USE OF INFORMATION COMMUNICATION TECHNOLOGIES (ICT) IN AGRICULTURAL RESEARCH: THE CASE OF HARAMAYA UNIVERSITY

M.Sc Thesis

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USE OF INFORMATION AND COMMUNICATION TECHNOLOGIES (ICT) IN AGRICULTURAL RESEARCH: THE CASE OF HARAMAYA UNIVERSITY

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By
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As thesis research advisors, we hereby certify that we have read and evaluated this thesis prepared, under our guidance, by Alayu Melaku, entitled: "**Use of Information and Communication Technologies (ICT) in Agricultural Research: The Case of Haramaya University"** we recommend it be submitted as fulfilling the thesis requirement.

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As member of the Board of Examiners of the Final M.Sc. Thesis Open Defense Examination, we certify that we have read, evaluated the thesis prepared by Alayu Melaku and examined the candidate. We recommended that the thesis be accepted as fulfilling the thesis requirement for the degree of Master of Science in Agricultural Information and Communication Management (AICM).

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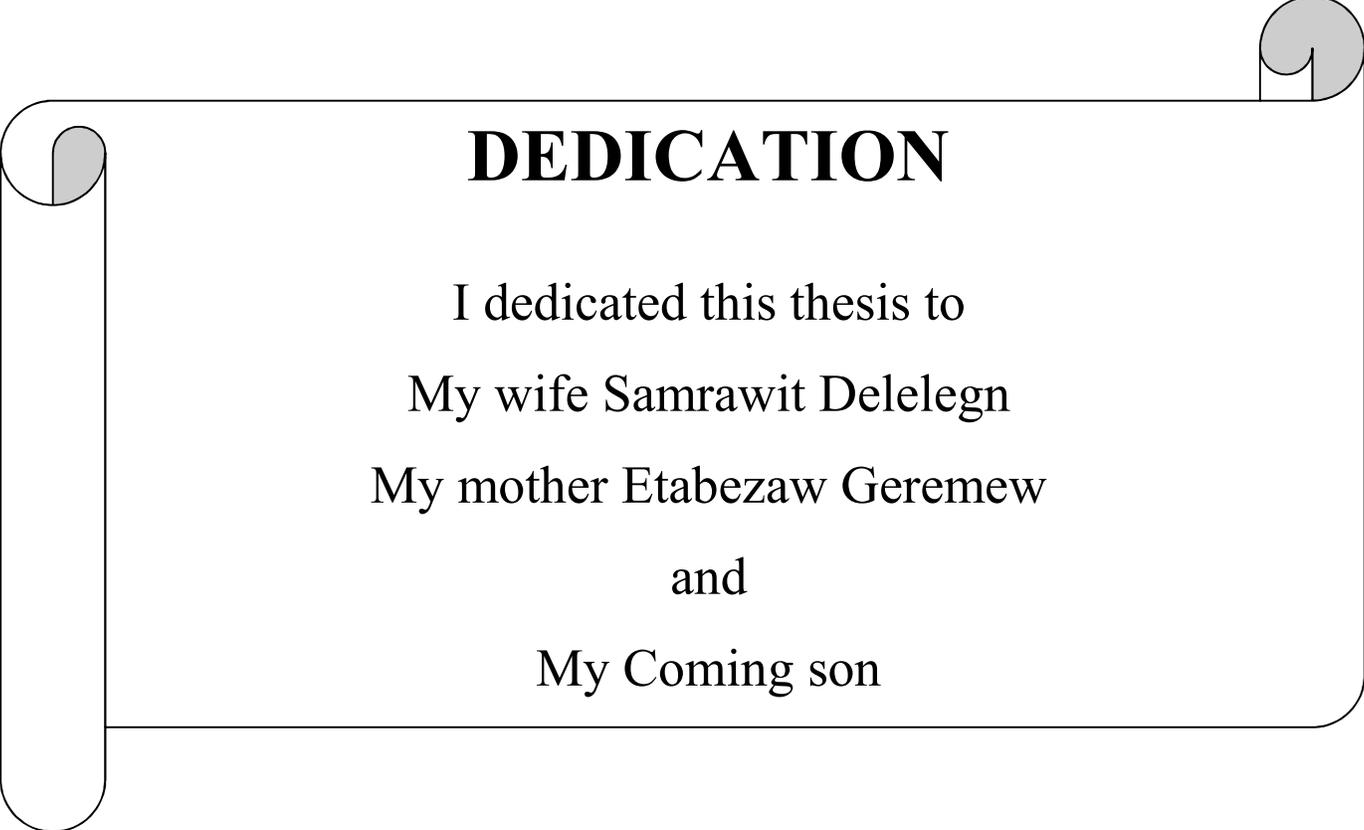

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DEDICATION

I dedicated this thesis to

My wife Samrawit Delelegn

My mother Etabezaw Geremew

and

My Coming son

STATEMENT OF AUTHOR

First, I declare that this thesis is the result of my work and that all sources or materials used for this thesis has been duly acknowledged. This thesis is submitted in partial fulfillment of the requirements for M.Sc. degree at Haramaya University and to be made available at the University's Library under the rules of the Library. I confidently declare that this thesis has not been submitted to any other institutions anywhere for the award of any academic degree, diploma, or certificate.

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BIOGRAPHY

The author was born to his father Ato Melaku Belay and his mother W/ro Etabezaw Geremew in October 1982 at Gelemso town, West Hararghe Zone of Oromia National Regional State, Ethiopia. He attended Elementary school at Gelemso Elementary and Junior School from 1989 to 1996; and Comprehensive Secondary School at Gelemso Senior Secondary School from 1997 to 2000 in Gelemso. He joined Menschen Für Menschen Agro-Technical Technology College and graduated in August with a Diploma in Electrical and Electronics Technology.

Soon After graduation, he was employed in Haramaya University as a HelpDesk Technician, and immediately joined the University Continuing Education program to pursue his B.Sc Degree and graduated in 2010 in computer Science and information Technology. Now he has been serving as a Senior Network administrator in the university Information Communication Technology (ICT) directorate.

The author joined the School of Graduate Studies at Haramaya University to continue his studies for the Master of Science Degree in the Agricultural Information and Communication Management (AICM) in September 2012.

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LIST OF ABBREVIATIONS

ADP	Automatic Data Processing
AGORA	Access to Global Online Research in Agriculture
AGORA	Access to Global Online Research in Agriculture
AGRICOLA	Agricultural Online Access
AGRIS	Agricultural Information Systems
AIC	Agricultural Information Center
ANOVA	Analysis of Variance
APAARI	Asia Pacific Association of Agricultural Research Institutions
BARC	Bangladesh Agricultural Research Council
CAD	Computer Aided Design
CDROM	Compact Disk Read Only Memory
CIARD	Coherence in Information for Agricultural Research for Development
DICT	Directorate of ICT services
DTP	Desktop Publishing
EIAR	Ethiopian Institute of Agricultural Research
FAO	Food and Agriculture Organization
FAO-ROA	Food and Agriculture Organization–Roles of Agriculture
FGD	Focus Group Discussion
GDP	Gross Domestic Product
GIS	Geographic Information System
GO	Governmental Organization
HINARY	Health InterNetwork Access to Research Initiative
HU	Haramaya University
ICT	Information Communication Technology
IPM	Integrate Pest Management
IT	Information Technology
JKKK	Jawatankuasa Kemajuan Keselamatan Kampung
LAN	Local Area Network
Mbs	Mega bit per second

MRI	Magnetic Resonance Imaging
NAIC	National Agricultural Information Center
NARS	National Agricultural Research System
NGO	Non-Governmental Organization
R&D	Research and Development
RARIs	Regional Agricultural Research Institutions
SAS	Statistical Analysis System
SME	Small and Medium Enterprise
SPSS	Statistical Package for Social Sciences
MLR	Multiple Linear Regression
SQL	Structured Query Language
TCA	Technical Cooperation Administration
TV	Television
UNESCO	United Nation Educational, Scientific and Cultural Organization
VOIP	Voice over Ip
WAN	Wide Area Network

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ABSTRACT

The study sets out to identify the Information Communication Technology (ICT) facilities used in agricultural research among agricultural researchers, to assess the benefits of ICT utilization in agricultural research and to identify the factors affecting the uses of ICT in agricultural research in Haramaya University. Purposive sampling technique was used to examine the entire population for the study with the sampling frame of M.Sc and above researchers was selected since they are actively engaged in research activity in the university. Accordingly a total of 143 respondents were selected, 38 from the area of plant science, 33 from animal science, 26 from the area of Agricultural economics, 26 from natural resource and environmental science and 20 from the rural development and agricultural extension. Pretested and validated structured interview questionnaire were used to gather data from respondents. An interview was conducted to generate additional qualitative data. In addition, secondary data were collected from relevant sources such as the university personnel office, research articles and internet. Data were analyzed using descriptive statistics and multiple linear regression models. The findings of the study revealed that computer, statistical packages, internet and mobile phones were highly used ICT by sample respondents, and accordingly the respondents benefited in easing their access of literature, foreign journals, sending and receiving papers to editors through email, minimizing the problems in the analysis and interpretation of research data, and reducing errors. The major reasons for not using ICT were found out to be lack of training, and lack of sufficient time for using ICT. The Multiple linear regression model output reveals that training taken, availability of sufficient time for ICT were found to be positive and significant influence while age of the respondents was found to be negative and has significant influence on the use of ICT in agricultural research. The more the respondents had exposure to different ICT with training, use of ICT on agricultural research conduction and dissemination also increases. The overall finding of the study underlined the importance of ICT in agricultural research. Therefore, it is recommended that use of ICT in agricultural research conduction and dissemination outputs should be recognized and given due attention by the university and other concerned bodies.

Key words: ICT, Agricultural Research, Haramaya University.

1. INTRODUCTION

1.1.   Background of the Study

Agriculture in Ethiopia is the foundation of the country's economy, accounting for half of GDP, 83.9% of exports, and 80% of total employment. Ethiopia's agriculture is plagued by periodic drought, soil degradation caused by overgrazing, deforestation, high population density, high levels of taxation and poor infrastructure (making it difficult and expensive to get goods to market). Yet agriculture is the country's most promising resource. A potential exists for self-sufficiency in grains and for export development in livestock, grains, vegetables, and fruits. As many as 4.6 million people need food assistance annually. Many other economic activities depend on agriculture including marketing, processing, and export of agricultural products. Production is overwhelmingly of a subsistence nature, and a large part of commodity exports are provided by the small agricultural cash-crop sector. Principal crops include coffee, pulses e.g. beans, oilseeds, cereals, potatoes, sugarcane, and vegetables. Exports are almost entirely agricultural commodities, and coffee is the largest foreign exchange earner. Ethiopia is Africa's second biggest maize producer. Ethiopia's livestock population is believed to be the largest in Africa, and in 2006/2007 livestock accounted for 10.6% of Ethiopia's export income, with leather and leather products making up 7.5% and live animals 3.1% (Yohannes, 2013).

Despite its role in the economy agriculture in Ethiopia remains being challenged to meet food security of the nation. The levels of domestic food production, amount of food import both commercial and food aid contributes to the national food security. The positive role of the agricultural sector in terms of ensuring national food security is measured by its contribution to the domestic food production and, hence, reducing dependence on food imports. There is a suggestion to start the assessment of the national food security situation with taxonomy of the country situations. The taxonomy will consider income per capita, the food trade position of the country: whether it is a net food importer or a net agricultural importer or a net agricultural exporter, etc. A theoretical framework and technical aspects for describing and measuring the national level food security situation as well as welfare gains from reduced dependence on food import due to increase in domestic production were provided by the support of the FAO-ROA central team.

With emerging of new ways in the development and transformation of rural areas through knowledge and building of (Shaik *et al,* 2004) strong agricultural R&D system that can significantly contribute towards transforming its traditional and subsistence farming. For Ethiopia to achieve this there has been an appreciably increasing government funding for agricultural R&D in spite of the country's meager financial resources (Tsedeke *et al*., 2004). The mission of agricultural research has always been to improve agricultural practice for the purpose of feeding the ever increasing global population.

Information and Communication Technologies (**ICT**) is Playing great role in recent era of globalization and the country's competitiveness and relevance in the global economy is increasingly determined by its capacity to effectively use information for design, production and marketing (Dzidonu, 2002). Application of new and contemporary ICT for rural and agricultural development in the Asia-Pacific region has been advancing quite rapidly over the last decade. Contemporary analyses accept that ICT, when applied in agricultural and rural development processes include hardware, software and applications for digital content generation, management and presentation (to the user), knowledge management and sharing as well as aspects of institutional management and organizational structures that are related to information, data and knowledge sharing. This blend of practices and processes can be termed Information and Communications Management (ICM) where digital technologies play a significant, if not dominant, role (Gerard, 2013).

