Determinants for Adoption of ICT-based Market Information Services by Smallholder Farmers and Traders in Mayuge District, Uganda

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2009/HD02/14755U

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A thesis submitted to the Directorate of Research and Graduate Training in partial fulfilment of the requirements for the award of a Master of Science degree in Agricultural and Applied Economics of Makerere University

October, 2012

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DECLARATION

I, Haruna Sekabira do declare that this is my original work and has never been presented for a degree in this or any other University or institution of higher learning or even for any publication. However any other sources of information that I have used are duly acknowledged.

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This thesis has been submitted upon our guidance and advice as University supervisors

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DEDICATION

This thesis is first and foremost dedicated to the Good Lord God whose guidance, provision, protection and love guided me to the proper completion of this work in a timely manner.

Thirdly this work is dedicated to my late mother Mrs. Jameeda Nabisubi Walusimbi whose earlier guidance gave me unbreakable courage of accomplishing tasks this thesis inclusive. Finally this work is dedicated to my family and lastly but not least to all those who truly understand, love and respect God.

ACKNOWLEDGEMENTS

I deeply extend my appreciation to the International Development Research Centre (IDRC) and the African Economic Research Consortium (AERC), whose financial support for this research ensured coordinated completion of this thesis. The farmers and traders of Mayuge district are also highly appreciated for their corporation in addition to the BROSDI management that allowed us necessary access to their affiliated farmers and traders.

Grand thanks are extended to my supervisors; Dr. J. Bonabana-Wabbi and Dr. N. Asingwire whose hard work, guidance and advice equipped me with the professional support that I needed to accomplish this thesis in good time but with uncompromised quality.

Sincere thanks go to my other lecturers who chipped in whenever I contacted them endlessly; Prof. J. Mugisha, Mr. J. Kiwanuka, Mr. S. Lwasa, Dr. W. Ekere, Prof. B. Kiiza all of Makerere University, Prof. V. O. Okoruwa of Ibadan University, Dr. J. Nzuma, Dr. R. Mulwa both of Nairobi University, Dr. J. Mutambara of Zimbabwe and Prof. A. Pannin of Ghana.

Finally I am greatly indebted to all my class mates of 2009-11 at both Makerere and Pretoria Universities whose direct and electronic advice, academic and social support was very instrumental. Specifically Mr. S. Ddungu, E. Leeta, A. Chinyophiro, M. Abdullahi and Ms. I. Bayiyana and F. Nakkazi all of Makerere, Mr. I. Phiri Pangapanga of Malawi, Mr. B. Mudiwa of Zimbabwe, Mr. E. Hirwa of Rwanda and lastly my long time friend Mr. Musa Bbuka Nsubuga.

ACRONYMS

MIS: Market Information Services

ICT: Information and Communication Technologies

WWW: World Wide Web

TV: Television

NAADS: National Agricultural Advisory Services

BROSDI: Busoga Rural Open Source and Development Initiative

IDRC: International Development Research Centre

ESCAP: Economic and Social Commission for Asia and the Pacific

CD-ROM: Compact Disc Read Only Memory

VSAT: Very Small Aperture Terminal

UTL: Uganda Telecom Limited

MTN: Mobile Telecom Network

FM: Frequency Modulation

UBOS: Uganda Bureau of Statistics

BDLG: Busoga District Local Government

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BASIC DEFINITIONS

Internet/Email: This is a global system of computer networks that enables exchange of information between people using different computers

World Wide Web (WWW): This is a mega-scale online reservoir of information from where interested parties can deposit or get information

Adopters: These are farmers or traders who choose to accept use of ICTs for Market Information Services (MIS). Note that some farmers or traders use these ICTs for other purposes and this study defines adopters as strictly those who use ICTs for MIS.

Knowledge broker: This is an academically and socially elevated farmer or traders in the village who picks agricultural market information and advice from the BROSDI management at the regional headquarters and delivers such knowledge to the farmers at a meeting point or individually and then returns to BROSDI responses of such farmers for action or advice.

ABSTRACT

Market access is increasingly relying on ICTs like telephony, internet and radios that are only adopted at a slow pace and haphazardly. Despite the need for ICTs in Market Information Services (MIS), ICT adoption and usage in Africa is very low. Little is known about available ICTs for use in MIS including; technology, its potential users, and characteristics of both entities. Closing such knowledge gaps is justified. The study assessed adoption of ICT-based MIS by smallholder farmers and traders in Mayuge, specifically determining; ICT components used, factors influencing; adoption of ICT-based MIS and choice of ICT component used. Stratified random sampling was used to collect data with structured questionnaires administered to 150 farmers and 50 traders and analysed using SPSS and STATA. Majority of adopters were males. Fifty four percent of respondents had knowledge of existence of ICT groups but only 22% had membership despite 80% agreeing that ICTs benefit agriculture. Average experience in using ICTs was 3.16 years and 55% of respondents were of primary education. The radio was the most used old ICT whereas the mobile phone was most used new ICT and mostly for calls. Expensive handsets, poverty, poor power supply, lack of expertise and poor network coverage limited ICT use. Logit model results showed that farmers with knowledge of existence of ICT groups and those who thought that ICTs benefited agriculture were more likely adopters. Family size and land farmed previous season significantly influenced farmers' adoption, whereas age, trading experience, family size and monthly expenses on ICTs influenced traders' adoption. Family size significantly and positively influenced adoption for both small-scale farmers and traders. Households that majorly used ICTs for making profit were more likely to use the mobile phone, whereas those who stayed further from towns were less likely to use it. If government dedicates her support to public education, rural ICT-based initiatives like BROSDI, rural electrification and rural income generating initiatives, households could adopt ICTs for MIS more. Further research need to be done to determine the impact of ICTs on agricultural productivity, and welfare of smallholders in Uganda.

Chapter I

1.0 Introduction

1. 1 Background

Access to markets has been one of the major factors that have influenced smallholder agriculture in developing countries. Accessing markets allows smallholder farmers buy inputs and sell surplus of their subsistence and semi subsistence agriculture to enhance household incomes (Barrett, 2008). These markets can be between communities, villages, sub counties or countries. Markets that are often accessed by smallholder farmers who form majority of the poor in developing countries are characterised by poor infrastructure and limited investment capital (Barrett and Swallow, 2006).

Market access helps alleviate poverty through commercialising agriculture and cause about uniform distribution of incomes in developing countries (DCs). Income distributions in DCs are biased by corruption tendencies which have hindered improvement in household welfare. Progress in household welfare is dependent on increments in productivity of household stocks of land, labour and capital, through adoption of better agricultural technologies that foster economic growth and alleviate poverty (Barrett and Moser, 2003). Even though important innovations continuously occur in many developing countries globally, Africa inclusive, new technologies are only adopted at a slow pace and haphazardly (Singh, 2006). The slow pace of new technological adoption has kept household incomes low. However increase in incomes would enable poor households save more financial resources and consequently gain required financial

ability to invest in new technologies that are needed in commercial agriculture (Okello, 2005). In many policy frame works of developing countries, there has not yet been a general format agreed upon, to enable smallholder farmers and traders access to markets. Most developing countries are characterised by poor infrastructure in roads and poor administrative systems that are ethnic based and usually marginalise sections of poor farmers and traders hence restricting smallholders' access to markets. Restriction of smallholders from market access locks them into persistent poverty for generations (Barrett, 2008).

However markets' liberalisation shifted the role of markets' control and service delivery from governments to private investors who are attempting to target every clientele, smallholder farmers inclusive. Private investors who need a safe policy environment to operate effectively have come with new technologies for use in promoting agricultural commerce with quick and easy information exchange. These new technologies in information exchange are generally referred to as new Information and Communication Technologies (ICTs) that include cellular telephony, internet/email, World Wide Web, Print media, and digital radio receivers. These new ICTs complement older ICTs that include; radios and Television sets (TVs) that were ealier mostly used by farmers to access information about agricultural commodities (Singh, 2006).

Despite the great need for these ICTs in Market Information Services (MIS), ICT adoption and usage in Africa is very low. For instance in Uganda, according to UBOS (2011), by the year 2010 only 0.99% of Ugandans had fixed telephone lines, 0.29% had operating pay phones and 38.9% were mobile subscribers though 70% of the population is covered by mobile telephony as

Farrell (2007) asserts. These figures are respectively low given Uganda's literacy rate of 68.2%, full school attendance of 31.5% and a population of 32.94 million annually growing at an average of 3.2% (UBOS, 2011). Farrell (2007) also adds that only 1.8% of this population are internet users, 0.5% has personal computers, only 6% of households have televisions and VSAT providers are only 8. Currently mobile cellular operators in Uganda are 6 including; Airtel, UTL, MTN, Orange, Smile and Warid telecom while private FM radios are 238 and private TV stations are 55 (UBOS, 2011).

1.2 Research Problem

Sustainable information exchange in agricultural markets, technology, and knowledge is becoming a critical area of agricultural development. Information exchange seems to be given limited priority and in agriculture the bulky load of agricultural information exchange between farmers and agricultural experts and advisors, has been left to extension agents. The effectiveness and efficiency of these extension agents have been declining partly due to limited funding from support organisations like government and donor agencies and the high costs required in maintaining and sustaining the physical movements of these agents between the rural areas where farmers are found and the urban areas where agricultural experts are mostly stationed. With the current need of efficiency in understanding market price trends, accessing inputs and support services, farmers and traders need to use more efficient and appropriate new ICTs to take advantage of the existing opportunities. Timely access to market information, inputs and other necessary information services like weather changes, pest control techniques and others, would increasingly enable small-scale farmers and traders make timely, reliable, realistic and economically viable decisions concerning what crops to grow, when to grow them, what

products are for sale when and where, what inputs to use and how to use them. Despite this acknowledgement, little is known about the available ICTs for use in market information exchange including the characteristics of both the technology and its potential users. Closing such knowledge gaps will enable small-scale farmers and traders draw informed and timely reliable decisions for better business margins.

1.3 Study Objective

The main objective of this study was to assess the adoption of ICT-based market information services (MIS) by smallholder farmers and traders in Mayuge district. The specific objectives were:

i. To determine ICT components and combinations used by farmers and traders in MIS
ii. To identify factors influencing farmers' and traders' adoption of ICT-based MIS
iii. To establish factors influencing choice of ICT components used by households

1.4 The Study hypotheses

i. For its mobility, cellular telephony is among ICT components households use.
ii. With formal education, farmers/traders gain capacity to adopt and use ICTs.
iii. With better incomes, households are more likely to use cellular telephony.

1.5 Justification

Despite the global increase in use of ICTs in agricultural markets to exchange information, the potential role of ICTs to uplift agricultural development has not been well understood by policy

makers (Singh, 2006). With the current competition and global integration in markets, information exchange is crucial for better market margins. Many African households depend on agriculture, a sector that is prone to risks of price changes, weather, pests and diseases, technology and others. According to UBOS (2011), 31.8% of Ugandans are illiterate and the majority of these people are smallholder farmers implying that their use of certain complex information services may be challenging. Less is documented about what really influences these farmers and traders to use ICTs and particular components used by these households under particular influence factors. The biggest impediment to understanding the factors that influence technological adoption in developing countries' agriculture is the unavailability of data on a household level (Barrett and Moser, 2003). Therefore this research was necessary to bridge the knowledge gaps as highlighted above for the smallholder farmers in Uganda.

Chapter II

2.0 Literature review

2.1 ICT Forms and Components

ICTs have several forms that include mobile phone calls, SMSs, radio and TV programs, electronic mails and internet blogs. Lee *et al.,* (2008) notes that some of these forms are well established in most countries and they foster human resources and infrastructural developments by allowing such countries have ICT volunteers, experts and trainees. They add that this human capital empowerment pushes for construction communication networks and government e-systems, training centres, hardware and software warehouses and ICT policy institutions. The coordination and usability of this infrastructure given the required human resource is made possible using ICT components like computers, phones, TV sets and radio receivers among others. Developing the human resource and infrastructure intermediated by various ICT components empowers the vulnerable and enhances the capacity of the poor including small-scale farmers towards better livelihoods (Heeks *et al.,* 2004).

Using new ICT components like computers and mobile phones with wide scale coverage in an economy enabled with ICT forms like electronic mails, videos and calls enhances formation of a competent business ecosystem. This creates an economic environment that is well conducted to local and foreign investments, innovations and entrepreneurship, leading to growth in businesses like farming, development of respective business enterprises and improvement of labour force skills (Nachira, 2006). These new ICT components and forms for instance World Wide Web, cellular telephony and electronic emails are changing the way that actors in the economy

communicate, coordinate and collaborate. For farmers such new ICTs enable exchange of information across a unified ground of interest that may be agricultural market prices, innovations, planting varieties, connecting farmer groups and or agricultural policy advocacy among others (Garrett, 2006).

The use of ICTs in the global market is more wide spread in the developed world than in the developing world. For instance 75% percent of the farmers aged between 20-29 years of age participating in precision agriculture in Denmark and 50% of such farmers in the U.S, use the internet daily to acquire specific information with a prime objective of limiting uncertainties in decision making (Fountas *et al.,* 2007). In most African countries modern ICTs like emails, World Wide Web (www), and cellular telephony have been used by rural farmers along the traditional ICTs like radio and TVs (Farrell, 2007). In India over 50% of grassroot projects use modern ICTs for the benefit of rural communities (Rao, 2004). The use of ICTs and their applications has not yet been fully explored in developing economies like Africa and Asia but ICT usage and adoption is of relative economic importance in these economies. Such usage importance is emerging at an increasing rate (Bartholomew *et al.*, 2009). These authors further state that rural farmers as actors in these developing economies believe that proper adoption of ICTs can create new businesses, improve, grow and develop existing smallholder businesses and soften processes on which these businesses run. The modern ICTs have bettered exchange of information amongst farmers and improved farmers' ability to make decisions, develop ideas and consequently improve their livelihoods (Rathgeber and Adera, 2000). The authors add that adoption of modern ICTs especially internet and cellular telephony improved living standards of people in developed countries, through facilitating peoples' education, market access and service

delivery. Therefore ICT usage and adoption is expected to bring about similar changes in developing countries by enriching rural communities in terms of information and knowledge a factor that is important in poverty alleviation and progressive development.

2.2 Market Information Services (MIS)

Markets are arenas or places where products and services of interest to consumers are found and exchanged between consumers and sellers. Information on the other hand is a prepared and planned chain or series of cryptogram, secret language and or signs that trace, prove, confirm and or verify a message, point and or a communication. Such information can be coded as symbols, cipher or signs that are transmitted, passed on or expressed as signals, gestures or indicators by waves. Services are defined economically as non-material equivalents of a good, while administratively services are defined as components of work consignment or load. In the perspective of the customer, buyer, purchaser, consumer, client and or shopper a service is defined as assistance, help, aid and or support as may be needed by such a person. Therefore Market Information Services (MIS) are generally defined as provisions of assistances that are of economic importance concerning series of signals and indicators as they occur in markets about material and non-material goods, Wikipedia (2011).

Market information needs are equated to the way information users behave with regards to market information systems and services accessible. This implies that any market information service to be beneficial to the user, such a service has to be necessary for a particular information need and compatible with available information systems, (Amponsah 1995, Wilson 2000). Market Information Services (MIS) are enormous and they comprise a networking system that

involves many actors such as market information providers, agents, consumers and brokers. The resource information supplied by market agents is sustained using ICTs like computers and mobile phones whose service providers use large databases for supplying market information services (MIS) (Buyya and Vazhkudai, 2001).

Market Information Services that include access to commodity prices, supplies of inputs and outputs, new innovations and risk awareness is beneficial to society. These societal benefits have improved with introductions of new ICTs like mobile telephony. ICTs have made access to market information services cheap and unlimited, thus allowing all market actors engage in balanced negotiations that ensure uniform market prices and efficient allocation of goods and services (Jensen, 2007). Sometimes such market information services include providing market information on labour opportunities and needs available in sectors on the economy like agriculture. Such labour market information services facilitate job-access and employment-broking that is necessary in efficient labour markets. All this is mainly made possible by use of new ICTs like mobile phones and internet that have been adopted by both private and public employment service commissions, (Thuy *et al.*, 2001).

2.3 Adoption of ICTs and factors influencing ICT adoption

Adoption is defined as the act of accepting with approval and or with favourable reception (Farlex, 2011). Adoption of ICTs for MIS is defined as choosing to take up the option of using ICTs for accessing Market Information Services (WR, 2011). Feder and Umali, (1993) defined adoption as the degree of use of a new technology in a long run equilibrium when a farmer has

full information about a new technology and its potential. Therefore, adoption at farm level describes realization of the farmer's decision to apply a new technology in production process. For effective diffusion of that technology there has to becompatibility between the technology and the target group to foster development (Voogt and Knezek, 2008).

ICTs are generally defined as a combination of activities that enhance capture, storage, processing, transmission and display of information by electronic means (Rao, 2004). Rao, (2004) also adds that ICTs bring about considerable opportunities to reduce poverty amongst rural communities and facilitate job creation. He adds that ICTs better farmers' access to market information and reduce transaction costs. These processes allow rural farmers realise better market margins and thus enhance ability of developing countries to participate in the global economy. Adoption of ICTs increases farming and any other business competitiveness through enhancing internal communication and organisation facilitating development of new services and products.

Majority of the factors affecting adoption of ICTs for MIS are generic in nature. For instance cost effectiveness and speed of information transfer. Generally these factors include; organisational characteristics like business size, system characteristics like availability and access to ICT services, and internal and external characteristics of the business household like education, experience and incomes among others, (Windrum and Berranger, 2002). According to Yang (2005) perceived benefit, knowledge, gender and adoption experience are some of the

important influence factors for adoption of mobile commerce, similar to accessing Market Information Services.

According to Dholakia and Kshetri, (2004) experience in using ICTs, perceived competition, specialised applications required for given ICT components and costs like power, subscription and repairs do influence adoption of ICTs for small businesses, a category for most Ugandan farmers and traders. Dholakia and Kshetri, (2004) generalise these factors into internal and external factors. Internal factors include business characteristics like; size and age, past experience in using ICTs, attitude towards ICTs and business objectives. Positive perception towards using ICTs, longer past experience in using ICTs, age and a larger business size were found to be positively associated with ICT adoption for small businesses. External factors include industry, for instance existence of infrastructure like roads and ICT service providers, macroeconomic and national policy. Good infrastructure like a good road networks to business premises, availability of reliable ICT service providers and business favourable macroeconomic and national policy like optimum business commodities' taxation and reasonable operations' business licences were also positively associated with small businesses' ICT adoption. The external factors affect the general and competitive environment of the business.

Dissemination of a technology is important in the process of development, and new technologies must be compatible with the surroundings of the adopter especially in the agricultural field. However sometimes the technology is usually not clear to prospective users hence education about the new technology is of importance (Udry and Conley, 2003).

The value and intensity of action by each farmer participating in agricultural activities using ICT based MIS rises with increasing level of adoption of ICTs that make individuals more efficient and cost-effective (Dholakia and Kshetri, 2004). Increased participation of individual farmers in ICT based MIS also comes with increased network coverage infrastructure in such locations of households (Saloner and Shepard, 1995, Dholakia and Kshetri, 2004).

Because of high variation in ICT forms, there is high variation in ICTs' adoption by smallholder farmers and traders. This adoption depends on how useful a certain ICT format is perceived especially considering its usage, ease and availability in business purposes. Galloway and Mochrie (2005) note that remoteness of farmer's area, government support to establishment of ICTs, awareness programs about ICTs, farmers' confidence in use of ICTs, costs of using ICT services, objective of farmers to use ICTs, general importance of ICTs, and farmers' literacy ability all influence farmers' adoption of ICTs. Galloway and Mochrie, (2005) further say that usage of these ICTs by smallholder farmers that inhabit mainly rural areas is constrained by limited education and poor technological infrastructure. Such inhibition of ICT usage is principally due to poor public transport to these rural areas, thus denying smallholder households access to information. That poor accessibility fails ICT service providers from realising profits from such rural markets that are not easily reachable and have a small customer base especially in developing countries; however sixty seven percent of the world's mobile subscribers are in the developing world (Bhavnani *et al*, 2008).

Jacobs and Herselman, (2006) say that the perceived lack of need for ICTs by smallholder farmers is responsible for farmers' failure to adopt ICTs and their services. They add that this poor perception stems from language problems experienced in using ICTs, attitude barriers like cultural beliefs, limited awareness about ICT benefits and lack of government support. Failure to adopt ICTs is also attributed to long hours taken to access information from source especially when downloading using internet, high costs of subscription and lack of precise content required for specific farmers' needs. This leads to a poor motivation for farmers to adopt ICTs.

2.4 Effectiveness of ICTs in linking smallholder farmers and traders to markets and MIS.

Effectiveness and efficiency of using ICTs in electronic agriculture to link smallholder farmers and traders to markets is the research project that was conducted in Mayuge in 2010 by IDRC. The International Development Research Centre (IDRC) is an organization with headquarters in Canada, supporting various research initiatives whose solutions are of local interest aimed at bringing choice and change to those who mostly need it in developing countries.

The IDRC achieves her contribution towards growth and development through collaboration with accomplished scholars to bring about better generations of researchers, advocates, practitioners and policy makers to improve living standards in terms of policies, improved nutrition, safer environment, better incomes and greater health for persons in developing countries.

