



Information Communication  
Technologies and Poverty  
Reduction in Rural Ethiopia  
Challenges and Prospects

Household Level Analysis

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# Information Communication Technologies and Poverty Reduction in Rural Ethiopia Challenges and Prospects

Household Level Analysis

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*“Eradicate poverty. This is all that matters in my country. When I am out of training I think about this a lot; when I am running it is going over in my mind. As a country we cannot move forward until we eradicate poverty.”*

*Haile Gebreselassie*

## **Abstract**

A number of findings revealed that access to information communication technologies has a positive impact on the living conditions of rural societies if it used in appropriate way. Now a day, many of these thoughts disregard the primitive approaches on ICT application that considers luxury goods and service rather than its importance. In this regard, rural Ethiopia is one of those places with low access and affordability of ICT's due to various reasons. This paper tried to see the prevailing challenges and opportunities behind the application of these technologies in line with poverty reduction. Specifically, it addressed the existing relationship between application of communication technologies and poverty including preconditions required in optimizing a range of information communication technologies, the way how these technologies benefit various actors working in rural areas and also the main determinants of household spending on these technologies. Household level survey was conducted in southern Ethiopia where primary data is collected. The predetermined research questions were addressed by using descriptive and statistical method. The analysis revealed that various socio economic features of the society including age, gender, marital status and family size are related with the application of information communication technologies in multiple ways. Further, it is observed that lack of awareness by households on the broad importance of these technologies, presence of gap between policy and its implementation regarding the application of diverse communication technologies and low level of interconnection among different institutions working in the area are the main findings. Moreover, the paper found that households' spending is highly correlated with cash crop producers, availability of information communication technologies infrastructure in the area, available farm size and single individuals in the society.

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## Acronyms

AIDS	Acquired Immunodeficiency Syndrome
CDMA	Code Division Multiple Access
ECX	Ethiopian Commodity Exchange
EI	Education Index
ETA	Ethiopian Telecommunication Agency
ETB	Ethiopian Birr
ETC	Ethiopian Telecommunication Corporation
EPDR	Ethiopian People's Democratic Republic
FAO	Food and Agricultural Organization
GDP	Gross Domestic Product
GDPI	Gross Domestic Product Index
GNI	Gross National Income
GSM	Global System for Mobile Communication
HDI	Human Development Index
HIV	Human Immunodeficiency Virus
HPI	Human Poverty Index
ICT	Information Communication Technology
IFAD	International Fund for Agricultural Development
IFIP	International Federation for Information Processing
IT	Information Technology
ITU	International Telecommunication Union
LEI	Life Expectancy Index
MFA	Ministry of Foreign Affairs
MOFED	Ministry of Finance and Economic Development
NLCC	National Library of Canada Cataloging
NGO	Non Governmental Organizations
OLS	Ordinary Least Square
PC	Personal Computers
PRB	Population Reference Bureau
SLU	Swedish University of Agricultural Science (Sveriges lantbruksuniversitet)
SRA	Social Research Association
SSA	Sub Saharan Africa
TV	Television
UN	United Nations
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNDP	United Nations Development Program
UNICTTF	United Nations Information Communications Technologies Task Force
USAID	United States Agency for International Development
US	United States
WB	World Bank
WHO	World Health Organization
WSIS	World Summit on Information Society



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## 1. Introduction

### 1.1. Background

Ethiopia is one of the oldest nations of the world found in the horn of Africa. Its history traces back to 500 BC when the famous Axumite Empire ruled the region with its known civilization (Bekerie n.d., pp.7; Hay 1991, pp.7-8; TDSB 2001, pp.101 and Connah 2001, pp.16). Demographically, the country is one of the most populated regions in the world composed of nearly 80 million people, out of these more than 83 % lives in rural areas and the remaining 17 % in urban areas (UNDP, 2011). Currently, Ethiopia is the second most populated country in Africa, following Nigeria.

Politically, Ethiopia is known by its official name, the Federal Democratic Republic of Ethiopia. At present, a total of nine regional states and two independent city administrative sub units are existed (MFA, 2011). The 1995 EPDR constitution affirm that, these regional states have their own and shared political rights with federal government. At the federal level, the government categorized under a parliamentary state where the prime minister becomes the head of the government.

According to the report made by UNDP (2011), the economy is mainly dependent on rain fed agriculture by holding 46 % of the national GDP. Similarly, service and industry sector comprises the share of 36 % and 13 %, respectively. It is believed that dependence on rain fed agriculture expose most Ethiopian farmers for seasonal shocks and food insecurity. As a result, most households in rural Ethiopia continued their living in absolute poverty that meeting their basic need is impossible. Notably, IFAD (2009) revealed that *significant variations in altitude, rainfall, climate, population density, infrastructure/market access, a multitude of different agricultural production systems* are counted as the main sources of poverty. Moreover, the national coverage of education sector is at a lower level even among the average Sub Saharan African which is certainly supposed to be one of the basic tools of poverty reduction. For instance, the literacy rates both on youth and adult holds 50 and 36 %, respectively (UNESCO, 2010). Similarly,

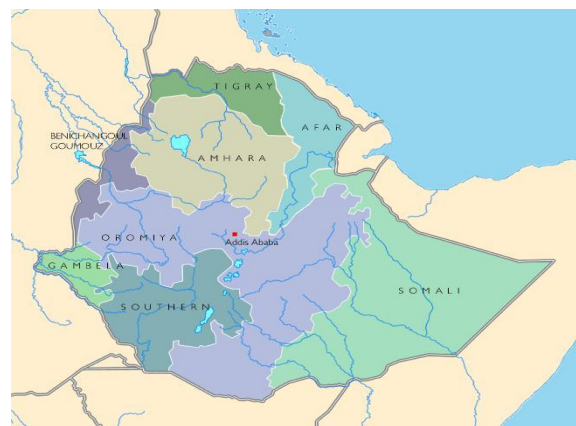


Figure1: Map of Ethiopia, Source: Google Images (2011)

health status of the nation is among the lowest one in the world where lack of national health policy for many decades, weak healthcare infrastructure and low government spending are counted as the main reasons (Wamai, 2009). The report made by (USAID, 2009) point out that life expectancy of 55.4 years and infant mortality rate of 80.8/1000 are the main indicators of low health coverage in the country as compared to other nations of the world. However, it is thought that the process of poverty reduction can be facilitated by intensive utilization of ICTs' among stakeholders participating on developmental activities in line with similar policies and strategies involved (Chapman and Slaymake, 2002).

Basically, the term ICT is derived from three words *information, communication and technologies*. Although ICTs' varies from goods to services depending on its type and nature, different authors forward their definition. One of the elaborations given by Viitanen (2003) states that, ICT's encompasses the combination of all manufacturing and service industries that captures, transmit and display data and information electronically. In the same way (Marcelle, 2000) illustrates the term ICT's as *a complex and heterogeneous set of goods, applications and services used for producing, distributing, processing and transforming information, through diverse means such as telecommunications, television and radio broadcasting, computer hardware and software, computer services and electronic media*. This definition is a broad one in its nature, covering the most comprehensive parts of ICT's.

ICT application in Ethiopia is among the lowest one in the world despite the current encouraging infrastructural expansion which is expected to improve the situation. For instance, the country is at the rank of 154 from a total of 159 countries in the world with ICT development index of 1.03 (ITU, 2010). Moreover, the index of price for fixed telephone, mobile cellular and fixed broadband sub baskets<sup>1</sup> as a %age of GNI per capita is among the highest in the world by taking a magnitude of 3.76, 10.19 and 2085.05, respectively (ITU, 2010). Consequently, it is whispered that the higher ICT basket price might prevent the uptake of these technologies due to the resulted lower distribution of ICT goods and services. This indicates the essentiality of such an endeavor in building basic ICT infrastructure to the majority of the population, particularly for the rural villagers.

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<sup>1</sup> The fixed telephone, mobile cellular and fixed broad band sub baskets are the three components of ICT price basket which measures the affordability of fixed and mobile telephony and fixed broad band internet by individuals (ITU, 2010). Lower prices may increase access and use, and higher levels of ICT uptake may reduce

Notably, previous works recognized the role of efficient distribution and application of ICT goods and services to improve the living condition of rural societies in different viewpoints. Among them, the report made by IFIP (2007) revealed that *ICT's have been playing a great role in promoting agricultural development through better access for technical and input related needs through provisioning of knowledge and technology and strengthening dialogue between and among farmers and farm linked institutions in rural areas*. Correspondingly, (Stienen, 2007) supposed that *application of ICT in rural areas widens market access through provisioning of up-to-date information on prices of commodities, inputs and consumer trends which advances farmers' livelihood*. This perhaps shows the potential role of various ICT's in rural areas.

Moreover, the provisioning of basic health service in rural area is influenced by the level of available information communication schemes. In this regard, the work made by Chaya (2007) argued that *the existing poor transportation and communication outlets limited provisioning of basic health services for societies residing in rural and remote areas especially on times of emergencies needed*. Furthermore, substantial development of e-health<sup>2</sup> system can be achieved by incorporating cost efficient internet and wireless communication technologies with health care industries by minimizing tremendous burdens from both patients and health care providers (Kurtinaityt, 2007).

On the other hand, it is observed that the level of educational coverage and quality is positively influenced by effective application of modern communication technologies where better exchange of knowledge and information between student and teachers takes place (Tinio, 2002). Broadly, the continuum of approaches<sup>3</sup> to ICT development in educational system as forwarded by UNESCO (2002) confirms that educational institution can add value on teaching-learning processes through four stages of ICT application; emerging, applying, infusing and transforming. These stages produce a way where various ICT's can potentially improve teaching-learning process. In addition to this, there is a possibility of optimizing these technologies among rural societies in terms of gaining knowledge and information (Chapman and Slaymaker, 2002).

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<sup>2</sup> E-health refers to an integrated set of information and communication technologies, together with related health delivery process enhancements, in providing basic health services to the patients (NLCC PD, 2005).

