteris paribus*. Accessibility of larger pieces of land is likely to entice youth to participate in agriculture mainly because they are interested in higher outputs and more profits. Additionally, large land offer more space to practice many enterprises hence the incentive to use more ICTs to get more diversified information. Therefore, youth that have access to larger pieces of land are likely to invest in agriculture using new agricultural related technologies and innovations. Similarly, Agwu et al. (2014) found that the likelihood for youth to participate in multiple agricultural enterprises is amplified by increase in land size.

Results reveal that the effect of extension services to the use of ICTs is positive and significant at 1% level of significance. This is expected because dissemination of knowledge plays a big role in technology adoption. For this reason, increase in extension services through use of ICTs is likely to improve flow of information dissemination by youth. This could be attributed to the fact that youth are the main users of ICTs especially mobile phones to source for information. This is supported by findings from the descriptive shown earlier in Figure 15.

CHAPTER FIVE

5.0 SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Summary

Although access to ICTs can provide opportunities for youth in the economy to eradicate poverty, use of ICTs in agriculture by youth has not been fully exploited. Use of ICTs is one major way of attracting youth to modern agriculture. Scholars have centered their studies majorly on the relationship that exists between ICT and agriculture and/or youth participation in agriculture, but little is known about the use of ICT tools in agricultural value chains, the extent of use and more so where youth are concentrated along the value chain. This study examined the factors that condition the use of ICT tools in agricultural value chains by youth in Busia County. This study specifically aimed at characterizing youth participation in agricultural value chains, analyzing factors that influence youth's use of ICTs in agriculture and also assessing the intensity of ICT use.

Results revealed that youth preferred to engage in cereals, horticultural and livestock (particularly poultry) enterprises. In addition, they were highly concentrated in the marketing and production stages of the agricultural value chain using ICT tools. Mobile phone was the most used ICT tool across all the agricultural chain activities. It was also observed that youth use mobile phones as a one stop shop for multiple purposes including; networking, surfing the internet and financial access. Generally, use of all ICT tools was high for non-agricultural activities as compared to use for agricultural purposes. The youth also reported electricity

shortage and unaffordable prices of ICT tools as their main challenge. Along the value chain, youth mainly used social media (5 to 6 times a week) to market their produce.

The logit regression analysis showed that number of ICT tool ownership, access to extension services, group membership and cost to the market had a positive and significant influence on youth's decision to use ICT tools for agriculture. Concerning ownership of ICT tools, the results suggest those with more than one ICT tool are more likely to use ICTs for agriculture and adopt new technologies than their counterparts.

The Poisson regression results revealed that age, marital status, transport cost, distance to the market, land size, number of agricultural value chain stages (a youth participates in) and access to extension services were the factors conditioning the extent of ICT usage in agricultural value chains. A unit increase in these in the values of these variables also increased the intensity of use of ICTs. However, age and marital status had a negative but significant effect. As expected the more the number of agricultural value chain stages a youth engages in the higher the likelihood of using ICTs. The findings also suggest that youth are more likely to use ICT tools for agricultural transactions, as distance to the produce market and transport cost increases.

5.2 Conclusions

The findings from this study show that different factors affect how youth use ICT tools in agriculture. Majority of young farmers are using ICT tools especially for marketing of produce with most of them making use of mobile phones, social media and internet. Remarkably, use of social media greatly motivates youth to participate more in agricultural marketing; it therefore highly influences the intensity of participation in the marketing stage. In this regard, there is need to link social media to agriculture.

Youth participation is high in cereals, horticultural and livestock (particularly poultry) enterprises, thus more efforts should be put for youth focused on these enterprises. They were highly concentrated in production and marketing stages of the agricultural value chain therefore; ICT tools should be tailored to these value chains to increase youth participation. Youth should be sensitized in ways to use ICTs on these stages. There is also need to expose youth/ show benefit of other enterprises and value chain stages where there participation is low. Although youth pointed out unaffordable ICTs prices as the major reason for not using ICTs for agriculture. Introducing affordable ICT packages especially for youth in agriculture can attract more to the sector.

Land size had a significant effect on the extent of use of ICTs. These results demonstrate that youth who had access to large land sizes used more ICTs in agriculture as opposed to those of smaller land sizes. This could be attributed to the fact that large land sizes translated to intensive farming which required more information; thus, they sought this information using ICTs. The number of agricultural value chain stages (a youth participates in) also positively affected intensity of ICT use. Promoting diversification of enterprises and participation in agricultural value chain activities is important to increase intensity of ICT use.