The IDRC fosters research and innovations that find lasting solutions to micro problems of developing countries through working closest to these communities using six IDRC regional offices in developing world found in Africa, Asia, Latin America, the Caribbean and Middle East. The IDRC runs several programs that mainly include; Agriculture and Environment, Canadian Partnerships, Donor Partnerships, Evaluation, Fellowships and Awards, Global Health Policy, Information and Communication Technologies for Development, Middle East Special Initiatives, Science and Innovation and Social and Economic Policy.

Among others, under the Agriculture and Environment program, IDRC puts emphasis on food, water and a healthy environment as these resources are essential to human well-being and can consequently lead to sustainable and equitable development. The ample existence of these resources is threatened around the world especially in developing countries.

The IDRC's Canadian partnerships program supports scientific, academic and development communities in Canada working on complex global issues but often with partners based in developing countries. The Donor partnership program is used to enable IDRC develop strong relationships with international communities and research funders. Through Evaluation programs IDRC avails evidence to her partners and public domain to understand that research contributes to solving development problems. That adds to showing that IDRC is an accountable learning organization.

Assistance and support to Canadians, permanent residents of Canada and citizens of developing countries to acquire more practical and research-guided knowledge is achieved through Fellowships and Awards program. Under Global Health Policy program, IDRC supports research in developing countries that is focused on poor health and root causes of health inequity caused by unfair access to health and health care.

IDRC believes that modern information and communication technologies (ICTs) for instance computers and mobile phones can positively transform developing economies. Therefore through Information and Communication Technologies for development program, IDRC enables better understanding and access to ICTs for persons in developing economies to make governments more accessible and accountable, improve health and safety, and create economic growth and development.

Through her Science and Innovation program, IDRC supports innovations, science and technology that can help establish just, inclusive and sustainable social and economic development in developing countries since these have a high potential to develop innovation systems. Lastly IDRC runs the Social and Economic Policy program to bring about public policy that can help reduce poverty and promote better social equity in developing and emerging economies, basing on IDRC's belief that strong and informed policies help establish more stable and sustainable economies that bear proper job chances for the poor, establish peaceful communities and cause economic growth and development.

IDRC realizes above programs under different themes including; development, economics, environment, evaluation, food and agriculture, governance, health, information and communication, natural resources, science and technology and finally social policy. These themes are equally executed by IDRC in various regions of the world that currently include; Eastern and Southern Africa with offices in Kenya, Latin America and the Caribbean with offices in Uruguay, Middle East and North Africa with offices in Egypt, South Asia and China with offices in India, South East and East Asia with offices in Singapore, West and Central Africa with offices in Senegal. Several resources including; publications, research databases, tools and trainings are generated by IDRC under above themes and help disseminate IDRC ideologies and interests to IDRC targets across all regions of operations in developing world, (IDRC, 2011).

The current research work was a supplement to a bigger research effort by IDRC that investigated effectiveness of ICT-based market information services in linking smallholder farmers and traders to markets. The bigger research effort was carried out in six countries that included Kenya, Madagascar, Benin, Malawi, Ghana and Uganda. IDRC had had earlier research programmes in these countries about electronic Agriculture, and used local communities' organisations that used these ICTs to connect farmers, markets and research organisation. In this research, focus was put on an established ICT using community organisation which was one of those recommended by IDRC in Uganda called Busoga Rural Open Source & Development Initiative (BROSDI)

2.5 BROSDI and MIS provision to farmers and traders using ICTs.

Busoga Rural Open Source and Development Initiative (BROSDI) is a not for profit organization with headquarters located in Wainha village, Baitambogwe sub county in Mayuge district. BROSDI works with government and civil society to help rural households improve their agricultural productivity, livelihoods and market access through using ICTs and open development mediums that include effective knowledge sharing, information management and use in rural homesteads. BROSDI executes above interests by putting prime emphasis on fields of importance to life that is; health, agriculture and education. BROSDI was an outcome of the South to South Exchange held in Uganda in 2002 supported by Human Institute for Cooperation in Full (Hivos), International Institute for Communication and Development (IICD) both based in the Netherlands and IDRC.

BROSDI's vision is to see rural communities empowered to exploit the environment using ICTs and other knowledge sharing methods for sustainable livelihoods. BROSDI runs three major programs including; health program (Youth and HIV AIDS Awareness Project, (YoHAAP)) intended to create awareness on sexual and reproductive health among rural communities with particular focus on the youth.

Under the education program (Hope Childrens Club, (HCC)) BROSDI struggles to build self esteem and confidence among rural children especially orphan children for improved behavior change and academic grades. With Agricultural program (Collecting and Exchange of Local Agricultural Content (CELAC)), BROSDI focuses on improving rural farmers' livelihoods

through enabling food security by engaging government, private sector, and civil society in knowledge sharing and information management of agricultural content using ICTs like cellular telephony, radio, worldwide web and others (BROSDI, 2011).

BROSDI provides market information services mostly to rural farmers using ICTs. BROSDI has operations in eastern, northern, central and south western Uganda. Generally BROSDI disseminates agricultural information to farmers and aims at improving rural farmers' livelihoods and food security through engaging government and civil society in knowledge sharing and information management using ICT components that include internet, audio cassettes, telephones, newsletters, brochures, information sharing forums and trade fairs. BROSDI also facilitates farmers' access to rural financial services thus enhancing improvement in farming credit access and flexibility of information flow between farmers and particular populations of interest through use of ICTs, (Brosdi, 2007)

Chapter III

3.0 Methodology

This chapter presents data collection methods that were used to generate data for this research and also show where data were collected from. The chapter also presents *a priori* expectations including researcher's conception of the study and data analytical methods.

3.1 Study Area

The research was carried out in Mayuge district situated in eastern Uganda. Mayuge was purposively selected to exploit essential experience of her farmers in dealing with ICT-based MIS under BROSDI (Brosdi, 2007). The study population comprised smallholder farmers and traders from five sub-counties of Mayuge district and from each sub-county 30 farmers and 10 traders were selected randomly as respondents. These were farmers and traders that had knowledge of, and participated in use of ICTs and those that did not.

Mayuge district was named after its major town "Mayuge" as the case is for most other districts in Uganda. Iganga district boarders Mayuge to the north, Bugiri district to the north east and east, the republic of Tanzania to the south, Jinja district to the west and Mukono district to the southwest. Mayuge district is located on coordinates, 33 30E and 00 20N. The headquarters of Mayuge district are located at Mayuge town about 38 kilometers when travelling by road to the east of Jinja town, the sixth largest city in Uganda.

Mayuge district is one of the districts that form Busoga kingdom along other districts including; Kaliro, Bugiri, Iganga, Kamuli, Jinja, and Namutumba among others. Mayuge is composed of 7,660 square kilometers of surface area being open water of Lake Victoria and that constitutes 77% of her total surface area, as 10% of this surface area is nationally protected forest reserves leaving only 13% for household settlement and farming activities for its population that is currently estimated to be about 417,300 persons. Economic activities in Mayuge are mainly farming and fishing. Crops grown include; Maize, Cassava, Groundnuts, Cocoa, Cotton, Coffee, Beans, Sweet potatoes, Millet, Simsim, Sunflower, Tomatoes, Passion fruits, Onions and Cabbages whereas fish are; Nile perch, Tilapia rargentae (Mukene), Clarias (Cat fish), Tilapia (Ngege) and Protopterus (Lung fish) MDLG (2011).

3.2 Sampling process for farmers' and traders' households

BROSDI management was contacted at their head offices in Kampala because BROSDI had been recommended by the financiers of this research, IDRC. While at eastern region headquarters of BROSDI in Mayuge, five sub-counties in which BROSDI operated by providing farmers with market information services and agricultural advice using ICTs were identified with the help of BROSDI regional coordinator. There were 47 BROSDI participants in Nawanjiri, 59 in Bugodi, 49 in Nalwensambula, 52 in Waina and 50 in Wanzuki sub-counties. The sub-county coordinators and knowledge brokers provided link to particular village knowledge brokers that we walked around villages with during data collection. Farmers and traders stay in smaller administrative units called villages. At each village BROSDI accesses farmers and or traders through village knowledge brokers who directly transfer agricultural market information and

advice received via ICTs like mobile phones or posters and other means from BROSDI to respective villagers.

Knowledge brokers for each sub-county were invited at BROSDI regional offices to access current market information to update farmers/traders who were still participating in BROSDI program of using ICTs to access market information services (potential adopters) and other agricultural advice.

A structured walk was made through randomly selected villages to interview randomly selected households. If the current household would be described by the village broker as a BROSDI participating household, the household head would be interviewed who would then confirm whether indeed he/she was a BROSDI participant or not. If the response of household head tallied with village knowledge broker's description for the current household and the knowledge broker described next household as also a BROSDI participating household then, the next household was skipped for interviews unless the knowledge broker described it as a non-BROSDI participating household. However if the third household would be described as a BROSDI participating household by the knowledge broker ahead of the first one that was interviewed and the second one that was skipped for participating, then the third household was interviewed. The same sequence was followed for interviewing both BROSDI participants and non-participants to generate a sample composed of adopters and non-adopters of ICTs for MIS.

Within each village identification of the starting household was random but maintained intervals of one household if more than one household were in the vicinity as immediate neighbors and of a similar BROSDI participation status. We kept intervals at one household because farming and trading households that were participating in BROSDI activities in Mayuge at the time was relatively small compared to the district population. BROSDI participating households were only 257 farmers and traders compared to the district population that is in tens of thousands. The process yielded a sample composed of 37 responses from Nawanjiri, 55 from Bugodi, 24 from Nalwensambula, 43 from Waina and 41 from Wanzuki sub-counties.

The randomness in this data collection process was particularly practiced at the point of identifying the first respondent for the day and there after an interval would be used to find the next respondent. The classification of BROSDI participatory status of the household head generated two groups; that is adopters of ICTs for MIS and non-adopters thus creating two strata.

Generally the data collection procedure followed a stratified random sampling technique to get the sample data. Specifically for traders, respondents were randomly picked following the methodology used for farmers but these were found from trading centres of the Project area other than homes. The decision maker in the business was the respondent interviewed by this research. However the sampling was slightly purposively subjective after the random start because of the limited number of BROSDI participating households.

The stratified random sampling technique used in this research limits sampling errors (StatPac, 2009). The main sampling unit was the local administrative unit (district) although the unit of analysis was the household. Therefore following the selection of Mayuge district, lower administrative units of ICT projects that led to the village and eventually the households were selected randomly from a pool of many households that were available and all was based on the random start that was continued at an interval of a single household.

3.3 Data collection

Primary and secondary data were both used in this research. Primary data were collected using questionnaires administered to respondents interviewed by IDRC enumerators to capture new variables that were not captured by IDRC, but left as part of the student's work. Close ended questions captured numerical and quantitative data that linked theory to research (quantitative method) and that enabled the researcher to describe the magnitude of the findings statistically. Open ended questions recorded observations and qualitative attributes (qualitative method) also referred to as interpretive research methods (Bogdan and Bilken, 2009). These questions were used to collect qualitative data that provided deeper meanings of the statistical data generated by quantitative methods and enabled understanding of subjective realities of respondents (see Appendix A). Secondary data used in this research was part of the earlier household data collected on adoption of ICTs by smallholder farmers and traders in Mayuge district in the year 2010 under IDRC.

3.4 The conceptual framework of this study research

ICTs were viewed as a link between various actors that enable flow of information and this conception is presented in the figure below;

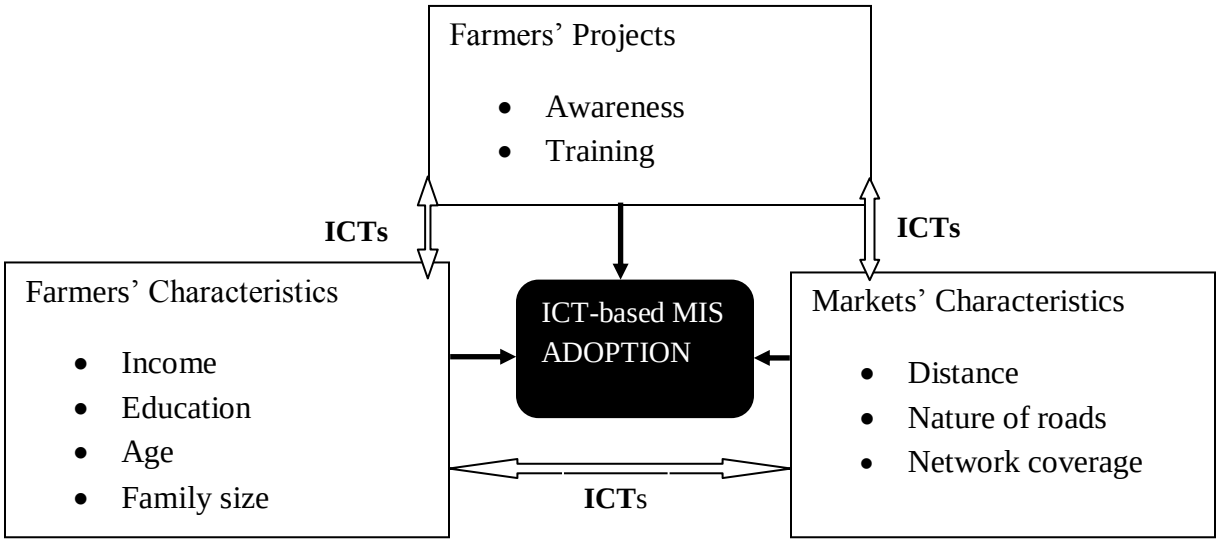


Figure 1: The conceptual framework of the study

Activities of farmers' groups such as awareness and training programs enable farmers to know the use and relevance of ICTs in agricultural production. Attributes of services influence farmers' decisions and farmers' attributes enable or disable farmers' adoption of ICTs. Market attributes also influence adoption of ICT-based MIS.

3.5 Data analysis

3.5.1 Analytical methods

Descriptive statistics were generated using computer Software Packages for Social Scientists (SPSS) and it involved calculating means, standard deviations, percentages or frequencies and F statistics. A Jarque-Bera (JB) test and general exploratory data analysis were carried out to establish the skewness, kurtosis and distribution of the data for continuous variables like age, education, family size, income, distance, costs and experience.

Combined measures of skewness and kurtosis enable to show if a random variable follows a normal distribution. If generated coefficients of skewness (S) and kurtosis (K) are not 0 and 3 respectively, then such a variable does not follow a normal distribution (Gujarati, 2004). In the current study these coefficients are used to calculate JB test. The JB test in association with Histograms showed that continuous variables do not follow a normal distribution and thus were transformed into natural logarithms, squares, inverse square roots and square roots. Transformations of raw data also ensured that heteroscedasticity is controlled as the variables' scale lowered (see Appendix B and C). Correlation tests were done using STATA computer packages and multicollinearity was found nonexistent (see Appendix D).

3.5.2 Analytical framework and Model specification

Binary responses were encountered during the cross sectional survey given the categorical nature of farm decisions. When introduced to ICT-based MIS technologies, farmers or traders either

adopted or declined it, given differing resources, education, aims and utility preferences hence positive decisions took a unit value and negatives a zero value, (Bogdan and Bilken, 2009). Qualitative choice models are the most feasible when analyzing such decisions for example the Probit, Logit and linear probability models, (Tambi *et al.*, 1999, Chunrong and Norton, 2003).

According to Greene (2002), choice models are based on random utility, where the i^{th} adopter is exposed to j choices. If the utility function of j is U_{ij}, then;

$$U_{ij} = \sum \beta X_{ij} + \varepsilon_{ij} \text{ ----------1}$$

Where X_{ij} is a vector of a particular characteristic of individuals who choose a particular choice

β is vector of parameters to be estimated and ε_{ij} are error terms. If an adopter takes the j choice, then the assumption that U_{ij} is the maximum of all J utilities holds, therefore the model is moved by the probability that the j choice is taken and thus; $\Pr ob(U_{ij} > U_{ik})$ for all other $k \neq j$ where k is any possible choice.

Both Logit and Probit models can be used based on above utility format. However the mathematical friendliness of the Logit model makes it easier, and thus it is used in this research. Assuming that Y_{ij} represents the final decision of the farmer/trader for a particular choice taken from a pool of various choices available, then with J disturbances being distributed identically and independently, Logit model is defined as below;

$$\Pr ob(Y_{ij} = 1 | \Sigma(X_{ji})) = \frac{e^{\alpha_j + \mathbf{X}_{ji}^{'}\beta}}{1 + e^{\alpha_j + \mathbf{X}_{ji}^{'}\beta}} \text{ ----------2}$$

But utility is based on particular aspect features of the person (X_i) and the choice he/she makes; therefore it is necessary to separate the utilities.

Greene (2002) adds that the binomial Logit is the unique case where J = 1, specified as below and it is used to determine factors that influence farmers/traders adoption of ICT-based MIS

$$\Pr ob(Y = 1 | \mathbf{X}) = \frac{e^{\mathbf{X}'\beta}}{1 + e^{\mathbf{X}'\beta}} = \Lambda(\mathbf{X}'\beta) \text{ ----------3}$$

Where $\Lambda(.)$ is indicating the logistic cumulative function. Basing on behavior of the latent or unobservable responses for the other choice when a respondent chooses a particular choice, Greene (2002) specifies the binomial logit model as;

$$y = \mathbf{X}_i^{'}\beta + \varepsilon \text{ ----------4}$$

Equation 3 represents a multinomial logit model specified by Nerlov and Press (1973), cited by Greene (2002) that provides a set of probabilities for the J + 1 choice for the decision taker with characteristics X_i. These probabilities can be generated as below;

$$\Pr ob(Y_i = j | \mathbf{X}_i) = \frac{e^{\beta_j^{'}\mathbf{X}_i}}{1 + \sum_{k=1}^{J} e^{\beta_k^{'}\mathbf{X}_i}} \quad \text{For j = 0, 1, 2, …, J, and } \beta_0 = 0 \text{ ----------4b}$$

Integrating equation 3 and 4b, we compute J log-odds ratio as;

$$In\left(\frac{P_{ij}}{P_{ik}}\right) = \sum X_i^{'}(\beta_j - \beta_k) = \mathbf{X}_i^{'}\beta_j \text{ if k = 0} \text{ ----------5}$$

3.5.3 Specifications of the models

Considering the fact that some farmers/traders adopt several components of ICTs for accessing Market Information Services (MIS), adoption of ICT-based MIS is categorized into three main prominent ICT components that include Mobile phone, Pay phone and others (such as any of CD-ROM, TV, World Wide Web, or Internet/Email). The radio is not mentioned here because it was owned almost in every household, thus it could not make a statistical difference in analysis when coupled with every component mentioned above. Marginal effects are used to interpret the impact of a change in the independent variable on the dependent variable (Greene, 2002).

3.5.3.1 Specification of the Farmers' logistic model

From equation 4, a Logit model with a constant for farmers is specified as below;

$$Y_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + ...+ \beta_8 X_8 + \varepsilon_i \text{ ----------6}$$

Where Y_i = Dependent Variable, ADOPT (1 if farmers used ICTs for MIS, 0 Otherwise)

β_0 = Intercept

β_1-------β_8 = parameters to be estimated

X_1----X_8 = Vector of Explanatory Variables

ε_i = Error terms

Specifically the Explanatory Variables in the model are;

X_1 = Gender of respondent, 1 if male, 0 otherwise (GEND)

X_2 = Knowledge of existence of ICT groups, 1 if Yes, 0 otherwise (KN)

X_3 = Perception towards ICTs, 1 if positive, 0 otherwise (BEAGRI)

X_4 = Education of respondent, measured in number of years spent in school (EDC)

X_5 = Monthly cost/expenses on ICTs, measured in Uganda Shillings (COST)

X_6 = Family Size of household, measured in number of persons per home (FS)

X_7 = Distance to and from nearest town, measured in Kilometers (DIST)

X_8 = Land farmed previous season, measured in acres (LAND)

3.5.3.2 Specification of the Traders' model

The traders' Logit model is also specified as below basing on equation 4;

$$K_i = \alpha_0 + \alpha_1 X_1 + \alpha_2 X_2 + ...+ \alpha_7 X_7 + \varepsilon_i \quad \text{----------7}$$

Where K_i = Dependent Variable, ADOPT (1 if traders used ICTs for MIS, 0 otherwise)

α_0 = intercept

α_1----α_7 = Parameters to be estimated

X_1----X_7 = Vector of Explanatory Variables

ε_i = Error terms

Specifically the Explanatory Variables in the Model are;

X_1 = Age of respondent, measured in years of life (AGE)

X_2 = Family Size of household measured in number of persons (FS)

X_3 = Monthly Costs/Expenses on using ICTs, measured in Uganda shillings (COST)

X_4 = Trading Experience, measured in years (EXP)

X_5 = Square of Age, measured in years of life of respondent $(AGE)^2$

X_6 = Square of Education, measured in years of formal education $(EDC)^2$

X_7 = Square of Asset Base, measured in Uganda shillings $(ASSETBASE)^2$

3.5.3.2b Justification for use of the Logit Models

The logit model for traders and that of farmers were specified differently with not exactly similar explanatory variables though majority of the variables were the same. The slightly different specification is due to the fact that traders and farmers are not exactly the same economic agents. However both these farmers and traders were generally operating in similar environments and characteristics of these households were similar. Literature was used to justify that explanatory

variables used to specify the two models were likely to influence adoption of ICT-based Market Information Services by both farmers and traders.