<sup>3</sup> Continuum of approach for ICT development is one of the two models developed by (UNESCO, 2002) both in developed and developing countries focuses on the adoption and use of ICT in educational system. It has four approaches with consecutive stages (see the document for detailed elaboration of these stages).

## **1.2. Objective**

The main objective of this research is to understand the challenges and opportunities behind utilization of ICT's in rural Ethiopia. Specifically, it examines the possible role of these technologies for poverty reduction.

## **1.3. Research Questions**

This research focuses on examining four questions associated with the application of a variety of ICT's in rural Ethiopia as they are believed to facilitate poverty reduction. Specifically, it is concerned with addressing the questions of:

- What types of relation exists between the application of information communication technologies and rural poverty in the context of Ethiopia?
- Under what circumstances can we recognize information communication technology as a tool of poverty reduction in the context of rural Ethiopia?
- How wider application of information communication technologies can benefit various sectors working on rural development in Ethiopia?
- What are the constraints that determine the application of information communication technologies' (both goods and services) at household level?

## **1.4. Significance of the research**

The research is expected to provide significant outcomes to the readers in different outlines. These include:

- Source of information to those institutions who want to get involved in the activities of policy making or implementation.
- Development of methodology concerning studies on the role of ICT's for rural improvement.
- Provides a solid document that might be used as a source of information on ICT and development issues for various actors working in rural areas.

## **1.5. Scope and Limitations**

The paper primarily concentrates on selected aspects of ICT and poverty variables. Firstly, availability of radio and telecom networks are considered as the main ICT variables since their penetration and usage is comparatively at a higher level in rural Ethiopia, and even at the whole country (Adam, 2010). Similarly, this paper uses the term poverty relying on a widely

used poverty measure known as Human Development Index (HDI) as elaborated by (UNDP, 2006). HDI is composed of education, health, and income aspects of a certain society.

Concerning the study population and sample size, a survey of 100 households and 64 institutions from public and private sectors are carried out in a rural village called Kode Lisana which is located near Hossana town, southern part of Ethiopia. The rationale behind choosing the sample size and place is related to the homogenous nature of poverty and ICT distribution in rural Ethiopia (IFAD, 2011 and ITU, 2009) which is believed to be the same as the study site. This prevents the expected bias coming from choosing study population and sample size.

### **1.6. Ethical Consideration**

Giving due attention to ethical issues in social science research is imperative as it tends to guarantee the quality of non scientific aspects of the study to be conducted. Thus, the paper is carried out based on a range of ethical principles as forwarded by Social Research Association in relation to different methodologies used. These principles or codes include Obligations to Society (*widening the scope of social research, considering conflicting interests, and pursuing objectivity*), Obligations to Colleagues (*maintaining confidence in research, exposing and reviewing their methods and findings, communicating ethical principles, ensuring safety and minimizing risk of harm to field researchers*) and Obligations to Subjects (*avoiding undue intrusion, obtaining informed consent, modifications to informed consent, protecting the interests of subjects, enabling participation, maintaining confidentiality of records, preventing disclosure of identities*) (SRA, 2009: 15-40).

### **1.7. Disposition**

The first part of the research comprises an introduction part where the background, objective, research questions, significance and limitations are elaborated. The second part includes review of various literatures and theories related to ICT and poverty. The third division contains methodologies and methods used in the paper. These include elaboration of methodologies, types of data used, survey and sampling procedures and data processing and analysis technique. Similarly, results and analysis on the collected data will be on the fourth part of the research. The fifth important component is related to discussion part where concise illustration and arguments takes place based on the collected data and theories. The final part ends up with a conclusion part.

## 2. Literature Review

### 2.1. Poverty and its Root Causes in Rural Areas

Various disciplines and scholars define poverty in multiple ways based on certain indicators. The contribution made by Chamber (1983) in elaborating poverty is among the prominent ones. He explained poverty tracing on five clusters which are supposed to reflect the nature of poverty in a brief way. These include poverty proper (income poverty), physical weakness, isolation, vulnerability and powerlessness. Another definition forwarded by UNDP described poverty as a constituent of income, material lack or want, capability deprivation, multi-dimensional view of deprivation (combination of material lack or want as mutually reinforcing dimension) and well being and equity (UNDP 2006, pp. 8). The multidimensional nature of poverty makes calculating poverty a very challenging task, not least as a result of problems in weighting different components (Maxwell, 1999). In spite of this, the current UNDP's HDI is widely used in measuring poverty. HDI considers three key aspects of poverty indicators including education, health and percapita income status of a certain societies (Todaro and Smith, 2009).

The main causes of rural poverty in Ethiopia are complex and multidimensional by their nature. Generally however, a number of authors have suggested various origins behind rural poverty. In a report from the (WB 2001, pp. 34), three most important origins of poverty have been suggested. These are, *Lack of income and assets to attain basic necessities; Lack of food, shelter, clothing, and acceptable levels of health and education; Sense of voicelessness and powerlessness in the institutions of state and society; and Vulnerability to adverse shocks that linked to an inability to cope with them are mentioned.* Another origin of poverty has been suggested by Khan who argued that poverty in most parts of developing countries is related to factors including culture, climate, gender, market, and public policy (Khan, 2001).

Despite the existence of various measure of poverty, about 1.75 billion people in 104 countries are living in multidimensional poverty where at least 30 % of the indicators reflect acute deprivation in health, education and standard of living (UNDP, 2010). Specially, this report revealed that *in countries including Ethiopia and Guatemala the numbers of people who are multi dimensionally poor are higher.* In general, the prevailing relations between poverty and ICT indicators have an implication that needs further investigation. In fact, related facts and figures showed that poverty situation at household level is widely distributed in Ethiopia where 44 % of the total population lives under the poverty line and more than 12 million people are periodically food insecure (IFAD, 2010). The largest number of poor

belongs to farmers in rural areas by practicing subsistence agriculture. Further, the report made by UNDP (2010) confirms lower level of human development index, holding a value of 0.328 for the year 2010. Specifically, it is shown by the three main human development indexes; life expectancy, expected years of schooling and GNI per capita (PPP US\$) of the country which holds a values of 56.1 years, 8.3 years and 992 US\$, respectively.

## **2.2. Communication Technologies and Rural Livelihood Framework Analysis**

Since this study aims to discuss the role of ICT in poverty reduction, it is imperative to define a livelihood framework and where ICT could possibly play through it. This again calls for a proper definition of the various terms used in this study. The term livelihood follows the definition of (Chamber & Conway, 1992) by which livelihood puts its foundation on the capabilities of households for various assets. Based on their definition, *livelihood comprises the capabilities, assets (stores, resources, claims and access) and activities required for a means of living*, (Chamber & Conway, 1992). In this study, it is suggested that rural livelihood framework represents a flexible and evolving approach which is informed by a number of key concepts and ideas (DFID, 2001). These concepts and ideas are applicable to a broad range of poverty. The major key components in analyzing livelihood of households through the framework are capital assets, their vulnerability context and transforming structures and processes (laws, policies, incentives) that can perhaps shape and influence the livelihood strategies<sup>4</sup> adopted (Duncombe, 2007).

Moreover, (Duncombe 2007, pp. 88) argued that combining the application of various ICT's with rural livelihood framework is believed to be helpful tool in facilitating poverty reduction in rural areas. He showed the vital contribution of ICT's through livelihood framework tracing on a case study of Botswana's urban and rural microenterprises as the frame work represents a viable route out of poverty through providing increased and more diversified income streams for the poor. Besides, integration of ICT's in rural livelihood framework can have a potential role in improving the decision making made by poor households and institutions on different strategies. The work made by Chapman *et al* (1999, pp.vi) elaborates it as *information communication systems possibly generates relevant information that ought to be used in livelihood strategies by households and institutions that are responsible for*

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<sup>4</sup> The term livelihood strategies are used to denote the range and combination of activities and choices that people make/undertake in order to achieve their livelihood goals-including productive activities, investment strategies, reproductive choices, etc (DFID, 2001).



decision making concerning policies and processes affecting those strategies. This explanation includes the main actors in livelihood strategies decision making activity.

Rural livelihood framework, as forwarded by FAO (2000, pp.16) below demonstrates a combination of outcomes resulted from a process of unpredicted trends, shocks and seasonality throughout time. In view of that, smooth flow of information between the vulnerable groups, available resources, intermediate actors, activities and final outcomes allows effective decision making by households and various institutions during poverty reduction process in multiple ways (DFID 2002, pp.10-17). Conversely, lack of adaptability of communication linkage at each level of the frame work; perhaps influences achieving the target outcome. The hypothetical blue line [drawn by the author] indicates an exchange of information between each steps of the livelihood framework and expected outcomes.