ICT have become a global tool often used by individuals, organizations, governments and intergovernmental organizations for personal or official activities. Its application cut across all fields of human Endeavour like medicine, commerce, engineering, architecture, education, library services and agriculture. ICT is emerging opportunities to leverage agricultural productivity also. For example, in facilitating knowledge and information share with development partners such as extension ICT is a convenient tool for research activities (Ifidon and Ifidon, 2007).

The most widespread ICT in developing countries today are mobile phone. The majority of people in the least developed countries still live in rural areas and their livelihood depends on the

primary industries. Even though this technological advancement in communication technology increases at a higher rate, the distribution and application varies from place to place and region to region (ITU, 2009). For instance, access for ICT goods and services is much easier for a person living in Europe and Unites States of America than the one living in Sub-Saharan Africa and Asia (ITU, 2010).

According to May *et al.*,(2007) effective agricultural development requires access to information in all aspects of agricultural production, processing and marketing and ICT is already showing the potential to play an important role in the delivery of this information to this sector in both developed and developing countries. In most cases, the base technology is universal, rather than being specific to agriculture, and hence usage evolves from existing designs and practices. The FAO distinguishes five broad categories through which ICT is used in the agricultural sector. These are technical and economic development for agricultural producers; community development; research and education; small and medium enterprise (SME) development; and media networks (FAO, 2006). Furthermore, unlike most other sources of information, ICT allow information accessibility at any time during the week or day. At the level of agribusiness, the value to a business of having access to ICT is potentially immeasurable.

Therefore, this study assesses how ICT are used by researchers to explore new information prior to conducting research and to disseminate research result in Haramaya University.

1.2. Statement of the Problem

About 85 % of the Ethiopian population gains its livelihood directly or indirectly from agricultural production including livestock. The importance of agricultural research and its impact on development in Ethiopia can hardly be over emphasized. Relative to other African countries, agricultural research in Ethiopia is quite young. Organized agricultural research activities and actual relations between agricultural research and development started with the inception of the Institute of Agricultural Research in 1966 (Tsedeke *et al.*, 2004).

From the different possible ranges of ICT that could be used for agricultural research development the most important one is that the internet, according to the report emphasized in

the study of Gerard (2013) The Coherence in Information for Agricultural Research for Development (CIARD) movement is working to make agricultural research information and knowledge publicly accessible to everyone. The CIARD pathways provide an introduction to the ways in which research outputs can be made more widely Available, Accessible and Applicable (also known as the '3As') to stakeholders. Optimizing the reach and use of research outputs has many advantages. The CIARD Manifesto and Checklist of Good Practices are statements on what needs to be done in order to achieve enhancement of the 3As. The CIARD pathways are practical guides, showing how the different elements of the Manifesto and the Checklist can be achieved by institutions around the world. A collection of case studies describes efforts by institutions around the world in opening up access to their research outputs. A set of standards and tools makes sure that research outputs/repositories are interoperable with other repositories and that data are interoperable, enabling ease of export to other platforms/applications.

While the inclination may be to find ways of integrating the most cutting-edge technology into value chains, practitioners should recognize the infrastructure constraints as well as gender-based constraints that can limit the effectiveness of these technologies. Programs need to identify what ICT are most appropriate for overcoming specific constraints and must avoid the temptation to design programs around ICT. Using the radio arguably remains one of the most effective means of reaching farmers in the field because the infrastructure already exists. Reports indicate that combined ICT programming using radio and mobile phone, might provide new opportunities for women. Although there can be disputes over control of the radio, programming can be designed to interest both men and women farmers (World Bank, 2011).

New ICT may represent appropriate tools to support environmental research and its transmission to policy-makers and the general public. According to Aline *et al.,* (2010) information issues are central to the challenge of environmental protection. However, the influence of ICT on sustainable development of human society is still not well understood and strongly disputed. On the one hand, ICT effects seem to be positive because it is often seen to improve the use of matters and energy.

Haramaya University has actively been involved in research activities, primarily in the field of agriculture. As a pioneer institution of agricultural teaching, research and extension in Ethiopia,

The University has developed and released several improved crop varieties and many improved crop and livestock management practices. In addition to many textbooks, book chapters, research articles, bulletins, proceedings, posters and a number of M.Sc theses and P.hD dissertations. According to the annual research and extension review meeting conducted on 2010/11 academic year a number of completed, on-progress and new research projects were presented and thoroughly discussed. Besides, the outreach office has been engaged in demonstration and scaling up of new technologies and farmers training with the objective of transfer knowledge that can boost productivity and the livelihoods of farming communities. However limited use of ICT in leveraging research and communicating research result to stakeholders are lacking in contrast to growing opportunities for ICT such as internet, different statistical software, different agricultural software and databases, radio, Televison, Cellphone, etc.

To meet this need, investigation of ICT usage in agricultural research has become critical. However, as far as the knowledge of the researcher, there are few studies conducted in Haramaya University that investigate Use of ICT in agricultural research. Therefore, this study attempts to fill this gap.

1.3.   Objective of the Study

The general objective of the study is to assess the use of information and communication technologies (ICT) in agricultural research in Haramaya University.

The specific objectives of the study are to:

- Identify the types of ICT facility (Hardware and Software) used for conducting agricultural research and dissemination in Haramaya University.
- Assess the perceived benefits of ICT for agricultural research in Haramaya University.
- Identify the factors affecting the use of ICT in agricultural research in Haramaya University.

1.4. Research Questions

The study was attempted to address the following research questions:

1. What are the types of ICT facility (Hardware and Software) used for conducting agricultural research and dissemination in Haramaya University?
2. What are the benefits of ICT for agricultural researcher in Haramaya University?
3. What are the factors affecting the use of ICT in agricultural research in Haramaya University?

1.5. Significance of the Study

The findings of this study could be useful to Haramaya University including sister universities and researchers working in related issues. Research institutions could benefit if Haramaya University considers the recommendations of this study as an input to promote technology (ICT) usage in research and teaching in general. As a result, universities would be more effective and efficient in their academic duties. This in turn will positively impact the agriculture education and research in the university and research institutions respectively.

The findings of this study will enable Haramaya University to make informed decisions to enhance their ICT usage in research works as well as in their academic duties. The findings will also provide input to introduce ICT supported curriculum and easily adapt in agricultural research of this century. It also provides input to formulate national policies to increase ICT usage in Ethiopian universities and research institutions as part of the academic and research process. Moreover, it will call up on attention of other researchers to conduct research on the same or related topic.

1.6. Scope and Limitations of the Study

This study will focus on use of ICT for agricultural research in Haramaya University, Ethiopia. Therefore, the study scope is limited to Haramaya University agricultural researchers as the theme of the research is ICT use for agricultural research.

The limited amount of ICT usage behavior and practices for agricultural research in the proposed study area will be of one limitation for this research as the expectation of the researcher and because the use of ICT to tackle rural development and agriculture challenges is so new and is constantly changing in nature, the amount of research done on the impacts and outcomes of programs and technologies are limited.

1.7.   Operational Definitions

There are some concepts, which need operational definition so as to avoid ambiguity and what it implied in this research. Hence the most frequently used concepts and terms assumed to be the key, are the following:

Information and Communication Technologies (ICT): ICT consists of a range of technologies that integrate information technology devices like personal computers with communication technologies such as telephones and telecommunication networks. Both the range of the technologies and their convergence with conventional media are expanding all the time. For the purpose of this study, ICT are defined as a range of technologies that consists of Computer, Agricultural Software (like DSATT), statistical packages (SPSS, SAS etc), database packages, the Internet, e-mail, electronic journals (AGORA, HINARY, etc), Phone (fixed line or cell phone), presentation of information in any format (i.e. voice, data, text and image), video, digital camera and the traditional ICT such as radio, television, newspaper and flipchart. In other words, ICT may refer to those technological outputs that facilitate the collection, storage, processing, transmission, retrieval, presentation and communication of agricultural research (voice, data, text, images) by using the above ICT tools (Rao, 2006).

Benefits of ICT: - ICT certainly play a key role to contribute to reduce asymmetries of information and communication between stakeholders of an agricultural value chain, and to help reduce the vicious circle of rural poverty. However, the positive impact that ICT may play in agricultural value chains depends in large part on the boost of supportive public policies and innovative initiatives in the use of ICT that tend towards equitable access to the most socially disadvantaged and vulnerable groups in rural communities, particularly, agricultural producers,

as the fundamental link in the value chain (FAO, 2011).In this study the benefits of ICT are to generate agricultural knowledge, exchange and disseminate it.

Research is an investigation that usually results in finding information that could be used to find a solution to a problem (Mohapi and Taole, 1997). In this study a research is an agricultural research conducted under plant sciences, Animal sciences, agricultural economics, rural development and agricultural extension and natural resource and environmental sciences.

Researcher or research worker is a scientist who devotes him/herself in doing research also called an investigator (http://www.answers.com/topic/researcher#ixzz2F2GWvITE).Accordingly in this study a researcher is a staff member of Haramaya University that participates in agricultural research.

Agricultural Research seems to be the oldest form of organized research in the world. Agricultural research can be broadly defined as any research activity aimed at improving productivity and quality of crops by their genetic improvement, better plant protection, irrigation, storage methods, farm mechanization, efficient marketing, and a better management of resources. According to Loebenstein and Thottappilly (2007) the primary goal of agricultural research is to support agricultural and rural development by proposing technical innovations adapted to the physical and socio-economic conditions and providing technical information as soil maps, inventory of biological resources, surveys of farms, pests and diseases, etc.

1.8.Organization of the Thesis

This thesis is organized into five chapters. Chapter one has already set out introduction, background to the study, statement of the problem, objectives, research question and the significance of the study. In chapter two, concepts of ICT in agricultural research, empirical studies are explained. Chapter three explains the description of the study area and the methodology used in the study. Chapter four discusses the results of this study. In the fifth chapter, the summary and conclusion are presented.

2. REVIEW OF LITERATURE

In this chapter, important documents necessary for the study were consulted in order to assess what has been done so far in line with the topic and to identify the research gaps. Besides, this chapter served as a theoretical framework for data analysis and interpretation.

2.1. Definition of ICT

Information and Communication Technologies (ICT) is among a widely known concepts, however, Jim (2012)noted that, apart from explaining an acronym, there is not a universally accepted definition of ICT. Because the concepts, methods and applications involved in ICT are constantly evolving on an almost daily basis. It is difficult to keep up with the changes that happen so fast. ICT are concerned with the storage, retrieval, manipulation or receipt of digital data. Importantly, it is also concerned with the way these different uses can work with each other.

A good way to think about ICT is to consider all the uses of digital technology that already exist to help individuals, businesses and organizations use information. ICT refer to technologies that provide access to information through telecommunications; it's similar to Information Technology (IT), but focuses primarily on communication technologies which include the Internet, wireless networks, cell phones, and other communication mediums. In the past few decades, information and communication technologies have provided society with a vast array of new communication capabilities. For example, people can communicate in real-time with others in different countries using technologies such as instant messaging, voice over IP (VoIP), and video-conferencing. Social networking websites like Facebook allow users from all over the world to remain in contact and communicate on a regular basis. Modern information and communication technologies have created a "global village," in which people can communicate with others across the world as if they were living next door. For this reason, ICT is often studied in the context of how modern communication technologies affect society (http://www.techterms.com/definition/ict).

In business, ICT is often categorized into two broad types of product: -

(1) The traditional computer-based technologies (things you can typically do on a personal computer or using computers at home or at work); and

(2) The more recent and fast-growing range of digital communication technologies (which allow people and organizations to communicate and share information digitally)

ICT in a Broader Context

ICT will almost certainly cover the above examples of ICT in action, perhaps focusing on the use of key applications such as spreadsheets, databases, presentation, graphics and web design software.

It will also consider the following important topics that deal with the way ICT is used and managed in an organization:- The nature of information which covers topics such as the meaning and value of information; how information is controlled; the limitations of ICT; legal considerations, Management of information - this covers how data is captured, verified and stored for effective use; the manipulation, processing and distribution of information; keeping information secure; designing networks to share information and Information systems strategy this considers how ICT can be used within a business or organization as part of achieving goals and objectives.

The term ICT by itself is a broad concept. It includes new, old and very old type of ICT. According to Obayelu and Oyulade (2006) categorized ICT in to three main classes. These are:-

New ICT: This group consists of computers, satellites, one-on-one connections, wireless phones (mobile), the internet, e-mail, the web, internet services, video conferences, CD-ROMs, personal computers, distance control systems, information-geographical systems, global positioning systems, electronic cameras, databases, etc.

Old ICT: This group consists of radios, televisions, telephones, telegraphs, audio and video cassettes, films and slides. This group of technologies has been used for several decades.