For instance; Hill *et al.* (2008) found age to be negatively associated with the likelihood of internet engagement and the situation was more serious at later years. Donner and Tellez, (2008), established that distance was positively associated with mobile banking. Kovacic and Vukmirović, (2008), found that monthly subscription costs were negatively associated with the likelihood to use internet. Donner J, (2007) found incomes to be positively associated with ICT use in small-scale business operations. Simeunović and Russo, (2010) found that education was an important aspect in adoption and use of ICTs and the two associated positively. Harindranath *et al.* (2008) established that the next useful reservoir of advice and support on using ICTs after ICT professionals was the family and socials allies. Warren (2003) found that there was a positive association between farm size used by farmers and ICT use. Wolcott *et al.* (2008) suggested that experience gained in using ICTs when ICTs are integrated into daily systems of work was positively associated with use of ICTs. Peansupap and Walker, (2005), found that a positive feeling for use of ICTs was positively associated with expansion in ICT use. Arun *et al.* (2004) established that improvement in asset base and ICT-based business management was positively associated.

According to Greene, (2002) squared independent variables accommodate and explain the possibility of opposite direction of influence exerted on the dependent variable at different magnitudes of the independent variable. Squaring these variables allows the model posses a very

important feature that allows the model execute a conceptual experiment that might not be observed in actual data especially if the data set is small. Therefore for the above reasons some independent variables in traders' model were squared. Other transformations like logarithms, square root and inverse square roots were also used to normalize the data whose distribution had been found non-normal under the Jarque-Bera test.

3.5.3.3 Specification of the Multinomial Logit model

Based on equation 5 and the fact that adopters had several choices of ICT components that they used with several factors influencing their choices, a multinomial Logit model is used to analyze the data. The model estimated two equations concurrently as specified below;

$$In\left(\frac{p_s}{p_o}\right) = C_s = \alpha_o + \alpha_1 X_1 + \alpha_2 X_2 + ------ + \alpha_7 X_7 + \varepsilon_i \quad \text{----------8}$$

$$In\left(\frac{p_r}{p_o}\right) = C_r = \beta_o + \beta_1 X_1 + \beta_2 X_2 + -----\beta_7 X_7 + \gamma_i \quad \text{----------9}$$

Where P_o = probability that household chooses to use the base alternative component

P_s = probability that a household chooses the first of ICT components

P_r = probability that household chooses the second of ICT components

C_s = household opts to use first alternative (1 if household uses, 0 otherwise)

C_r = household opts to use second alternative (1 if household uses, 0 otherwise)

Alternatives were the three ICT mostly independently used components that were available to households for a choice including; mobile phone, others (WWW, internet/email or CD-ROMs) payphone. Radio was used by everyone hence the reason for eliminating it from this analysis.

α_o and β_0 = intercepts

α_1-----α_7 and β_1----β_7 = Parameters to be estimated

X_1-----X_7 = Vector of Explanatory Variables, γ_i and ε_i = Error terms

Specifically the explanatory variables in the multinomial logit model are;

X_1 = Knowledge of Existence of ICT groups, (1 if Yes, 0 otherwise) (KN)

X_2 = Major Objective of using ICTs, (1 if Profit, 0 otherwise) (OBJ)

X_3 = Experience in Using ICTs, measured in years (EXP)

X_4 = Family size, measured in number of persons per household (FS)

X_5 = Distance to and from nearest town centre, measured in kilometers (DIST)

X_6 = Monthly Income, measured in Uganda shillings (INC)

X_7 = Land farmed previous season, measured in acres (LAND)

3.5.3.3b Justification for use of the Multinomial Logit model for Choice analysis

The Multinomial Logit model (MNL) has been used to identify factors influencing households' choice for use of particular components in MIS amongst available options including; mobile

phone, pay phone and others aggregated (CD-ROM, WWW and internet/email). For its universality almost in every household, radio component was not considered in this analysis as its independence as a component across households would not be realized.

The MNL method has previously been used to analyze choice of adaptation strategies against climate change by farmers (Deressa et al., 2009; Hisali et al., (2011), crop choices (Kurukulasuriya and Mendelsohn, 2008), and livestock choices (Seo and Mendelsohn, 2008). Therefore the MNL was appropriate for use to analyze factors influencing choice for given components of ICTs by households.

The MNL enables examination of decisions across more than two available categorical options for choice; thus permitting determination of choice probabilities for each categorical option, (Madalla, 1983). The MNL is also mathematically easy to deal with, (Greene, 2002)

However for unbiased and consistent parameter estimates, the MNL assumes independence of irrelevant alternatives (IIA). In more detail, the IIA assumption demands that probability of choosing a certain ICT component for MIS by a given adopting household is independent of from the probability of choosing another component, (Greene, 2002). This explains why consideration of the radio component has been dropped for this particular analysis, since the radio was almost a universal component across all households.

Basing on Greene, (2002) parameter estimates of the MNL are only used to tell the direction of influence of independent variable on the dependent. He adds that differentiating the MNL model equation with respect to explanatory variables enables generation of marginal effects. Marginal effects provide the expected change in probability of choosing a particular choice, considering a unit change from the mean of an independent variable.

3.5.4 *a priori* expectations

Age (AGE)

Age was expected to be negatively associated with ICT use for MIS because with old age farmers and traders tended to fear risks more by avoiding new trials for the safety of their families thus adopting new technologies like use of ICTs for MIS becomes more likely.

Distance/Cost to and from nearest town centre (DIST/COSTTWN)

Accessibility to town centres proxied by distance/cost to and from the nearest town centre influences farmers access to market information. Distance/Cost to and from the nearest town center was expected to be positively associated with the likelihood of using ICTs for MIS. The longer the distance, the more difficult it became to move to and from town physically thus necessitating use of ICTs for MIS, however distance could also be negatively associated with ICT adoption for MIS especially in rural areas where ICTs for MIS needs like battery charging and buying can only be accessed from towns.

Monthly Costs of ICT use (COST)

Monthly costs were expected to be negatively associated with the likelihood of ICT MIS adoption for since high costs limited ability of farmers and traders to use ICTs due to requirements like monthly subscription fees and others. However in the struggle of farmers or traders to put to use all money spent on ICTs for MIS like monthly subscription fees, monthly costs could also yield a positive association with ICT adoption for MIS.

Monthly Income (INC)

Income was expected to be positively associated with ICT use for MIS since with better incomes farmers and traders became more able to pay for ICT requirements needed in MIS such as repairs, battery charging and subscription fees among others.

Education of the respondent (EDC)

Farmers and traders with better education, and education of the spouse (EDCS) were expected to use ICTs for MIS more easily because good education enabled them to read, understand and execute procedures for proper use of ICTs for MIS.

Family size (FS)

Household heads with a large family size were expected to be more likely to adopt and use ICTs for MIS. For such household heads coordinating the large family size and to save ample time to

monitor market conditions may not be easy physically. Hence to ease the physical work load, heads of large household sizes were expected to more likely adopt ICTs for MIS.

Farmed Land size (LAND)

The size of land farmed previous season was expected to have a positive association with the likelihood of using ICTs for MIS. It was expected that the larger the land farmed the more the output and consequently the farm incomes that would enable the farmers to pay for the services to use ICTs for MIS.

Experience in Using ICTs (EXP)

Experience in Using ICTs was expected to be positively associated with ICT adoption and use for MIS because the more the farmers and traders got familiar with ICTs, the easier these ICTs became for farmers or traders' use for MIS.

Perception towards ICTs (BEAGRI)

Positive perception towards use of ICTs in agriculture was expected to have a positive association with ICT use for MIS, since this gave the farmers and traders more determination and courage to explore and use ICTs for MIS. Positive perception towards ICTs was a more broad issue than merely making monetary profits. Positive perception included farmers or traders having their trust in using of ICTs that included; ability to deliver and enable exchange of information in time, transfer money and keep records among others.

Asset Base (ASSETBASE)

Traders and farmers with a heavy asset base were expected to be more likely to use ICTs for MIS. Such assets that also included physical assets were sometimes liquidated to enable the farmer/trader have access to financial resources that could make usage and adoption of ICTs for MIS more possible and likely.

Chapter IV

4.0 Results and Discussions

This chapter presents findings of the research, their implications and interpretations. Various past studies were also highlighted in this section to further support findings or show a contrast between study results and those of past studies. Possible explanations for such contrasts or support have also presented.

4.1 Socio-Economic Characteristics of farmers and traders

The sample consisted of 62% males of whom 66% adopted ICTs for market information services (MIS). Of adopting farmers 37% were females and of non adopting farmers 42% were females. For adopting traders, only 30% were females thus in all categories males were more participative in use of ICTs. The use of ICTs was bent towards men more than women because males controlled household incomes that were used to acquire ICT components. Furthermore, women were sometimes restricted from owning ICT components by their husbands for fear of being contacted by other men.

Majority of respondents that is 98% of adopting farmers and 93% of adopting traders agreed that using ICTs was of benefit to agriculture. Eighty percent of adopting farmers had knowledge (Knowledge) of existence of ICT groups and only 42% of non adopting farmers had such knowledge. Thirty percent and 20% of adopting traders and non adopting traders respectively also had knowledge of existence of ICT groups (Table 1). More adopters of ICTs had knowledge

of existence of ICT groups because they were more focused on making profits than non-adopters. The adopters' possession of knowledge of existence of ICTs was consistent with the categories' respective membership (Membership) to ICT groups. Thirty seven percent of adopting farmers were members, and only 8% of adopting traders were members in ICT groups. For each category there were more respondents who had knowledge of existence of ICT groups than those who had membership. Eighty percent, 42%, 30% and 20% for adopting farmers, non adopting farmers, adopting traders and non adopting traders respectively had such knowledge. However respective membership to ICT groups for above categories was 37%, 15%, 8% and 0%. The discrepancy implied that amongst farmers and traders there were other reasons like subscription fees and physical access to ICTs groups that inhibited farmers and traders from being members of ICT groups even when they were aware of existence of such groups.

On the other hand the disparity in ratios between farmers and traders to ICT groups was due to the fact that traders had limited time for attending to these groups even though they too had an economic drive of making profits. Although non adopting farmers had the time, they did not have the economic drive of making profits, which would have encouraged them more to participate in these groups. Generally the means of numbers of both farmers and traders amongst adopters and non adopters, who had an objective of making profits and those who thought that ICTs benefited agriculture, were statistically significant. This implied that the perception of the farmers and traders towards use and benefit of ICTs was important.

Table 1: Socio-Economic Characteristics of Farmers and Traders in discrete variables

Variables		Over all sample percentage	Percent				F-test
			Farmers		Traders		
			Adopting (N=84)	Non adopting (N=66)	Adopting (N=40)	Non Adopting (N=10)	
Gender	Male	61.5	63.1	57.6	70.0	40.0	1.229
Knowledge	Yes	54.5	79.8	42.4	30.0	20.0	16.324***
Objective	Profit	11.5	22.6	0	10.0	0.0	7.327***
Membership	Yes	22.0	36.9	15.2	7.5	0.0	7.421***
Marital Status	Married	73.5	76.2	63.6	80.0	90.0	1.685
BEAGRI	Yes	80.0	97.6	47.0	92.5	100.0	33.438***

*** Represents significance at 1% level

Source: Survey data 2010-11

BEAGRI=Thought if ICTs benefit agriculture

Table 2 presents continuous socio-economic characteristics of farmers and traders. Results show that there was a difference in means of variables at differing levels of significance. Mean values of experience in using ICTs and distance to and from nearest town were statistically different at 1% level, Incomes at 5% whereas education and family size were different at the 10% level.

Results in Table 2 show that adopting traders had the largest average monthly income of 103,916.7 Ushs, and their family sizes were also averagely larger than for any farmers' category. Non adopting farmers had the lowest average family size of 4 persons while adopting farmers and traders had 5 persons and non-adopting traders had 6 persons per home. Non-adopting traders had a larger family size average because perhaps they spent less on ICTs as they did not pay for market information services' access while using their ICTs. Spending less on ICT services allowed non-adopting traders save financial resources that became redundant and consequently channeled to polygamy hence large family sizes.

The limited monthly income of non-adopting farmers that was averagely 62,705.8Ushs restricted their family size. Better incomes for traders enabled them to support a relatively larger family size. However all these categories by the largest percentage had family sizes that were below or equalled six persons. The results were in agreement with UBOS, (2011) and perhaps in line with government of Uganda initiative on family planning that is advocating for a maximum of four children and two adults.

Table 2: Socio-Economic characteristics of Farmers and Traders in continuous variables

Variables	Over all Means (N=200)	**Mean Values of Farmers and Traders**				**F-test**
		Farmers		**Traders**		
		Adopting(N=84)	Non adopting(N=66)	Adopting(N=40)	Non Adopting(N=10)	
EXP	3.16 (3.81)	3.67 (4.35)	1.70 (3.15)	4.15 (3.17)	4.5 (2.7)	5.387***
AGE	37.6 (11.4)	37.82 (12.12)	37.44 (11.87)	36.67 (9.47)	40.8 (7.9)	0.364
EDC	6.52 (5.45)	6.68 (5.52)	5.71 (5.33)	8.08 (5.19)	4.3 (5.8)	2.184*
EDCS	3.93 (4.64)	3.87 (4.78)	3.53 (4.09)	4.18 (5.06)	6.0 (5.3)	0.866
INC	75,322 (66,504)	72,428 (75,435)	62,705 (57,186)	103,916 (57,800)	68,516 (47,836)	3.467**
FS	4.79 (3.34)	5.02 (3.32)	3.98 (2.74)	5.30 (4.05)	6.1 (3.3)	2.280*
COST	5,008 (6,019)	4,867 (6,772)	4,284.1 (6,780)	6,437.5 (2,678)	5,250 (1,296)	1.093
DIST	2.36(1.05)	2.49 (1.00)	2.70 (0.96)	1.719 (1.04)	1.55(0.59)	11.131***

*, **, *** Represents significance at 10%, 5% and 1% levels respectively, Figures in parenthesis are standard deviations

Source: survey data 2010-11

Results from Table 2 for the F test show that there was no statistical difference between the means of ages of respondents**.** The non difference in the age variable confers with findings of Mugisha *et al,* (2004) from their study on determinants of use of ICTs by agri-business firms in

Uganda. That implied that age did not matter in as far as adopting ICTs for MIS by farmers and traders were concerned. The average age of the sample was 38 years.

Experience in using ICTs and household monthly income matter in as far as adopting ICTs for MIS was concerned. These findings were in agreement with Langyintuo and Mekuria, (2005) who highlighted that incomes and experience were positively associated with ICT use. The results also implied that the more the farmer or trader mastered use and importance of ICTs with time, the more he or she was attracted to ICT use for MIS. Non-adopting traders had the highest experience in using ICTs while non-adopting farmers had the lowest. Averagely it was 4, 2, 4 and 5 years of ICT use experience respectively for adopting farmers, non-adopting farmers, adopting traders and non-adopting traders. Non-adopting farmers had less interest of making profits attached to their use of ICTs thus prolonged maintenance of ICT use was difficult given the constraint of low incomes. Traders were more interested in promoting and expanding their businesses through several lines of communication and timely exchange of information, a matter that was majorly possible with use of ICTs.

Education mattered in use of ICTs and results were in line with findings of Galloway and Mochrie, (2005); Simeunović and Russo, (2010) who found that education was an important aspect in adoption and use of ICTs. They added that education and ICT use were associated positively. However education for spouses of both farmers and traders was not statistically different at considered levels implying that education of spouses did not matter in using ICTs for MIS. Household decisions were made by household heads thus rendering limited significance for

the education of spouses. Education of farmers and traders was only statistically different across groups at highest level of significance because most respondents were primary level graduates. Generally however education mattered in use of ICTs for market information services because access to education enabled household personnel to read instructions such that using ICTs for MIS exchange was possible (Olatokun, 2009).

Adopting traders were more educated at an average of 8 years in school than adopting farmers whose average was 7 schooling years; therefore adopting traders were more literally able to use ICTs than adopting farmers and that explained why there was a high percentage of adoption of ICTs for MIS amongst traders than farmers. Non-adopting traders had the shortest formal education exposure being 4 years on average.

Distance to and from nearest town centre mattered in as far as usage of ICTs for MIS was concerned to both farmers and traders. Most respondents travelled to towns on foot; therefore the magnitude of distance covered from their homes to and from nearest town centre was of significant importance. These findings were consistent with Donner and Tellez, (2008) who established that distance was positively associated with ICT use and particularly distance influenced mobile banking. Traders covered the shortest distance on average in that traders who adopted ICTs for MIS travelled distances of 1.7 kilometers while their non adopting counterparts covered 1.6 kilometers. Traders covered the shortest distance because they ran their businesses in areas where markets were more guaranteed that is town centers. ICT centers were also mostly found in town centers a matter that largely exposed traders to ICTs use and adoption for MIS.

Non-adopting farmers in contrast covered the longest distance averagely being 2.7 kilometers to and from nearest town center as on average adopting farmers covered 2.5 kilometers. Close proximity to town centers generally explained why 80% of traders adopted use of Information Communication Technologies (ICTs) for Market Information Services and only 56% of farmers adopted ICTs for such market services.

Table 3 presents socio-economic characteristics of farmers and traders for continuous variables partially categorized into levels. The class of households' monthly income, costs and distance covered to and from the nearest town mattered in adoption of ICTs for MIS.

Table 3: Socio-Economic Characteristics of farmers and Traders in Levels of Variables

Variables		Over all sample percent	**Percent**				**F test**
			Farmers		Traders		
			Adopting (N=84)	Non adopting (N=66)	Adopting (N=40)	Non adopting (N=10)	
EDC	≤ 7years (primary)	55.0	54.8	65.2	35.0	70.0	1.913
AGE	>30 to 50years	51.0	50.0	47.0	57.5	60.0	0.481
INC	<70,000 (30$)	62.0	66.7	71.2	35.0	70.0	3.852**
FS	below or 6 persons	78.0	76.2	83.3	75.0	70.0	0.606
COST	< 2,500or 1$	45.5	61.9	59.1	0	0	17.6***
EXP	≤5 years	80.5	77.4	92.4	67.5	80.0	1.972
DIST	≤ 2 KM	54.5	47.6	40.9	60.0	90.0	8.24***

, * Represents significance at 5% and 1% levels respectively

Source: survey data 2010-11

For all categories; adopters/non-adopters and traders/farmers, majority of respondents' highest level of education attained was primary (≤ 7 years). Limited education of rural small-scale

farmers and traders hindered their movement to towns where means of livelihoods were mainly based on jobs attained on education grounds.

Adopting traders had better incomes as only 35% of them earned below 70,000 Ushs (30 US$) per month. Good incomes allowed these traders attain higher education levels. Better incomes also made adopting traders more able to live closer to towns as 60% of them are in a distance of below or equaling to 2 kilometers.

None of adopting traders spent below 2,500Ushs or 1 US dollar per month on costs involving use of ICTs, where as majority of adopting and non-adopting farmers, that is 61.9% and 59.1% spent below or 2,500Ushs. Big expenditures on ICTs by trader categories were because traders used ICTs more frequently especially in market information exchange in order to improve their businesses positions.

In all categories, adopter/non-adopters and farmers/traders, majority of respondents were between 30 to 50 years of age. This was the age group in which persons gained considerable incomes and responsibilities thus becoming household heads. Fewer respondents were above 50 years of age, an age level where life in Uganda was expected to climax; that is at 52.2 years for men and 54.3 years for women WorldStat, (2011).

Table 3b, presents a focus on some of socio-economic characteristics of the sample considering two broad sample strata; adopters and non-adopters. Results reveal that there was a statistically significant difference between means for several variables between adopters and non-adopters.

Table 3b, General Socio-economic characterization of the sample based on adoption

Variable	**Mean values of sample (Std. deviations)**		**t-test**
	Adopters (N = 124)	**Non-adopters (N = 76)**	
Education	7.129 (5.43)	5.526 (5.37)	-2.03**
Experience in using ICTs	3.823 (3.99)	2.066 (3.22)	-3.24***
Age	37.452 (11.35)	37.882 (11.45)	0.259
Monthly Income	82,586 (71,537)	63,470 (55,792)	-1.99**
Family size	5.109 (3.56)	4.263 (2.88)	-1.75
Distance to town	2.24 (1.07)	2.549 (0.997)	2.013**

, * Represents significance at 5% and 1% levels respectively

Source: survey data 2010-11

The mean value of years of formal education spent at school was statistically significantly different between adopters of ICTs for MIS and non adopters. Adopters had averagely spent over 7 years at school (over primary level) whereas non adopters spent on average only about 6 years (never completed primary education). Ability to read and write better than their counterparts, gave adopters an advantage in using the ICTs, thus consequently better enabled to adopt ICTs for MIS. The study's findings conquer with Galloway and Mochrie, (2005) who established that education was positively associated with ICT adoption.

The average number of years of experience in using ICTs also statistically significantly differed between adopters and non adopters. Adopters of ICTs for MIS had a better duration of using

ICTs (3.8 years) as opposed to only 2 years for non-adopters. Longer exposure to ICTs enabled adopters to use ICTs for more specialized duties, like MIS, through trial and error learning experiences. Results were in line with conclusions of Langyintuo and Mekuria, (2005) who found experience to be influential in ICT adoption. These findings were also consistent with Bertschek and Fryges, (2002), and further supported by Shaffril *et al.*, (2010) who found that experience generally usefully influenced use of ICTs. Results were further supported by Wolcott *et al.* (2008) who found that experience gained in using ICTs when ICTs were integrated into daily systems of work was positively associated with adoption of ICTs in such systems.