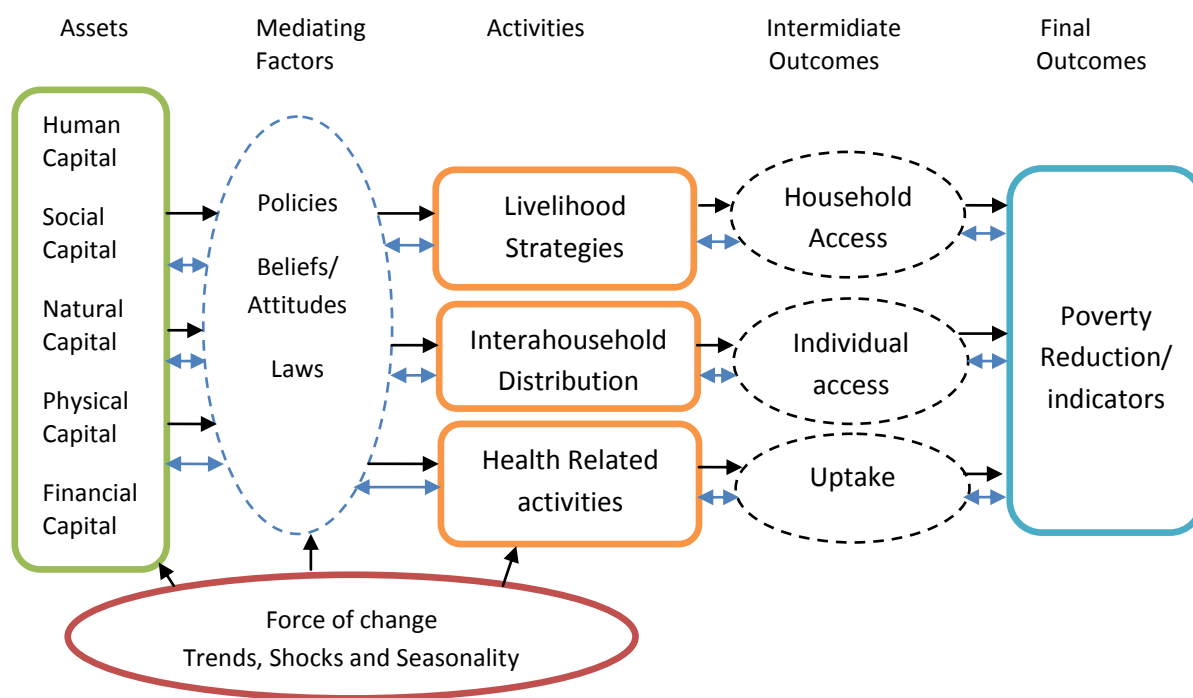


Figure 2. Livelihood framework and information channel. Source: (FAO, 2000).

Generally, rural livelihood framework classified in to five main categories or steps. The assets which are owned by the households, mediating factors including policies beliefs and laws, the activities which are composed of implementing livelihood strategies, intrahousehold distribution that focuses on sharing of resources among households and health related activities. The last column is concerned with the final outcome of the process. This illustration is advocated by Chapman *et al* (1999) in a way that well integrated rural livelihood framework lined up with the application of information communication technologies will

possibly improves the livelihood of rural households through facilitating poverty reduction process.

### **2.3. Trends of Digital Divide in the Global Perspective**

The development of modern digital communication technologies in the world is a result of dynamic technological innovation in science and technology (Herne, n.d.). 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).

In fact, most of the innovations and developments of these technologies comes from western world that lift them to higher level of ICT application status. However, it should be considered that technological transfer to developing world becomes an important part of minimizing the existing digital divide. In this regard, creating competitive and innovative environment for ICT sector is a key instrument in booming expansion the infrastructure in developing countries (Kimura *et al*, 2010).

Practically, many developing countries have been registering tangible progress in the last few years by expanding ICT infrastructure and universal access of communication technologies (WB, 2011). For instance, the report made by ITU (2010) on mobile phone coverage of Africa revealed that, *only the mobile penetration rates alone will reach an estimated 41 % growth at the end of 2010 (compared to 76 % globally) leaving a significant potential for growth*. This can be counted as a promissory development in dropping down the existing gap of ICT application level known as ‘digital divide’ between countries. On contrast, the spread of these technologies might worsen the digital divide as companies create dependency on the technology and service they are providing. This must be addressed by well organized and effective ICT policy. Generally, it is considerably important to expand ICT infrastructures as this advancement enhances the overall economic, social and political transformation of the poor living in rural areas.

### **2.4. Demographic Characteristics and ICT Distribution**

In a study made by Yin Wen, (2005), it is recognized that ICT distribution is highly correlated with the demographic characteristics including age, gender and marital status of an individual. According to his argument, gender affects the application of various ICT’s in a way that

males are more likely to use ICT's than females. Similar thoughts on gender-technology relationship also indicate that technology is not neutral but depends on the established culture (Gurumurthy, 2004). Particularly, female in rural areas have less access and opportunity for communication technologies in a place where the culture of gender equality is minimal. However, it is quite different in those urban places where most women have a chance to use these technologies in their day to day activity (Odame, n.d.). The other vital factor that influences ICT distribution in a certain society is their marital status. The same study made by Yin Wen (2005) on identifying the determinants of ICT expenditure of households revealed that most likely the one who is single have less chance of using ICT in his day to day life where as married one has high possibility.

Other studies also suggested that there are a variety of factors apart from age, gender and marital status that can be associated with the level of ICT application in a certain society. Additional socio demographic variables including education, population size and distribution, pattern of settlement either in urban versus rural contexts are closely associated with ICT distribution (Billon *et al*, 2010). Thus, in studying ICT uptake, it is therefore imperative to classify socio demographic characteristics and the level of ICT distribution in a certain society.

## **2.5. Knowledge, Information, and Technologies**

The term knowledge is supposed to be a main subject of several scholars in the field of epistemology<sup>5</sup>. Although many of them elaborate the term using multiple approaches, their main theoretical narration confined to similar angle where knowledge is a subset of information exchanged among human being. One of the classical definitions of knowledge which was forwarded by a known philosopher Plato enlightens the term as an *infallible and unlike belief it is directed to an immutable object* (cited in Aune, 2008). Importantly, there are convincing thoughts developed in recent eras concerning what knowledge is and how it could be acquired by human being. Among them, Lehrer (2000) justified knowledge as a correct sense of the word 'know' which is implicated by others sense of the word. He argued that *one must be able to tell whether one has correct information or not in order to engage in experimental enquiry test and scientific rationalization* (Lehrer, 2000). Possibly, this is an indication for the real connection between knowledge and information. In reality, the

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<sup>5</sup>Epistemology is the branch of philosophy concerned with the nature and scope (limitations) of knowledge It addresses the questions, what is knowledge, How is knowledge acquired? How do we know what we know?

possession of correct information is not sufficient condition to gain knowledge rather it should become useful and convertible in to reasoning.

On the other hand, the word information comes from the amalgamation of meaningful data which can be stored and disseminated (Stallings, 2000). Principally, information has its own source, the way how it can be transmitted and the final destination where it reaches. In this regard, overall quality and relevance of information is influenced by the channel where it exchanged at a given point of time. This perhaps suggested that the amount and quality of information is highly determined by the prevailing ICT's as they are the tunnels where information is flowing and exchanged. The work made by Jarvenpaa and Staples (2000) strengthen this argument as the use of computer-based system to accomplish various activities such as accessing, searching, sharing, storing, and publishing information in a computer network provides much promise within and across the organizations which are possibly encourages smooth exchange of information.

Moreover, it is believed that source of knowledge is related to the effective utilization of available information where communication technologies play great role in disseminating information from the source to the destination (Kramer *et al*, 2007). In fact, modern communication technologies are going to be one of the basic needs that human being requires in his usual activity. For that reason, modern development and growth theorist, and organizations advocate the fundamental importance of ICT's in socio economic transformation of a certain society (Panos, 2008; Odame, n.d.; Chapman and Slaymaker, 2002; WB, 2006 and UNESCO, 2009).

## **2.6. Direct and Indirect Benefits of ICT's in Rural Areas**

In modern context, efficient application of ICT's has an impact on rural society's socio economic ground either directly or indirectly. The paper forwarded by Chapman and Slaymaker (2002) revealed that *improved systems of information and communication have a dual function; in supplying the information required by the poor in order to pursue sustainable livelihood strategies, and to supply information required by institutions responsible for making decisions that affect those strategic livelihood options.* This indicates the comprehensive relevance of ICT's in developmental activities. The diagram below shows the direct and indirect contribution of ICT's to the rural societies.

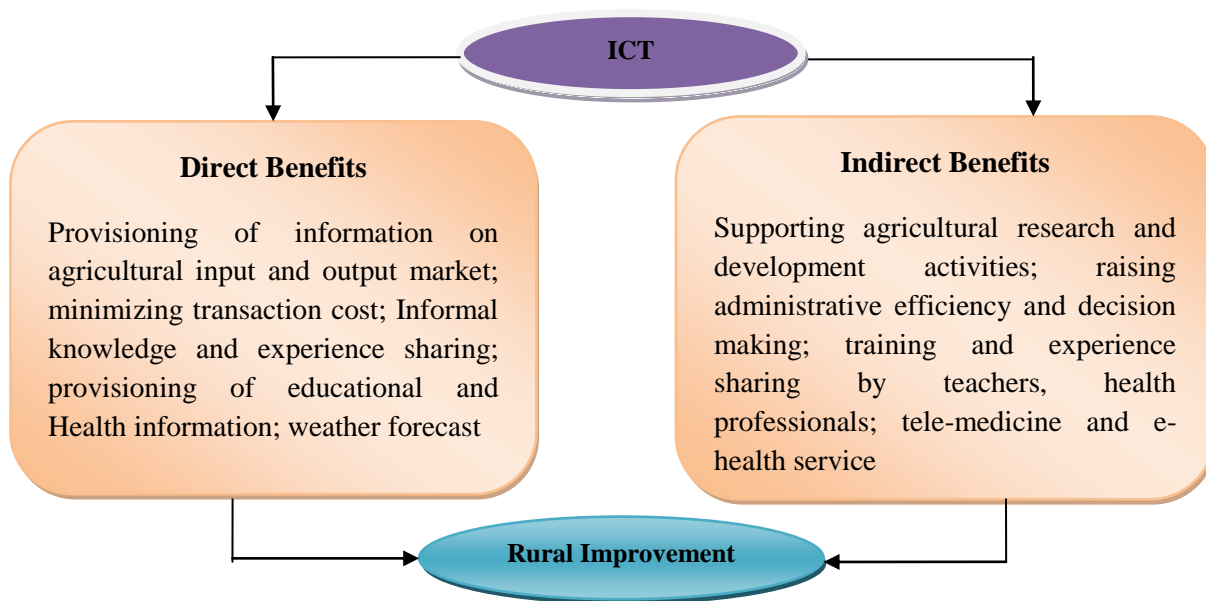


Figure 3: Benefits of introducing and mainstreaming ICT's in rural area. Source: Own illustration (2011)

Accordingly, better ICT infrastructure benefits rural societies at the household and institutional level. For instance, market and health information, informal knowledge and weather forecast are among the direct benefits believed to be obtained. Similarly, intensive agricultural research and development, administrative efficiency, training and experience sharing by teachers and health professionals, e-health services are among the indirect benefits accrued for rural households.