5.3 Policy Recommendations

Based on the results of this study, to stimulate and enhance youth use of ICTs in agriculture more efforts should be directed towards creating more avenues for accessing agricultural information on social media platforms. Social media has rapidly replaced conventional communication tools in Kenya especially by youth; therefore, the government and other stakeholders should reinforce existing web-based information and knowledge sharing platforms that target youth involvement in agriculture. To be successful in doing so, broadcasting stations and mobile operators need to

have a clear understanding of the Kenyan youth context in terms of challenges and opportunities. Thus, policy interventions that adequately address the issues of youth in agriculture should be implemented so as to exploit their full potential.

In order to change youth's negative perception on agriculture, success stories on successful youth-led ventures such as; *M-farm* and *Mkulima* young should be broadcasted widely through various channels. Publishing and airing success stories (on magazines, newspapers, radio, TV, social media platforms) would address the issue of negative publicity on agriculture. Considering there is low usage of ICTs for agricultural purposes by youth especially the internet, there is need for Kenyan government to continue promoting use of internet for agricultural purposes. This can be done by establishing more ICT hubs for e-agriculture training in places where youth can easily access them.

Since empirical evidence in this study has shown that land size is crucial in increasing the intensity of participation in agriculture using ICTs. Therefore, policy interventions that could help young farmers maximize their land use through technical support are needed. This could include but not limited to optimizing use of small land area through diversifying their value chain activities by concentrating more on specific activities such as; mixed farming, agricultural intensification, marketing, transportation, processing, input supply and extension services. Also, equally important could be encouraging high value entrepreneurial production that can be done with small amount of startup capital.

The study found that number of agricultural value chain stages a youth participates in, also influenced the intensity of ICT use. In this regard, ministry of agriculture extension programs should introduce training programs specifically tailored to build capacity in understanding each

value chain stage and enterprise of interest. In addition, it is important to conduct a survey to establish specific agricultural value chain needs in different counties; in terms of use of different ICTs appropriate to farmers engaging in different enterprises and value chain stages. Further, training young farmers on value addition and providing awareness on local, urban and global market produce requirements/standards, price trends and change in consumer preferences.

Targeted value chain research and development, information sharing and training on local platforms such as youth groups, farmer field days, at the county level would enhance development of the particular value chains as well as expose youth to new and existing ICT tools. Thus, the policy makers in Kenya should prioritize including youth in designing, planning, and implementing agricultural sector specific youth policies. Youth should also be given initiative to lead in the implementation of programs targeting them.

The Kenyan County governments should work towards developing county-specific agricultural strategies that are based on ICT development in the agricultural sector targeting youth. Inclusion of youth focused issues in the Busia County strategic plan and establishing centers whereby farmers can access agricultural information online will form a basis for enhancing high degrees of participation. The national government, County government and partner organizations should take initiative in conducting ICT courses to be attended by youth in agriculture in order to produce e-farmers.

This study identified unaffordable ICT prices as a major challenge that youth face in the use of ICTs. On this basis, the government should intensify its efforts in incorporating ICT infrastructure and policy interventions to create an enabling environment that will make ICTs more accessible and affordable to rural youth. Therefore, reducing costs of purchasing and

operating ICT tools will increase diversity of use by youth across age and marital status differentials.

In order to invest in high-valued agricultural enterprises, young people need access to resources and skills. Therefore there is need for national and county government to provide capacity building support and incentives (for example secure land access and capital) that enable youth to integrate ICTs in less-laborious, but more attractive/prestigious value chain activities such as finance, processing, information supply and transportation where it is currently low.

5.4 Contribution to Knowledge

The current study showed the factors that influence the use of ICT tools in agricultural value chains by youth in Busia County. This work adds on literature on ICTs as it focused on finding which enterprises youth prefer most, where youth are majorly concentrated along the agricultural value chain and the intensity of ICT use for agricultural purposes. Unlike the previous similar studies, this study incorporated the number of ICT tools ownership and number of agricultural value chain stages a youth participates in, as variables in the model to determine the effect on intensity of ICT use in agriculture.