The monthly average incomes in Uganda shillings (UGX) were also statistically significantly different between adopters and non-adopters. Adopters of ICTs for MIS had better monthly incomes (82,567 UGX) compared to 63,470 UGX for non-adopters. Incomes were important in enabling households access ICT services including; buying handsets, repairs, paying MIS subscription fees and general maintenance. Better average incomes of adopters allowed them an advantage in achieving requirements necessary for using ICTs for MIS. Findings were in line with, UBOS (2011), that established the importance of better incomes in enabling households achieve better standards of living, including information access.

The average distance in kilometers to nearest town center was also statistically significantly different between adopters of ICTs for MIS and non-adopters. Adopters' households were located at an average distance of 2.24 kilometers from town as opposed to 2.55 kilometers for non-adopters. Farmers' groups that were training farmers on use of ICTs for MIS were located

closer to town centers. Furthermore, service centers for ICT components used in MIS were also located in or nearer to town centers. Therefore closer proximity of adopters to town centers brought them nearer and opened their easy access to ICT service providers and trainers in addition to reducing transport costs to such centers. Study findings were in agreement with Donner and Tellez, (2008) who found distance to influence ICT usage.

4.2 Components of ICTs that Farmers and Traders used

Table 4 presents components of ICTs that farmers and traders used for various functions. The mean number of respondents who use new ICT components was statistically different at 1% level. Radio was most used old ICT (OICTs) component across farmers/traders and those adopting or non-adopting. The radio was widely and extensively used because radio handsets were cheapest, signals more reliably available, maintenance costs low, repairs less expensive and radios used dry cells as opposed to TVs and CD ROMs that had to be used with electricity whose supply and consistence was limited and poor in Mayuge.

Table 4: Components of ICTs used by Farmers and Traders in Mayuge

Variables		Over all sample percent	**Percent**				F test
			Farmers		Traders		
			Adopting (N=84)	Non adopting (N=66)	Adopting (N=40)	Non Adopting (N=10)	
OICTs	Radio	72.0	72.6	80.3	57.5	70.0	1.308
NICTs	Mobile phone	57.8	63.1	26.2	87.5	100.0	5.32***
OPTION	Calls	100.0	100.0	100	100.0	100.0	-------

*** Represents significance at 1% level OICTs=Old ICTs, NICTs=New ICTs,

Source; survey data 2010-11

Results show that of new ICT components (NICTs), the mobile phone dominated. The largest numbers of persons in several categories comprising 63% of adopting farmers, 88% of adopting traders and 100% of non-adopting traders used mobile phone. In a study by Bhavnani *et al*, (2008) concerning the role of mobile phones in sustainable rural poverty reduction, majority of rural populations used mobile phones implying relatedness in their findings to results of this research.

Only 26% of non-adopting farmers used the mobile phone because these farmers had a low economic motivation in using ICTs. Additionally non-adopting farmers had low academic ability and such a result was in agreement with findings of Jacobs and Herselman, (2006) who found that economic importance was positively associated with ICT use by rural communities.

Traders used the mobile phones more than any other gadget. Traders used mobile phones more because mobile phones were more reliable in accessing information and allowed traders make better and quick decisions. Results were in line with Rathgeber and Adera, (2000) who found that mobile phones were widely used in information revolution of rural and urban Africa. Additionally, mobile phones were readily movable to any destination, a factor that characterized day to day lives of traders. Traders continuously moved in search for better business opportunities and markets for better profits that translated into traders' better incomes.

Generally cellular telephony was most ICT component used by traders and farmers. These findings were consistent with (Singh, 2006), who found that mobile phones were the most usable ICTs in connecting agricultural systems of rural developing economies particularly India.

Basing on results of figure 2, internet/email was least used because internet service providers were very few and non-existent in some areas of Mayuge. The persons' limited academic ability to read several instructions that were involved in using internet/emails also restricted the component's use. Pay phones were moderately used because they were located at distances away from people's homes for farmers, and areas of operations for traders.

All categories of respondents used call option of cellular telephony information transfer. Calls allowed immediate information exchange for quick and reliable decisions making. Use of calls involved limited procedures including only dialing numbers as opposed to writing SMSs that required locating messages' menu, knowing how to write words and grammar correctly, and then sending to a known number. Therefore using calls was more user friendly to all persons than SMSs.

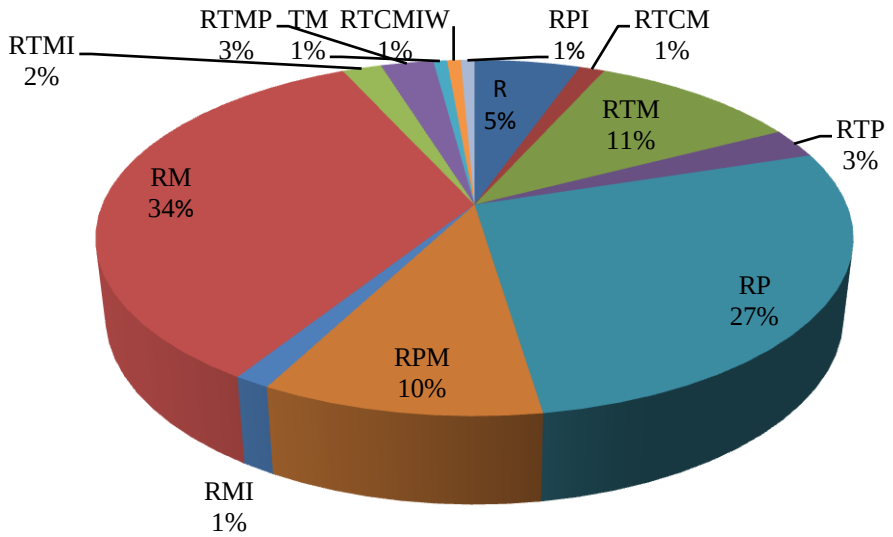
Further relying on statistics in figure 2, worldwide webs as the internet were also limitedly used. Worldwide webs required more technical knowledge and understanding of different web sites that the user was interested in. They both (WWW and Internet) required a higher level of

education yet in Mayuge all farmers were averagely of primary level (averagely 5 years of formal education; table 2), and traders were just slightly above the same.

CD ROMs (C) were least used of old ICTs, followed by TVs (T) and Radio was most used. CD ROMs required sub components to be used like the screen, CD drive and others ahead of being relatively more expensive and technical during usage compared to TVs and radios.

4.3 Combinations of ICT Components used in MIS by farmers and traders

Figure 2 presents combinations of ICT components that farmers in Mayuge district used. Radio and mobile phone combination of components was most used by farmers at a ratio of 34%.

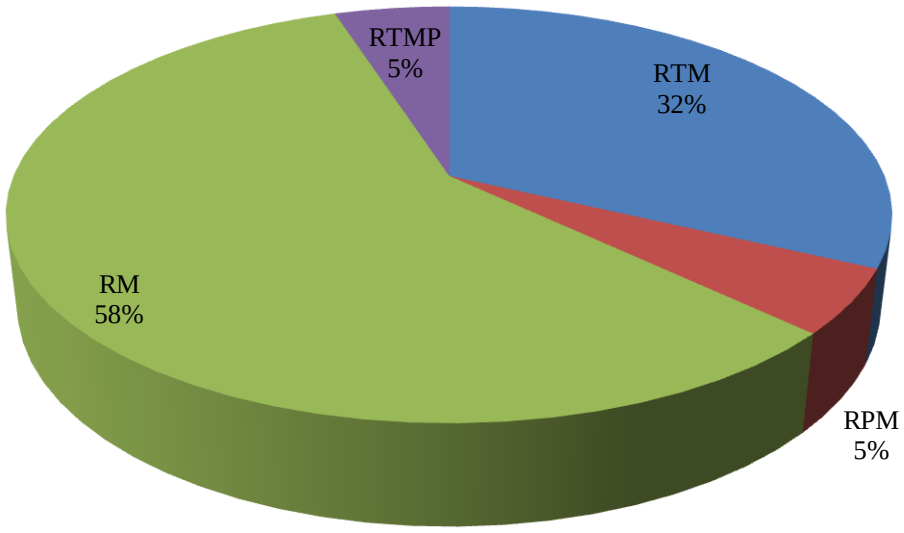


RMI=Radio Mobile Internet, RPM=Radio Payphone Mobile, RP=Radio and Payphone, RM=Radio and Mobile, RTMI=Radio TV Mobile Internet, RTMP=Radio TV Mobile Payphone, TM=TV Mobile, RTCMIW=Radio TV CD-ROM Mobile Internet WWW, RPI=Radio Payphone Internet, RTCM=Radio TV CD-ROM Mobile, RTP=Radio TV Payphone, RTM=Radio TV Mobile and R=Radio.

Figure 2: ICT Combinations of Components used by Farmers in Mayuge District

Source: *Survey data 2010-11*

Figure 3 presents components of ICTs used by traders in Mayuge. The results also show that the radio and mobile phone ICT components were the most used by traders at a ratio 58%.



R=Radio, T=TV, M=Mobile phone, P=Pay phone, W=Worldwide web, I=Internet/email, C= CD-ROM

Figure 3: ICT Combinations of Components used by Traders in Mayuge District

Source: *Survey data 2010-11*

Table 5 presents ICT components according to three major components that were used by households of in Mayuge.

Table 5: Components of ICTs used by Farmers and Traders

Variable	Components	Over all sample	Frequency (percentage)	
			Adopters (N=124)	Non Adopters (N=76)
Components used	Pay Phone	41 (20.5%)	13 (11%)	28 (37%)
	Mobile Phone	110 (55%)	92 (74%)	18 (24%)
	Others (WWW, Internet/email, CD-ROM)	49 (24.5%)	19 (15%)	30 (39%)

Source: survey data 2010-11

Figures 2 and 3 show that Radio (R) and Mobile phone (M) that is RM was most used combination by farmers and traders at proportions of 34% and 58% respectively. Table 5 shows that with farmers and traders combined still majority of households (55%) used Radio and Mobile phone combination. Therefore farmers and traders use both new and old ICTs at the same time, consistent with Farrell, (2007) and Singh (2006) who established that new ICTs complement old ones in enabling farmers' access timely and reliable information.

Table 5 also shows that 37% of non-adopters used payphone compared to 24% who used Mobile phone. The relatively broader use of pay phone stemmed from the fact that the component required no expenditure on handsets. Pay phones also had operators alongside their stations that guided users during operations.

From figure 3 traders used neither of WWW nor internet in their combinations because they were largely not aware of ICT groups that provide user skills about such rare ICT components in Mayuge. Traders were largely not members of ICT groups. Furthermore traders were involved in a lot of movements given the nature of their work. Movements denied traders a chance to master the use of two most recent components of new ICTs.

4.4 Reasons limiting use of ICT components in Mayuge

Table 6 presents reasons that limit use of ICTs to farmers and traders. Results show that insufficient income barred majority of farmers and traders from using ICTs for agricultural market information services.

Figure 4, *showing an operator of a phone battery charging centre in the town. Long distances to charging centers and the costs of charging were some of the factors limiting ICT-based MIS.*

Table 6: Reasons limiting Use of ICTs for Farmers and Traders

Variables		Percent			
		Farmers		Traders	
		Adopting (N=84)	Non adopting (N=66)	Adopting (N=40)	Non Adopting (N=10)
Major reason limiting the use of ICTs	Insufficient income	66	84.4	48.7	44.4
	Poor power/network supply	8.5	6.6	48.8	55.5
	Ignorance	12.8	6.6	0	0
	Fake parts and theft	12.7	0	0	0

Source: survey data 2010-11

Table 6 results show that insufficient income related reasons like handsets being expensive, poverty and lack of monies for repairs, limited 66%, 84%, 49% and 44% of adopting farmers, non-adopting farmers, adopting traders and non-adopting traders respectively from using ICTs. Therefore farmers were most affected with limitations to ICT use by income related causes because traders generally had a better average income (Table 2) as opposed to farmers.

Lack of and/or inconsistent power supply failed majority of traders from using ICTs. Traders were mostly located in close proximity of town centers where power supplies and network coverage were more reliable. Disturbances in such supplies or coverage affected traders' use of ICTs. Since farmers stayed at an average distance of 2.6 kilometers from town against the 1.6 kilometers for traders, Poor network coverage and power supply less affected farmers because non-town home information was generally tapped from radios. Radio frequencies were easily tapped in Mayuge and did not require erection of masts that depend on electricity as needed for cellular telephones that traders used mostly. Farmers also used dry cells to power their radios instead of electricity dependence as was witnessed in towns.

Ignorance that included divisions like; lack of knowledge on how to use ICT components, delicateness of components, and husbands refusing their wives to own ICTs mostly affected farmers. Farmers had the lowest level of education compared to traders. Therefore failure to use ICTs due to ignorance related reasons were more likely amongst farmers.

Fake repair parts on market like batteries and fear for theft of these components especially mobile phones at charging places also mostly affected farmers. Farmers were attracted towards these fake batteries because they were sold at lower prices. Such repair parts could wear out easily and consequently limited farmers' use of ICTs.

Generally considering the whole sample as showed in figure 5, low incomes prohibited majority of households from accessing ICT-based MIS. Low incomes limited households from acquiring handsets, paying for service, repair and charging fees. Travelling to town centers for ICT-based MIS trainings and subscribing to agricultural MIS services or only partially. For instance a farmer at minimum could charge a phone once per week at 500 UGX thus 2,000 UGX. Therefore almost 3% of the farmers' monthly income (Table 2) would all only be committed to charging fees before he/she accesses any information services.

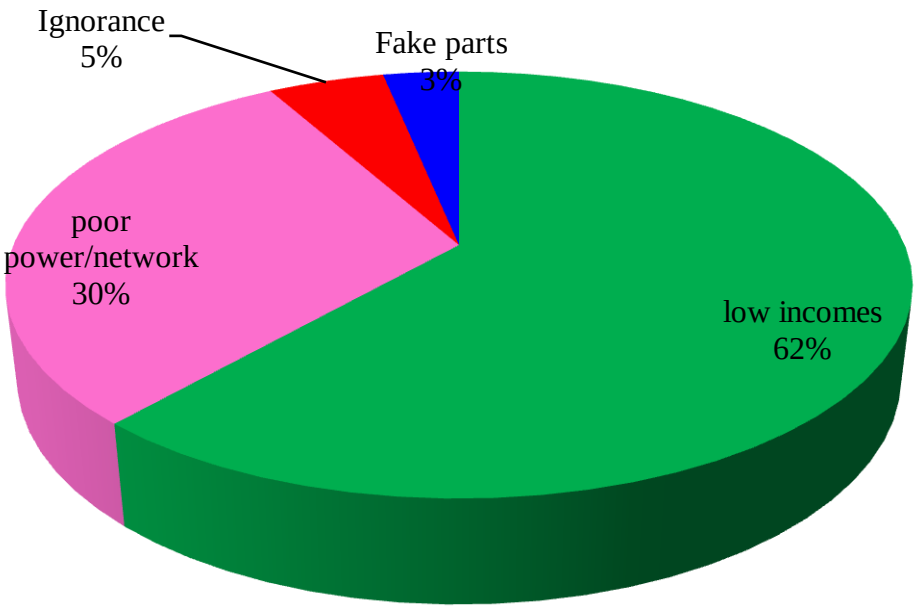


Figure 5, showing reasons limiting use of ICT-based MIS, considering all sample

Source: *survey data, 2010-11*

4.5 Factors Influencing Farmers' Adoption of ICT-based MIS

Results of the Logit model as presented in Table 7. Results also indicate that knowledge of existence of ICT groups, perceived benefit of ICTs to agriculture and family size significantly influenced adoption of ICTs for Market Information Services by farmers. Amount of land farmed previous season, significantly influenced adoption of ICTs for MIS by farmers at a 5% level.

Table 7: Logit model estimates of determinants of farmers' adoption of ICT-based MIS

Dependent variable: Adoption of ICTs for MIS (1 if adopted and 0 otherwise)

Variable	Coefficient	Marginal effects
Gender^	-2.058 (1.185)*	-0.409
Knowledge of ICT groups (KN)^	2.318 (0.967)**	0.522
Thought if ICTs benefit Agriculture (BENAGRI)^	5.941 (1.395)***	0.872
Education of respondent[a] (LNEDC)	1.387 (1.115)	0.340
Monthly Cost on ICTs[a] (LNCOST)	-0.268 (0.388)	-0.066
Family size[a] (LNFS)	2.453 (0.715)***	0.602
Distance to nearest town center[a] (LNDISTTWN)	0.691 (0.748)	-0.169
Land farmed previous season (LAND)	-0.626 (0.278)**	-0.153
Constant	-7.213 (4.264)*	

Logistic regression — Number of observations = 96
LR $chi^2(10)$ = 80.54
Prob > chi^2 = 0.0000
Log likelihood = -25.248491 — Pseudo R^2 = 0.6146

^=dummy variables [a] = Logarithm,
*, **, *** Represents significance at 10%, 5% and 1% levels respectively, in parentheses are standard errors

Source: *Survey data 2010-11*

Results show that male farmers were less likely to adopt use of ICTs for agricultural market information services. Much of small-scale household farming in the study area was mostly practised by women who had the primary responsibility of farming for household food security as mothers. Therefore males were less likely to devote to use of ICTs in agricultural market information exchange since much of agricultural practices like land preparation, planting, harvesting and storage were mainly engaged in by females.

Results show that farmers who had knowledge of existence of ICT groups adopted use of ICTs for market information services more than such farmers who had no knowledge of existence of these ICT groups. Results further show that farmers, who thought that using ICTs was beneficial in agriculture, were more likely to adopt use of ICTs for MIS than those who thought that ICTs

were not beneficial in agriculture. Farmers that also had knowledge of existence of ICT groups were more likely to adopt ICTs for MIS. Having knowledge of ICT groups' existence availed farmers with an opportunity that attracted farmers to use and adopt ICTs for MIS. Most importantly ICT groups were the sources of information and learning on how to use ICTs and benefits of ICTs, thus the positive influence, consistent with Pickernell *et al.*, (2004).

Adding to the above, perceived benefit positively influenced adoption of ICTs for MIS because majority of farmers believed that ICTs had potential to enable them access useful information on new agricultural technologies, geographical market locations and prices, awareness and access to financial support from credit providers. ICTs also enabled farmers to access general agricultural information like weather patterns, pests control, mobile money and others that were required in crucial decision making and that was consistent with Opata *et al*., (2011), Peansupap and Walker, (2005) who found that a positive feeling for the use of ICTs was positively associated with expansion in ICT use. Positive perception gave farmers more hope, determination and commitment to stick to the use of ICTs thus influenced use and subsequent adoption of ICTs for MIS by farmers.

Results further show that a one person increase in family size increased the probability to adopt ICTs by 60%. The larger the family size grew the more the household head was tasked with physical communication difficulties with each member and that competed with concentration on business communications. In order for the household head to communicate effectively, s/he was more likely to rely on ICTs as family size grew bigger. On the other hand, for the major component of ICTs used in Mayuge, the radio, farmers tapped and received frequencies

exclusively for free, and farmers listened to radios on loud speakers. Access to especially information from radios therefore became a public good. Family size greatly influenced ICT-based MIS adoption by household head as every member brought in varying information. The more this information varied due to several sources (family members), the more the household head was pushed to adopting ICTs for MIS, to access, verify and harmonise information. These results were in agreement with findings of Smoreda and Thomas, (2001) and Warren, (2004) who respectively found that telephony is more used for family communications than direct physical contact between members. The authors also excavated that household membership performed outstandingly in family's adoption of ICTs. Research findings were also consistent with Harindranath *et al.* (2008) who established that the next useful reservoir of advice and support on using ICTs after ICT professionals was the family and social allies. Such advice and support from family members attracts others to easily adopt ICT use.

Results indicate contrary to *a priori* expectations that an acre increase in land farmed previous season reduced probability to adopt ICTs for MIS for farmers by 15.3%. Land farmed previous season reduced the probability of adopting ICTs for MIS because most farmers in Mayuge were practising subsistence agriculture. They mainly farmed for household food supply, and mainly used rudimentary tools like hand hoes, knives and family labour. The average family size of farmers was small; below six persons. An increase in farming area meant use of hired labour and machinery that competed against required expenses for ICTs that included charging costs (500Ushs = 0.2US$ per charge that lasts for at most 3days with a well functioning battery), transport charges to charging places, battery repairs and buying, airtime and service charges that were required frequently. Therefore farmers with large farm size were less likely to adopt ICTs

for MIS as they channelled resources on the large farm land. Adding to the above, farmers who grew small acreages were generally low income earners. The low incomes generated from small farmed acreages could not afford to facilitate costs involved in adopting and using ICTs for MIS. Further still, with more output farmers gained from large output own-marketing thus needed limited use of ICTs for connections to big social and market networks thus less likely to use ICTs for MIS as output increased. Findings were consistent with Njuki *et al.,* (2008), who found that large output proxied by large farm size in this research markets itself thus limiting need for market searches that were largely done using ICTs. However Warren (2003) found that there was a positive association between farm size and ICT use as farmers try to locate market for their surplus production to avoid heavy losses.