## 2.7. Barriers of Using ICT's by Rural Households

The coverage and distribution of ICT infrastructure in most rural areas of developing countries is at a lower level (Osterwalder, n.d). This situation is recognized by the current ICT position at the household and institutional level of these countries. To understand this disparity, it is important to look at the main challenges behind optimization of communication technologies over socio economic aspects of the society. Accordingly, the work made by (Yin Wen, 2005; Balamoune, 2003; Pierre and Vincenzo, 2009) showed that income, age, educational level, occupation, gender, ICT infrastructure and ICT policies are the dominant factors supposed to be the barriers for application of ICT's by households and institutions in rural areas.

Primarily, it is imperative to distinguish the major determinants of communication technologies in rural areas of developing countries where many factors are believed to be mentioned. In this regard, basic infrastructure including electricity and telecommunications infrastructure are the main constraints limiting the usage of these technologies (Chinnb and

Fairlie, 2006). As a result, identifying broader infrastructural issues related to ICT's is critical in utilizing the potential benefits from application of communication technologies.

## **2.8. Effective Communication Policy in Modern Information Age**

ICT policy is believed to be one of the main factors that determine the extent of communication infrastructure in a given country (Lutz, 2003 & Guerrieri *et al*, 2011). Particularly, in the era where innovation and technological advancement on communication technologies grows at a higher rate, effective ICT policy found to be crucial for corresponding socio economic development (Kramer *et al*, 2007). Mainly, effort to make those marginalized poor as one of the beneficiaries is important task needing the involvement of different agents including households, institutions, governmental and non-governmental organizations. The work made by Vaughan (2006) shares this thought in a lucid way.

Basically, technological diffusion and adoption in many developing countries is negatively influenced by lack of effective communication policy. The paper presented by Heeks, *et al* (2010) revealed that lack of coherent ICT policy is counted as the main challenge of these countries in optimizing benefit from the application of ICT's. Their paper revealed that, *coherent ICT policy involves both horizontal and vertical perspectives by which the former requires ICT policy not only seeks to put infrastructure available, but also ensures there are policies that support the utilization in appropriate way. Similarly, vertical coherence indicates the prevalence of policy integration among those involved in policy implementation* (Heeks, *et al*, 2010).

Therefore, ICT policy that promotes the involvement of both public and private sector in provisioning of communication goods and services is expected to raise the benefits accruing from the application of ICT. Another policy area is concerned on privatizing telecommunication sector which is possibly opens competitions in the sector so as to improve the accessibility and quality of the service (Labelle, 2005). Tracing on microeconomic theory of household consumption behavior, cutting tax on ICT goods and services possibly increases the application of these technologies through the countered increase in purchasing power of the households (Varian, 2006).

### 3. Methodological Framework

The research is relied on both quantitative and qualitative data covering socio economic aspects of the society. The importance behind using these types of data is favored by a number of researchers. Among them, Yoshikawa and Weisner (2008) are examples who argued that examining *human behavior and belief system requires both quantitative and qualitative approach to search as the former method tends to understand the prevalence of a particular practice, behavior and beliefs and the later tries to identify meaning, functions and goals and intentions*. In this regard, close ended and open ended questioners are designed and used throughout the entire survey. Moreover, quantification of qualitative data which is obtained from open ended questioner is done by using coding/ indexing technique as elaborated by Bryman (2008). According to his thought, performing this technique in the research facilitates interpretation of the data coming from those being studied. Finally, descriptive and inferential statistics are used in addressing the research questions.

#### 3.1. Types of Data

Rural households and institutions<sup>6</sup> are main constituent of the entire survey. Consequently, data covering socio economic aspects of household's such as age, gender, marital status, educational background, main farm activities, estimated annual income, expectation on the application of various ICT's, and expenditure level on these technologies is gathered from the study population. Further, a range of available data on ICT indicators as prescribed by UNICT task force is also compiled from the survey result. These include, access to computer, internet, basic telecom services, electricity, radio and television at the household level (UNICTTF, 2005). Regarding qualitative data, the expectation and willingness of households in using ICT's is acquired from open ended questioner. In addition to this, the status of ICT utilization and perception by rural institutions such as agricultural, health and educational centers in the area is assessed. In addition, secondary data is also obtained from MOFED, ITU, CSA, various publications, articles, reports, web resources and manuals.

#### 3.2. Survey and Sampling Technique

Survey is conducted in a village located 8 kilometers from the town of Hossana, found on 232 kilometers south of Addis Ababa. As a rule, certain criteria's are considered in determining the geographical location of the study population and sample size. Firstly, similar pattern of

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<sup>6</sup> These institutions are those main actors working in developmental activities in the region; specifically it is to refer health, education and agricultural centers.

poverty and ICT distribution in rural Ethiopia as illustrated by IFAD (2011); ETA (2009) and ITU(2009), which is important in capturing the expected bias coming from selection of appropriate sample size and technique. Secondly, accessibility of transport around the field site is easy which adds efficiency during the process. Thirdly, availability resources especially time and financial budget are taken in to consideration. And finally, previous knowledge of the area including culture and language facilitates the survey process effectively. These criteria's are considered in determining the sample size and location and most of them are favored and applied in scientific research (Bryman, 2008).

Thus, implementation of cluster sampling technique<sup>7</sup> allowed randomization of the sample population. During the survey time, a total number of three qualified data collectors who have previous experience on similar works are involved in the survey. Notably, preliminary survey is done in order to avoid risk of information bias coming from engagement of many data collectors. This part of the survey was imperative and helps to acquire reliable data through correction and adjustment of draw backs. In this regard, a total of 164<sup>8</sup> randomly selected respondents, of them 100 farmer households and 64 institutions are taken.

### **3.3. Data processing and Analysis**

As stated previously, both descriptive and inferential statistics are used during processing and analyzing of the collected data. In particular, univariate and bivariate analysis<sup>9</sup> are carried out in addressing the research questions. Importantly, the qualitative data is transformed in to quantitative one through coding technique so as to make the process of analysis straightforward. Moreover, following the approach developed by Yin *et.al* (2005), a simple ordinary least square/OLS<sup>10</sup> regression model is developed with some modification in order to see the main socio economic factors counted as constraints for ICT application by rural

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<sup>7</sup> Cluster sampling technique refers to the simple random sampling, but instead of selecting from individual sampling units in a total population, you select from clusters of units, (Nichols, 1991). This method will usually result in major savings in travel costs and time, and ability to collect large sample. The other most important underlying principle for using cluster sampling is because of its flexibility and simplicity without missing some important information in sub groups of the cluster.

<sup>8</sup> This sample size is statistically enough to make inference about the whole population due to the homogenic distribution of poverty and ICT in rural Ethiopia (IFAD, 2011; ITU, 2009). This resulted for consistence and unbiased conclusion.

<sup>9</sup> According to Walega (n.d), univariate analysis emphasize on the numeric and graphical methods of data analysis that could show the characteristics and relationships of a single variable. Similarly, bivariate analysis involves measuring the effects that two or more variables (independent) have on one or more dependent variable.

<sup>10</sup> The method of OLS regression is one of the methods of regression analysis used to generate estimators and other statistics of certain relationships among variables based on quantitative data. Detailed illustration is found on (Gujirati, 2004; pp.58).



households. Particularly, software's known as Gretl and Stata11 are used in addressing some of the research questions.

### **3.4. Reliability**

Reliability refers to the consistency of evaluating concepts during data collection process (Bryman, 2008). Thus, an internal comparison of data from different indicators is conducted particularly with a range of national survey done by Central Statistics Agency of Ethiopia (CSA). Moreover, execution of preliminary survey helps to obtain better data through adjustment of various factors affecting the quality of data.

### **3.5. Validity**

The word validity refers to the issue of whether an indicator or set of indicators are devised to gauge a concept really measures that concept (Bryman, 2008). In other word, validity seeks to answer whether the research truly measures what was intended to be measured or how truthful the research results are. In this regard, the research considers the validity of data during the entire research process, particularly with preliminary survey and review of related works and literatures.

**4. Results and Analysis**

**4.1. Socio Economic Environment and ICT Status of the Households**

This part of the research looks at the prospective role of different communication technologies in alleviating poverty from the rural Ethiopia. In this regard, households and institutions working on development arena are the main constituents of the survey. In this regard, total of 87 male and 13 female randomly selected households are incorporated into the sample. In addition, 50 public and 14 private institutions composed of schools, Agricultural and health centers become parts of the survey. The pie chart below shows the share of each group in the sample.