5.5 Suggestions for Further Research

In light of this study's findings, future studies could offer further insights by analyzing participation and the use of ICTs by youth on specific enterprises. This study assessed ICT tools in a generalized manner thus the study can be enhanced by narrowing down to analyzing factors influencing the use of each tool for agriculture. Moreover, future research can focus on analyzing each ICT tool for the different stages of the agricultural value chain so as to better understand how to integrate ICT tools in the various chain stages.

Further, another study should be carried out to assess the impact of ICT use on youth's income and welfare to capture the outcomes of different ICT tools on production, productivity and profits. Finally, research should be done to explain the differences between male versus female ICT users taking into consideration the female burdens (including social barriers).

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APPENDICES

Appendix 1: Focus Group Discussion Checklist

UNIVERSITY OF NAIROBI

Theme: Understanding youth participation in Agricultural value chains and ICT use in Agriculture

Introduction

The purpose of this focus group is to obtain key insights on youth participation in agricultural value chains in Busia County, Kenya.

Location.....Ward.....Date.....

Questions for Discussion:

1. Over the last 10 years, what has been the trend of youth engaging in farming and agriculture-related activities?
2. What have been the drivers of this trend of youth engaging in agricultural activities?
3. Please fill the table below:

What agricultural enterprises are mainly practiced in this area?	What has been the trend in choice of agricultural enterprises among youth over the past 10 years?	What are the drivers for enterprise choice?	Which stages of the agricultural value chain do youth in this County mostly participate in?	Which activities are youth involved in the stages identified above?	What determines the choice of the stage of the agricultural value chain one chooses to participate in?

4. What are some of the common ICT tools and how are they used in agriculture-related activities?
5. What benefits result from the use of ICT tools in farming?
6. What are the main challenges of using ICTs in agriculture-related activities in this area?
7. What training is available on the use of ICTs in agriculture?
    a. Sources of training

b. Information obtained from these training sessions

c. Perception of the training sessions

8. Apart from direct farm activities, what roles do ICT tools play in;
   a. Credit access
   b. Marketing
9. What agriculture-based ICT applications are commonly used in this area

Appendix 2: Household Questionnaire

UNIVERSITY OF NAIROBI

Youth Participation in Using Information and Communication Technology tools in Agricultural Value Chains in Busia County, Kenya

Household Survey Questionnaire, May 2017

INTRODUCTION

The University of Nairobi, Department of Agricultural Economics, is conducting a survey on youth participation in integrating ICTs in agriculture in Busia County, Kenya. The objective of this study is to examine the effects of ICT use in increasing youth participation in agricultural value chain activities. Respondents for this survey shall be young farmers who must be at least 18 years old and below 35 years old. You have been randomly selected among other 200 respondents who will be interviewed. The findings will provide important insights to develop policies targeting improved youth participation in farming. The information provided will be treated with utmost confidentiality and will be used only for purposes of this survey and will not be disclosed to anyone else. The survey interview will require about one hour to be completed and your contribution will be highly appreciated. I therefore request your permission to begin the interview. For further information, please contact Pauline Katunyo 0700904855.

Respondent Screening questions

Are you of the age between 18 to 35 years? 1= Yes; 0= No.
Do you participate in agriculture? ____, 1= Yes; 0= No.

If Yes to both questions, proceed to the next section. If No to any of the questions, terminate the interview.

IDENTIFICATION

Name of interviewer	
Questionnaire number	Date of interview……. /…..……/……
Phone number	
Village	Sub location
Location	Sub County

SECTION A: YOUTH PARTICIPATION IN AGRICULTURE AND OTHER LIVELIHOOD ACTIVITIES

1. Do you participate/ have you ever participated in the following agricultural enterprises in the last 12 months?

Agricultural enterprise	Do you participate? 1=Yes; 0=No	If yes, in which stage of the agricultural value chain did you participate in? 1=Input supply in production 2=Production process 3=Marketing and trade 4=Processing, packaging, & storage 5=Finance access 6=Transportation 7=Extension services	In what way did you participate in the agricultural value chain? 1= Supplying inputs 2= Providing labor 3=Providing information 4= Managing 5= Financing	Duration of participation 1= less than a year 2= 1 year 3= 2 years 4= 3- 5 years 5= more than 5 years	Challenges in Participation in agricultural value chain activities 1= High cost of inputs 2= Lack of capital 3= Lack of adequate resources (water, land, fertilizers, seeds) 4= Outbreak of pests and diseases 5= Price uncertainty/ Low prices 6= Weather variability 7= Inadequate markets 8= Inadequate information on markets 9= Poor roads/Distance to the market 10= High transport cost 11= Inadequate knowledge and skills in agriculture 12= Other, specify	Main reason for engaging in this enterprise 1= Food 2= Sale 3= Both food and sale
Horticulture						
Cereals						
Livestock keeping						
Fish farming						
Bee keeping						
Service provision						
Other, specify						