Though was not significant perhaps due to the very low levels, formal education had a positive influence on farmers' adoption of ICTs for MIS. Therefore with better formal education farmers were more likely to adopt ICT-based MIS.

4.6 Factors Influencing Traders' Adoption of ICT-based MIS

Results of Logit model (Table 8) show factors influencing Traders' adoption of ICT-based MIS. Age of the trader, trading experience and monthly costs, family size, asset base, later age and better education significantly influenced the probability of adopting ICTs for MIS by traders at 5% significance level.

Table 8: Logit model estimates of the determinants of Traders' adoption of ICT-based MIS

Dependent Variable: Adoption of ICTs for MIS, (1 if adopted and 0 Otherwise)

Variable	Coefficient	Marginal effects
Family size[a] (LNFS)	6.793 (3.105)**	0.00091
Age (AGE)	-5.778 (2.499)**	-0.0008
Trading Experience (EXP)	-1.875 (0.809)**	-0.0003
Asset base[a] (LNASSETBASE)	-3.803 (1.872)**	-0.0005
Age[s] $(AGE)^2$	0.063 (0.027)**	0.00008
Education[s] $(EDC)^2$	0.102 (0.044)**	0.00001
Monthly Cost[a] (LNCOST)	13.076 (5.558)**	0.00175
Constant	55.687 (39.126)	
Logistic regression	Number of observations = 47	
	LR $chi^2(7)$ = 24.22	
	Prob > chi^2 = 0.0010	
Log likelihood = -12.214723	Pseudo R^2 = 0.4979	

^=dummy variables. [a] = Logarithm, [S] = square transformations

*, ** Represents significance at 10% and 5% levels respectively, in parentheses are standard errors

Source: *Survey data 2010-11*

Results of (Table 8) show that a one shilling increase in monthly cost on ICTs increased the probability to adopt ICTs for MIS by 0.18%. Increase in monthly cost on ICTs implied increased use and realisation of economic purpose of ICTs to traders hence the traders' attraction to ICT-based MIS as costs increased. The focus on cost effectiveness enabled traders to earn more money from each shilling invested in use of ICTs for MIS and subsequently their businesses. Furthermore whenever monthly costs increased, traders shifted to more efficient ICTs like mobile phones that give them quick and more reliable information per unit cost, thus an increase in costs positively influenced adoption of ICTs. Results were in agreement with Ulrich (2003), who found that with an increase in monthly costs, ICT usage moved up more rapidly. Ulrich (2003) explained that as usage of ICTs expands with a growing deployment as business grows, ICTs enable a wider coverage of operations and this happens in phases. He added that technological alternatives deployed during such a growing coverage of an expanding business are rapid and up-scaled in costs. However such operations are usually cost-effective.

Findings of this research on monthly costs were however, contrary to the *a priori* expectations and to the findings of Kovacic and Vukmirovic, (2008) who found that monthly costs were negatively associated with the likelihood to use and adopt ICTs like the internet.

Results show that a one year increase in age of the trader reduced the probability to adopt ICTs for MIS by 0.08%. As traders grew in age they became more risk averse, only wishing to use technologies they were sure of other than ICTs that are ever full of innovations. With more age spent in running businesses, traders mastered business patterns, thus the trends and tactics of the business environment. The more traders mastered the business environment the less they preferred changes thus the less they needed to be informed about new market signals and indicators for fear of new risks. That explained the reduction in need and use of ICTs to access market information services as trading experience increased. Results were consistent with Hill *et al.* (2008) who found age to be negatively associated with the likelihood of ICT engagement particularly the internet and that the situation was more serious at later years.

Results further show that ICT adoption for MIS by traders tended to reduce more rapidly at later ages of traders. Later age caused physical and mental inabilities to run trading businesses thus also reduced need and ability to use ICTs for MIS. Generally Age had a negative influence on adoption of ICTs for MIS by traders because older traders were more risk averse than young traders. The results were in agreement with the findings of Samah *et al.*, (2009), who established that the young age group adopted ICTs more easily.

On the other hand trading experience reduced the probability of adopting ICTs for MIS by 0.03%. As trading experience increased, the traders' likelihood of using ICTs for MIS lowered since traders acquired better market scenario speculative ability. Such speculative ability lowered traders' dependence on ICTs for MIS since traders could increasingly predict and speculate market behavior rightly. Such experience had been considered important for such an area where it was not automatic that every adult had to use ICTs given natural hindrances like poverty, illiteracy and others. Note that as showed in appendix D, AGE and EXP were not correlated (correlation = 0.214) thus the impact of trading experience was different from that of age, hence making such experience worth consideration.

Results also show that with a one person increase in household personnel, the probability of traders to adopt ICTs for MIS increased by 0.09%. The increment in the adoption probability was caused by continued efforts of each family member in advising household heads given variant information sources. The need to harmonize information from various sources attracted more the household head to direct access to information through using and adopting ICTs-based Market information services to enable access to agricultural input/output related information.

Further still, the need for the head to be well informed, connected and in touch with all his/her household membership while at work, as family size increased, attracted him/her more to adopting ICTs for MIS. Findings were in agreement with Harindranath *et al.* (2008) who identified family as one of the most important pool factors in as far as sustenance and maintenance of using ICTs was concerned.

Later formal education was positively and significantly associated with the probability of adoption of ICTs for MIS by traders. However an increase by one year in later formal education of traders, the probability for adoption of ICT-based MIS, increased by 0.001%. These results are consistent with Galloway and Mochrie, (2005); Simeunović and Russo, (2010) who found that education was an important aspect in the adoption and use of ICTs.

Asset base of a trader contrary to the *a priori* expectations had a negative and significant influence on the traders' adoption of ICT-based MIS. Assets locked up liquid capital like cash which was needed to facilitate ownership and maintenance of ICTs and their services for MIS. Such lock-up of resources was significantly felt in Mayuge, where the average monthly income for adopting and non-adopting traders was respectively less than 30 U.S dollars per month (Table3). These findings are also in contrast with Arun *et al.* (2004) who established that improvement in asset base and ICT-based business management was positively associated.

4.5 Factors influencing Choice of ICT components used by households

Figure 6 shows a diagrammatic presentation of ICT components that were used by households. Table 5 presents similar results but in more detail considering adopting and non-adopting households. This categorization (figure 6) has been used to guide the MNL analysis. The mobile phone was most used as 55% of Mayuge households chose the component for information exchange services. The others (WWW, CD-ROM, internet/email) component was next most used, chosen by 25% of households and pay phone was the least used at a ratio of 20%.

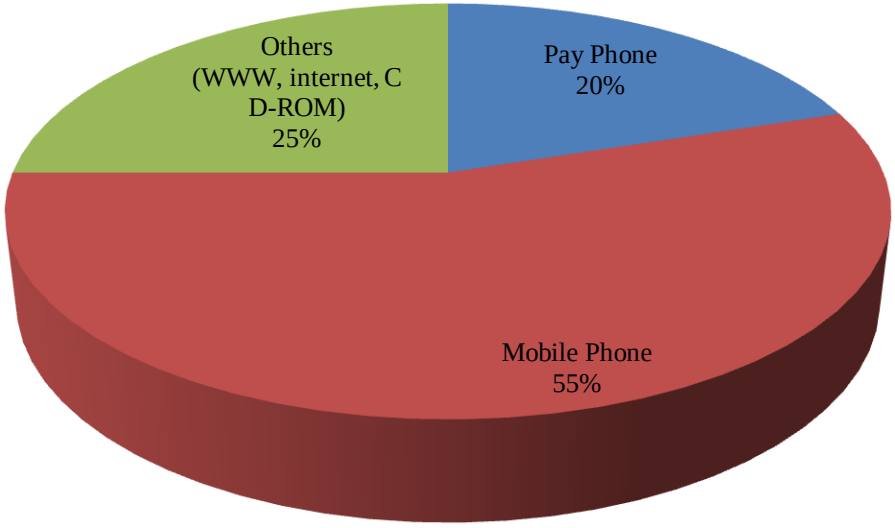


Figure 6: ICT components used by sampled households

Source: *Survey data 2010-11*

Majority of households used Mobile phone because of the component's mobility and speed in information delivery. The payphone component was associated with delays in information delivery as well as constraints requiring moving to a communication centre like pay phone stations in town centres.

The others component was also mildly used because of distance disturbance involved in moving to training centres and cafes for computer access to use WWW or internet. Heavy costs of purchasing personal computers necessary to use WWW/internet also limited access and use of the component by households. Operational technicalities especially concerning use of CD ROMs, WWW, and Internet/emails that were based on a good academic and financial

background also explained the mild usage. The component was seemingly the most feasible option in delivering bulky information because many respondents claimed that if they needed heavy documents explaining procedures and prescriptions, they could only access them via the internet, web browsing or using CDs.

Table (9) presents results of a MNL for factors influencing choice for use of ICT components. The users of various ICT components were categorised into three major component based on usage (table 5; figure 6) including; pay phone, mobile phone, and Others where any component was placed except the first two for their prior consideration and the radio for its universality**.** The mobile phone was used as the base alternative because it was the most chosen by majority of households. The results were intended to study the general behaviour influencing choice of households for particular ICT components.

Table 9: Multinomial Logit Model (MNL) estimates for determinants of Choice of ICT Components used by households

Dependent Variable: Choose Pay phone or others, compared to Mobile phone

Variable	Coefficient	Marginal effects
Pay phone		
Knowledge of existence of ICT groups^ (KN)	-1.452 (0.817)*	-0.055
Profit making (OBJ)	-2.651 (0.763)***	-0.107
Experience of using ICTs [a] (LNEXP)	1.832 (0.699)***	0.0613
Family size [a] (LNFS)	-1.159 (0.539)**	-0.043
Distance to nearest town center [a] (LNDISTTWN)	2.457 (1.018)**	0.101
Monthly Income [c] (1/√INC)	177.69 (99.24)*	9.739
Land farmed previous season [b] (√LAND)	0.949 (0.791)	-0.038
(www, CD ROM, internet/email and TV)		
Knowledge of existence of ICT groups^ (KN)	-1.127 (0.532)**	-0.1873
Profit making (OBJ)	-0.557 (0.486)	-0.071
Experience of using ICTs [a] (LNEXP)	1.643 (0.527)***	0.2704
Family size [a] (LNFS)	-0.609 (0.364)*	-0.0955
Distance to nearest town center [a] (LNDISTTWN)	0.372 (0.486)	0.041
Monthly Income [c] (1/√INC)	-214.897 (125.55)*	-39.583
Land farmed previous season [b] (√LAND)	-0.265 (0.496)	-0.0369
Mobile phone, is the Base outcome		
Multinomial logistic regression	Number of observations =	116
	LR chi2(16) =	102.93
	Prob > chi2 =	0.0000
Log likelihood = -75.975361	Pseudo R2 =	0.4038

^=dummy variables. [a] = Logarithm, [b] = square root, [c] = Inverse square root transformations

*, **, *** Represents significance at 10%, 5% and 1% levels respectively, in parentheses are standard errors

Source: *Survey data 2010-11*

The households' probability of using a Payphone compared to Mobile phone was influenced by person's profit making objective of using ICTs, experience in using ICTs, distance to and from nearest town centre, knowledge of existence of ICT groups, monthly income and family size. Four factors influenced use of WWW, CD-ROM and internet/email component compared to mobile phone including; monthly income and family size significant at 10% level, knowledge of existence of ICT groups significant at 5% level and experience in using ICTs significant at 1% level (Table 9).

Households who used ICTs mainly for profit making were less likely to use payphone compared to using mobile phone. The mobile phone was more instant in information delivery, enabled two-way direct exchange of information and was readily movable wherever the user was other than the payphone.

Small numbers of households used pay phones for communication with fellow farmers, traders, neighbours and family on business and market information matters. These households mainly lived in close proximity, in that by the time such households moved to town centres for pay phones' access, they would have moved almost the same or more distances as those required to be moved physically to the people they needed to communicate with.

Furthermore these households farmed and dealt in local crops and merchandise whose information was easily got from neighbours if needed. Thus the more the focus of households was towards profit making, it decreasingly generally necessitated use of a pay phone.

Adding to the above, focussing on making more profits meant limiting expenses on ICTs, thus leading to a reduction in intensity and frequency of using pay phones where hidden costs like airtime, operator's fee, business premise rent, handsets repairs and others were all considered on the call charge by the operator. Some of such costs were not incurred when using a mobile phone for instance; operator's fees and business place rent. Therefore households interested in making

more profits were more likely to use the mobile phone that required generally lower expenses compared to the service offered.

With more experience in using ICTs, households were more likely to use the pay phone compared to that of a mobile phone. The likelihood to use the pay phone increased with more years of using ICTs because households gained a better perception towards pay phone and ability to use it given guidance of the operators. Results were consistent with Bailey, (2009), who found that good experience in using ICTs positively influenced demand to use such ICTs for better services. Assistance of pay phone operators rendered farmers/traders good experience in using ICTs.

With an increasing family size, households were less likely to use pay phone compared to mobile phone. The bigger the family got the more the number of people including business partners that the household head had to be in touch with. The business partners and the different family members each had independent different movements. The varying locations of these family members necessitated more the need of communicating with each other using a more mobile device thus the increasing likelihood of using a mobile phone as compared to the pay phone. These findings were in agreement with Gutierrez and Gamboa (2008), who found that family size principally influenced mobile phone usage amongst residents from the South and North of Europe.

With increasing monthly income households were more likely to use the pay phone compared to the mobile phone. More incomes were associated with better business focus thus cost effectiveness and that made households to strictly pay for the service used. Cost effectiveness was more exhibited when using a pay phone where households never paid for costs like battery charging, network provider service fees, buying phone handsets, risks of theft and others. These findings were not a surprise as they were similar to those of Donner, (2007) and Shaffril *et al*, (2009) and who found incomes to be positively associated with such ICT usage in small-scale business operations.

With increasing distance to and from nearest town centre, households were more likely to use the pay phone than a mobile phone. A one kilometre increase in distance to and from nearest town centre increased the probability of using pay phone by 10.1%, as compared to mobile phone. As distance away from town increased, the more rural household locations in Mayuge became, and these rural areas were characterised with poor or no network coverage and limited or no power supply. Therefore functionally owning a mobile phone increasingly became impossible as distances to and from the nearest town centre increased.

Limited power and network availability as distances away from town centres increased, forced households to be more interested and likely to use pay phones given the availability of power and network coverage at village pay phone stations. The findings were also consistent with Soriano, (2007), who found that ICTs like pay phones were necessary in information exchange to reduce the burden of the physical distance.

Households with knowledge of existence of ICT groups were less likely to use the pay phone combination as compared to that of a mobile phone. Knowledge of ICT groups attracted households to gain membership to these ICT groups in which they were more likely to be advised on using modern ICTs like mobile phones, thus a decreasing likelihood to use the pay phone as compared to the more modern ICTs of the mobile phone combination.

Having ICT groups' knowledge constituted a human capital and consequently a social asset as defined by Parkinson and Ramirez (2006), who specifically categorized assets into human, social, physical, natural and financial assets. Consequently based on such a definition these results were in agreement with the findings of Arun *et al.* (2004) who established that improvement in assets was more likely to cause an ICT-based business management.

On the other hand households with increasing experience in using ICT were more likely to use the WWW, CD-ROM and internet/email compared to the mobile phone. Increased experience in using ICTs enabled households acquire better skills and interest to use more complex ICTs like WWW and internet/email. Complex ICTs also facilitated access and exchange of more bulky information as compared to the mobile phone. Such importance explained a 27% increase in the probability of using the WWW, CD-ROM and internet/email for every year increase in experience of using ICTs compared to the mobile.

These findings were also consistent with Bailey (2009), who established that experience in using ICTs was positively associated with use of modern ICTs particularly the internet. Therefore with more interest in accessing bulky and general information, households were more likely to use the WWW, CD-ROM and internet/email. The findings were also in line with Latchem and Walker, (2001) who found that communication needs generally positively influenced the use of modern ICTs like the internet.

Households who had knowledge of existence of ICT groups were less likely to use WWW, CD-ROM and internet/email compared to mobile phone. The most commonly used ICT component in Mayuge was a mobile phone, therefore information readily available and easily accessible from the population that also constituted ICT groups was that on mobile phone usage. Hence Mayuge households were more likely to be influenced through ICT groups to use the mobile phone compared to any other ICT component.

Households with large family sizes were less likely to use WWW, CD-ROM and internet/email compared to a mobile phone. An increasing family size competed with household resources like finances that were also more required to use the WWW, CD-ROM and internet/email that were also capital intensive requiring assets like computers.

However with increasing incomes, households were less likely to use WWW, CD-ROM and internet/email compared to mobile phone because others component was more capital intensive

compared to the mobile phone. Households were rational in allocating their household financial resources. The findings of this work were in agreement with ESCAP (2002) and Huyer and Sikoska, (2003) who established that low income earners were more willing to use the internet and WWW at a cost than high income earners. They further added that low income earners used such ICTs at higher rates than their counterparts.

Chapter V

5.0 Summary, Conclusions and Recommendations

5.1 Summary

The study focused on finding out the determinants for adoption of ICT-based Market Information Services (MIS) by smallholder farmers and traders in Mayuge district of Uganda. Specifically the study aimed at establishing components and component combinations of ICTs that farmers and traders use in MIS, and factors that influenced farmers and traders' adoption of ICT-based MIS. Three major ICT components were used in this study and these included the Mobile phone, Pay phone and others that included; internet/email, WWW, CD-ROM and TV.

Cross sectional data were collected from 150 farmers and 50 traders randomly selected respondents. The data were analyzed using SPSS and STATA. The data were mainly composed of socio-economic characteristics of farmers and traders. Descriptive statistics were used to characterize farmers and traders while logistic models were used to determine factors that influenced farmers' and traders' adoption of ICTs. A multinomial Logit was used to establish factors that influenced choice for the ICT components used by households.

Results show that more males used ICTs for market and other information services. Majority of respondents agreed that using ICTs was beneficial to agriculture, though a limited number of them were members to ICT groups. An average number of respondents were knowledgeable about existence of such groups. Experience in using ICTs, education of respondents, monthly

income, family size and distance to nearest town centers were statistically different across all categories of farmers and traders. Sixty two percent of respondents earned below 70,000Ushs (30 US $) as monthly income. A household family size of less or equal to six persons dominated.

The mobile phone was the most used new ICT component amongst farmers and traders while the radio was the most used old ICT. The most used new ICT component was of a significant importance amongst all farmers and traders. Expensive handsets, batteries, cells and other repairs, poverty, poor power supply and lack of network coverage were some of the major reasons that limited use and/or cause failure to use ICTs by both farmers and traders.

Farmers with knowledge of existence of ICT groups and those who thought that ICTs were of positive benefit to their agriculture were more likely to adopt ICTs for MIS more than those who thought otherwise about ICTs and/or had no knowledge of existence of ICT groups. Family size was significantly positively associated with adopting ICTs for MIS across farmers and traders. However land farmed was negatively associated with such ICT adoption.

The respondent's age, trading experience, later education, asset base, family size and monthly expenses on ICT use influenced traders' adoption of ICT for MIS. However as traders grew older their adoption of ICTs decreased more rapidly.

Considering a combination of both old and new ICT components, both farmers and traders mostly used the radio and mobile phone followed by Radio and Pay Phone for farmers and Radio, TV and Mobile Phone for traders. World Wide Web (WWW) was least used new ICT.

Farmers and traders whose major objective of using ICTs was to make profits were more likely to use the mobile phone compared to any other component. Households that stayed at longer distances away from nearest town were less likely to use the mobile phone compared to any other component due to power and network coverage failures. Farmers and traders with large family sizes were also more likely to use the mobile phone than any other component.

5.2 Conclusions

The mobile phone was one of the most important ICT components used by households to access market information services. The importance of the mobile phone was made more possible by existence of rural initiatives like BROSDI that educated and trained households on use of ICTs and also provided the required agricultural market information. Family size significantly and positively influenced ICT-based MIS adoption for both small-scale farmers and traders. However infrastructural limitations like rural poverty and rural poor power supply make it difficult for farmers and traders to access such ICT rural initiatives and the ICTs services.

5.3 Recommendations

Efforts of rural initiatives like BROSDI that train and educate farming and trading households on using ICTs for MIS need to be maintained within such rural settings and continuously sufficiently supported with most especially financial resources. If government extended formal adult education to Mayuge households through such rural based initiatives, it could better households' ability to use ICTs and their market participation through prompt agricultural market information exchange.

If such rural initiatives could also include job creation and apprenticeship skills training schemes within their frameworks for rural households, it could better rural households' off-farm incomes, thus reducing poverty and risks associated with rain-fed agriculture as the case was in Mayuge district.

If government prioritized rural electrification plans and rural road network building, it could reduce costs associated to accessing ICT training groups and ICT service centers that were mostly located in town centers. Such cost reductions through a better infrastructure would improve the ability of households to use ICTs for MIS and other services.

Further research need to be done to determine the economic impact of ICTs on household agricultural productivity and welfare of smallholder farmers in Uganda, since majority of the respondents asserted that ICTs are of benefit to household agriculture.