Very Old ICT: This group of technologies have used for several centuries and includes newspapers, books, photo albums, posters, theater, human interactions, markets and plays.

But for the purpose of this research proposal, ICT includes Computer, Agricultural Software (like DSATT), statistical packages (SPSS, SAS etc), database packages, the Internet, e-mail, electronic journals (AGORA, HINARY, etc), Phone (fixed line or cell phone).

ICT are part of so many aspects of our daily lives and the key for much innovation, including significant health innovations like MRIs (Magnetic Resonance Imaginig) and environmental solutions like hybrid cars (Obayelu and Oyulade, 2006).

ICT covers all forms of computer and communications equipment and software used to create, design, store, transmit, interpret and manipulate information in its various formats. Personal computers, laptops, tablets, mobile phones, transport systems, televisions, and network technologies are just some examples of the diverse array of ICT tools. Studies in ICT include many disciplines, such as mathematics, information systems, physics and design. The skills acquired in an ICT degree can be applied to everything from satellites to iPhone applications, from CT scanners to computer games. While many people think of Information Technology when they think of ICT, Multimedia Design, Computer Systems Engineering and Software Engineering also lead to careers in ICT.

Specialized Business and Industry Uses ICT as enabling technologies, ICT is used strategically in almost all businesses and industries. Many have developed specialized systems and uses of ICT and many have specialized legal and regulatory requirements; quality control systems; integrations with production and research equipment and systems; security requirements; and software application. For example Bioscience industries rely on specialized ICT systems and applications to conduct research, analyze organic materials, and produce biotech products and do Required reporting; Financial services industries rely on ICT to maintain customer records, do business, conduct trades, do financial reporting, secure proprietary information and comply with regulations; Manufacturing industries use specialized computer controlled systems and robotics to design, Produce and test products. Property management operations use ICT to network and control heating and cooling, lighting and building access systems. Electric utilities use ICT to

monitor and manage electricity distribution, customer billing and Smart metering systems. Telecommunications, cable TV and other entertainment industries use ICT to store content, manage customers and deliver their service. We need to develop a competent workforce that understands not only relevant technologies, but also specialized business and industry environments and operations, to meet these specialized needs.

ICT Research and Development Scientists – ICT fields themselves are under constant pressure to evolve and improve. We need people who deeply understand the science and technologies underlying ICT and who can work to advance the fields. Invirtually all modern businesses, industries and in modern society in general, ICT has key strategic roles. It is strategically important to develop citizens and workers who can competently and efficiently operate and add value in these systems and environments (Obayelu and Oyulade, 2006).

2.2. ICT in Agricultural Research

Information and communication have always mattered in agriculture. Ever since people have grown crops, raised livestock, and caught fish, they have sought information from one another. What is the most effective planting strategy on steep slopes? Where can I buy the improved seed or feed this year? How can I acquire a land title? Who is paying the highest price at the market? How can I participate in the government's credit program? Producers rarely find it easy to obtain answers to such questions, even if similar ones arise season after season. Farmers in a village may have planted the "same" crop for centuries, but over time, weather patterns and soil conditions change and epidemics of pests and diseases come and go. Updated information allows the farmers to cope with and even benefit from these changes. Providing such knowledge can be challenging, however, because the highly localized nature of agriculture means that information must be tailored specifically to distinct conditions.
(http://www.ictinagriculture.org/sourcebook/module-1-introduction-ict-agricultural-development)

The application of ICT to agricultural research has attracted comments and several publications across the globe, many of which concentrated on review of programmes or established systems. According to Salau and Saingbe (2008) Information technology is a key to agricultural

development. Consequently agricultural researchers, trainers, extension workers, farmers and students must have easy and uninterrupted access to ICT facilities in their immediate environment. They studied 3 tertiary institutions and the ADP in Nasarawa State in 2006 to determine the accessibility and level of utilization of ICT by agricultural scientists and extension workers.

The findings revealed that researchers had 87% access to ICT facilities while extension workers had 66% access. On the level of utilization of ICT for agricultural communication the researchers scored 84% while extension workers scored 70.3%. The regression analysis further revealed that the level of education positively influenced the level of utilization of ICT while years of working experience had negative influence. The key problems militating against the use of ICT in the area were poor access to ICT facilities, lack of computer knowledge, low income and poor power supply. It was recommended that agricultural organizations should install all necessary ICT facilities in their establishments and provide training opportunities for their staff. Constant power supply to both urban and rural communities should be considered a fundamental human right and treated as such.

Maoz (2007) reviewed the European Research Areas Network and reported that ICT supported collaboration in agricultural research can be very productive with a high value added. He stated that many barriers stand in the way of coordinating national research programs adding that research managers are constantly frustrated when realizing that nationally funded research is duplicated in other countries, which in a sense is "wasting" someone's scarce national research funds. Adoption of ICT to alleviate coordination constraints is a unique challenge and a specific public concern with regional, national, and international strategic significance. ICT adoption can be catalytic as it transforms the way agricultural researchers conduct their research, innovate, and cooperate among themselves, and with the wide range of users of agro-technology.

Singh (2006) reported that the success stories of agricultural information systems in the Asia-Pacific in which he stated that agricultural extension systems since the 1990's in the region have been significantly weakened and reduced in their effectiveness due to a variety of reasons primarily reduced funding to agricultural development when economic development policies shifted. Investments in using ICT in extension by NARS consequently very limited. However, in

recent years, agriculture is regaining attention. Most focus is in enabling smallholder farmers, the majority in the farming communities of the region participate more equitably in national, regional, and global markets.

Several countries in Asia are seeing very innovative use of ICT in agricultural and rural development. He stated further that are transforming conventional agricultural extension. A common learning from these ICT enabled initiatives for agricultural development has been that farmers' information needs to be satisfied through use of ICT are for market related information including price agricultural problems, especially diagnosis of disease and pest problems and getting solutions to them. The type of services that use of "new" ICT can provide include call centers, help desks, web based question and answers, frequently asked questions, e-mail based electronic discussion lists and on-line "communities of practice". This is leading to transformation of how ICT use is also transforming through extension, with the focus in rural development on universal access (Singh, 2006).

In Bangladesh, Alam and Ahmed (2008) reported efforts of the government in the application of ICT and Geographic Information System (GIS) for agricultural development. Through this project, a computerized land information system for Bangladesh was established. It includes land resource inventory, crop viewer, climatic map, drought mapping, and crop pattern suitability model. They reported further that NARS scientists have developed fifty-five new technologies. Database of the new technologies includes name and address of the scientist, test location, where being implemented, yields, expected return, etc. Agricultural information center(AIC) of BARC provides Library service to all agricultural scientists, Internet search opportunities, CDROM search facilities and National Agricultural Information System (NAIS) database search service.

Gelb and Levanon (2008) made a case study of Israel in the management of public funded research and affirmed that the traditional management methodology to manage R&D in agriculture was and is supported by use of basic ICT-skillfully adapted and employed to do "traditional" clerical chores. They stated that innovative research management methodology supported by ICT involves coordinating interactive knowledge accessing, cross referencing and integration of ever expanding and varied data sets, real time client feedback of research results

and product implementation, maintaining geographically-neutral collaboration, synchronizing long term goals with resource allocation priorities and much more.

Agricultural research and ICT in Africa R&D management methodology and practice exploiting innovative ICT supported management practices can considerably improve the efficiency of research, research results, and their dissemination and eventually result implementation. This efficiency can be expressed via an increase in general agricultural productivity, product quality, and technological progress. They gave some changes and/or improvements enabled by ICT Adoption to include On line and real time addressing of large audiences efficiently via the Chief Scientist's Portal and individual e-mail contacts. Both in turn facilitate online accessing of relevant information and individual contacts as and when required; Computerized handling of the research proposals enable improved and efficient decision making (Gelb and Levanon, 2008).

In Makerere University, Uganda, efforts are being made to develop and maintain an advanced technology environment in order to support and enhance the teaching, research, and learning, service, & administration activities of the Faculty of Agriculture community. The ICT Unit of the Faculty of Agriculture in collaboration with the Directorate of ICT Services (DICT) is responsible for support, maintenance, and improvement of ICT in the Faculty of Agriculture. The Unit handles all issues concerning ICT and offers Skills Training in ICT focusing on Agriculture in the information age. It is the mission of the ICT Unit to develop and maintain an advanced technology environment in order to support and enhance the teaching, research, learning, service, and administrative activities of the Faculty of Agriculture community (Attahiru and Afolabi, 2012).

Mwatawala (2005) discussed the potential for utilization of ICT in IPM (Integrated Pest Management) in Tanzania and concluded that there is a great potential for Tanzanian farmers to use ICT in IPM. There is an ICT policy, which shows strong government commitment to support ICT programmes as well as a pilot project for the utilization of ICT in rural areas. According to him what is required now is the implementation of the IPM policy with emphasis on the provision of information to the majority in rural areas.

Agricultural research and ICT in Ethiopia

Despite the modest achievements of agricultural research on developments in Ethiopia in the past few years, there are some serious challenges that literally dilute/neutralize the progress achieved. Even during the last couple of years when the country received more than adequate, well distributed rain in the major crop producing areas, about four million Ethiopians need food assistance. Developments through agricultural research do not occur in a vacuum. Obstacles to achieve these goals should be constantly accessed and given serious considerations to help the country become food self-sufficient and food-secure. Good governance emanates from listening to professionals and the farmers at large and making changes as the needs arise especially when realities on the ground do not conform to political policies. In this regard, some serious issues need to be addressed by the Ethiopian government for agricultural research to have a meaningful impact on alleviating the chronic and perpetual food shortages the country is facing (Ephrem, 2007).

Although Ethiopia has one of the most extensive extension and advisory service in the world, and deploys several extension agents who work with farmers at designated farmer training centers in the country; many farmers complain that they don't see extension agents. The use of ICT with face-to-face encounters would enable farmers to obtain the knowledge and information required for innovations in agriculture makes a case for the adoption of ICT as a platform for providing knowledge and information for farmers in Ethiopia. (sbuzzelli, 2012).

Research centers and Higher learning institutions in the sector of agriculture in Ethiopia in general and HU in particular these days have many ICT facilities among them the 100mb broadband internet, more than 2000 internet connected computers, every researchers own mobile phone individually accordingly researcher has to be benefited by using the already structured ICT tools, even though there are constraints faced.

2.3.   Factors affecting ICT Utilization in HU Agricultural Research

Faculty members' attitude towards technology can be influenced by many factors including their demographic and professional characteristics. Younger faculties are deemed more open to technological innovation having become familiar with computers or the Internet in their undergraduate or graduate education whereas, experienced faculty at higher ranks (associate, full professor) not only may be older, cannot work easily with these technologies, because of not learning information and communication technologies in the process of their education.

However, it is found that faculty with more years of teaching experience and those teaching at doctoral and research institution had the most favorable attitude toward using the Web, which should provide a cautionary note to anyone assuming that only younger faculty appreciate using the Web. It is not clear whether there are gender, race, or discipline differences in technology use, although there remains the perception that female, minorities and the humanities are less "tech- savvy" or suffer from the digital divide. These differences need to be moved from the realm of speculation and empirically tested. Another set of characteristics of faculty that may play a role in technology use is a faculty member's other duties. Learning new technologies takes time. There is ample evidence that online education currently demands more time from faculty, but proponents argue that time commitment can decrease when faculty are well versed in technology use and redesigned course work may demand less faculty time than before (Seyed and Leila, 2009).

Lastly, moreover the demographic and professional measures, the role of some contextual factors in faculty technology use should be examined. For instance, discipline differences in technology use have not been sufficiently studied even though academic specialties strongly influence the distinctive epistemology professional commitment and attitudinal and behavioral characteristics of faculty members within disciplines.

Information and communication technologies are new emerging technologies in Ethiopia. In recent years, these technologies have attracted the attention of many scientists, policymakers, planners, economists and even politicians in many universities and some governmental organizations involved in various areas and disciplines (Seyed and Leila, 2009).

However, using ICT in HU agricultural college still in their infancy stages and there are only a few online programs, although it is a necessity for research and enormous demand for education. By taking account of importance of this fact and more benefits and potential of ICT for agricultural research and higher education in general the necessity for preparing the faculty members to use these technologies for research and for educational programs is crucial and this research is conducted to study the use of ICT in agricultural research in HU.

2.4.   Empirical Studies

Even though it is difficult to find empirical studies on the use of ICT in agricultural research especially in our country, some of the recent initiations and others that were accessed through internet are reviewed and presented hereunder.