SECTION B: YOUTH INTEGRATION OF ICTs IN AGRICULTURAL VALUE CHAINS

2. ICT tools use and ownership

Type of ICT tool	Do you own any ICT tool 1=Yes; 0=No	If No, do you have access to any ICT tools through; friends, family, resource centers? 1=Yes; 0=No	Do you use the ICT tools for agricultural purposes? 1=Yes; 0=No
1=Internet			
2=Mobile phone			
3=Radio			
4=TV			
5=Computer			
6=Office software			
7=Social media			
8=Blogs and websites			
9=Facebook			
10=Camera			
11=YouTube/online videos			

3. Do you participate in the following stages of agricultural value chains using ICTs?

Stage of agricultural value chain	Do you participate? 1= Yes; 0= No	Did you use ICTs in this stage? 1= Yes; 0= No	Type of ICT tool used 1= Internet 2= Mobile phone 3= Radio 4= TV 5= Computer 6= Office software 7= Social media 8= Blogs and websites 9= Facebook 10= Camera 11= YouTube/online videos	Frequency of use of ICT tool 1= 3 times a week 2= 4-6 times a week 3= more than 7 times a week	What do you like about use of the ICT in the specified stage? 1=Cheap 2=Reliable 3=Easily accessible 4=Timely 5=Other……..	Challenges in using it? 1= Unaffordable prices of ICT materials 2= Electricity shortage 3= Highly costing service/Costly to run 4= Telecommunication network shortage/Service is not available 5= Lack of knowledge to use ICT 6= ICT services are far away 7= Computer illiteracy 8= Other……
Production Input supply Fertilizer/seeds Production process						
Marketing Price information Trade/sell output						
Processing, packaging, & storage						
Finance access						
Transportation						
Extension services						

4. Give your opinion on the following;

Type of ICT tool	How does ICTs serve you in your daily agribusinesses' activities? 1= Developed farming competences 2= Market information 3= Price information (e-) 4= Weather and diseases information 5= E-billing and/or e-payment 6= Money transfer	If you compare your farming businesses conditions before and after the use of ICT, what can you assert? 1= Production competences have increased 2= Market grown 3= Time saving/time used to search for buyers reduced 4= Farming skills have developed 5= New production technologies 6= Other, specify	What are the main challenges associated to the use of ICTs in your daily agribusiness activities? 1= Unaffordable prices of ICT materials 2= Electricity shortage 3= Highly costing service/Costly to run 4= Telecommunication network shortage/Service is not available 5= Lack of knowledge to use ICT 6= ICT services are far away 7= Computer illiteracy 8= Roads are poor 9= Other, specify
1=Internet			
2=Mobile phone			
3=Radio			
4=TV			
5=Computer			
6=Office software			
7=Social media			
8=Blogs and websites			
9=Facebook			
10=Camera			
11=YouTube/online videos			

5. Reasons for not using ICTs in agricultural activities.

Type of ICT tool	**Reason for not using ICT tool** 1= Unaffordable prices of ICT materials 2= Electricity shortage 3= Highly costing service/ Costly to run 4= Telecommunication network shortage/ Service is not available 5= Lack of knowledge to use ICT 6= ICT services are far away 7= Computer illiteracy 8= Roads are poor 9= Other, specify	**Would you be willing to use ICTs in farming?** 1= Yes; 0= No	**If yes, what kind of enterprises would you like to engage in?** 1= Livestock keeping 2= Cereals and crop farming 3= Horticulture 4= Fish farming 5= Bee keeping 6= Other, specify	**What stage of the value chain?** 1=Input supply in production 2=Production process 3=Marketing and trade 4=Processing, packaging & storage 5=Finance access 6=Transportation 7=Extension services	**If you adopt ICTs how beneficial will they be in respective enterprise?** 1= Keeping records 2= Obtaining market information 3= Getting extension services 4= Other, specify
1=Internet					
2=Mobile phone					
3=Radio					
4=TV					
5=Computer					
6=Office software					
7=Social media					
8=Blogs and websites					
9=Facebook					
10=Camera					
11=Youtube/online videos					

6. Perception on reliability, affordability and quality of information generated from ICT tools.

Please indicate your opinions on the following statements.