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APPENDIX A: The Questionnaire for Missing Variables for Farmers and Traders

Determinants for ICT-based Market Information Services by smallholder farmers in Mayuge district, Uganda

RESEARCH QUESTIONNAIRE (for missed variables)

By Haruna Sekabira, Makerere University Faculty of Agriculture

Date of interview		Start time	End time
Interviewed by		District	
Checked by		Date checked	
Date entered		Entered by	

1. FARMER AND SITE IDENTIFICATION

Full names		sub county	
Phone number		Village	
Parish			

2. COSTS ON ICTs , TRANSPORT AND ASSET ENDOWMENTS

Cost to and from nearest town centre		Monthly cost on ICT repairs/charging/top up	
Distance to and from nearest town centre		Value of assets owned	
		Land farmed previous season	

3. DO YOU USE ICTs to get MARKET INFORMATION. Yes------, No----------
4. DO YOU BELONG TO ANY ICT farmers group? Yes----------, No----------
5. Do you have any knowledge of existence of farmers' groups using ICTs? Yes--, No--

6. What is your objective of using ICTs? 1) Make profits---------- 2) others (specify)-----
7. How many years have you spent using ICTs? ----------
8. HOUSE HOLD CHARACTERISTICS FOR THE RESPONDENT

Age		Sex	
Years in school for respondent		Years in school for most educated member	
Family size		Marital status	
Total Income earned last season		Months in a season	

9. Do you think that using ICTs is of benefit to your agriculture? Yes----------, no------

10. If yes, give 3 major uses of ICTs to your agriculture starting with the most important one,

a)---------- b) ---------- c) ----------

11. Of the OLD ICTs, (TVs, Radios, and CD ROM), which ones do you use? A) ----------

b) ----------, c) ----------

12. If you use more that two of them, which one do you use MOST? ----------

13. Of the new ICTs, (mobile phones, pay phones, worldwide web (web sites), and internet) which ones do you use? A) ----------, b) ----------c) ----------, d) --

14. If you use more than two new ICTs, which one do you use MOST? ----------

15. If it is the phones that you use most, of SMSs and calls, what do you use MOST? -----

16. If DO NOT use ICTs, starting with the most important give three reasons why

a)----------b) ---------- c) ----------

17. If you OWN ICTs, starting with the most important outline five limitations that you face to sustain the use of these ICTs, a) ---------- b) ----------

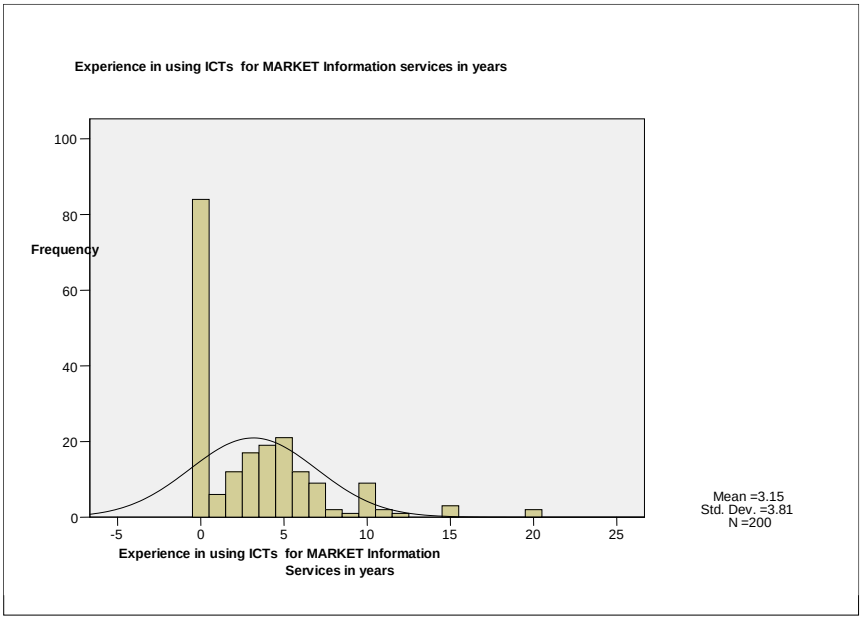
c) ---------- d) ---------- e) ----------

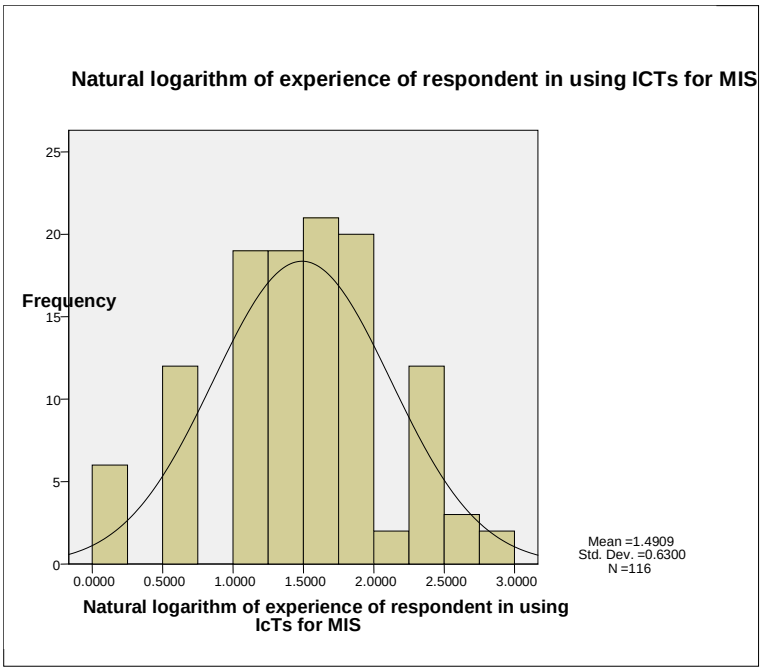
18. If you own ONLY old ICTs, starting with the most important, give the reasons that have limited you from owning and using NEW ICTs, a) ---------- b) ----------

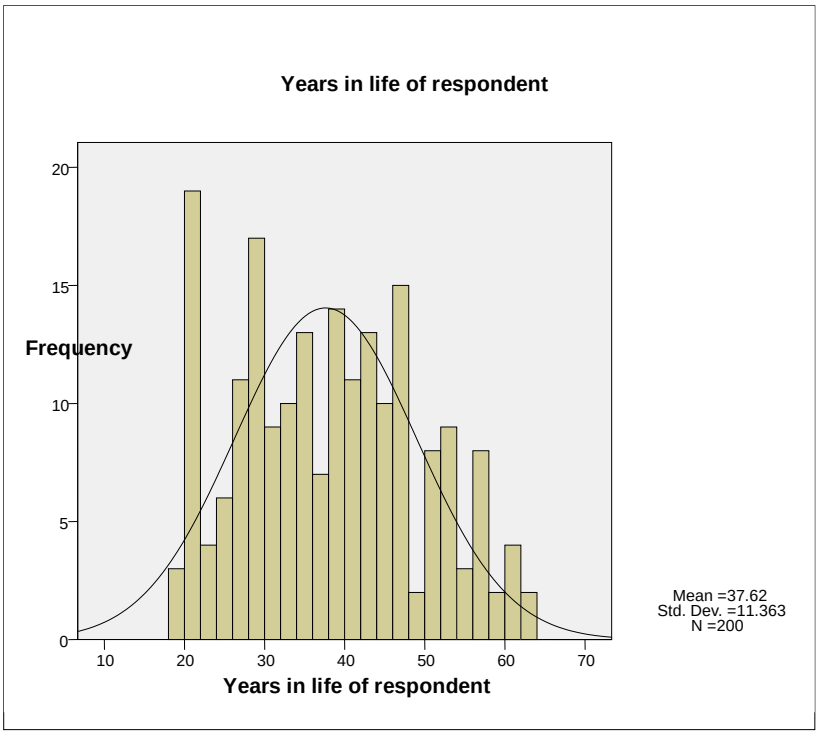
c) ---------- d) ---------- e) ----------

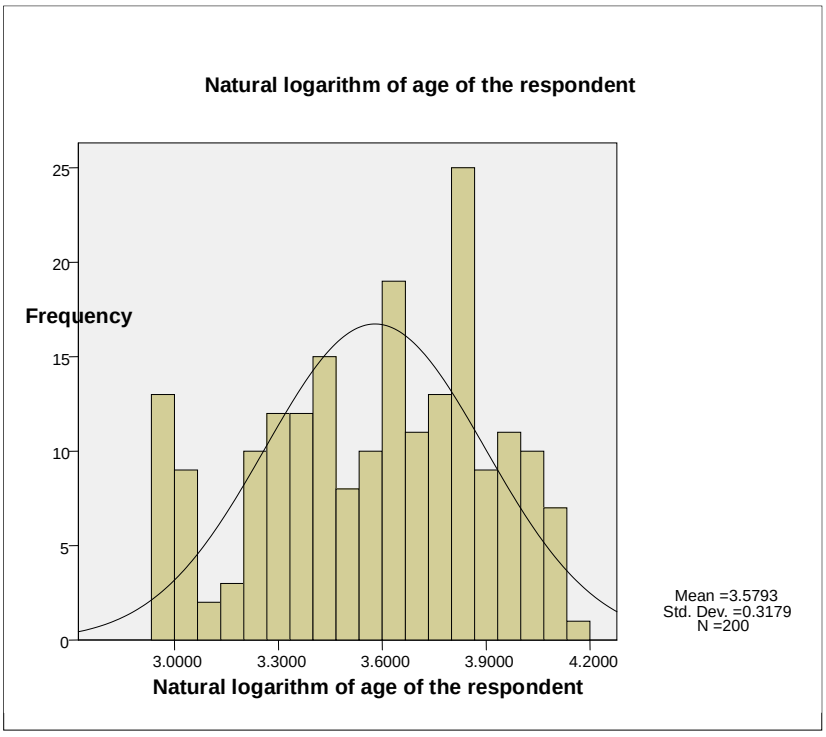
Thank you very much

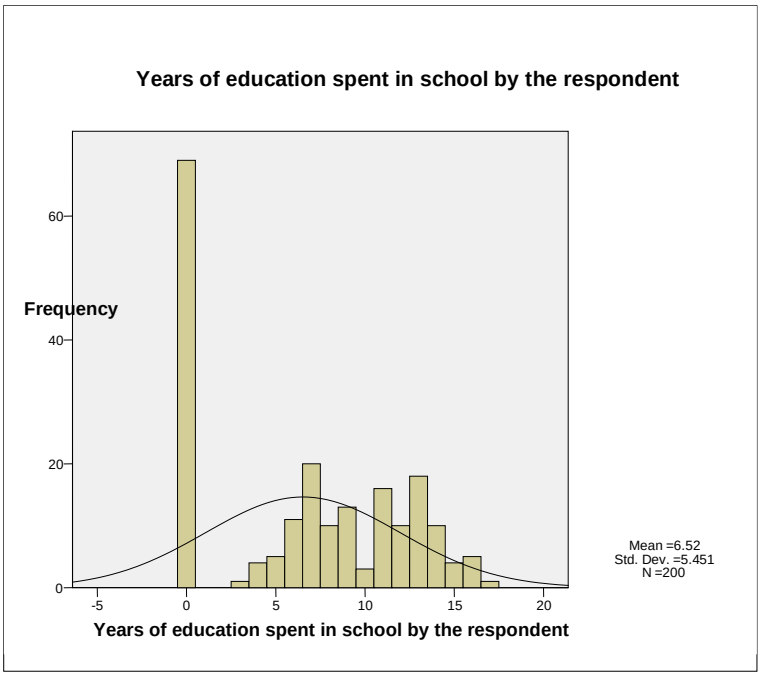
APPENDIX B: Distribution Curves before and after Transformations

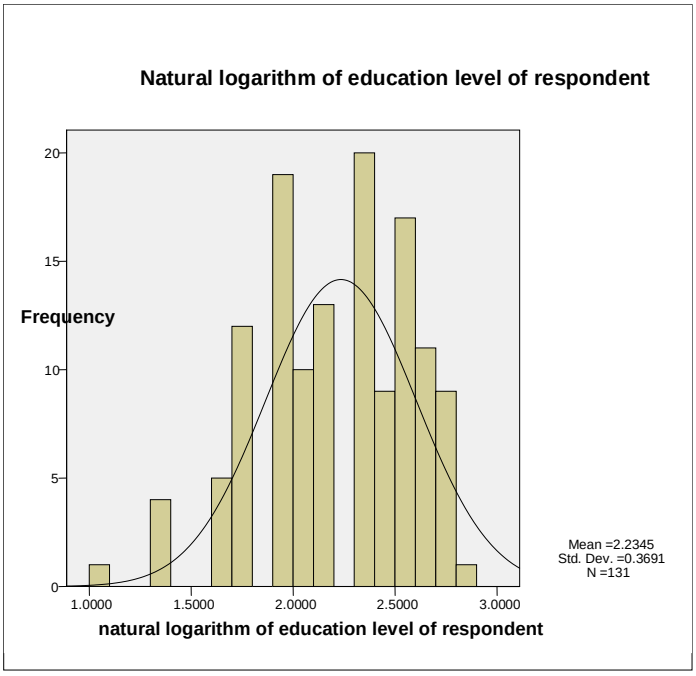


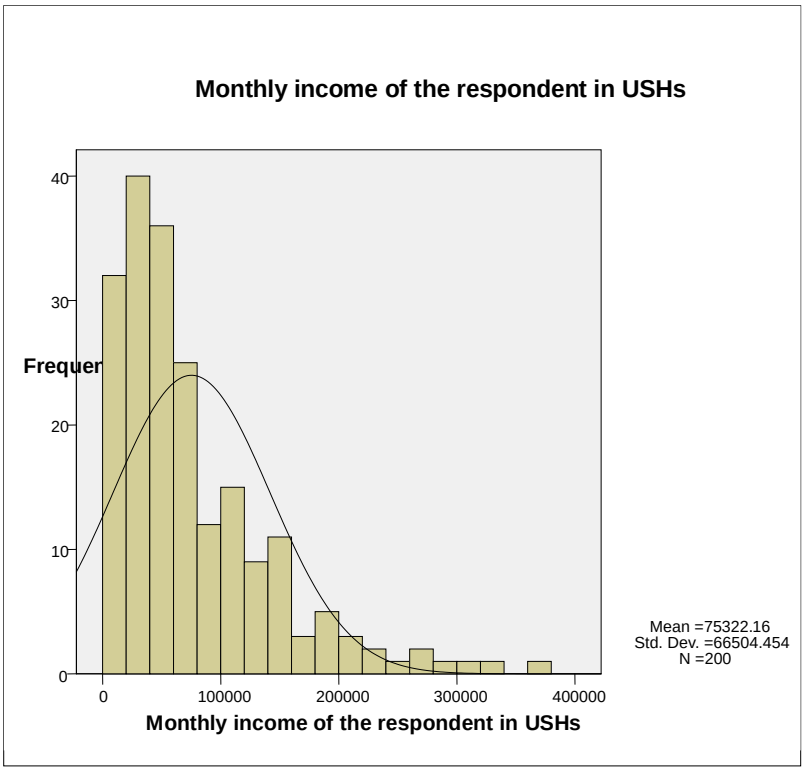


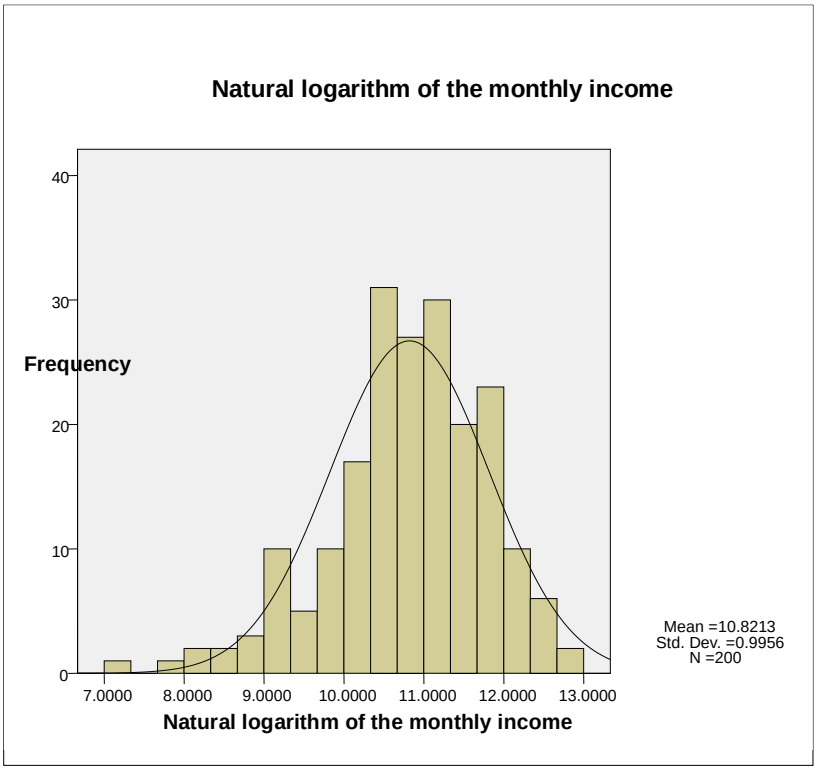

Years in life of respondent
Frequency
20
15
10
5
0
10
20
30
40
50
60
70
Years in life of respondent
Mean =37.62
Std. Dev. =11.363
N =200

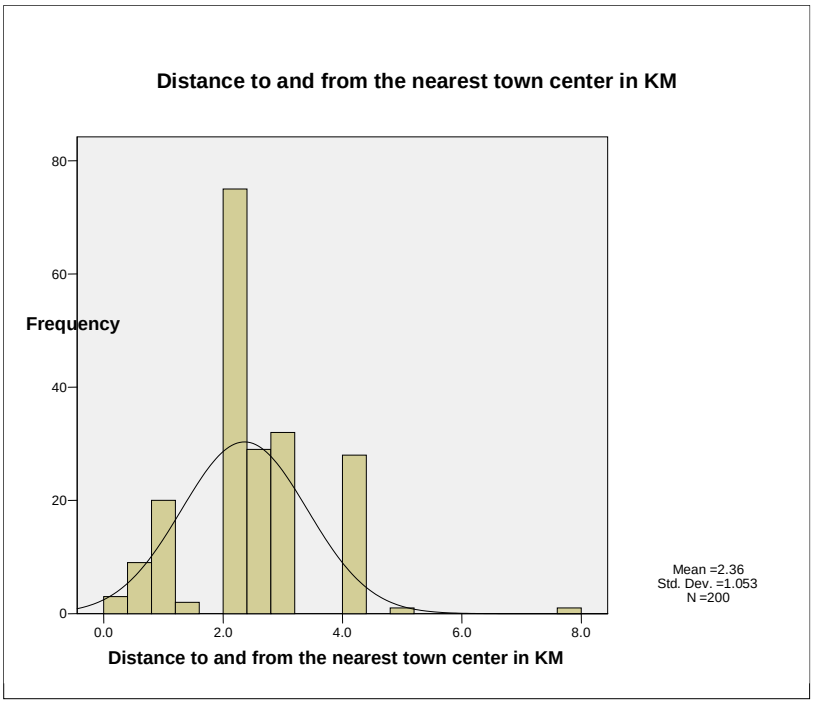

Natural logarithm of age of the respondent
Frequency
25
20
15
10
5
0
3.0000
3.3000
3.6000
3.9000
4.2000
Natural logarithm of age of the respondent
Mean =3.5793
Std. Dev. =0.3179
N =200

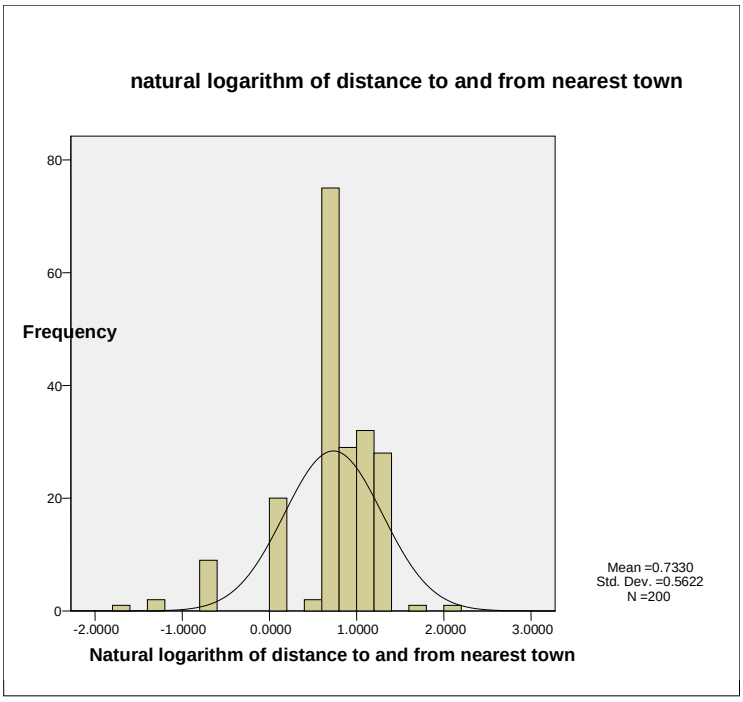

Years of education spent in school by the respondent
Frequency
60
40
20
0
-5
0
5
10
15
20
Years of education spent in school by the respondent
Mean =6.52
Std. Dev. =5.451
N =200