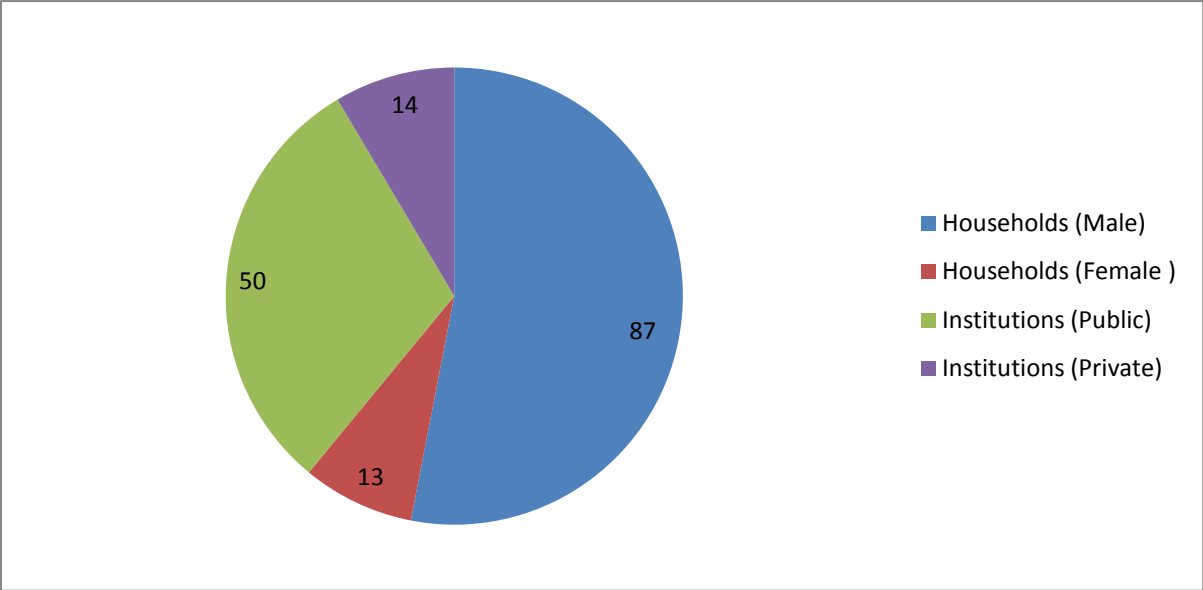


Figure 4: Survey Sample Size. Source: Survey (2011)

Regarding marital status, majorities of the respondent are married and have at least one child. These groups of the society hold 84 % of the sample. On the other hand, those married without children and single individuals' accounts 4 and 5 % of the study population, respectively. From these figures, it is possible to realize that most households in the region are married. The other imperative task to be done is related to assessment of household's educational level. Accordingly, large number of households attained maximum of primary education (between grade 1 and 8). For instance, 54 % of the sample households have a maximum educational level of grade 8 at the primary level. Similarly, 31 % does not have any background putting them down to the illiteracy category. However, only 13 % of the sample population completed their high school study (either grade 10 or 12).

Economically, the majorities are dependent on production of various crops with small-scale farming method. Among the main crops produced by the households, teff /*eragrostis tef*<sup>11</sup>, wheat/*triticum*, bean/*phaseolus vulgaris*, sorghum/*sorghum bicolor*, khat/*catha edulis*<sup>12</sup> and inset/ *false banana*<sup>13</sup> are the major ones. These households revealed that teff, wheat and khat are mainly produced for market purpose whereas others are for home consumption. On the other hand, the estimated level of annual income for the year 2010 shows a variant distribution among respective households. Half of the respondents from the study population earn an estimated amount between US\$ 388 to US\$ 853<sup>14</sup>. Similarly, 43 % of the households are getting an estimated annual income between US\$854 and US\$1860. However, 7 % of the households get an estimated annual income of more than US\$1860. The bar chart below summarizes the anticipated income level of households.

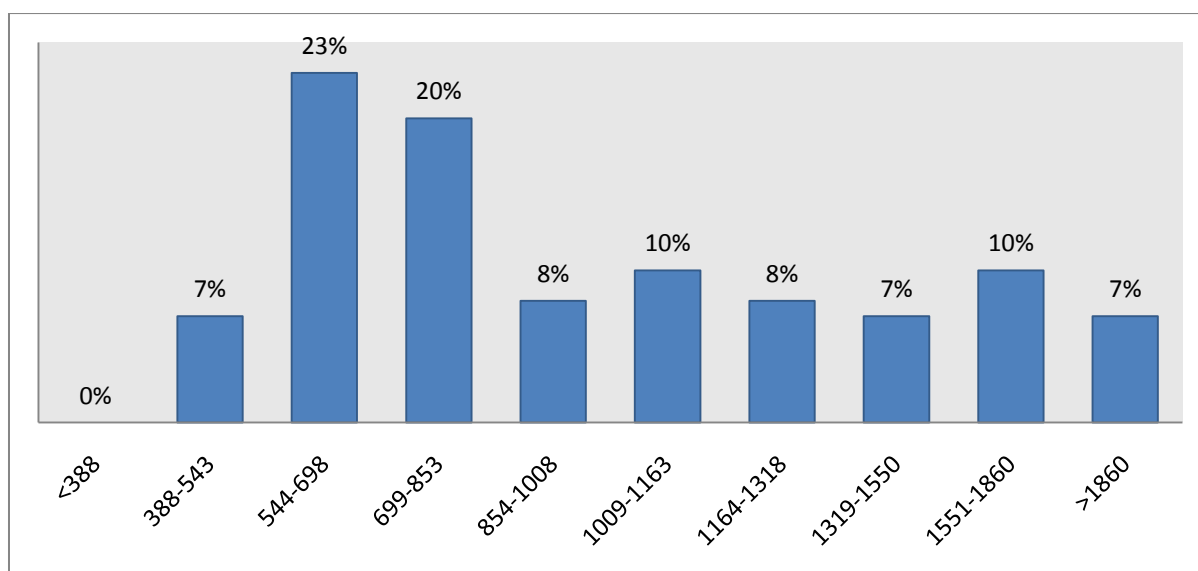


Figure 5: Estimated income level of households. Source: Survey (2011)

The distribution of farm land among the households is at a small level where the majority owns between 1 and 2 hectares. This is almost in the same range with the national average land holding per household, equivalent to 1.15 hectare/household, (CSA 2011, pp.12). These households comprise 64 % of the sample population. Despite the fact, this finding is in line with the justification forwarded by Gebreselassie (2006) that 87.4 % of rural households

<sup>11</sup> Teff (*Eragrostis Tef*) is an intriguing grain, ancient, minute in size, and packed with nutrition which was originated in Ethiopia between 4000 and 1000 BC ( Gambo and Ekris 2008).

<sup>12</sup> Khat is the name generally used for *Catha edulis*, a dicotyledonous evergreen shrub of the family Celastraceae (Kennedy, 1987), as quoted on (Al-Hebshi & Skaug, 2005)

<sup>13</sup> The word inset refers to herbaceous plant with the scientific name of *Enset Ventracosum* that forms the staple diet of many in many parts of southern Ethiopia (Berhanu, 2002)

<sup>14</sup> The exchange rate is taken for the month of 1 January 2010 based on the data obtained from commercial bank of Ethiopia converting Ethiopian birr to US dollar.

operate in less than 2 hectares of land. Drastically, 12 % owns less than 1 hectare of farm land, which is lower one as compared to the national average. The other vital aspect of household's character is related with marketing activity of their agricultural products. Accordingly, most household's conduct their entire marketing activity on what they produced is through involvement of middle's men. This category represents 63 % of the sample population. Obviously, this is an indication for the leading role of intermediaries in connecting producer and final consumers. Conversely, the remaining households supply their product to the market without the involvement of intermediaries.

Pertaining to the location of main product markets, most of them are found on more than 6 kilometers away from the farm site. In this regard, 36 % of the households confirmed that the first nearest market is found more far than 15 kilometers. Similarly, 19 % replied that the first nearest product market lies between 6 and 8 kilometers from their village. In the same way, input markets are also in far distance from their village. Accordingly, 42 % of the respondents identify the first nearest input market between 9 to 11 kilometers. On the other hand, 27 % replied that the location of their first nearest input market between ranges of 6 to 8 kilometers from their farm site.

Concerning the way how to access product and input-related information from sources, respondents use a variety of ICT devices. In this aspect, radio is the key means to obtain information, which is the device owned by 76 % of the respondents. However, mobile phone is becoming a crucial device as its application rate has been increasing at a tremendous rate<sup>15</sup>. Interestingly, 48 % of the respondents are getting price-related information from the product market through a mobile phone SMS service. In a similar way, 26 % get information from an input market.

Application for basic ICT goods and services differ among households with respect to its availability of various infrastructures in the area. Based on the survey result, no one has access to electricity, television and computer at his home. However, the majority has an access for radio and mobile phone. Table 1 below summarizes the application of different ICT goods and services in the households.

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<sup>15</sup> This improvement is the result of massive investment on telecom infrastructure including fiber optics backbone throughout the country. As a part of this progress, the mobile sector has been growing by 100% or more per annum in recent years, taking the network to its capacity limit and resulting in major infrastructure expansion efforts. Several broadband initiatives launched during 2004 promise to bring the country closer to the information society (Internet World Stat, 2011).

Types of Device	Number	Percent
Access for Electricity	0	0
Radio	76	0,76
Fixed Telephone	18	0,18
Mobile	53	0,53
Television	0	0
Computer	0	0
Internet <sup>16</sup>	21	0,21

Table1: Application of information communication tools and services in the household

It is known that finding internet cafe around the village where household's living is impossible. Based on the survey, internet cafe is found in far distance (more than 10 kilometers). Moreover, the main language of websites that are mostly visited by those few respondents who are using the internet, particularly through their mobile is entirely in English. In this regard, those households that are not using internet at their home justify various reasons. About, 73 % of the households replied that lack of knowledge is the main barrier not to use internet service at their home. Besides, absence of electricity in the region and high price for computer are other challenges believed to be the reasons not to access internet, particularly through their personal computer.

Households have varied perception on the expected benefits accrued from effective application of ICT goods and service. For instance, most households consider the application of these technologies as a sign of socio-economic development. This group comprises 57 %. While, 74 % argued that using ICT will benefit them in farming and related activities. The other imperative argument shared by 88 % of the households is that application of various ICTs could be an instrument in minimizing transaction cost associated with their marketing activities. Finally, 92 % of the study population thought that using these technologies has a potential of getting knowledge and updated information from different sources (Survey, 2011).

One of the crucial incentives towards better application of ICT's in a rural area is related to provisioning of basic logistic and technical support by suppliers of ICT goods and service. In this regard, most respondents found that they are getting these services in a limited way. However, some of them are obtaining different service from suppliers including maintenance

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<sup>16</sup> The exiting internet service is entirely accessed through mobile network, which is known as GSM/ Global system for mobile communication and a separate device called WCDMA/ Wireless Code Division Multiple Access. This number indicates only the availability of internet service through mobile phone rather than its application by the households.

of equipments and counseling on how to use the devices they bought. The other parallel challenge shared by these households is related to provisioning of spare parts, which is almost in a very negligible condition. Specially, low quality products supplied by sellers are their most limiting factors in using and adopting ICT goods and services.