The agricultural sector is facing a range of challenges. Key among these is population growth (Connors *et al.*, 2004), which needs not only more food but also more variety and more nutritious food. This will put massive pressure on natural resource bases. Agricultural information professionals must support agriculture by managing and improving access to a proliferating and increasingly complex array of information in a climate of shrinking resources (Smith, 2003). Thus, today's agricultural students will require new abilities to thrive in the future, and information plays a vital role in the lives of individuals. Information is a powerful tool in addressing agricultural needs and if it is used appropriately it can radically change anation's economy (Tshabalala, 2001).

There is an overwhelming awareness that there are great potentials in the availability and use of information and communication technologies. The use of ICT promotes development and improves services in any organization. It brings changes in today's business environment. In academic environment, it speeds up information delivery, facilitates teaching, learning and research. In spite of the above observation about the potentials, and benefits of using ICT, the level of awareness and use in Nigeria appears to be very minimal. Organizational, environmental and cultural factors stand against the good and perceived will of the use of ICT.

Omolayole (2002) points out three strong reasons that stand against the effective use of ICT in Nigerian academic libraries. Each of the factors she has mentioned has a resultant effect on availability and use of ICT. The factors are low level of computer culture, poor telecommunications infrastructure and general lack of awareness. Another constraint that affects the use of ICT in Nigerian academic libraries is low level of computer culture. When librarians are not computer literate, utilizing the facility would be a problem. In other words, having a good background in computer skill makes the use of computers in work places very practicable. Lack of awareness on the other hand makes availability impossible. Library managers must be aware of the advantages of using ICT in libraries and information sector. Training workers on the use of computers and other related technologies for services in any organization including academic libraries is very important. A well trained worker can perform effectively and efficiently in his/her work place than he/she who is not trained at all.

Attitude is seen as an evaluative disposition based upon cognitions, affective reactions, behavioral intention and past behaviors and it provides the response of someone's like or dislike towards something (Shih, 2004; Luarn and Lin, 2004). Previous studies have tried to seek the relationship that might occur between attitude and ICT usage among the rural community. Shiro(2008) for example, through his research, has proved that rural community possess positive attitude towards ICT and they welcome any ICT project to be built in their areas. However, Shiro(2008) also found that their lack of ICT knowledge reduces their ICT usage.

Dixon (2009) has concluded that ICT usage and exposure are the important things needed to form a positive attitude towards ICT. Frequent use and exposure to ICT will drive people to accept that ICT will assist them and become useful in their daily life. Thus, this is an indication of creating a positive attitude towards ICT usage. Also, Dixon (2009) noted that frequent use and exposure to ICT will develop the strength of ICT knowledge and skills. Zhang and Aikman (2009) have another view when they claimed that attitude can be a mediator on the role of attitude towards behavioral intention.

Another important factor that can construct positive attitude towards ICT usage is the socio demographic factors. A study done by Yuandong *et al.* (2005) concluded that age and gender will influence the attitude of rural community towards ICT usage. Gender has always been an

important factor to constitute positive attitude and gender differences proved to have a significant impact on some studies (Sayan *et al.*, 2004). Olatokun (2007) has come to a specific result when he claimed that females do have a positive attitude towards ICT usage. Income is one of the important factors to constitute a positive attitude towards ICT usage and this is not surprising as it is in tandem with what have been completed by Akman and Rehan (2010) and Lenhart and Horrigan (2003).

Computer usage is another significant factor that can be associated with positive attitude towards ICT usage. People who use computer more will have a positive attitude towards ICT usage. The same results also occurred for Internet usage; those who use Internet more will have a positive attitude towards ICT (Markus and Soh, 2002). Education without doubt has a direct influence on ICT usage. Studies done by Roe and Broos (2005) and Bonfadelli (2003) have claimed that low educated people possess negative attitude towards ICT usage while people with high level of education will have a positive attitude towards ICT usage. As such, it would be useful to know whether besides these findings, the situation also occurs in Malaysia especially among the JKKK members. Thus, the main objective of this study is to assess the use of ICT in agricultural research the case of Haramaya University.

2.5.   Conceptual Framework of the Study

Based on literature review, empirical studies, discussion with experts and personal observation the conceptual framework for the present study was formulated by taking into consideration independent variables which include the personal/demographic, technological; behavioral and institutional factors expected to affect and influence the dependent variables (use of ICT in agricultural research).

Personal/Demographic Factors

- **Age**
- **Work experience**
- **Field of study**

Institutional Factors

- **Training**
- **Leadership Support**
- **Type of the research**
- **Availability of time**

Use of ICTs in Agricultural Research

Technological Factors

- **User Friendliness**
- **Relative advantage**

Behavioral Factors

- **Information seeking behavior**
- **Mass media exposure**
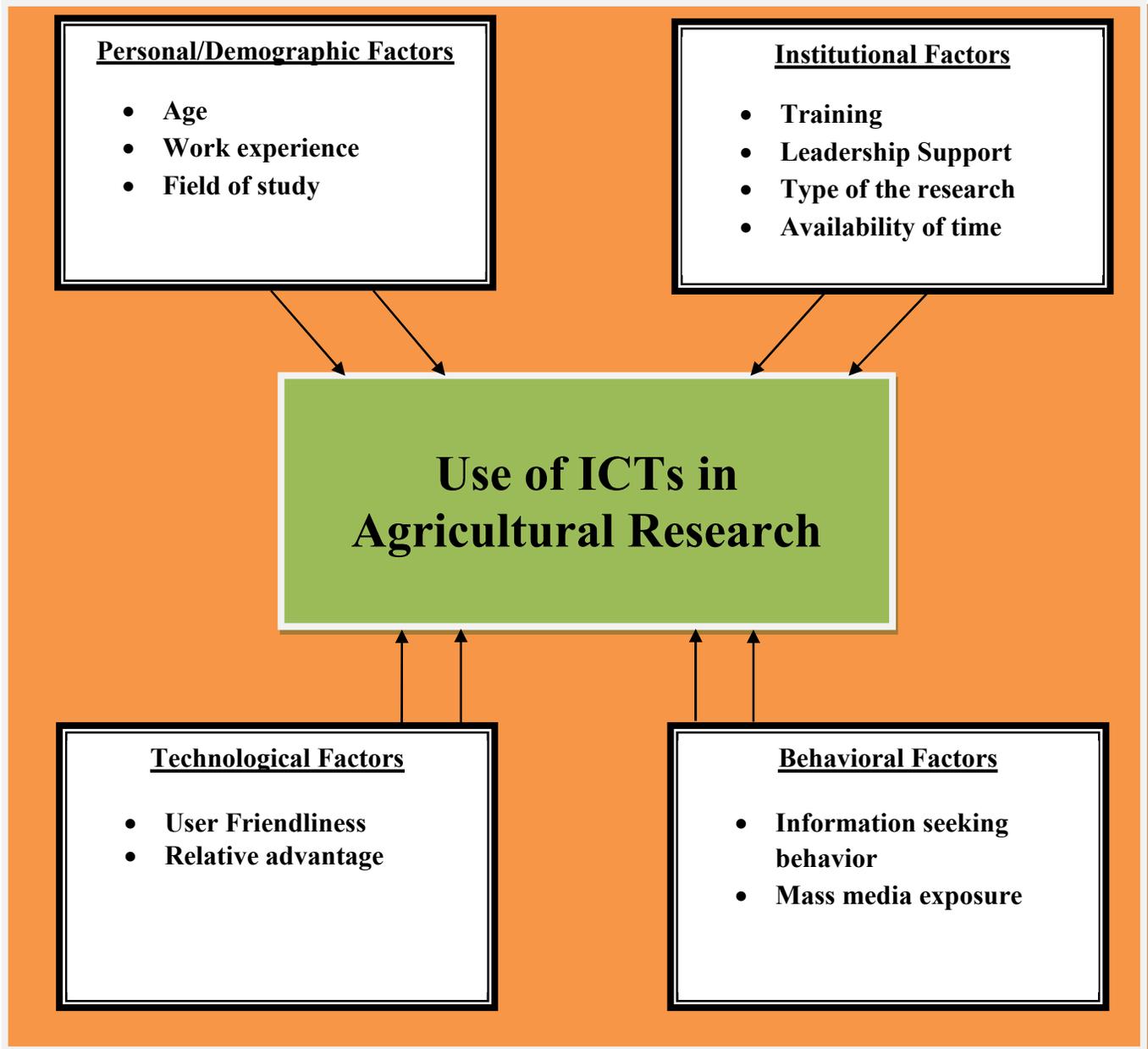
Figure1. Conceptual Framework   (Source: Own Formulation)

3. RESEARCH METHODOLOGY

3.1. Description of the Study Area

Haramaya University is located in Eastern Hararghe Zone, about 25 kilometers from the city of Harar and 40 kilometers from Dire Dawa, Ethiopia. Its foundation was laid as a result of Agreement for Cooperative Agricultural Education Program between the United States and the then Ethiopia Government in May 15, 1952. Accordingly, agreements signed between the Technical Cooperation Administration (TCA) and Oklahoma State University to establish the Imperial Ethiopian College of Agriculture and Mechanical Arts in May 16, 1952 (Belay, 2000). To this end, the Jimma Agricultural and Technical School was used since October15, 1952, to serve as a source of the future college candidates and an interim site for the would be Imperial Ethiopian College of Agriculture and Mechanical Arts. The first classes in the then College of Agriculture and Mechanical Arts began in September 1953 with an intake of fourteen freshman students from those who had completed high school courses in agriculture from Jimma (www.aet-africa.org).

In 1967, the College of Agriculture and Mechanical Arts became part of the then Haile Selassie I University (at present Addis Ababa University) and was renamed as Alemaya College of Agriculture in 1968. Development and expansion continued and in 1985, it was given University status as Alemaya University of Agriculture (Johannes *et al*., 1994). In 2006, it was renamed again as Haramaya University.

Haramaya University is one of the oldest higher learning institutions with distinguished history of achievement in education, research and development in agriculture. Currently, the University is running 83 programs at PhD/ MSc/ Med/MA BA/MD/BSc/ BEd/ DVM and LLBlevels, and there about 39 regular undergraduate programs, 32 masters programs and 12PhD programs (Planning Office, 2013). Haramaya University's annual intake capacity of students in all programs has reached to 29, 441 in the 2011/2012 academic year. In addition, the university has more than 3,000 academic, administrative and support staff members, providing a great variety of opportunities for individuals with diverse backgrounds (Personnel Office, 2013).

The existing academic unit in Haramaya University has reached to eleven colleges, three institutes. The colleges are College of Agriculture and Environmental Sciences, College of Medical Sciences, College of Educational and Behavioral Sciences, College of Business and Economics, College of Law, College of Veterinary Medicine, College of Natural and Computational Sciences, College of Computing and Informatics, College of Continuing and Distance Education, College of Social Sciences and Humanities and College of Health Sciences. The three Institutes are Institute of Pastoral and Agro-Pastoral Studies, Institute of Technology for Agro industry and Forest Development, Institute of Technology.

The University has three campuses. The Haramaya Campus is the main campus, by far the largest, hosting ten colleges, two institutes and offices of the management. The second campus is Harar Campus which is located in Harar town. On this campus, there are the College of Health Sciences and College of Medical Sciences. The third campus, Chiro Campus is located in Chiro town. It hosts Institute of Technology for Agro industry and Forest Development (Personnel office, 2014).

Research is one of the areas that Haramaya University will be known starting from its establishment especially in the areas of Agriculture. Since its inception, the University has been actively involved in research activities, primarily in the field of agriculture. As a pioneer institution of agricultural teaching, research and extension in Ethiopia, Haramaya University has developed and released several improved crop varieties and many improved crop and livestock management practices. The institution has produced many textbooks, book chapters, research articles, bulletins, proceedings, posters and a number of M.Sc. thesis research reports as stated in the official web site of the institution.

ICT has started as the office in 2000 in the University in small unit with a staff member of 3 and it is established at that time simply to maintain computers in the university. But now the office will become strong and re-established as ICT directorate with the sub section of infrastructure and service, support and maintenance, teaching and learning technologies, business application administration and development and also training and consultancy to effectively conceive, develop, implement, utilize, and manage appropriate information systems in order to provide

integrated, coordinated and customer-focused quality ICT services to Haramaya University in line with its vision, mission and objectives.

Accessibility of the Internet in Haramaya University has improved with the introduction of broadband Internet access in mid to late 2000s (Yared, 2010). Moreover, there were two Local Area Network installation and expansion projects implemented between 2005 and2011. The projects have significantly increased number of Internet access points in the university particularly in offices, staff residences, computer laboratories, libraries even wireless zone has been established in recreational areas. Moreover, the increasing national Internet bandwidth and ICT infrastructure at a national level has contributed to the improving accessibility of Haramaya University.

Currently, Haramaya University has more than 2000 wired Internet access points and more than 20 wireless zones. The Internet bandwidth of Haramaya University has reached to 200 Mbs. (Haramaya University ICT Office, 2014).