Type of ICT tool	**Statement** **1-** ICT prices are high **2-** If ICTs are affordable youths would engage in agricultural activities more **3-** The government should help young farmers purchase ICT tools at subsidized prices **4-** Availing ICT tools will entice youth to participate more in agriculture **5-** Use of ICTs make agriculture a lucrative business **6-** Participating in agriculture using ICTs can help in improving way of farming/productivity **7-** ICTs are readily available **8-** Use of ICTs is the quickest and preferred way of getting agricultural information **9-** Would you say ICTs information services are important **10-** Information shared on ICT platforms (TV, Radio, Internet) can be trusted **11-** Agricultural-based ICT applications improve information dissemination **12-** Modern ICTs are easy to learn and use **13-** Training on use of ICTs would help manage and operate agricultural-related business enterprises **14-** Use of ICT tools enables access to new markets, keep records **15-** Usefulness of online content for agricultural purposes is often unclear	**1= Strongly agree** **2= Agree** **3= Neutral** **4= Disagree** **5=Strongly disagree**
1=Internet		
2=Mobile phone		
3=Radio		
4=TV		
5=Computer		
6=Office software		
7=Social media		
8=Blogs and websites		
9=Facebook		
10=Camera		
11=Youtube/online videos		

SECTION C: ACCESS TO CREDIT, EXTENSION AND ASSET OWNERSHIP

7. Did you apply for a loan in the last one year? ____, 1= Yes 0= No

If yes, what were the main sources of credit? 1= Friends/ relatives 2= Commercial bank 3= Micro-finance institution 4= Savings and credit cooperative 5= Government fund/ Youth fund (*UWEZO*) 6= Farmer group/ Youth group 7= Project/ NGO 8= Mobile Credit 9= Other, specify	Type of credit facility? 1= Financial/ Cash 2= In kind e.g. inputs 3= Both financial and in kind	Did you get it? 1= Yes, 0= No	What proportion of the credit you applied for did you get? 1= 25% 2= 25-50% 3= 50-75% 4= 100%	For what purpose did you acquire the credit for? 1= Improve livestock/ crop production 2= Purchase farm machinery 3= Purchase of ICT tool 4= Purchase feed 5= Purchase of inputs 6= Other, specify	Did you use the credit for the intended purpose? 1= Yes, 0= No

8. Did ICT play any role in accessing credit? 1= Yes, 0= No

If yes, what kind of credit facilities did you acquire using ICTs? 1= Financial/ Cash 2= In kind e.g. inputs 3= Both financial and in kind	What roles did ICT tools play in access of credit? 1= Provision of information 2= Reduction of transaction costs 3= Credit platform 4=Other……

9. For the last twelve months have you received any extension services? _____, 1= Yes 0= No

If yes, what type of extension services? 1= Private/ NGO 2= Public (Government) 3= Farmer cooperative extension 4= Farmer to farmer/ farmer group 5= e-service 6= Local traders 7= Input dealers	What extension advice or technologies were provided or disseminated to you? 1= Crop husbandry 2= Livestock husbandry 3= Marketing information 4= Pests and disease management 5= Improved breeds/ seeds 6= Record keeping 7= Financial management 8= Other, specify	Was extension services delivered through ICT tools? 1= Yes 0= No	If yes, what role did ICTs play in access to extension services? 1= Communication 2= Payment for services 3= Source of information 4= Other, specify

10. Do you belong to any development group?

If yes, specify the kind of a development group.	Membership 1= Yes 0= No	Duration/ No. of years	Frequency meetings 1= Daily 2= Weekly 3= Fortnightly 4=Monthly	Role/ Main function of the organization 1= Produce marketing 2= Input access 3= Savings and credit 4= Welfare/ funeral group 5= Tree planting and nurseries 6= Faith based organization 7= Farmer research group 8= Other, specify	Role in group 1= Official 2= Ex-official 3= Ordinary member	ICT Tools used 0-None 1= Internet 2= Mobile phone 3= Radio 4= TV 5= Computer 6= Office software 7= Social media 8= Blogs and websites 9= Facebook 10= Camera 11= YouTube/online videos	Purpose of ICT Tools used 1-Keep records 2-Communication 3-Savings and Credit 4-Other……..
Farmer group/ cooperative							
Youth group							
Women's group							
Savings and credit group							
Welfare organization							
Other, specify							