Assessment of household's opinion towards their potential plan of spending on a telecommunication goods and services showed a divergent view. In this regard, feedback on household's potential spending by assuming the service is fully available indicates that mobile phone/GSM<sup>17</sup> with its full service is the first choice which is commonly shared by most respondents. Secondly, some respondents want to have their own personal radio. Importantly, they revealed similar thought concerning their plan of spending given the existing telecommunication infrastructure (Survey, 2011).

#### **4.2. Trends of ICT Application by the Institutions**

In addition to covering rural households in the survey, it is vital to include institutions involving on developmental activities as they are the main actors of poverty reduction. In this regard, the collected data on the application of ICT showed that agriculture, education and health sectors are comparatively at lower stage. For instance, even at a national level only 29 agricultural centers are connected with the federal government through a national project known as *Agri-net*<sup>18</sup> (ITU, 2009). Similarly, 668 high schools are linked with the *school-net*<sup>19</sup> project which provides education throughout the country relying on the application of satellite television (ITU, 2009). Regarding, health centers, similar project was launched aiming to link regional hospitals and introducing telemedicine throughout the country (Adam, 2010).

Basically, the overall mission of these institutions is focused on serving the societies in different perspectives. In this regard, the key beneficiaries include farmers, students, patients and women. This indicates, efficient use of ICTs can be used as a bridge for exchange of information among internal or/and external customers. In general, the survey result reveals almost lower status of utilizing communication technologies with respect to the purpose and

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<sup>17</sup> A GSM phone is a type of mobile phone that uses the Global System for Mobile Communications to send and receive phone calls. It is a digital standard first offered commercially in 1991 and is currently the most popular mobile phone transmission technology in the world

<sup>18</sup> Agri-net project is a project aimed interlinks a total of 29 agricultural institutions with the federal government and each other through satellite internet connection (ITU, 2009).

<sup>19</sup> School-net is the joint initiative by the Ministry of Education and UNDP aims on connecting high schools with a minimum of 15 networked computers per lab all connected to the Internet(Hare, 2007).

types of each device by the respective institutions. Particularly, related to accessing and disseminating information. Table 2 below summarizes the types ICTs and its purposes.

Tools	Number	%	Internal Purpose	%	Accessing	%	Disseminating	%
Computer	14	0,23	14	1,00	0	0,00	0	0,00
Fax	5	0,08	0	0,00	5	1,00	5	1,00
Telephone	32	0,53	32	1,00	32	1,00	32	1,00
Internet	7	0,12	0	0,00	7	1,00	7	1,00
Mobile	49	0,82	49	1,00	49	1,00	49	1,00
TV	14	0,23	5	0,36	9	0,64	0	0,00
Radio	43	0,72	0	0,00	43	1,00	0	0,00

Table 2: Purposes of ICT use by institutions; Source: Calculated based on the survey result (2011)

It is believed that these institutions have the possibility of optimizing ICT devices to maintain effective communication with public or private stakeholders. Despite this fact, only regular in person meeting has been using as the main way of communication. Specifically, deployment of various ICTs including video conferencing and radio transmission are negligible. At the same time, application of these devices as a tool of exchanging information with the local community is not observed.

These institutions state different reasons for lower level optimization of ICT’s in their entire activity. The first one is related to a shortage of IT professionals where only 26 trained personals are working with the institutions on IT-related issues. In addition to this, poor network access, lack of knowledge on how to use these technologies by officers and the community, lack of policy towards the application of these technologies and high cost of installing ICT goods and services are among the main challenges claimed by the institutions holding 48, 21, 40 and 52 % of the institutions, respectively.

In fact, these institutions believed that ICTs have a potential of extracting benefits in multiple ways. For instance, some argued that use of ICTs can have a positive impact on successful accomplishment of their ongoing projects as in facilitates the interaction of many stakeholders involved in the project. These institutions point out five main streams on the relevance of ICT’s behind their activity. Firstly, 88 % thought that deployment of ICT’s helps them to collect data from the society. Secondly, 80 % argued that various ICT’s can be used as an instrument of processing, analyzing, and interpreting data. Thirdly, 65 % of the total institutions in the sample understood that ICTs allows them to publish up-to-date information to the community and even to the public as a whole. Fourthly, 67 % of them believed that

monitoring and following various stages of project activity can be facilitated by application of relevant ICT goods and service, which is one of the paramount functions of ICTs. Finally, thought about potential prospects of learning and experience sharing with similar institutions comprise 87 % of the respondents.

Agricultural centers are one of the most important institutions working on farm-related issues. Accordingly, most of these centers argued that their main activity is related to creating awareness on how to use new farming and production techniques, supply of pesticides, seeds, fertilizers and conservation of soil and water in the village. Furthermore, some of them are working on dairy farming and provisioning of modern agricultural technologies to the farmers. Despite their activity, query conducted to assess the benefits of ICTs showed that there is a high expectation on the benefits of these technologies. Among these, efficient exchange of information between the internal and external customers, better use of organizational resources including budget and human resources, provisioning of training for farmers on how to use technologies and creates a link with similar organizations, knowledge sharing, fast and reliable decision making, searching market access and improving the culture of information acquisition in day to day working activity (Survey, 2011).

In the same way, educational centers in the village are serving the society by producing educated and qualified citizens through provisioning of better education, provisioning of basic kindergarten study and preparation of students for primary study. According to them, the major challenges counted for low level of ICT application is related to lack of trained IT professionals in schools, lack of ICT resources like computers and internet services. Conversely, they believed that wider application of ICT assists these schools through facilitating teaching-learning process, creating external links with similar institutions, supplying necessary technologies, accessing modern way of information exchange and training and updating staffs (Survey, 2011).

The other important institutions in the village are health centers. The main activity of these centers is related to provisioning of basic emergency and first aid medical care, prevention of malaria and related water borne diseases. Specially, they conduct a task of distributing medicines for the society, teaching communities regarding personal hygiene and sexually transmitted diseases like HIV/AIDS, provisioning of vaccination and child health care service, family planning, pregnancy and environmental sanitation. Besides, they work on creation of awareness for students on how to protect and get relief from HIV/AIDS through school based



trainings. The majority of these health centers recognized that efficient application of ICT's could have a tremendous potential in training and experience sharing among staffs, providing fast and easy transmission of information to the community, helping staffs to develop their skill and importantly it allows quick decision making, Moreover, it helps for counter response during emergencies, distribution of drugs, guidance and teaching of victims and potentially risky societies (Survey, 2011).

## 5. Discussion

### 5.1. Comparative Analysis of ICT Usage and Poverty in the Households

It has been argued that optimal use of different ICTs helps to reduce poverty and enhances development in rural areas (Chapman & Slaymake, 2002). Particularly, being familiar with modern ICTs becomes imperative as the value of information in shaping society's socio economic aspects of life become prominent. In order to elaborate this thought, assessing the relevance of ICTs from the standpoints of poverty reduction at the micro level is crucial. This mainly concerned on analyzing the existed relationship between these technologies and poverty at the grass root level. In this study, two ICT indicators from the sample population are taken tracing on their degree of accessibility for the majority of rural dwellers in Ethiopia. These are availability and application of basic telecom and radio networks. Similarly; factors related to poverty, including age, gender, family size, marital status, educational level, land size and income are included. Thus, the existing relationship among these variables is illustrated by the correlation coefficient matrix<sup>20</sup> (Table 1A in the Appendix).

Based on the collected data, it is observed that availability and application of basic telecom network with average age of the individuals show a negative association [-0.0914] (Table 1A in the Appendix). This indicates the existence of weak negative relationship among the variables. On the other hand, being male in the society has a positive correlation coefficient where on average females have negatively associated with the existing telecom network [0.1094]. This probably demonstrates how the gender issue is a key in shaping who is using various ICTs among rural households.

The other important poverty related variable is family size where those households with a high number prove positive dependency [0.0106]. This suggests the existence of possible interconnection with those big households. Moreover, marital status is related with utilization of telecom network in different ways. For instance, those single and married individuals without children have negative sign, [-0.0598] and [-0.2168], respectively. However, those married with children have a better degree of relationship as prescribed by positive sign of the coefficient value [0.2448]. This is perhaps consistence with the value of large families, since they are also belonging to the same group. Regarding the educational level of the households,

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<sup>20</sup> The correlation coefficient matrix reflects a combination of variables according to their direction of relationship and the values shows the degree of relation existed. Therefore, the correlation coefficient value always lies between -1 and 1, where -1 reflects perfect negative correlation and 1 for perfect positive correlation. On the other hand, value of 0 reflects absence of correlation between ICT and poverty.

those without any background have a negative coefficient value [-0.3219] suggesting a negative relationship. Finally, land size and income level shows a positive sign [0.3905] and [0.6439], respectively, and they have comparatively a higher degree of relationship with the application of basic telecom network.

The second ICT indicator to be compared with poverty-related variables is availability and accessibility of radio network by individuals. In this regard, the coefficient for age in the matrix shows a negative sign [-0.1669] that both variables interrelate in an opposite way. On the other hand, still male respondents have a positive sign of correlation coefficient [0.0918] as the same as telecom network. The other variable is family size that proves relatively very weak negative coefficient value [-0.0077], which is different from the value indicated on a telecom network. In another round, single individuals are positively correlated with radio network contrary to telecom network as it is observed by a positive coefficient sign in the matrix [0.0215]. This possibly suggests single individuals have a low level of relation network in the society. Similarly, those respondents married with children have a positive coefficient value [0.2018] showing relatively high level of interconnection. Furthermore, the variables indicating illiteracy, land size and income level have coefficient signs of [-0.0790], [0.3734], [0.3936], respectively.