3.2.   Data Types and Data Sources

To elicit the necessary information for a given study, first the type of data that needs to be gathered and the sources from which the data was collected were determined. Both qualitative and quantitative, and primary and secondary data were collected to answer the research questions and objectives of the study. It includes personal/demographic, institutional, behavioral, technological, as well as use of ICT in agricultural research. Data were gathered through questionnaire and interview with researchers. The primary data sources were an agricultural researcher that uses ICT in research, and secondary data sources were with subject matter specialists, who have been working in the area, and documents and official reports that were written based on the evidence of the study area. Pre-testing was done on 8(5%) of the total sample size.

3.3. Sampling Procedure

Sampling procedure is important to establish the representativeness of population. It represents the target population comprising some or all members of population. In this study, every staff member of the population *i.e.* all agricultural researchers in the college of agriculture and environmental sciences (CAES) of Haramaya University were interviewed or tested with the sampling frame of M.Sc and above educational level. Because it was assumed that M.Sc and above staff members were actively engaged in research in the university scenario so that the unit of analysis would be an agricultural researchers in Haramaya University. As shown in Table 1, the total population size of the study was 143. Thus, this study uses purposive census in order to achieve accuracy (Morris *et al*., 2004).

Table . Population of the study of Agricultural Researchers in HU-CAES

Research Area conducted	Educational Level			Total
	Professor	**PhD**	**M.Sc.**	
Plant Science	7	17	14	38
Animal Science	1	9	23	33
Agricultural Economics	2	7	17	26
School of NRES	1	6	19	26
RDAE	0	3	17	20
Total	11	42	90	**143**

Source: - From respective departments, Haramaya University Research and extension office (2013)

3.4.   Data Collection Procedure

The study was designed, developed and carried out to determine and analyze the current status and use of ICT in agricultural research of Haramaya University. Survey method is used to collect data from respondents. The study uses both primary and secondary data. Accordingly, Primary data was collected using survey questionnaires, interview schedules and informal discussions with the sample unit from agricultural researchers of Haramaya University. Therefore, Agricultural researchers from Plant sciences, Animal sciences, Natural resource and environmental sciences, Agricultural economics and Rural development and agricultural extension staff members were included. Secondary data were gathered from prior published and unpublished studies, facts and figures, reports, websites and records of various university and research centers, documents of GOs and NGOs which are related to the study at hand was consulted.

A carefully designed questionnaire was used as a principal tool for the collection of data in person and by using an institutional email address. Apart from questionnaire, interviews were adopted for data collection and the informal discussions used are carefully chosen to include all the stakeholders in agricultural research.

3.5.   Methods of Data Analysis

After collection of quantitative data, the responses in the questionnaires were checked for completeness and consistency. Then the data were coded and entered into a computer using SPSS Version 20. The descriptive statistical tools such as frequency distribution, mean, standard deviations, t-test and chi-square of variables were computed. Furthermore, 95% CI and p-value was used to assess the degree of statistically significance. Multiple linear regression analysis was used to test the potential power of selected continuous and discrete variables that may affect the use of ICT in agricultural research in Haramaya University. This test was used to measure the effect of sex, age, type of the research, background, experience, training, sufficient time, information seeking behavior and mass media exposure among non-users and small, moderate, high and very high users of ICT in agricultural research.

Multiple linear regression model

To identify the determinants of utilization of ICT in agricultural research, the multiple linear regression model was used. It is used to estimate the probability of utilization of ICT in agricultural research that takes0 = non user, 1 = small user, 2 = moderate users, 3 = high users and 4 = very high users of ICT.

3.6.   Variables under the study

Putting the objectives of the study at the center, the following variables were expected to affect the uses of ICT in agricultural research were selected based on review of literature, past research findings, expert and author's knowledge of the ICT situation of Haramaya University. Accordingly, the major variables that expected to have influence on the uses of ICT are listed below.

3.6.1. Dependent variable

The dependent variable (Y) is a variable being affected by the independent variable. In this study, researchers' utilization of ICT in agricultural research was a dependent variable. The respondents ICT use status for the analysis, which was, the dependent variable is as follows.

Y = Mean of the 9th Major ICT facilities used in agricultural research. i.e.

$$Y = \frac{X1+X2+\cdots+X9}{9}$$

Utilization of ICT, the dependent variable were,

- Non ICT user (Y=0): this refers to respondents that showed not used ICT in research.
- Small user of ICT (Y=1): this refers to a condition where the respondents are using ICT for conducting research and dissemination in small level.
- Moderate user of ICT (Y=2): this uses ICT facilities in moderate level for to conduct research and disseminate by using ICT.

- High user of ICT (Y=3): Respondents that uses ICT in better, Higher level of ICT user for a research
- Very high user of ICT (Y=4): another category in which very nicely incorporate ICT in research conduction and dissemination.

3.6.2. Independent variables

Age: It refers to the age of the researcher's in years. As the age of the researcher increases, the probability of utilization of ICT decreases. Because, with age, a researcher may become more risk averse and less interested then, tend to be reluctant to new technologies. Past study also asserted that elderly people might be less interested in the use of hi-tech innovations (Salau and Saingbe, 2008). Therefore, in this study it is hypothesized that age of researcher is likely to affect ICT utilization for agricultural research negatively.

Sex: Sex is a dummy variable that takes 1 for male and 0 for female. This research assumes that male tends to use ICT for agricultural research better than female. Past study also shows that males dominated agricultural research and extension in Nasarawa State and it further implies that technology development and transfer will be gender biased(Salau and Saingbe, 2008).Therefore, in this study it is expected that male researcher was likely to use ICT more than female for agricultural research.

Research Experience: Experience in teaching and research influence the use of ICT even though some research reported that teachers' experience in teaching did not influence their use of computer technology in teaching (Niederhauser & Stoddart, 2001), most research showed that teaching experience influence the successful use of ICT in classrooms (Wong & Li, 2008). Gorder (2008) reported that teacher experience is significantly correlated with the actual use of technology. In her study, she revealed that effective use of computer was related to technological comfort levels and the liberty to shape instruction to teacher-perceived student needs. Also, Baek *et al* (2008) claimed that experienced teachers are less ready to integrate ICT into their teaching. Younger officers are expected to have higher level of ICT awareness and utilization (Salau E. S. and Saingbe N.D, 2008). Therefore, in this study it is hypothesized that experienced researchers are more resistant and risk averse in using the technolog**y.**

Field of study (Background): - Field of study is a dummy variable takes a value of 1 if the researchers were from ICT background and 0 otherwise. The researcher's field of study or academic background was expected to influence utilization of ICT for agricultural research. That is hypothesized if the researcher's background was of ICT discipline he/she uses ICT more.

Type of the research: - The type of a research/approach affects ICT utilization either positively or negatively. So it was a categorical variable which takes 1 if quantitative, 2 if qualitative and 3 if it is mixed one.

1. **Qualitative:** - Qualitative research is the approach usually associated with the social constructivist paradigm which emphasizes the socially constructed nature of reality. It was about recording, analyzing and attempting to uncover the deeper meaning and significance of human behavior and experience, including contradictory beliefs, behaviors and emotions. Researchers were interested in gaining a rich and complex understanding of people's experience and not in obtaining information which can be generalized to other larger groups. Qualitative researchers do not base their research on pre-determined hypotheses. Nevertheless, they clearly identify a problem or topic that they want to explore and may be guided by a theoretical lens - a kind of overarching theory which provides a framework for their investigation. So it is hypothesized that in qualitative type of research ICT was not utilized that much.

2. **Mixed Research:** - The pragmatic approach to science involves using the method which appears best suited to the research problem and not getting caught up in philosophical debates about which was the best approach. Pragmatic researchers therefore grant themselves the freedom to use any of the methods, techniques and procedures typically associated with quantitative or qualitative research. They recognize that every method has its limitations and that the different approaches can be complementary. They may also use different techniques at the same time or one after the other. For example, they might start with face-to-face interviews with several people or have a focus group and then use the findings to construct a questionnaire to measure attitudes in a large scale sample with the aim of carrying out statistical analysis.

Depending on which measures have been used, the data collected is analyzed in the appropriate manner. However, it is sometimes possible to transform qualitative data into quantitative data and vice versa although transforming quantitative data into qualitative data is not very common.

Being able to mix different approaches has the advantages of enabling triangulation. Triangulation is a common feature of mixed methods studies. It involves, for example in some studies, qualitative and quantitative methods are used simultaneously. In others, first one approach is used and then the next, with the second part of the study perhaps expanding on the results of the first. For example, a qualitative study involving in-depth interviews or focus group discussions might serve to obtain information which will then be used to contribute towards the development of an experimental measure or attitude scale, the results of which will be analyzed statistically a research approach that shares both quantitative and qualitative research. This study therefore hypothesized that mixed methods of a research uses ICT more.

Training: - The breakdown of a computer causes interruptions and if there is lack of technical assistance researchers would be discouraged from using computers because of fear of equipment failure since no one would give them technical support in case there was technical problem. Training plays much role in using ICT for agricultural research and affects the dependent variable. Therefore in this study it was hypothesized that a researcher that gets access to training in ICT may use higher than those didn't take.

Leadership Support: It is believe that a leader who implements technology plans and also shares a common vision with the researchers stimulate them to use technology in their work. Although ICT accesses and opportunities were high in the Haramaya University, the quality of leadership and management of ICT was crucial to the provision of good ICT learning opportunities. As the quality of ICT leadership improves, so does the percentage providing good quality ICT learning opportunities.

Time Availability: - If one researcher gave sufficient time for accessing and using ICT he/she may be comfortable with different technologies, but if he/she has additional task given in addition to his/her normal duty they may suffer for the technology, So time was crucial and it is directly related to the dependent variable. If one researcher has additional responsibility to

perform like administrative work he/she doesn't have enough time to use ICT properly so it would affect the dependent variable negatively. This variable was a continuous independent variable.

Information seeking behavior- This is defined as the degree to which the respondent was eager to get information from various sources on different roles he/she performs. It was measured based on the researcher's effort to get a range of information, frequency and range of sources using the scale suggested by Pareek and Rao (1974). When a person was eager to get information from various sources, he/she would-be motivated to access and consequently utilize the agricultural information. It is a dummy variable which takes 1, 2 and 3.1represent low, 2 represents medium and 3 represents high tendency to seek information about maize technology respectively. So it was expected to have positive influence on using of ICT.

Mass media exposure: - Mass media play the greater role in creating awareness in shortest time possible over large area of coverage. It was measured in terms of frequency of contact with different media (TV, radio, printed materials mobile and internet). Therefore, it was expected to have positive influence on ICT use in agricultural research.

Technological Characteristics

User friendliness and Relative advantage was technological characteristics taken into consideration to maximize the use of ICT in agricultural research. Technology characteristics influence the diffusion processes of an innovation and were significant factors impacting an innovation adoption. Evidence suggests that innovation attributes: relative advantage, compatibility, complexity, trialability and observability as perceived by individuals influence the rate of adoption (Rogers, 2003). He stresses the need to understand the perceptions of an innovation, as this has strong influence on future prediction of adoption of specific innovation. Understanding educators' perceptions of innovation is a key to successful adoption of technology in learning, which according to Watson (2006) is a particular kind of instructive innovation. Groff &Mouza (2008) assert that when teachers integrate ICT into teaching they operate as innovators. Accordingly in this research it was hypothesized that Technological characteristics (User friendliness and Relative advantage) affects usage of ICT in agricultural research.

4. RESULTS AND DISCUSSIOINS

As already discussed, this study was conducted based on cross-sectional data collected from a total of 143 agricultural researchers from the entire departments under Agricultural and Environmental Sciences College, Haramaya University. The result of this study is presented and discussed to address the objectives of the research. Furthermore, it discusses sex, age, educational level, training, research experience, field of study (Study background), research type, time availability, information seeking behavior, mass media exposure and technological characteristics with use of ICT. In addition to discussing the type of ICT facilities used for agricultural research, it also explained benefits that users gain in using ICT facilities during conduction and dissemination of their research. Thus, the findings obtained are discussed in detail. The results of the descriptive statistics analysis are important before passing into the econometric model based statistical analysis. The respondent's personal and demographic, institutional and technological variables were analyzed using descriptive statistics.

4.1. Description of the Influence of Independent Variables with the Use of ICT on agricultural research

4.1.1. Personal and Demographic Variables

4.1.1.1. Sex

Table 2 represents the distribution of researchers according to sex. From the result in the table below most of the respondents were male 131(91.6%) and from them 45 respondents were ICT moderate users, 76 high user and the rest 10 very high ICT users. Similarly 12(8.4 %) were female respondents and accordingly 2 of them was moderate user, 9 of them high user and 1 of them was very high ICT user. According to Agnetha Broos, females had more negative attitudes towards computers and the Internet than did men. Results indicate a positive relationship between ICT experience and ICT attitudes. This experience is measured by period of time using a computer and self-perceived computer and Internet experience. Males were found to have less computer anxiety than females (Agnetha, 2005). The chi-square test in this analysis found that there is no significant difference on sex.