11. Market access. Do you sell any of the commodities you produce? _____ 1= Yes, 0= No

Enterprise	Do you sell? 1=Yes 0= No	In what type of market? 1= Farm gate 2= Brokers 3= Online markets 4= Farmer group 5= Open air markets 6= Export markets	Do you use ICTs in any of these markets? 1= Yes 0= No	ICT Tools used 1= Internet 2= Mobile phone 3= Radio 4= TV 5= Computer 6= Office software 7= Social media 8= Blogs and websites 9= Facebook 10= Camera 11= YouTube/online videos	What role does ICT play? 1= Price negotiations 2= Advertising 3=Market information 4=Price changes	Do you sell your produce in groups or individually? 1= Group 0= Individually
1= Horticulture						
2= Cereals and crop farming						
3= Livestock keeping						
4= Fish farming						
5= Bee keeping						
6= Other, specify						

12. Distance to nearest market; Kilometers _____, Walking minutes _____, Cost _____.

13. Have you acquired any piece of land? _____, 1= Yes 0= No

If yes, what is the land size? _____, acres.	How did you acquire the land? 1= Purchased, 2= Inherited land, 3= Leased in, 4= Borrowed land, 5= Gift	Do you have a title deed for the land you own? 1= Yes, 0= No

14. Is there electricity (that can be tapped) in this area? _____ 1= Yes, 0= No

If yes, do you have electricity yourself? 1= Yes, 0= No	If No, what is the distance to the nearest electricity supply in Kilometers?

SECTION D: SOCIO-ECONOMIC CHARACTERISTICS

15. Gender of respondent_____, (1= Male, 2= Female)

16. Age of the respondent_____

17. Age group of respondent_____, (1= 18 – 25, 2= 26 – 30, 3= 31 – 35)

18. Marital status of respondent_____ (1= Married, 2= Single 3= Widow, 4= Divorced, 5= Separated)

19. What is your occupation?

(1= Farming, 2= Trading, 3= Artisanship, 4= *Bodaboda* operator, 5= Teacher, 6= Tailor, 7= Civil servant, 8= Driver, 9= Student, 10= None, 11= Other, …….(specify)

20. Level of education

Highest level of formal education completed 1= None, 2= Primary, 3= Secondary, 4= Tertiary certificate, 5= Diploma, 6= Undergraduate degree, 7= Masters, 8= PhD	Number of years of formal education completed.

21. What are the main sources of livelihoods?

Source of Livelihood	Percentage of income derived
1= Farming (crop & livestock) 2= Salaried employment 3= Business / self-employed off-farm 4= Casual laborer on-farm 5= Casual laborer off-farm 5= *Bodaboda*/motorcycle operator 6= Fishing 7= Other, specify	1= Over 75% 2= 51-75% 3= 26- 50% 4= 11- 25% 5= 0-10% 6= Not a worker

22. On average, what is your monthly income in Kenya Shillings?

Income category	Indicate average amount in Kenya Shillings
1= Below Kshs. 10,000 2= Kshs. 10,001- 25,000 3= Kshs. 25,001- 35,000 4= Kshs. 35,001- 45,000 5= Above 45, 000	

Thank you for your participation.

Appendix 3: Results of Variance of Inflation Factor (VIF)

Variable	VIF	1/VIF
Age	1.40	0.714
Gender	1.28	0.779
Marital status	1.47	0.680
Occupation	1.31	0.766
Education (no. of years)	1.37	0.729
Lntransport cost	1.80	0.556
Lndistance to market	1.78	0.561
Lndistance to electricity	1.21	0.829
Lnincome	1.15	0.886
Number of AVCs	1.51	0.663
Group membership	1.53	0.655
Land size	1.15	0.866
Credit	1.46	0.685
Extension	1.16	0.864
Mean VIF	**1.40**	

Source: Survey Data (2017).