Generally, the relationship between ICT and poverty-related variables show different coefficient signs and values depending on how they interact with each other. Visibly, all poverty-related variables show a similar sign of coefficient value in both ICT indicators. However, family sizes, marital status of single individuals, and educational background with a maximum of high school have different signs. Income and available farm land by the households show a relatively high degree of correlation with the main ICT indicators in the area. Independently, existing causal relationship between these variables is estimated in the preceding part.

## **5.2. Preconditions in Optimizing ICTs as a tool of Poverty Reduction**

Poverty reduction by its nature requires strong partnership among various stakeholders involved on developmental activities. Among them, the society which poverty puts its pressure on, the state that holds the power of policy-making and implementation activities and various institutions working in the society are the main partners where the process of poverty reduction should give due attention. Basically, the degree of familiarity with the application of modern communication technologies and prevailing working system perhaps matters the

potential benefits of ICT in reducing poverty. Thus, extensive deployment of ICTs as a catalyst of poverty reduction depends on the extent where the above organs shares common interest relating to ICT deployment.

Finding from the collected data however shows that there is a scrappy linkage between these actors on efficient application of ICTs. Absence of a principal system which relies on the application of modern ICTs is the main reason for this poor communication scheme by the institutions (Survey, 2011). Further, it is highly aggravated by the prevailing backward information exchange system within the households and institutions. For instance, lack of knowledge on a broad use of these technologies, limited access for a variety of ICT infrastructure, including computer, television and electricity by the households, and high installation cost are among the root causes (Survey, 2011). Particularly, institutions argued that exchange of information between the institutions and the community is mainly carried out through direct meeting, which is inefficient in many cases. Moreover, exchange of information with public is still dominated by direct meeting with the exception of lower radio communication. Possibility, increasing efficiency of policy implementation on ICT sector can create a coordinated system among these actors and enables optimization of various ICTs as a vehicle of poverty reduction. Whereas incoherent activities among these agents which does not consider the crucial importance of ICT's for poverty reduction might not be effective.

In many cases, those households living in rural areas should have broad awareness on what, how and where ICT's potentially improves their livelihood. This requires successful design and implementation of ICT programs that aim on reduction of poverty. Particularly, inadequate awareness on the overall importance of ICT's limits the expected benefits obtained from the application of these technologies. For example, 57 % of the households in the survey thought that one of the expected benefits obtained from using ICTs is related to an indication of development in their personal life (Survey, 2011). Understanding this desire of the households may affect wider adoption of these technologies.

In Ethiopia, there is a comprehensive ICT policy document adopted by the council of ministers in 2003, which aims to increase the status and role of ICT's in different sectors (WSIS, 2003). This document clearly sets possible project areas that require financial and technical support. Among them, sector program development is the one that noticeably elaborated by the document. It encompasses three prominent areas; improvement of education, health and agricultural centers with modern ICTs. In this regard, the survey result

showed negligible ICT utilization among these three prominent sectors. For instance, only 14 % of these institutions uses computer. Similarly, mobile phone/GSM, fax machine, and television are used by 49 %, 5 % and 14 % of the institutions, respectively (the detail is briefly justified in table 2). This drift perhaps indicates the prevailing gap between policy and implementation, which most likely prohibits the effective use of various ICT devices. Moreover, these institutions clearly shares common thought on the main reasons for the existing gap between policy and implementation as poor network access and lack of know-how for various ICT tools by staffs (Survey, 2011).

On the other hand, not relying on analog communication and replacing it with the digital one have a great possibility of delivering efficient service for the customers in respective institutions. In this regard, assembled feedback from the institutions shows a backward working system which is mainly depend on inefficient communication system. For example, 60 % of the institutions argued that their main ways of exchanging information with higher public organ and the community goes through direct meeting where use of other modern ways of communication technologies are unusual to find. This suggests that alteration of working system that favors the application of various ICT's and in this aspect, the role of public and non-governmental organization is enormous. Particularly, in the areas of system development, adoption and implementation of new ICT's and capacity building are the main target areas.

### **5.3. The Benefits of ICT's and Rural Development Agents**

It has been thought that ICTs are crucial in facilitating poverty reduction process and there by achieving long-term development among rural societies. Specially, building extensive interconnection between development actors is highly recommended as the influence of ICT on working efficiency and decision making is becoming inevitable. Among them, Chapman and Slaymake (2002) argued that *the potential of ICTs' to support and enhance communication across a broad spectrum of actors and activities through the integration of a multimedia mechanism into daily processes is renowned*. This possibly has a potential in raising actors working efficiency in different perspectives. Similar works are also justified it as *communication for development is about aiding different types of actors interested in understanding needs and assessing opportunities jointly; it is about providing them with the methods and media to reach common meaning, and about enabling them to negotiate with other actors with contrasting perceptions and interests* (Ramirez, 1998 cited on Chapman and Slaymake, 2002, pp.38).

On the other hand, the collected data showed that utilization of ICTs as a tool of exchanging information with outside customers is found at a very lower level. For instance, 100 % of the existing computers are owned by the institutions, and mainly they have been using for the internal purpose. Importantly, it should be noticed that low number of computers makes the potential role of ICT's lower in exchanging information with the outside customers. Significantly, regular telephones and mobile phones are mainly utilized by the institutions. The existence of these technologies alone does not guarantee the benefit that ICT provides but understanding the reason why these technologies required matters. This might limit the possible optimization of all services obtained from these technologies. In this respect, an assessment made to know the expectation on the vital role of ICTs with respect to the ongoing activity of these institutions indicates a positive expectation behind deployment of various ICT's. Firstly, 88 % of the institutions argued that deployment of various ICT's enables them in collecting relevant data from the community. Secondly, around 80 % of the respondents expect that ICT's helps them in analyzing and interpreting the collected data. Thirdly, publication of updated information for the external bodies is supported by 65 % of the institutions. Fourthly, 67 % believes that ICT's can helps them in monitoring and evaluating activities held, which are necessary in developmental activities. Finally, their expectation on learning and experience sharing with other institutions is critically favored by 87 % of the respondents.

Therefore, it can be possible that institutions can play a big role their capacity on developmental activities through better access and efficient application of ICT's. Importantly, maintaining strong interconnection among these agents has a potential of creating an information wheel<sup>21</sup> that leads to the successfulness of different strategies designed by these institutions. For instance, creating a channel of information between health centers and schools can possibly helps to take proactive action on the potential outbreak of malaria and tuberculosis in a certain community. This role is confirmed by 52 % of the institutions by revealing their expectation as *effective utilization of various ICTs can allow them to get learning and experience sharing from similar institutions* (Survey, 2011).

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<sup>21</sup> The concept of information wheel is briefly elaborated by (Chapman & Slaymake, 2002) with respect to its relevance of long-term capacity building for decision-making in appropriate livelihood strategies, usually through education, training, and technical support and assistance with problem solving plus, updating regularly for people to make short term decisions regarding their immediate livelihood activities.

#### 5.4. Determinants of ICT Application by the Households

Findings showed that the application of ICTs' is determined by numerous socio-economic factors. For instance, the work made by Yin *et.al* (2005) on identifying the determining factors of U.S household's expenditure on computer hardware's and software's revealed that there is a substantial effects of age, marital status, computer ownership, gender, education, income, and region on the amount of households expenditure. Basically, U.S has relatively different socio economic background related to most developing countries that deployment of an alternative model is necessary to investigate these constraints. Alternatively, the trend of ICT expenditure in developing countries is studied by (Baliamoun, 2003; Ssewanyana & Busler, 2007; Pierre and Vincenzo, 2009) which considers the real situation existed.

Based on the collected data, a regression model that explains the trend of ICT spending by individual household is developed by putting ICT expenditure as a linearly dependent variable<sup>22</sup>. That means, age, gender, marital status, family size, educational level, types of crops produced by the households and main ICT infrastructures used by the households (access and use of telecom and radio network) are become independent variables<sup>23</sup>. It should be noticed that the model in this paper uses the main crops produced by households in place of income as they are the main determinants of livelihood in rural Ethiopia (IFAD, 2006). Theoretical justification of these variables related to ICT spending is done in the literature part.

Moreover, OLS estimation aimed on finding the estimates of explanatory variables is calculated by considering assumptions behind the estimation procedure (Gujarati, 2004). Further, the model is evaluated for its value of coefficients of determination(R-squared), collinearity and homoscedasticity<sup>24</sup>. Thus, the result is tested whether it satisfies the formulated hypotheses or not. Accordingly, the first hypothesis states that age, family size and educational level impacts on the level of ICT expenditure positively. Secondly, cash crops, Income, ICT infrastructures and land size are positively affecting ICT expenditure. Notably, single individuals impact ICT expenditure in a negative way. Therefore, the functional form of ICT expenditure can be expressed as;

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<sup>22</sup> Dependent variable refers to those variables that are not controlled or manipulated in any way, but instead are simply measured or registered (Gujarati, 2004 and Stock & Watson, 2007).

<sup>23</sup> The independent variables are those variables which are more or less *controlled* and researcher can *manipulate* them as they see fit (Gujarati, 2004 and Stock & Watson, 2007).

<sup>24</sup> The brief definition of these terms including the main assumptions of OLS estimation is found on (Gujarati 2004, pp.81-105; and Stock & Watson 2007, pp.186-216).

$$ICTExpe = f(\text{Socio Economic Factors}) \dots \dots \dots (1)$$

Equation (1) can be decomposed in to more meaningful mathematical expression as;

$$ICTExpe_i = \alpha_1 + \alpha_2 x_{1i} + \alpha_3 x_{2i} + \alpha_4 x_{3i} + \alpha_5 x_{4i} + \alpha_6 x_{5i} + \alpha_7 x_{6i} + \alpha_8 x_{7i} + \alpha_9 x_{8i} + \alpha_{10} x_{9i} + \alpha_{11} x_{10i} + \alpha_{12} x_{11i} + \alpha_{13} x_{12i} + \varepsilon_i \dots \dots \dots (2)$$

In equation (2),  $\alpha_1$  is the constant term,  $\alpha_2, \alpha_3, \alpha_4, \dots, \alpha_{13}$  are estimated coefficient parameters of the explanatory variables,  $x_{1i}, x_{2i}, x_{3i} \dots \dots x_{12i}$  are explanatory variables of the model and  $\varepsilon_i$  refers to the stochastic error term<sup>25</sup>. The detail of these expressions is illustrated in table 5A of the Appendix. Table 3 below shows those significant variables that affect households ICT expenditure.