Table .Distribution of Sample Respondent Researchers by Sex (n=143)

		ICT Use Category			Total	%	X^2
		Moderate User	High User	Very High User			
Sex	Female	2	9	1	12	8.4	
	Male	45	76	10	131	91.6	0.452
Total		47	85	11	143	100	

Source: Own survey data, 2013.   NS=None significant

4.1.1.2.Age

Table 3 represents researcher's distribution according to age. The age structure of the sample respondents showed that the average age of the sampled respondent was 33.12 years. The average age of moderate user (n=47), high user (n=85) and very high user (n=11) researchers' were 35.6, 35.64 and 37.63 years, respectively. As the t-test shows, there was not significance difference in average age of the groups (Table 3). The finding indicates that most of the ICT users are young and middle aged (adults) groups. This implies that young and middle aged researchers have more access and interested to use ICT than elders for different purpose in addition to research whereas the elder people were not quit familiar with ICT use due to reluctant to new technologies. This finding was also supported by (Salau and Saingbe, 2008) which confirmed that elderly people might be less interested in the use of hi-tech innovations.

Table . Distribution of Sample Respondents Researchers by age (n=143)

ICT Usage Category	Age			
	Mean	**SD**	**F**	**Sig**
Moderate User (n=47)	35.6	8.78		
High User (n=85)	35.64	11.82	0.991	0.489
Very high User (n=11)	37.73	15.21		

Source: Own survey data, 2013.   NS=None significant

4.1.1.3.Research Experience

An experience is assumed to be important and valuable in a research. Table 4 represents the distribution of researchers according to their experience in research. The average research experience of the respondents was 8.02 years with the minimum and maximum of 1 and 45years respectively. The result in this table showed that the mean of the research experience for moderate user, high user and very high user is 9.7, 12.07 and 7.09 years, respectively. This shows that with the increase in research experience the use of ICT increases, majority of the respondents was more than high user of ICT. In the study of (Rosnaini *et al.*, 2010) discussed as ICT experience influences the teacher's knowledge, skill and attitude. The result of this study showed that there is no significant relationship between research experience and use of ICT.

Table . Distribution of Sample Respondent Researchers by the Experience in research (n=143)

Category	Mean	SD	F	Sig
Moderate User	9.7	18.204		
High User	12.07	24.555	1.051	0.41
Very high User	7.09	9.148		

Source: Own survey data, 2013.   NS=None significant

4.1.1.4.Background/Field of Study

Table 5 shows the distribution of researchers according to study background. Therefore the result showed that from the whole respondents 11 of them have ICT background where as the rest 132 have not. Interms of ICT use category, from the moderate users of ICT 45 of them were not from the background of ICT and 2 of them were from ICT background, from the high users 76 of them were not from ICT background and 9 of them were from ICT background and from the very high users 11 of them were not from ICT background and none of them were from ICT background. So the result of this study showed that there is no significant relationship between the background of the study and use of ICT.

Table .Distribution of sample respondent researchers by the Study Background/Field of Study

		Is your background ICT related		Total	X^2
		no	yes		
	moderate user	45	2	47	
ICT use category	high user	76	9	85	0.259
	very high user	11	0	11	
Total		132	11	143	

Source: Own survey data, 2013.   NS=None significant

4.1.2. Institutional Variables

4.1.2.1.Educational Level /Academic Rank

The other important demographic variable is educational level and academic position status, and the sample result showed that most researchers had educational level of masters, that is, 106 (74.1%) from which 34 were moderate users, 65 were high users and 7 of them were very high users of ICT. 37 (25.9%) holds a rank of doctoral level from which 13 of them were moderate users, 20 of them high user and the remaining 4 very high users of ICT. Accordingly from the sampled respondents 10 (7%) were Professors, 4 (2.8%) Associate Professors, 25(17.5%) Assistant Professors and the remaining 104 (72.7%) Lecturers. Therefore, the result of this study found that there is no significant relationship between Educational level and use of ICT.

Table . Distribution of Sample Respondent Researchers by Educational Level (n=143)

		Educational level		Total	X^2
		Doctoral level	Masters level		
ICT Use Category	Moderate user	13	34	47	
					0.621
	High user	20	65	85	
	Very high user	4	7	11	
Total		37	106	143	

Source: Own survey data, 2013.   NS=None significant

Table . Distribution of Sample Respondent Researchers by Academic Rank (n=143)

		Academic position				Total	X^2
		Professor	Associate professor	Assistant professor	Lecturer		
ICT use Category	Moderate user	2	2	9	34	47	
	High user	6	2	14	63	85	0.747
	Very high user	2	0	2	7	11	
Total		10	4	25	104	143	

Source: Own survey data, 2013.   NS=None significant

4.1.2.2.Number of Research Conducted

It is assumed that if the researcher conducts many researches he/she is familiar in doing research at the same time using ICT like using a computer to write up and analyzing statistical software easily for analysis purpose. The minimum and the maximum number of research conducted by the respondents were 1 and 140 respectively with the average of 11.73. So according to table 8

below, the result of this study showed that there is no significant relationship between the number of research conducted and use of ICT.

Table .Distribution of Sample Respondent Researchers by the number of Researches conducted so far (n=143)

Category	Mean	SD	F	Sig
Moderate User	9.7	18.204		
High User	12.07	24.555	1.167	0.297
Very high User	17.73	26.108		

Source: Own survey data, 2013.   NS=None significant

4.1.2.3.Training

The role of training is vital to use ICT in research. Researchers benefited by incorporating the technology to conduct and to disseminate research like using statistical software (SPSS, SAS, STATA and so on).   It was found that trainings were not constraints to use ICT in the study conducted by Jibril and Michael (2012).Table 9 showed that the distribution of researchers according to training taken. The result showed that from the moderate ICT users category 34 of the respondents had not taken any training on ICT and the rest 13 have taken, from the high users of ICT category 54 respondents had no any training and 31 of them have taken and from the very high users of ICT 4 of them have not taken and 7 of them have taken training on ICT. The Chi-square test (χ^2) of the sample researchers also indicated statistically significant difference in the training taken between ICT users and non-users at less than 10% probability level, so this study found that training significantly affect the use of ICT.

Table .Distribution of Sample Respondent Researchers by Training taken or not (n=143)

		Training taken		Total	X^2
		No	yes		
	moderate user	34	13	47	
ICT use category	high user	54	31	85	0.079[*]
	very high user	4	7	11	
Total		92	51	143	

Source: Own survey data, 2013.   *= significant at less than 10%

4.1.2.4.Working Environment

The working environment is a favorable condition for a researcher so that he/she is able to conduct a research easily and without any problem. In relation to this study from the category of moderate user of ICT (n=47) 4 of them answered that working environment provides good condition for ICT use in small degree, 16 of them moderate degree, 22 of them high degree, 5 of them very high degree. From the category of high user (n=85) 4 of them replied that working environment does not have any contribution for ICT, 8 of them were in small degree, 25 of them in moderate degree, 32 in high degree and the rest 16 in very high degree. And from the very high users of ICT 2 of them have replied that working environment does not have any contribution in the usage of ICT, 4 of them in small degree, and 5 were in high degree as summarized in table 10.

Table . Distribution of Sample Respondent Researchers by Working Environment (n=143)

		Does your working environment provides good condition for ICT					Total	X^2
		Not at all	Small degree	Moderate degree	High degree	Very high degree		
ICT use category	Moderate user	0	4	16	22	5	47	
	High user	4	8	25	32	16	85	0.139
	Very high user	2	0	4	5	0	11	
Total		6	12	45	59	21	143	

Source: Own survey data, 2013.   NS=None significant

4.1.2.5.Time Availability

If a researcher have enough time to utilize ICT for his/her research to conduct, i.e., if he/she is not busy in some administrative tasks he/she will have an opportunity to use ICT more often. Accordingly from the moderately ICT user category 15 researchers spend moderate time for research, 13 spent higher and 11 very higher time for utilizing ICT in research and from the higher ICT user category 17 respondents spent moderate time, 35 spent higher time and 20 spent very higher time. From the very high user of ICT 3 respondents spent moderate time, 4 respondents were in the higher time category and the rest 4 were very high time users. As a result this study found that there is no significant relationship between time and use of ICT.

Table . Distribution of Sample Respondent Researchers by Time Availability (n=143)

		Sufficient time for ICT					Total	X²
		Not at all	Small degree	Moderate degree	High degree	Very high degree		
ICT use Category	Moderate user	1	7	15	13	11	47	
	High user	0	13	17	35	20	85	0.462
	Very high user	0	0	3	4	4	11	
Total		1	20	35	52	35	143	

Source: Own survey data, 2013.   NS=None significant

4.1.3. Behavioral Variables

4.1.3.1.Information seeking behavior of respondents (attitudes)

Information seeking behavior is an attitude that is reflected in a researchers' eagerness to get new information from different sources in research conduction and dissemination process. Table 12 showed the distribution of researchers according to their information seeking behavior. Accordingly from the moderate users category, 31 of the respondents replied that they seek information very highly, 10 of them highly, 4 of them moderately, 1 of them small and 1 of them was not eager to seek information at all. From the high users category 64 of them were very highly, 16 of them were highly, 3 of them were moderately, 1 of them was in small degree and 1 of them was not eager to seek information. From the very high user's category, 7 of them seek information very highly, 3 of them highly and 1 of them was moderately eager to seek. This result showed that the more to seek information from different sources will improve the use of ICT.

Table . Distribution of Sample Respondent Researchers by Information Seeking Behavior (n=143)

		Are you eager to seek information from d/t sources					Total	X^2
		Not at all	Small degree	Moderate degree	High degree	Very high degree		
ICT use Category	Moderate user	1	1	4	10	31	47	
	High user	1	1	3	16	64	85	0.923
	Very high user	0	0	1	3	7	11	
Total		2	2	8	29	102	143	

Source: Own survey data, 2013. NS=None significant

4.1.3.2.Mass Media Exposure

Mass media exposure

Mass media play the greater role in creating awareness in shortest time possible over large area of coverage especially to disseminate research outputs in this respect Television, Radio and News Papers are the major mass media used in our country therefore, according to table 13 in this research Television was used to hear important research information in small, moderate, high and very high degree in 21.7%, 16.1%, 12.6% and 14.7%,respectively and 35 % did not use at all to disseminate research outputs 84.6% of the respondents were not used television at all and 9.8% was used in small degree.

Radio is also another mass media frequently used especially by our farmers. In this regard if researchers used to disseminate agricultural research outputs that is relevant to our farmers by radio, the farmers could easily be addressed. But in this research radio was not used by researchers both to conduct and to disseminate research frequently as shown in the following table (Table 13).

Newspapers are also another mass media that are usually used. In this research to read important research information from newspapers, 25.9% of the respondents have used it in a smaller degree, 23.1% moderately, 13.3% highly and 12.6% used it in a very high degree and the rest 25.2% have not used at all .On the other hand to disseminate research information 13.3% of the respondents have used it in small degree, 9.1% moderately, 2.1% highly, and another 2.1% have used it highly and the reset 73.4 % have not used Newspapers to disseminate research results at all.

Table Distribution of Sample Respondent Researchers by Mass media exposure (n=143)

	To hear (Read) information for research %					To disseminate research %				
	Not at all	Small Degree	Moderate Degree	High Degree	V.High Degree	Not at all	Small Degree	Moderate Degree	High Degree	V.High Degree
Television	35	21.7	16.1	12.6	14.7	84.6	9.8	4.2	0.7	0.7
Radio	44.1	21	18.9	9.1	7	81.1	7	7.7	2.1	2.1
News Paper	25.2	25.9	23.1	13.3	12.6	73.4	13.3	9.1	2.1	2.1

Source: Own survey data, 2013.   NS=None significant

4.1.4. Technological Variables

Table 14demonstrates the technological characteristics of respondent's user friendliness and relative advantage specifically to this research. Accordingly 3.5% and 1.4% of the respondents answered that statistical packages were not user friendly and relative advantage respectively so that they are suffering to use, manipulate and interpret statistical packages like SPSS, Stata and others in their research works, 4.2% of the respondents were using statistical packages in their research in small degree where as 35% and 21.7 % have moderately used statistical packages in user friendly manner and understanding its relative advantage respectively.