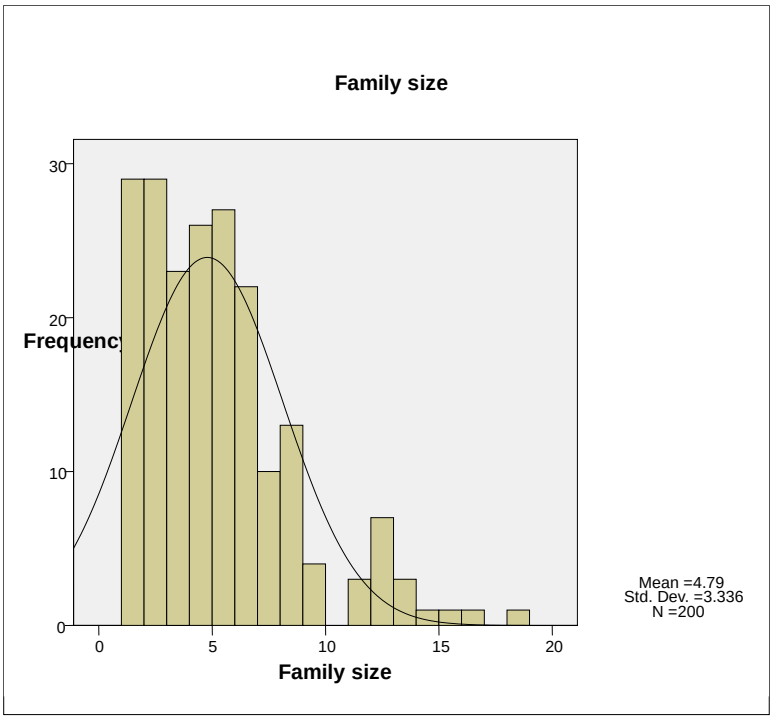

Natural logarithm of education level of respondent
Frequency
20
15
10
5
0
1.0000
1.5000
2.0000
2.5000
3.0000
natural logarithm of education level of respondent
Mean =2.2345
Std. Dev. =0.3691
N =131

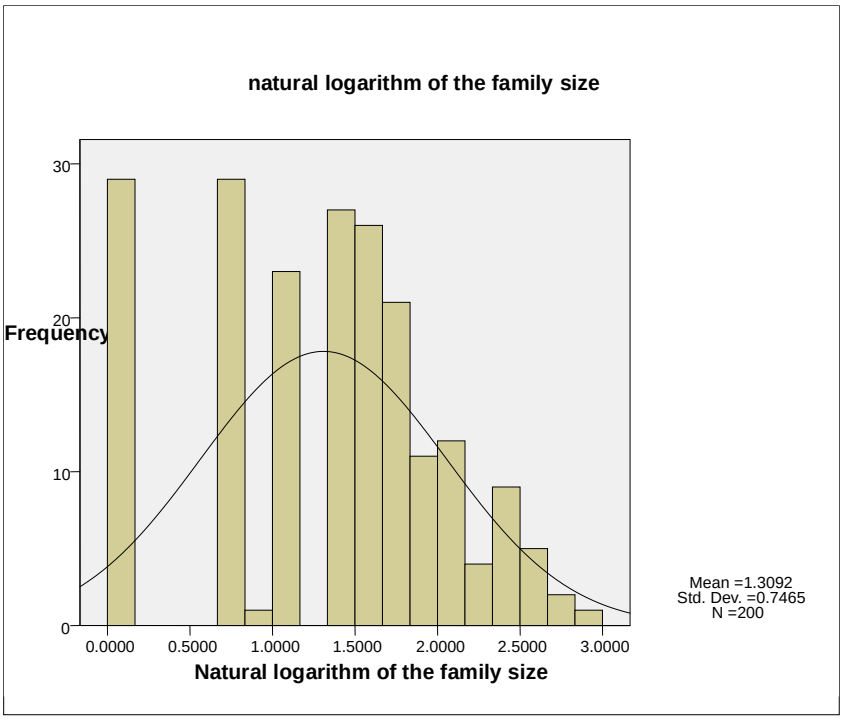

Monthly income of the respondent in USHs
Frequen
40
30
20
10
0
0
100000
200000
300000
400000
Monthly income of the respondent in USHs
Mean =75322.16
Std. Dev. =66504.454
N =200

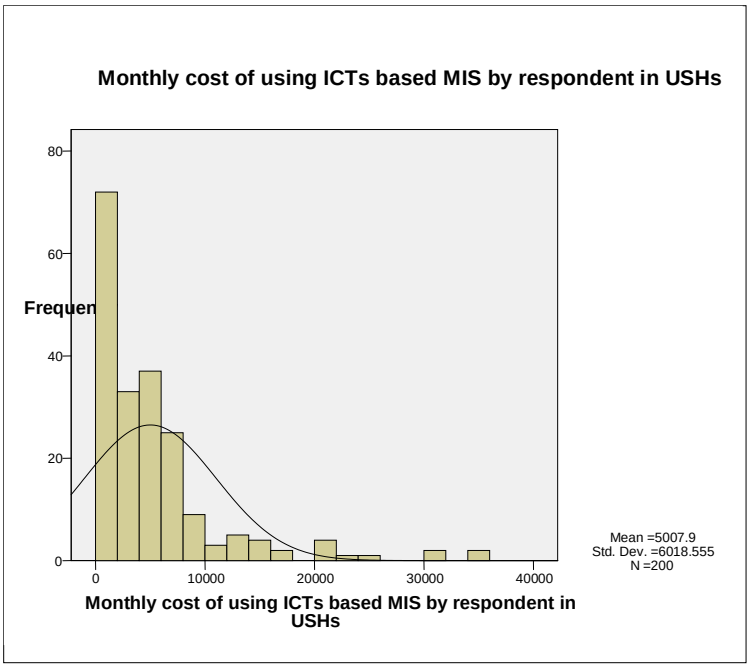

Natural logarithm of the monthly income
Frequency
40
30
20
10
0
7.0000
8.0000
9.0000
10.0000
11.0000
12.0000
13.0000
Natural logarithm of the monthly income
Mean =10.8213
Std. Dev. =0.9956
N =200

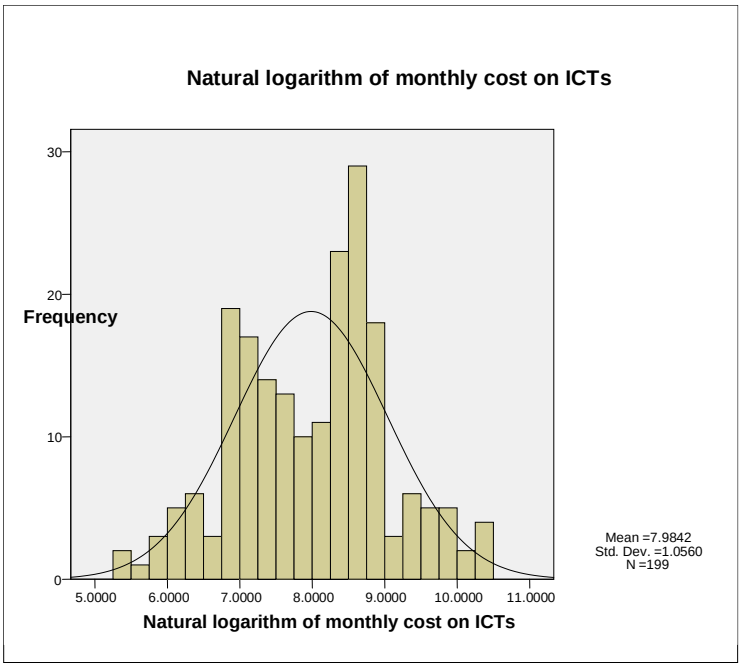

Distance to and from the nearest town center in KM
Frequency
80
60
40
20
0
0.0
2.0
4.0
6.0
8.0
Distance to and from the nearest town center in KM
Mean =2.36
Std. Dev. =1.053
N =200


natural logarithm of distance to and from nearest town
Frequency
80
60
40
20
0
-2.0000
-1.0000
0.0000
1.0000
2.0000
3.0000
Natural logarithm of distance to and from nearest town
Mean =0.7330
Std. Dev. =0.5622
N =200


Family size
Frequency
30
20
10
0
0
5
10
15
20
Family size
Mean =4.79
Std. Dev. =3.336
N =200


natural logarithm of the family size
Frequency
30
20
10
0
0.0000
0.5000
1.0000
1.5000
2.0000
2.5000
3.0000
Natural logarithm of the family size
Mean =1.3092
Std. Dev. =0.7465
N =200


Monthly cost of using ICTs based MIS by respondent in USHs
Frequen
80
60
40
20
0
0
10000
20000
30000
40000
Monthly cost of using ICTs based MIS by respondent in USHs
Mean =5007.9
Std. Dev. =6018.555
N =200


Natural logarithm of monthly cost on ICTs
Frequency
30
20
10
0
5.0000
6.0000
7.0000
8.0000
9.0000
10.0000
11.0000
Natural logarithm of monthly cost on ICTs
Mean =7.9842
Std. Dev. =1.0560
N =199

APPENDIX C: SKEWNESS AND KURTOSIS STATISTIC OF THE JB TESTS

[DataSet1] C:\Users\GEN Haruna Sekabira\Documents\FARMERS AND TRADERS 2B.sav

Testing for Skewness and Kutosis statistics before transformations

	Experience in using ICTs for MARKET Information services in years	Years in life of respondent	Years of education spent in school by the respondent	Years of education spent in school by spouse of respondent	Monthly income of the respondent in USHs	Family size	Monthly cost of using ICTs based MIS by respondent in USHs	Distance to and from the nearest town center in KM	Land used in the previous season for farming in acres
N	200	200	200	200	200	200	200	200	200
Missing	0	0	0	0	0	0	0	0	0
Skewness	1.628	0.191	0.035	0.590	1.723	1.322	2.719	0.825	1.719
Std. Error of Skewness	0.172	0.172	0.172	0.172	0.172	0.172	0.172	0.172	0.172
Kurtosis	3.526	-0.874	-1.417	-1.304	3.465	2.079	8.667	3.316	3.321
Std. Error of Kurtosis	0.342	0.342	0.342	0.342	0.342	0.342	0.342	0.342	0.342

Testing for Skewness and Kutosis statistics after transformations

	Natural logarithm of experience of respondent in using ICTs for MIS	natural logarithm of age of the respondent	natural logarithm of education level of respondent	Natural logarithm of education level of the spouse	Natural logarithm of the monthly income	natural logarithm of the family size	natural logarithm of monthly cost on ICTs	natural logarithm of distance to and from nearest town	Natural logarithm of LANDUSED
N	116	200	131	94	200	200	199	200	199
Missing	84	0	69	106	0	0	1	0	1
Skewness	-0.209	-0.303	-0.573	-1.257	-0.675	-0.286	0.004	-1.458	-0.017
Std. Error of Skewness	0.225	0.172	0.212	0.249	0.172	0.172	0.172	0.172	0.172
Kurtosis	0.345	-0.863	-0.295	1.204	0.591	-0.642	-0.376	3.017	-0.675
Std. Error of Kurtosis	0.446	0.342	0.420	0.493	0.342	0.342	0.343	0.342	0.343

APPENDIX D: STATA Models, Marginal Effects and Pair wise Correlations

```
___  ____  ____ ____  ____ tm
 /__    /   ____/   /   ____/
___/   /   /___/   /   /___/    9.0   Copyright 1984-2005
  Statistics/Data Analysis            StataCorp
                                      4905 Lakeway Drive
                                      College Station, Texa> s 77845 USA
                                      800-STATA-PC h
> ttp://www.stata.com
   979-696-4600        s> tata@stata.com  979-696-4601 (fax)

Single-user Stata for Windows perpetual license:
       Serial number:  1990519589
         Licensed to:  Gen Haruna Sekabira
                       Univ of Pretoria
Notes:
      1.  (/m# option or -set memory-) 1.00 MB allocated
> to data
. use "C:\Users\GEN Haruna Sekabira\Documents\FARMERS-viva.dta", clear

. logit ADOPT Gend KN BENAGRI LNEDC LNCOST  LNDIST  LANDUSED LNFS

Iteration 0:   log likelihood = -65.517646
Iteration 1:   log likelihood = -32.334425
Iteration 2:   log likelihood =  -26.94173
Iteration 3:   log likelihood = -25.466291
Iteration 4:   log likelihood = -25.255367
Iteration 5:   log likelihood = -25.248501
Iteration 6:   log likelihood = -25.248491

Logistic regression                               Number of obs   =         96
                                                  LR chi2(8)      =      80.54
                                                  Prob > chi2     =     0.0000
Log likelihood = -25.248491                       Pseudo R2       =     0.6146

------------------------------------------------------------------------------
       ADOPT |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        Gend |  -2.058825   1.184552    -1.74   0.082    -4.380505    .2628542
          KN |   2.317837   .9668396     2.40   0.017     .4228659    4.212807
     BENAGRI |   5.940568   1.395248     4.26   0.000     3.205932    8.675205
       LNEDC |   1.386866   1.114625     1.24   0.213    -.7977595    3.571491
      LNCOST |  -.2675513   .3881361    -0.69   0.491    -1.028284    .4931816
      LNDIST |   .6910258   .7476972     0.92   0.355    -.7744338    2.156485
    LANDUSED |  -.6256078   .2756298    -2.27   0.023    -1.165832   -.0853832
        LNFS |   2.453193   .7150692     3.43   0.001     1.051683    3.854702
       _cons |  -7.213183   4.263923    -1.69   0.091    -15.57032    1.143952
------------------------------------------------------------------------------

. mfx

Marginal effects after logit
      y  = Pr(ADOPT) (predict)
         =  .56861792
------------------------------------------------------------------------------
variable |      dy/dx    Std. Err.     z    P>|z|  [    95% C.I.   ]      X
---------+--------------------------------------------------------------------
    Gend*|  -.4086852      .17004   -2.40   0.016  -.741956 -.075414   .791667
      KN*|   .5222615      .17611    2.97   0.003   .177084  .867439   .614583
 BENAGRI*|   .8723233      .06277   13.90   0.000   .749295  .995351     .6875
```

```
   LNEDC |   .3401866       .2703    1.26   0.208  -.189582  .869955   2.21231
  LNCOST |  -.0656281      .09528   -0.69   0.491  -.252364  .121108   7.81617
  LNDIST |   .1695028       .1825    0.93   0.353   -.18819  .527196   .885903
LANDUSED |  -.1534563      .06747   -2.27   0.023  -.285693  -.02122   1.51823
    LNFS |   .6017475      .17492    3.44   0.001   .258905  .944591   1.21122
------------------------------------------------------------------------------
(*) dy/dx is for discrete change of dummy variable from 0 to 1


. corr Gend KN BENAGRI LNEDC LNCOST SQRTEXP SQRTINC SQRTFS SQRTDIST SQRTLANDUSED
(obs=96)
             |     Gend       KN  BENAGRI    LNEDC   LNCOST  SQRTEXP  SQRTINC   SQRTFS SQRTDIST SQRTLA~D
-------------+------------------------------------------------------------------------------------------
        Gend |   1.0000
          KN |   0.0154   1.0000
     BENAGRI |   0.0968   0.4358   1.0000
       LNEDC |   0.0533   0.1499   0.2273   1.0000
      LNCOST |   0.1448  -0.0364  -0.0033   0.1049   1.0000
     SQRTEXP |  -0.1014   0.1297   0.1573   0.0804   0.0864   1.0000
     SQRTINC |   0.1728  -0.0177   0.0683  -0.0887   0.7212  -0.0336   1.0000
      SQRTFS |   0.1228   0.0193   0.0746  -0.2620   0.1560   0.0431   0.2187   1.0000
    SQRTDIST |  -0.1722  -0.0403  -0.1968  -0.0530   0.0460   0.3699  -0.1346  -0.2138   1.0000
SQRTLANDUSED |   0.1869   0.1498   0.1741  -0.0057   0.1823   0.1006   0.2437   0.0655  -0.0761   1.0000

. use "C:\Users\GEN Haruna Sekabira\Documents\FARMERS AND TRADERS 2B.dta", clear
. mlogit COMPONENTS KN OBJ LNEXP LNFS LNDIST INVSQRTINC SQRTLANDUSED, noconstant

Iteration 0:   log likelihood = -127.43903
Iteration 1:   log likelihood = -82.256515
Iteration 2:   log likelihood =  -77.05743
Iteration 3:   log likelihood = -76.057578
Iteration 4:   log likelihood = -75.976163
Iteration 5:   log likelihood = -75.975361
Iteration 6:   log likelihood = -75.975361
Multinomial logistic regression                 Number of obs   =        116
                                                LR chi2(14)     =     102.93
                                                Prob > chi2     =     0.0000
Log likelihood = -75.975361                     Pseudo R2       =     0.4038
------------------------------------------------------------------------------
  COMPONENTS |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
RADPAY       |
          KN |  -1.452483   .8167983    -1.78   0.075    -3.053378    .1484127
         OBJ |  -2.651277   .7628163    -3.48   0.001     -4.14637   -1.156185
       LNEXP |   1.831651   .6985071     2.62   0.009     .4626024      3.2007
        LNFS |  -1.158932   .5391278    -2.15   0.032    -2.215603   -.1022613
      LNDIST |   2.456716   1.017744     2.41   0.016     .4619751    4.451457
  INVSQRTINC |   177.6896   99.24723     1.79   0.073    -16.83135    372.2106
SQRTLANDUSED |  -.9488476   .7914825    -1.20   0.231    -2.500125    .6024296
-------------+----------------------------------------------------------------
RADOTHER     |
          KN |  -1.127047   .5316064    -2.12   0.034    -2.168977   -.0851177
         OBJ |  -.5567473   .4861735    -1.15   0.252     -1.50963    .3961353
       LNEXP |   1.643347    .527132     3.12   0.002     .6101871    2.676506
        LNFS |  -.6098385   .3637118    -1.68   0.094    -1.322701    .1030236
      LNDIST |   .3720732   .4855697     0.77   0.444     -.579626    1.323772
  INVSQRTINC |   -214.897   125.5461    -1.71   0.087    -460.9628    31.16877
SQRTLANDUSED |  -.2650235   .4968503    -0.53   0.594    -1.238832    .7087851
------------------------------------------------------------------------------
(COMPONENTS==RADMOB is the base outcome)

. mfx, predict (p outcome (1))

Marginal effects after mlogit
      y  = Pr(COMPONENTS==1) (predict, p outcome (1))
         =  .04453104
```

```
------------------------------------------------------------------------------
variable |      dy/dx    Std. Err.     z    P>|z|  [    95% C.I.   ]      X
---------+--------------------------------------------------------------------
      KN*|  -.0550695      .04693   -1.17   0.241   -.14706  .036921   .594828
     OBJ |  -.1071632      .04707   -2.28   0.023   -.19942 -.014906   1.86207
   LNEXP |   .0612754       .0368    1.67   0.096  -.010847  .133398   1.49093
    LNFS |  -.0431287      .02461   -1.75   0.080  -.091367  .005109   1.32868
  LNDIST |   .1007569      .04888    2.06   0.039   .004945  .196569   .814739
INVSQR~C |   9.738645      5.7406    1.70   0.090  -1.51273    20.99    .00509
SQRTLA~D |  -.0376852      .03346   -1.13   0.260  -.103269  .027898   1.14883
------------------------------------------------------------------------------
(*) dy/dx is for discrete change of dummy variable from 0 to 1

. mfx, predict (p outcome (3))

Marginal effects after mlogit
      y  = Pr(COMPONENTS==3) (predict, p outcome (3))
         =  .22762738
------------------------------------------------------------------------------
variable |      dy/dx    Std. Err.     z    P>|z|  [    95% C.I.   ]      X
---------+--------------------------------------------------------------------
      KN*|  -.1872917      .09693   -1.93   0.053  -.377271  .002688   .594828
     OBJ |  -.0710089      .08558   -0.83   0.407  -.238748   .09673   1.86207
   LNEXP |   .2703555      .09012    3.00   0.003    .09372  .446991   1.49093
    LNFS |  -.0954701      .06164   -1.55   0.121  -.216273  .025333   1.32868
  LNDIST |   .0405129      .08467    0.48   0.632  -.125437  .206463   .814739
INVSQR~C |  -39.58287      19.636   -2.02   0.044  -78.0679 -1.09784    .00509
SQRTLA~D |  -.0369766      .08566   -0.43   0.666  -.204863  .130909   1.14883
------------------------------------------------------------------------------
(*) dy/dx is for discrete change of dummy variable from 0 to 1


. cor COMPONENTS KN OBJ LNEXP LNFS LNDIST INVSQRTINC SQRTLANDUSED
(obs=116)

             | COMPON~S       KN      OBJ    LNEXP     LNFS   LNDIST INVSQR~C SQRTLA~D
-------------+------------------------------------------------------------------------
  COMPONENTS |   1.0000
          KN |  -0.1158   1.0000
         OBJ |   0.0449  -0.1264   1.0000
       LNEXP |   0.0050   0.0187   0.0002   1.0000
        LNFS |   0.0949  -0.0529  -0.0832   0.2217   1.0000
      LNDIST |  -0.1658   0.1783  -0.1656   0.1868  -0.2025   1.0000
  INVSQRTINC |  -0.3405   0.1187   0.0926  -0.1077  -0.2699   0.1340   1.0000
SQRTLANDUSED |   0.0039   0.1990  -0.2202  -0.0323   0.0277   0.1427  -0.0964   1.0000


. use "C:\Users\GEN Haruna Sekabira\Documents\B TRADERS.dta", clear

. logit ADOPT LNFS AGE  EXP SQAGE SQEDC LNCOST BENAGRI   LNASSETBASE

note: BENAGRI != 1 predicts success perfectly
      BENAGRI dropped and 3 obs not used

Iteration 0:   log likelihood = -24.327124
Iteration 1:   log likelihood = -18.648989
Iteration 2:   log likelihood = -16.535237
Iteration 3:   log likelihood = -14.603379
Iteration 4:   log likelihood = -12.942207
Iteration 5:   log likelihood = -12.324775
Iteration 6:   log likelihood = -12.218413
Iteration 7:   log likelihood = -12.214728
Iteration 8:   log likelihood = -12.214723
```

```
Logistic regression                                     Number of obs   =         47
                                                        LR chi2(7)      =      24.22
                                                        Prob > chi2     =     0.0010
Log likelihood = -12.214723                             Pseudo R2       =     0.4979

------------------------------------------------------------------------------
       ADOPT |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        LNFS |    6.792927   3.104578     2.19   0.029     .7080655    12.87779
         AGE |   -5.777668   2.499447    -2.31   0.021    -10.67649   -.8788421
         EXP |   -1.875296   .8098596    -2.32   0.021    -3.462592   -.2880006
       SQAGE |    .0627685   .0271254     2.31   0.021     .0096038    .1159332
       SQEDC |    .1023769   .0443592     2.31   0.021     .0154344    .1893195
      LNCOST |     13.0761   5.557866     2.35   0.019     2.182887    23.96932
 LNASSETBASE |   -3.803074     1.8717    -2.03   0.042    -7.471538   -.1346099
       _cons |    55.68689   39.12636     1.42   0.155    -20.99938    132.3731
------------------------------------------------------------------------------

note: 0 failures and 10 successes completely determined.

. mfx

Marginal effects after logit
      y  = Pr(ADOPT) (predict)
         =  .99986595
------------------------------------------------------------------------------
variable |      dy/dx    Std. Err.     z    P>|z|  [    95% C.I.   ]      X
---------+--------------------------------------------------------------------
    LNFS |   .0009105        .003    0.30   0.762  -.004973  .006794   1.38795
     AGE |  -.0007744       .00255   -0.30   0.761  -.005769  .004221    37.617
     EXP |  -.0002514       .00083   -0.30   0.762  -.001878  .001375   4.14894
   SQAGE |   8.41e-06       .00003    0.30   0.761  -.000046  .000063   1502.85
   SQEDC |   .0000137       .00005    0.30   0.762  -.000075  .000102    81.234
  LNCOST |   .0017527       .00582    0.30   0.763  -.009656  .013162   8.67379
LNASSE~E |  -.0005097       .00168   -0.30   0.762  -.003803  .002783   12.3969

. corr LNFS AGE  EXP INC SQAGE SQASSETBASE SQEDC LNCOST BENAGRI
(obs=50)

             |     LNFS      AGE      EXP      INC    SQAGE SQEDC   LNCOST  BENAGRI
-------------+------------------------------------------------------------------
        LNFS |   1.0000
         AGE |   0.6249   1.0000
         EXP |   0.1866   0.2149   1.0000
         INC |   0.2380   0.1833   0.2311   1.0000
       SQAGE |   0.5794   0.9900   0.1808   0.1641   1.0000
       SQEDC |  -0.1242  -0.0582   0.6265   0.4242  -0.0919   1.0000
      LNCOST |  -0.0694  -0.0187  -0.1407   0.0731   0.0063  -0.0331   1.0000
     BENAGRI |  -0.1260   0.0505  -0.0931  -0.0772   0.0704  -0.0845   0.2056   1.0000


. ttest     EDC, by(ADOPT)

Two-sample t test with equal variances
------------------------------------------------------------------------------
Variable |     Obs        Mean    Std. Err.   Std. Dev.   [95% Conf. Interval]
---------+--------------------------------------------------------------------
      NO |      76    5.526316     .615437    5.365255    4.300302    6.752329
     YES |     124    7.129032    .4879841    5.433961    6.163098    8.094967
---------+--------------------------------------------------------------------
combined |     200        6.52    .3854098    5.450517    5.759989    7.280011
---------+--------------------------------------------------------------------
    diff |           -1.602716    .7878384               -3.156348   -.0490853
```

```
------------------------------------------------------------------------------
    diff = mean(NO) - mean(YES)                                   t =  -2.0343
Ho: diff = 0                                     degrees of freedom =      198

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 0.0216         Pr(|T| > |t|) = 0.0433          Pr(T > t) = 0.9784

. ttest      EXP, by(ADOPT)

Two-sample t test with equal variances
------------------------------------------------------------------------------
Variable |     Obs        Mean    Std. Err.   Std. Dev.   [95% Conf. Interval]
---------+--------------------------------------------------------------------
      NO |      76    2.065789    .3691315    3.218014    1.330442    2.801137
     YES |     124    3.822581    .3590369    3.998065    3.111889    4.533272
---------+--------------------------------------------------------------------
combined |     200       3.155     .269384    3.809664    2.623787    3.686213
---------+--------------------------------------------------------------------
    diff |           -1.756791    .5421997               -2.826018   -.6875639
------------------------------------------------------------------------------
    diff = mean(NO) - mean(YES)                                   t =  -3.2401
Ho: diff = 0                                     degrees of freedom =      198

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 0.0007         Pr(|T| > |t|) = 0.0014          Pr(T > t) = 0.9993

. ttest       AGE, by(ADOPT)

Two-sample t test with equal variances
------------------------------------------------------------------------------
Variable |     Obs        Mean    Std. Err.   Std. Dev.   [95% Conf. Interval]
---------+--------------------------------------------------------------------
      NO |      76    37.88158    1.313221     11.4484    35.26551    40.49765
     YES |     124    37.45161    1.019631    11.35413    35.43332    39.46991
---------+--------------------------------------------------------------------
combined |     200      37.615    .8034998     11.3632    36.03053    39.19947
---------+--------------------------------------------------------------------
    diff |             .429966    1.659275               -2.842154    3.702086
------------------------------------------------------------------------------
    diff = mean(NO) - mean(YES)                                   t =   0.2591
Ho: diff = 0                                     degrees of freedom =      198

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 0.6021         Pr(|T| > |t|) = 0.7958          Pr(T > t) = 0.3979

. ttest        INC, by(ADOPT)

Two-sample t test with equal variances
------------------------------------------------------------------------------
Variable |     Obs        Mean    Std. Err.   Std. Dev.   [95% Conf. Interval]
---------+--------------------------------------------------------------------
      NO |      76    63470.38    6399.833    55792.45    50721.26     76219.5
     YES |     124    82586.15    6424.263    71537.56    69869.71    95302.58
---------+--------------------------------------------------------------------
combined |     200    75322.15    4702.575    66504.45    66048.88    84595.43
---------+--------------------------------------------------------------------
    diff |           -19115.76    9617.272               -38081.19   -150.3354
------------------------------------------------------------------------------
    diff = mean(NO) - mean(YES)                                   t =  -1.9876
Ho: diff = 0                                     degrees of freedom =      198

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 0.0241         Pr(|T| > |t|) = 0.0482          Pr(T > t) = 0.9759
```

```
. ttest         FS, by(ADOPT)

Two-sample t test with equal variances
------------------------------------------------------------------------------
Variable |     Obs        Mean    Std. Err.   Std. Dev.   [95% Conf. Interval]
---------+--------------------------------------------------------------------
      NO |      76    4.263158     .330533     2.88152    3.604702    4.921613
     YES |     124    5.108871      .31969    3.559917    4.476064    5.741678
---------+--------------------------------------------------------------------
combined |     200      4.7875    .2359211    3.336428    4.322274    5.252726
---------+--------------------------------------------------------------------
    diff |           -.8457131     .483553               -1.799288    .1078619
------------------------------------------------------------------------------
    diff = mean(NO) - mean(YES)                                   t =  -1.7490
Ho: diff = 0                                     degrees of freedom =      198

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 0.0409         Pr(|T| > |t|) = 0.0818          Pr(T > t) = 0.9591

. ttest   COST, by(ADOPT)

Two-sample t test with equal variances
------------------------------------------------------------------------------
Variable |     Obs        Mean    Std. Err.   Std. Dev.   [95% Conf. Interval]
---------+--------------------------------------------------------------------
      NO |      76    4411.184    726.9261    6337.195    2963.073    5859.295
     YES |     124    5373.629     521.799    5810.508     4340.76    6406.498
---------+--------------------------------------------------------------------
combined |     200      5007.9    425.5761    6018.555    4168.682    5847.118
---------+--------------------------------------------------------------------
    diff |           -962.4448    876.3239               -2690.571    765.6813
------------------------------------------------------------------------------
    diff = mean(NO) - mean(YES)                                   t =  -1.0983
Ho: diff = 0                                     degrees of freedom =      198

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 0.1367         Pr(|T| > |t|) = 0.2734          Pr(T > t) = 0.8633

. ttest    DIST, by(ADOPT)

Two-sample t test with equal variances
------------------------------------------------------------------------------
Variable |     Obs        Mean    Std. Err.   Std. Dev.   [95% Conf. Interval]
---------+--------------------------------------------------------------------
      NO |      76    2.548684    .1144091    .9973957     2.32077    2.776599
     YES |     124    2.242339    .0962925    1.072268    2.051734    2.432944
---------+--------------------------------------------------------------------
combined |     200     2.35875    .0744245    1.052521    2.211988    2.505512
---------+--------------------------------------------------------------------
    diff |           .3063455    .1521675                .0062685    .6064225
------------------------------------------------------------------------------
    diff = mean(NO) - mean(YES)                                   t =   2.0132
Ho: diff = 0                                     degrees of freedom =      198

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 0.9773         Pr(|T| > |t|) = 0.0454          Pr(T > t) = 0.0227
```