When we think of Agricultural software 10.5%, 16.8 %, 14.7 % and 6.3 % of the respondents used agricultural software in user friendly manner in their research in small, moderate, high and

very high degree, respectively and 51.7% of the respondents did not use because it was not user friendly. On the other hand, 3.5%, 23.1%, 22.4% and 12.6% of the researchers understood the relative advantage of using agricultural software in small, moderate, high, and very high degree respectively where as 38.5% did not use because it did not give relative advantage.

Internet is Major sources of Literature in the process of research conduction. Therefore, in this research 41.3% and 48.3% of the respondents used internet highly in a user friendly manner and very high degree, respectively. And37% and 55.9% were used it by understanding the relative advantage of the internet respectively. So this shows that internet is majorly adopted by the respondents.

An electronic journal is also the main source where journal publications are found. In this research according to the table below electronic journals were used as user friendly in high degree by 40.6% and very high degree 35.7% of the respondents and relative advantage of electronic journals are understandable by the respondent's 36.4% and 37.1 % high and very high degree respectively.

Online agricultural databases are another sources of databases in which researchers are able to catch journals like AGORA (Agricultural online).Accordingly in this research 11.2%, 21%, 30.8 and 18.9% of the respondents know the user friendliness of online databases in small, moderate, high and very high degree respectively and 38.5% did not use online databases due to its lack of user friendliness whereas the relative advantage of online databases is understandable by the respondents in 12.6%, 17.5%, 32.9% and 20.3 % in small, moderate, high and very high degree respectively and 16.8% was not used at all.

Table Distribution of Sample Respondent Researchers by Technological characteristics (n=143)

	User Friendliness %					Relative Advantage %				
	Not at all	Small Degree	Moderate Degree	High Degree	V.High Degree	Not at all	Small Degree	Moderate Degree	High Degree	V.High Degree
Stat. Packages	3.5	4.2	35	41.3	16.1	1.4	0	21.7	44.1	32.9
Agri. Software	51.7	10.5	16.8	14.7	6.3	38.5	3.5	23.1	22.4	12.6
Internet	1.4	2.8	6.3	41.3	48.3	1.4	0	4.9	37.8	55.9
Electronics Journals	0.7	9.1	14	40.6	35.7	1.4	9.1	16.1	36.4	37.1
Online Databases	18.2	11.2	21	30.8	18.9	16.8	12.6	17.5	32.9	20.3

Source: Own survey data, 2013.

4.2. Major ICT facilities used

In table 15 the most frequently used ICT are described briefly with the degree of use. All of the respondents used the computer (100 %) to process their research work, i.e. to analyze and to write up a proposal and thesis/dissertation works. Thus, researchers have used statistical packages 7.7% in moderate degree, 25.2% in high degree, 65% in very high degree and the rest 2.1% not used statistical software for their research. Moreover, the researchers have used agricultural software 44.1 % in different degree level and 55.9% of them did not use agricultural software in a research , Internet has been used 100 % as in the table explained below(table 15).

Fixed line and mobile phone was another major ICT tool which was used to communicate about research among different stakeholders in research conduction and dissemination by the respondents. Accordingly fixed line phone was used 39.2 % in different usage level and 60.8% of the researchers did not use it as a research tool whereas mobile phone user were 95.1 % and

4.9% were not users. Fax was also another ICT device that is used by the researchers and as a result33.6 %of the respondents have used and66.4% have not. Video and photo cameras are important tools for research conduction, and thus, video camera has been used by 67.1 % of the researchers whereas the rest did not use. Similarly, photo camera was used by 94.4 % of the respondents and 5.4 % have not used it for their research.

Table .ICT facilities used in agricultural research

ICT Facility	Degree of use (% of user response) n=143				
	Not at all	Small degree	Moderate user	High degree	Very high use
Computer	0	2.8	3.5	21.7	72
Statistical package	2.1	0	7.7	25.2	65
Agricultural software	55.9	5.6	5.6	16.8	16.1
Internet	0	1.4	6.3	21	71.3
Fixed line phone	60.8	11.2	15.4	7	5.6
Mobile phone	4.9	11.2	11.2	28	44.8
Fax	66.4	16.1	11.9	0.7	4.9
Video camera	32.9	16.1	18.9	16.1	16.1
Photo camera	5.6	9.8	21	32.2	31.5

Source: Own survey data, 2013

4.3.Relationship between ICT facilities uses (Correlation)

Correlation is the relationship between two or more different variables, According to the table below statistical users was significant at 1% with the use of computer. This showed that a researcher runs statistical programs using computer, i.e., statistical package without using computer is meaningless .Thus, as a computer skill increases, using and operating statistical software increases or vice versa. In the other words, using an internet is more correlated at 1 %

with the use of computer, i.e., a researcher will run internet by a computer, and as the habit or knowledge of internet use increases so does the computer use. Internet and mobile phone were correlated significantly at 1% and it showed that internet was also accessed more on mobile phone in addition to the computer. Fax and fixed line phone were also correlated significantly at 1% because fax was linked to fixed line phone.

Video camera with mobile phone was correlated more and significant at 1% since video is also accessible by a mobile phone these days. Photo camera is significant with the video camera with 5 % significance level. This is due to the fact that many video cameras have an imbedded photo camera and vice versa.

Table Correlation

1	2	3	4	5	6	7	8	9
2	1.000							
3	.638***	1.000						
4	-.098	.035	1.000					
5	.454***	.290***	.050	1.000				
6	-.142	-.206**	.037	-.035	1.000			
7	.282***	.184**	.063	.268***	-.006	1.000		
8	.045	-.105	.081	.081	.343***	.268***	1.000	
9	.114	.057	-.100	.210**	.163	.355***	.342***	1.000

Source: Own survey data, 2013

***. Correlation is significant at the 0.01 level (2-tailed).

**. Correlation is significant at the 0.05 level (2-tailed).

 *. Correlation is significant at the 0.10 level (2-tailed).

Code

1= Computer user	5= Fixed line phone user
2= Statistical package user	6= Mobile phone user
3= Agricultural software user 7= Fax user	
4= Internet user	8= Video camera user
9= Photo camera user	

4.4.Perceived benefits that ICT facilities gives for agricultural research

This study also assesses the perceived benefits of ICT for agricultural research. Therefore, according to table 17, 9.8% of the respondents have moderately benefited from internet to search literature easily, 23.1% of them highly benefited and 67.1 % were benefited very highly. So this shows that the majority of respondents are highly benefited from the use of ICT. Interms of access to foreign journals they were still benefited more, i.e., 18.9 %, 30.8%, 44.8% of the respondents moderately, highly and very highly benefited respectively.

Access to receive questionnaire online using internet was also one of the benefits that the respondents get. Thus, 14.1% was small, 9.7% moderately, 8.4% highly, 10.5% very high degree benefited and 57.3 % of them did not at all. In addition, 4.9%, 16.1%, 30.8%, 39.2% of the respondents were benefited in sending their papers by emails to editors in small, moderate, high and very high degree respectively and only 9.1% of the respondents were not benefited.

What is more, 9.1%, 11.2%, 12.6%, 9.1% of the respondents get benefit in sending their respective questionnaire by using email in small, moderate, high and very high degree respectively and 58% of them were not. Registering for important sites are very important to access a variety of information to conduct a research. Accordingly in this research 10.5%, 32.2%, 12.6%, 30.8% of the respondents were benefited in small, moderate, high and very high degree respectively to register for a variety of information and 14 of them were not. Besides registering for research information, using email is also another benefit that the respondents were getting, So 9.8%, 30.8%, 16.1%, 32.2% of them was receiving a research information due to registration in a small, moderate, high and very high degree respectively and 11.2% of them were not benefited this.

Sharing an agricultural information using email is also another important thing in conducting and disseminating a research so in this study 92.3% of the respondents were sharing this important agricultural information due to the use of email in different degree of measurement and the others was not.

Research without Analysis and interpretation of different research data is almost meaningless, So in this study how much was analysis and interpretation of data was easier and how much the qualities of the graphical representation was improved in using computer is also addressed. Accordingly 100% of the respondents were getting benefits in analyzing and interpreting data and also getting quality graphical representation in different degree in research conduction and dissemination as in the table below.

Journal publication is also another important thing in a research. In this study 79% of the respondents was benefitted using internet to improve their journals publication since they use agricultural databases in different degree. Finding different enough research information is important in a research either printed or electronically accordingly this research assesses the perceived benefits of enough electronics resources, so 98.6% of the respondents benefited in accessing enough information from electronics resource.

Reading journals online is important as a researcher to get up to date literature and many thing, so this study assesses also the use of internet in reading online journals. Therefore; In this study 97.2% of the respondents benefited in reading online journals. References are an important issue in a research, this study assess also the issue of answering reference in electronics. So in this study 87.4% of the respondents was benefited to answer there reference queries electronically. Finally as a benefit this study assess also the experiences of errors in different research activities so that as in the following table majority of the respondents of this research answers as they experience less errors due to ICT usage.

Table . Benefits of ICT facilities in agricultural research

Benefits earned due to ICT use	Degree of benefits (% of user benefits) n=143				
	Not at all (0)	Small degree	Moderate degree	High degree	Very high degree
Literature search Access	0	0	9.8	23.1	67.1
Foreign journals Access	1.4	4.2	18.9	30.8	44.8
Receive questionnaire online	57.3	14.7	9.1	8.4	10.5
Sending papers to editors	9.1	4.9	16.1	30.8	39.2
Sending questionnaire	58	9.1	11.2	12.6	9.1
Register for a variety of information	14	10.5	32.2	12.6	30.8
Receive research information	11.2	9.8	30.8	16.1	32.2
Share agricultural information	7.7	11.9	21.7	30.8	28
Easiness of Analysis and interpretation of data	0	4.2	7.7	23.8	64.3
Quality of Graphical representation	0	5.6	14.7	20.3	59.4
Improvements of journal publications	21	17.5	14.7	25.9	21
Access to Enough research information	1.4	11.2	22.4	33.6	31.5
Read journals online	2.8	9.1	12.6	26.6	49
Reference queries are answered electronically	12.6	11.9	18.9	31.5	25.2
Experience less errors	4.9	7	25.9	37.8	24.5

Source: Own survey data, 2013

4.5.Determinants of ICT Use for Agricultural Researchers

Multiple linear regression econometric model (MLR) was used to see the relative influence of different personal, behavioral, institutional, technological variables on the use of ICT in agricultural research conduction and dissemination. Finally, ten variables which were fitted to the model was checked was used for running the model. Prior to the estimation of the model parameters, it is crucial to look into the problem of multicollinearity among the potential candidate variables.

Test for Multicollinarity

Before running the MLR model all the hypothesized explanatory variables were checked for the existence of multicollinearity problem. There are two measures that are often suggested to test the existence of multicollinearity. These are Variance Inflation Factor (VIF) for association among the explanatory variables .VIF explains how the variance of an estimator is inflated by the presence of multicollinearity (Gujarati, 2003).

According to Maddala (1992), VIF can be defined as: VIF (Xi) = $\dfrac{1}{1-R^2}$ Where, R^2 is the squared multiple correlation coefficient between Xi and the other explanatory variables. As a rule of thumb, if the VIF of a variable exceeds 10, there is multicollinarity. To avoid serious problems of multicollinarity, it is quite essential to omit the variable with VIF value greater than or equal to 10 from the analysis (Gujarati, 2003). The values of VIF for continuous variables were found to be less than 10. To avoid serious problem of multicollinearity it is quite essential to omit the variables with VIF value greater than or equal to 10 from model analysis. Based on VIF result, the data have no serious problem of multicollinearity in use of ICT dependent variable in Table 18.

Table : Multicollinearity check for the variables

Variable	VIF	1/VIF
RESEARCHEXP	2.82	0.354710
EDUCATIONL~L	2.56	0.389988
NUMBEROFRE~H	2.08	0.480734
AGE	1.56	0.640137
INFORMATIO~K	1.21	0.827757
WORKLOADAD~K	1.18	0.845162
WORKINGENV~T	1.08	0.923867
BACKGROUND	1.08	0.929910
TRAINING	1.07	0.937028
SUFFICIENT~E	1.06	0.941341
Mean VIF	1.57	

Source: Own survey, 2013

After the test of multicolinearity ten independent variables statistics were used in the analysis of MLR model. Among the ten independent variables three were found to be statistically significant influence on use of ICT. These factors were Age, Training, sufficient time and their level of significance are 10%, 5% and 5% respectively. Moreover, the two variables have a positive relationship except age which has a negative relationship. The rest independent variables research experience, sex of the researcher, educational level of the respondents, number of the research conducted so far, work load, working environment, background of the researcher and information seeking behavior were found to be insignificant.

4.6.Interpretation of the Model Result

Multiple Linear Regression Analysis

In the preceding parts of this thesis the descriptive analysis of important independent variables, which are expected to have influence on the use of ICT in agricultural research conduction and dissemination were presented. In this section, the selected independent variables were put to MLR model to identify the factors influencing the use of ICT for conducting agricultural research and disseminations. A MLR model was fitted to estimate the influence of the hypothesized independent variables. SPSS version 20 was used for analysis.

Table .Coefficients of regression function

Variables	Coefficients		T	Sig.
	B	Std.errors		
(Constant)	-.161	0.82	-2.51	0.72
SEX	-.937 ^{NS}	.664	0.57	0.534
AGE	.108*	.031	- 4.03	0.073
EDUCATIONL~L	-.771 ^{NS}	.21	-1.65	0.168
RESEARCHEXP	-.009 ^{NS}	.93	-0.37	0.753
NUMBEROFRE~H	.031 ^{NS}	.176	2.06	0.248
BACKGROUND	.430 ^{NS}	.136	0.75	0.418
TRAINING	.890**	.074	2.23	0.006
WORKINGENV~T	-.172 ^{NS}	.231	-1.13	0.481
SUFFICIENT~E	.306**	.058	1.71	0.009
WORKLOADAD~K	-.134 ^{NS}	.031	-1.68	0.510
INFORMATIO~K	.031 ^{NS}	.21	0.71	0.944

Source: Computed from own survey data

** Significant at 5%, * significant at 10%, NS none significant.

Table 19 indicates, from the ten variables regressed in the model, three variables found to be significant. These are significantly affecting the use of ICT in agricultural research conduction and dissemination at 10%, 5% and 5% levels of significance. These influential variables include Age, Training, Sufficient time respectively. From the ten independent variables sex, educational level, research experience, the number of research conducted, background, working environment, work load and information seeking behavior had no significant impact on the use of ICT in agricultural research conduction and dissemination under the study.

For the (MLR) model, the independent variables as the result of the model are indicated as follows.

$$Y = \alpha + \beta 1X1 + \beta 2X2 + \beta 3X3 + \ldots\ldots + \beta kXk + \varepsilon$$

Where: Y = Use of ICT in Agricultural research (USEOFICT)

X2 = Age (AGE)

X7= training (TRAINING)

X9 = Sufficient time (SUFFICIENT~E)

USEOFICT = -.161+ .108X2 +.890X7+.306X9

 (-4.03) (2.23) (1.71)

Here the result in the parenthesis indicates the calculated t-values for the respective coefficient parameters obtained from the analysis of regression in the SPSS.

USEOFICT = -.161+ -.108AGE +.890TRAINING+.306SUFFICIENT~E

Hence the result of the above regression model has discussed as in the following manner:

4.6.1. Age

This study found that the age of the researchers is significantly affecting his/her usage of ICT while conducting a research. The study also found that Age has negatively affecting (negatively

relationship) ICT usage. This means when age increases the likelihood of ICT usage decreases by 31%. The result of this study was similar with the study done by (Salau and Saingbe, 2008).

4.6.2. Training

As expected training in ICT has significant influence on the usage of ICT at 5% significant level and have a positive relationship. This implies that the more researchers acquire training in ICT the more would the likeliness of ICT usage or when one acquire training in ICT his/her possibility of using ICT increases by 74%. The result of this study was similar with the study done by Jibril and Michael, 2012.

4.6.3. Sufficient Time for ICT

The more you give time for something the more your gain, in the university scenario many researchers are busy in many administrative tasks due to this reason they don't have sufficient time to use ICT for a research to conduct and to disseminate. In this study the model result indicates the respondents having sufficient time influences the use of ICT positively and significantly at 5% as indicated in the above table. The finding of this study is in agreement to Jibril and Michael (2012) again.

5. SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1.Summary

To summarize, this study was conducted in Haramaya University to investigate the use of ICT in agricultural research among the university agricultural researchers.

This study uses purposive census to examine the entire population. all agricultural researchers in the college of agriculture and environmental sciences (CAES) of Haramaya University will be questioned or tested with the sampling frame of M.Sc and above educational level, Because it is assumed that M.Sc and above staff members are actively engaged in research in the university scenario. The primary data sources were an agricultural researcher that uses ICT in research. A questionnaire was developed, pre-tested with 8(5%) non sampled researchers in the study area and used for collecting the essential data. Descriptive statistics and Multiple linear regression model were used to analyze the data collected and entered into SPSS and Stata software.

Result of descriptive statistics using ANOVA and chi-square tests indicated that most of the variables hypothesized to influence ICT usage were found to have insignificant influence upon the usage of ICT and only training found to influence ICT usage significantly.

The result of the econometric model revealed that from among the ten descriptive independent variables only three independent variables found to have significant influence upon researchers usage of ICT. The model further revealed that among these three variables Age is negatively correlated and significant at 10% level of significance, while the rest two training in ICT and sufficient time for ICT usage are positively correlated and significant at 5% level.

5.2.Conclusions

Based on the finding of this study the following conclusions are made.

- Older researchers are found to be less likely to use ICT that young researchers. This is because according to the result of this study age is negatively correlated with the usage of ICT.
- Training on ICT is found to enhance the usage of ICT among researchers. This is because the result indicated that the use of ICT among researchers with ICT training is by far greater than researchers who made no prior training in ICT.
- Having sufficient time or not being occupied by different duties is also found to influence researchers' usage of ICT positively.

5.3.Recommendations

Based on the results and conclusions of the study the following recommendations are made.

- ❖ Encouraging elder researchers to use ICT while conducting and disseminating their researches. This can be done by preparing different ICT application forums.

- ❖ Training in ICT found to be the instrumental in ICT application in research. Thus, different trainings should be provided for researchers around ICT application.

- ❖ Giving different non-research duties for researchers found to affect researchers time to spare ICT usage. Thus, it is recommended to unburden researchers from non-research related while duties while they are engaged in research activities.

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7. APPENDIX

Survey Questionnaire

The main purpose of this survey is simply to assess the use of Information and Communication Technologies (ICT) in agricultural research; therefore, feel free to give your answer for every question because it is necessary only for the study purpose.

SECTION I: Personal Information (please check √ only one answer)

1. Sex [a] Male   [b] Female

2. Age (years) _____.

3	Academic Position		Professor		Associate professor		Assistant Professor		Lecturer
4	Educational Level		Doctoral Level		Masters Degree		Other (Please Specify) _____.		

5. Your work experience in years _____.

6. Your research experience in years _____.

7. How many research have you conducted so far (on average)? _____.

8. Are you from a background of ICT related discipline?   1. Yes   2. No

9. What type of research are you conducting mostly?   1. Qualitative   2. Quantitative   3. Mixed

10. Have you taken any training on ICT?   1. Yes   2. No

11. If yes, what types of training did you take?

_____,_____,_____,_____.

S.N	Please rate the extent to which you agree for the following questions (Please check √ only one option) (0= Not at all 1= Small degree 2= Moderate degree 3=High degree 4= Very high degree)					
12	On your Q6, Did your research experience helps you to enhance your ICT utilization?	0	1	2	3	4
13	If yes in Q8, did your academic background helps you to use ICT easily?	0	1	2	3	4
14	On your Q9, Is your type of research that you are conducting more contributes in your ICT utilization?	0	1	2	3	4
15	If yes, If yes in Q10, does it add any value in your ICT utilization?	0	1	2	3	4
16	Does your working environment provide a good condition for your ICT utilization in your research work?	0	1	2	3	4
17	Do you have sufficient time for using ICT for your research work?	0	1	2	3	4
18	If disagree in Q17, is it b/se of the additional responsibility that you are working like administrative task?	0	1	2	3	4
19	Are you eager to get new information from different sources for your research work?	0	1	2	3	4
20	Do you use Internet to explore new information prior to conducting agricultural research and to Disseminate your research results?	0	1	2	3	4
21	If agree in Q20, overall how often do you use the Internet?	0	1	2	3	4

SECTION II: ICT facilities used for agricultural research

S/N	Please rate the extent to which you agree in using each ICT facility below. (Please check √ only one option) (0= Not at all 1= Small degree 2= Moderate degree 3=High degree 4= Very high degree)					
22	Do you use Computer to process your research work?	0	1	2	3	4
23	Do you use Statistical packages to analyze your research?	0	1	2	3	4
24	If agree, which statistical packages you used ☐SPSS ☐SAS ☐STATA Other (Please Specify) _____.					
25	Do you use Agricultural Software(s) typically for research purpose?	0	1	2	3	4
26	If agree, which agricultural software(s) you used ☐DSSAT ☐Other (Please Specify) _____.					
27	Do you use Internet to get up to date literature for your research?	0	1	2	3	4

28	Do you use E-mail to send a questionnaire and to receive a completed questionnaire online?	0	1	2	3	4
29	Do you use E-mail to send your papers to editors for publication in journals?	0	1	2	3	4
30	Do you register for variety of research information in your e-mail box?	0	1	2	3	4
31	Do you use e-mail to share agricultural information with colleagues for research?	0	1	2	3	4
32	Do you use Electronic journals to publish your research reports?	0	1	2	3	4
33	If agree, which Journal(s) you used _____,_____,_____,_____					
34	Do you use On-line databases for research purpose?	0	1	2	3	4
35	If agree, which database(s) you used ☐AGORA ☐AGRICOLA ☐other (Please specify)_____					
36	Do you use Fixed line phone to communicate with peoples for your research purpose?	0	1	2	3	4
37	Do you use Mobile phone to communicate with peoples for your research purpose?	0	1	2	3	4
38	Do you use Fax to communicate with peoples for your research purpose?	0	1	2	3	4
39	Do you use Video Camera for your research purpose?	0	1	2	3	4
40	Do you use Photo camera to capture an image for research purpose?	0	1	2	3	4
41	Do you use Television to hear important information about research?	0	1	2	3	4
42	Do you use Television to disseminate your research result?	0	1	2	3	4
43	Do you use Radio to hear important information about research?	0	1	2	3	4
44	Do you use Radio to disseminate your research result?	0	1	2	3	4
45	Do you use Newspaper to read important information about research?	0	1	2	3	4
46	Do you use Newspaper to disseminate your research result?	0	1	2	3	4

If there are other ICT facilities that you used for agricultural research purpose you may state here:

_____, _____, _____.

SECTION III: Perceived benefits of ICT for agricultural research (Please check [√] only one option)

(0= Not at all 1= Small degree 2= Moderate degree 3=High degree 4= Very high degree)

S/N	Perceived benefits of ICT for agricultural research					
47	Literature search is made easier for you with the Internet	0	1	2	3	4
48	You have been able to open new areas of research due to Internet use	0	1	2	3	4
49	You now have a wider access to foreign journals as a result of Internet use	0	1	2	3	4
50	You send your questionnaires on-line using e-mail	0	1	2	3	4
51	You receive your completed questionnaire online by e-mail	0	1	2	3	4

52	You now send your papers by e-mail to editors for publication in journals	0	1	2	3	4
53	You now register for variety of research information in your e-mail box	0	1	2	3	4
54	You now receive variety of research information in your e-mail box	0	1	2	3	4
55	You share agricultural information with colleagues through e-mail	0	1	2	3	4
56	Analysis and interpretation of your data is made easier with the computer	0	1	2	3	4
57	The graphical presentations in your research publications are of higher quality using computers	0	1	2	3	4
58	Your journal publications have improved tremendously since you started using agricultural databases	0	1	2	3	4
59	You find enough research information in electronic resources	0	1	2	3	4
60	You now read journals on-line	0	1	2	3	4
61	Your reference queries are answered electronically	0	1	2	3	4
62	You now experience less errors in your research papers due to ICT use	0	1	2	3	4

If you perceived another benefits of ICT for agricultural research you may specify here

_____

_____.

S/N	Technological characteristics (0= Not at all 1= Small degree 2= Moderate degree 3=High degree 4= Very high degree)					
63	Did you find that the Statistical package software(s) is/are user friendly?	0	1	2	3	4
64	Did you find that the Statistical package software(s) gives you a Relative advantage?	0	1	2	3	4
65	Did you find that the Agricultural software(s) like DSSAT are user friendly?	0	1	2	3	4
66	Did you find that the Agricultural software(s) gives you a Relative advantage?	0	1	2	3	4
67	Did you find that using the internet is user friendly?	0	1	2	3	4
68	Did you find that using the internet gives you a Relative advantage?	0	1	2	3	4
69	Did you find that using Electronic Journals are user friendly?	0	1	2	3	4
70	Did you find that the Electronic Journal give you a Relative advantage?	0	1	2	3	4
71	Did you find that the On-line database(s) is/are user friendly?	0	1	2	3	4
72	Did you find that the On-line database gives you a Relative advantage?	0	1	2	3	4

If you have any additional comments you wish to make about the use of ICT in agricultural research, please add them here.

Thank You!