APPENDIX E: VITA

A: PERSONAL BIO DATA

First Name:	Haruna
Surname:	Sekabira (A)
Date of birth:	17th July 1984
Permanent address:	Matugga, Kampala, Uganda
Gender	Male
Marital Status	Married
Languages spoken	English, Arabic, German and Luganda
Contact address:	P. O. Box, 7062 Kampala Uganda; Sch. of Agric. Sci, Makerere University

Nationality Ugandan

B: EDUCATIONAL QUALIFICATIONS

Year	AWARD	INSTITUTION
September 20th 2012, successfully defended Research Thesis, (Topic: Determinants for Adoption of ICT-based Market Information Services by Smallholder Farmers and Traders in Mayuge District, Uganda) for Collaborative Masters in Agricultural and Applied Economics (CMAAE) (2009-2011) Statistical software used: SPSS, STATA, LP software (SLP88 and QSBL) and limited exposure to GAMZ		Makerere/Pretoria Universities (4.31 CGPA)
2009	BSc in Agriculture (Economics)-Hons	Makerere University (3.8 CGPA)
2003	Uganda Advanced Certificate of Education (5 principal passes out of 5 subjects i. E B, C, D, D and 4)	Kibuli Secondary School
2001	Uganda Advanced Certificate of Education (5 distinctions and 5 credits out of ten subjects i. E. 1, 1, 1, 1, 1, 3, 3, 3, 3, and 3)	Kibuli Secondary School
1997	Primary Leaving Examinations (4 distinctions out of 4 subjects i. E. 1, 1, 2 and 2)	Bukoto Primary School

Bi: PROFESSIONAL & PERSONAL ACADEMIC AND RESEARCH EXPERIENCES

1. Worked as a credit Officer at PEARL Microfinance Ltd, in charge of Small Business appraisal, doing business assessment, analysis, award of credit, evaluation, monitoring and recovery. Mostly used EXCEL
2. Worked with International Development Research Centre (IDRC), on a six country ICT project that was looking at how smallholder farmers and traders use ICTs to access markets. On this project, I was the Country Masters' Student for Uganda in 2009 - 2011. Used Multinomial logit model and Survey data. Worked on main project as Research Assistant.
3. Worked on the evaluation of the Gender for Growth project run by the National Union of Coffee Agribusiness and Farming Enterprises (NUCAFE), in Uganda funded by ABi - Trust, in 2011 – 2012. I worked as a Research Assistant

4. Worked on a project to Determine the Economic effect of the Banana Bacterial Wilt (BBW) in Uganda, with a US - based research at Michigan University, in 2011. I was the Research Assistant in Uganda

5. Worked on a Study to identify factors influencing the number of adaptation measures used by smallholder farmers against Climate Chenge in the Teso region of Uganda in 2011, Using Count data models,specifically a negative binomial and I was a research Assistant.

6.Worked on a project to determine the importance of Capital Structure on the performance of Micro-Finance Institutions in Uganda, in 2012 and I was a research assistant. Used Panel data and Probit models, given different levels of performance.

7. Worked on a special project required for the award of the BSc of Agriculture estimating the Profitanility of Poultry (Layers) in Wakiso District of Uganda, in 2008. OLS and Cost Benefit Anlysis methods were used on farm data. I worked as both Student and Main researcher

8. Worked on a case study and a feasibility study was done on small farms, as a requirement of my BSc. degree, to establish the profitability of various small farm enterprises in 2007.

9. Presented one of the best Agricultural Economics proposals and selected amongst the best 30 students out of over 70 students at University of Pretoria, and I was awarded attendence to the Conference of the Association of African Agricultural Economists (AAAE) in Capetown, South Africa in, 2010

10. Worked on an evaluation of the performance of the Heifer program, funded by Heifer International to determine the effectiveness and the sustainability of the program in Uganda in 2012. Survey data was used OLS models, binomial probit and Gross Margin Analysis were used and estimated.

11. June 2011, admitted to the research team of Prof. Matin Qaim of George August-University-Gottingen, Germany.

12. 19-24th August-2012, participated (presented a paper and moderated a session) in the 28th Triennial international Conference of Agricultural Economists, (ICAE), in Foz Do Iguacu, Brazil

Bii: PUBLICATIONS

1. Haruna Sekabira, Jackline Bonabana and Narathius Asingwire, 2012, "Determinants for Adoption of ICT-Based Market Information Services by Smallholder Farmers and Traders in Mayuge District, Uganda", Journal of Development and Agricultural Economics (JDAE), 2012 (forthcoming)

C: PROFESSIONAL WORK EXPERIENCE

Operations Manager/Director, LADS Consult (January 2011 to date)
Responsibilities:

- Oversee all operations of the firm
- Attract consultancy works for the firm
- Participate in data collection, entry, analysis and report writing
- Supervising field teams and effecting quality data collection
- Recruiting appropriate field work personnel as per the required data collection

Private Teaching/Research Assistant to Assoc. Prof. B. Kiiza, Makerere University (2009 to date)
Responsibilities;

- Deliver lectures and exams when directed
- Head student teams of Researchers to the field
- Carry out data collection, entry and analysis
- Report writing and proof reading reports or intended publications

- Carrying out desk reviews and relevant secondary data and literature search
- Meeting possible clientele, partners and carrying out key informant interviews
- Report deliveries and posting and any other assignments

Credit Officer, PEARL Microfinance Limited (July 2009 to July 2011) but I had to spend half year in South Africa for my Collaborative Masters degree, thus leaving office on July 2010.

1. Mobilization of clients
2. Training of clients and ensuring proper record keeping
3. Timely disbursements and recovery of loans
4. Maintenance of clean portfolio and maintenance
5. Report writing

Enumerator and team leader on effectiveness of ICTs to smallholder farmers and traders in Market Information Services access with the International Development Research Centre (IDRC) and Makerere University, Department of Social Work and Administration, in Uganda April 2010- July 2010 and December 2010 to September 2011

Responsibilities:

- Making reconnaissance of the target research area
- Training subordinate enumerators and effecting payments to them
- Participating in the survey tool design, testing and corrections
- Writing field reports to the Department Investigator and sometimes to the Principal investigator
- Data collection, editing, entry and cleaning
- Data analysis and progress report writing
- Reviewing final reports as instructed by the department and Principal Investigator

Secondary School Teacher, Katwe Noor Secondary School (November 2003 to September 2004)

Responsibilities

- Conducting lessons
- Setting and marking examinations
- Facilitating students' community work
- Report writing

D: RESPONSIBILITIES HELD

Chairperson Graduate students, Makerere University, (2010-2011)

- Head the executive Senior Common Room of Graduate students
- Make budgeting for graduate students' residence
- Representing Graduate students in the University Students' guild council
- Representing Graduate students' to the University administration

University Council Member, Makerere University, (2007)

- Discuss submissions of various sections of the University
- Agreeing in consensus with other members of council
- Formulating policies governing the University

Vice President, Makerere Students' Guild, (2007)

- Deputizing the guild president
- Facilitating cabinet meetings
- Formulating and/or review of project proposals for various ministries
- Representing Students at the University Council

Member, Makerere Students' Guild Representative Council, (2006 to 2008 and 2010)

- Attending council meetings
- Discussion of submissions from other members of Council
- Formulating conclusions on issues concerning student matters

President, Uganda Young Democrats (UYD), Makerere University, (2005 to 2006)

- Representing the Party as a candidate in the Guild race
- Providing guidance to members of the UYD executive
- Mobilizing and creating awareness to the youth on the interests of the Party
- Making public address on rallies, Television, radios on the goals of the Party

General Secretary, MUARIK, Electoral Commission, (2007 to 2007)

- Conducting elections of the succeeding executive
- Ensuring proper count of all cast votes and a successful electoral process
- Training the electorate and candidates of peaceful, free and fair elections
- Report Writing on election details to the Chair Person for publication
- Planning and scheduling voting dates and places
- Convening all meetings of the Electoral Commission executives

Head Prefect, Kibuli Secondary School, (2002 to 2003)

- Heading the entire students' community
- Heading the prefectorate body
- Representing the students' body's interests to the school administration
- Conducting assemblies every Monday
- Heading the General Paper class
- Providing advice to other student leaders' bodies at the school
- Conducting a General Students and Teachers' assembly every Monday

Academic Chairman, Kibuli Secondary School, (2002 to 2003)

- Heading all High School students in General Paper classes
- Ensuring that all students attend the General Paper lessons
- Standing in for the Teacher (Director of Studies) in case of absence
- Conducting General Paper discussions every week

Deputy Head Prefect, Kibuli Secondary School, (2000 to 2001)

- Deputizing the head prefect at any time of his/her absence
- Heading the O-Level Section of students

- Ensuring good academic and social discipline of all students

Academic Chairman, Kibuli Secondary School, (2000 to 2001)

- Academically, heading all candidate students for the UCE in school
- Ensuring that all academic needs of students are well communicated to the administration
- Encouraging all candidate students to perform above average academically and socially for a successful candidacy

House Prefect, Kibuli Secondary School, (2000 to 2001)

- Heading all students belonging to Agakhan House in general cleanliness
- Deputizing the Senior House Prefect
- Ensuring proper representation in sports activities

Junior Prefect, Kibuli Secondary School, (1999 to 2000)

- Assisting all in-coming senior one students academically and socially
- Ensuring proper treatment and behaviour of senior students towards the junior students
- Supervising Senior one students during day and night revision sessions (preps)

Head Prefect, Lufuka Islamic Primary School, (1996 to 1997)

- Heading the Pupils body
- Conducting Pupils General Assembly once a week
- Ensuring that Pupils do not escape from the school during learning hours
- Delivering the voice of the pupils to the administration

General Secretary, Lufuka Islamic Primary School, (1995 to 1996)

- Taking records of all meetings of the General Assembly
- Report writing to the Head
- Ensuring general good conduct of all pupils academically and socially
- Convening all meetings of the General assembly and the Executive

Global Ambassador, Global Youth Partnership for Africa, 2007 to date.

- Preaching peace and development
- Promoting peace and development

E: MAJOR TRAININGS AND WORKSHOPS ATTENDED

Advanced Study in Institutional & Natural Resource Analysis and Design (9th July-25th Aug-'12)
Under International Forestry Resources and Institutions Research (IFRI)

Topics covered include;
Institutional policy analysis and Natural resource governance

Natural resources data collection, analysis and interpretation
Governance of the commons and common pool resources

Skills in Credit Management, PEARL Microfinance, (June 2009)

Topics covered include:

Mobilization of clients, facilitation of trainings, disbursements and recovery of loans and financial report writing

Peace Making and Development, Global Youth Partnership for Africa, (July 2007)

Topics covered include:

Formulation of peace in disaster struck areas, Peer training, visiting disaster struck areas

Conflict Resolution, CECORE, Makerere University (2006)

Topics covered include:

Skills to prevent strikes, Proper communication skills in crisis situations, formulating harmony in crisis situations

Membership to International bodies

i. International Association of Agricultural Economists (IAAE)
ii. African Association of Agricultural Economists (AAAE)

F: REFEREES

i. **Dr. J. Bonabana**
Senior Lecturer & Coordinator Postgraduate Programs
School of Agricultural Sciences, College of Agricultural and Environmental Sciences, Makerere University P.O. Box 7062, Kampala, Uganda, Phones: +256774899799, email: jbonabana@agric.mak.ac.ug

ii. **Hajj Abbas Kawaase Mukasa**
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