Table 3: Constraining Factors Affecting ICT Expenditure in Rural Households of Ethiopia  
(The Dependent Variable is ICT Expenditure by rural Household)

Statistically Significant Variables	(1) ictexpe	(2) ictexpe	(3) ictexpe	(4) ictexpe
Marital status of single individual	-144.0 (274.7)	-324.7** (152.5)	-440.0** (201.6)	-278.3* (162.5)
Total available farm land in hectare		452.6*** (63.04)	323.4*** (56.23)	234.7*** (48.73)
Crop production of wheat			396.6*** (100.7)	139.5* (80.03)
Crop production of bean			-189.0** (84.38)	-116.0* (65.77)
Availability and use of telecom network by the individual				597.7*** (78.58)
Availability and use of radio network by the individual				234.4*** (55.84)
Observations	100	100	100	100
R-squared	0.146	0.438	0.596	0.778

Robust standard errors in parentheses  
\*\*\* p<0.01, \*\* p<0.05, \* p<0.1

<sup>25</sup> According to (Stock & Watson, 2007) stochastic or error term is a variable that incorporates all the factors responsible for the difference between the  $i^{th}$  average score and the value predicted by the population regression line.



As stated above, the regression model covers analysis of socio-economic factors affecting ICT spending by the individual households. In other terms, the estimated result shows a number of statistically significant variables that influence ICT expenditure. Availability and use of radio network, telecom network, and size of farm land shows 99 % significant level, respectively. In other term, the estimated parameters have the probability of 99 % being true to explain the ICT expenditure by respective coefficient values. Correspondingly, they have positive coefficient values, indicating direct relationship with ICT expenditure.

On the other hand, the main sources of household's income such as production of wheat and bean are significant at 90 % level, respectively. These crops are used in place of income in the regression model due to the existence of strong correlation among them, and this improves the significance level of explanatory variables. Perhaps this happened since gross income of the individual possibly influenced by other sources of income, which are different from agricultural activities. For instance, remittance might affect income significantly. Regarding the sign of coefficients, wheat shows positive impact on ICT expenditure which is the main cash crop in the region and even in the country, holding 2.4 % of the national wheat production (ECX, 2008). However, bean, which is mainly produced for home consumption purpose indicates a negative sign implying that those households producing bean are less likely to spend on ICT goods and services. From the economic point of view, it is realized that cash crops are prominently market oriented, and the gain obtained from rely on the availability and access of information in the entire market (Kiiza *et al*, 2011). The other important variable that shows a high significant level is marital status of single individual. Accordingly, it has a negative sign that being a single individual is inversely related with ICT expenditure at a significant level of 90 %.

Besides, inclusion of additional explanatory variables to the model aiming to check the interaction effect shows an imperative result. Particularly, the relation between wheat production with availability and use of telecom network is extremely significant, which is at 99 % level (Appendix II). This implied that those households producing the main cash crop have high demand for utilization of telecom network in the region. Similar observation is occurred between single individual and availability and use of radio network with 99 % significant level (Appendix III). Furthermore, interaction of bean with availability and use of radio network shows a negative coefficient value at 90 % significant level. Perhaps, this happens due to the dieting style of the society that bean is mostly consumed at home rather than for market sell.

Generally, infrastructure and economic variables are the main determinants of ICT spending showing statistically significant value. In addition, marital status of single individual is the variable that affects ICT spending in a substantial way. Importantly, those cash crop producers who are most likely dependent on information oriented market indicates high tendencies of using a number of ICTs as pointed by their behavior of expenditure on these goods and service. Finally, the overall result of the model leads to a conclusion on predetermined hypotheses that we accept the null one on the second and third hypothesis since their result lies within the acceptance region. However, we reject the null hypothesis for the first hypothesis that age, family size and educational level lies in the critical region.

Finally, with the regression technique used by this research, it is possible to identify a causal relationship of different socio economic variables and ICT expenditure. In this regard, one of the interesting results in the model is the impact of cash crop production on ICT expenditure, which is highly significant. However, it is not known whether the larger cash crop producers spend more because they are wealthier, or whether cash crop farms that make more use of ICT services have been growing faster in the past. To understand this potential causality with respect to efficiency of market participation and the role of investments into ICT for household income generation, it would be necessary to go back to the survey side and ask more questions. This however, is clearly beyond the scope of this thesis but can be discussed as future research.

## 6. Conclusions

So far, this research tried to look at the main challenges and prospects of ICTs in line with reducing poverty from the rural Ethiopia. Particularly, deepening on the questions of how ICTs relates with poverty reduction, preconditions required for optimization of these technologies, its benefits among different stakeholders involving on developmental activities and the main constraints faced by households not to use ICT's. Consequently, the collected data covering socio economic characteristics of the society revealed a number of findings for these queries.

Understanding the connection between application of ICT and poverty reduction is crucial in drawing appropriate strategies intended to minimize poverty with respect to efficient ICT optimization. Accordingly, the result from this research shows that social aspects of the society including household age, family size (for some ICT goods and service) and illiteracy are indirectly related with usage pattern of the main ICT variables in the region. Similarly, being male is directly associated with application of ICTs in the society that female individuals are connected in opposite way. Income levels and available land size by individuals are the other key variables that correlated positively. In general, the relationship of poverty and socio economic variables with the main ICT's in the region shows a varied trend (Table 1A in Appendix D).

On the other hand, optimizing ICTs in the reduction of rural poverty requires numerous preconditions set for the main actors in rural arenas. These include societies, the state and institutions. In this regard, the societies living in rural areas should have broad awareness on what, how and where ICT's potentially helps in improving their livelihood. This requires successful implementation of ICT programs, which are focused on reducing poverty and also starts from the expectation of households on how they think and behave on the relevance of communication technologies.

Undoubtedly, the compiled information from the society revealed that there is a lack of awareness by the households on broad benefits of different ICTs where they perceive it only as a sign of development. The state, on the other hand, should create an efficient working environment in different sectors, which is equipped with utilization of communication technologies. In view of that, the collected data indicates a gap between ICT policy and its implementation that prohibits the effective application of these technologies either in agriculture, health and educational sectors. Principally, these sectors share the prevailing gap

of policy and implementation as a product of poor network access and lack of knowledge on how to use various ICT tools. On the other hand, the working surrounding of the main institutions in the area is dominated by analog communication, which is less likely supported by modern communication schemes. Furthermore, most of the institutions argued that direct meeting is their main way of exchanging information with higher public organs and the community.

It is believed that the process of poverty reduction in a rural area is prominently influenced by the overall status of inter and intra communication among different actors working on developmental activities. Predominantly, the state of ICT utilization among them can strongly impact working efficiency and decision making process in different ways. In this regard, the collected data confirms the utilization of ICTs as a tool of exchanging information with outside customers is at a very low level. This is perhaps due to low level of ICT devices and infrastructure in the region. However, an assessment made to know the expectations on the vital role of ICTs with respect to the ongoing activity of these institutions showed that deployment of various ICTs can help them in several modes. Consequently, the existence of various communications goods and services among the development agents working in rural areas have a big role in raising efficiency and facilitate poverty reduction as observed from feedback of the institutions.

The level of ICT spending by individual households is also influenced by various socio-economic factors. In this regard, the paper realizes the amount of expenditure on ICT goods and services is highly related with the availability of ICT infrastructures, types of crops produced by the households and marital status of the individuals. Especially, lack of ICT infrastructure in rural areas limits the spending of household's level of usage as it must come prior. Moreover, cash crops which are mainly market oriented showed the high level of influence on ICT expenditure made by the individual as those producing these crops revealed a higher tendency of spending on ICT goods and services.

At the end, this research found two thoughts which are potentially require involvement of intermediate actors and further study. Firstly, alteration of working system that favors the application of various ICTs requires an endeavor of both public and non-governmental organization in an enormous way, particularly targeting the areas of system development, adoption of new ICTs and capacity building areas. Secondly, one of the interesting results in the regression model is the substantial impact of cash crop production on ICT expenditure.

With the regression techniques used by this research, it is not known whether the larger cash crop producers spend more because they are wealthier, or whether cash crop farms that make more use of ICT services have been growing faster in the past. To understand this potential causality with respect to efficiency of market participation and the role of investments in to ICT for household income generation, it would be necessary to go back to the survey side and ask more questions. This, however, is clearly beyond the scope of this thesis but can be discussed as future research.

## Appendix

### Appendix A: Lists of Tables

Table 1A: Correlation coefficients, using the observations 1 - 100

5% critical value (two-tailed) = 0.1966 for n = 100

age	familysize	dgend	dmrssingle	dmrsmarwchil	
1.0000	0.6090	0.1363	-0.2681	0.0601	Age
	1.0000	0.1449	-0.3052	0.4406	Family size
		1.0000	0.0964	0.1986	Gender
			1.0000	-0.5257	Dmrssingle
				1.0000	dmrsmarwchil
dmrswoutchil	dednoschool	dedhighschool	dedsomecol	landhec	
0.0128	0.4488	-0.3110	-0.1240	-0.1464	Age
-0.2227	0.3378	-0.2446	-0.0825	0.0195	Familysize
-0.0572	0.0999	-0.1068	0.0791	0.0858	Dgend
-0.0468	-0.1538	0.2117	-0.0887	0.1097	Dmrssingle
-0.4677	0.1156	-0.1292	0.0876	0.1109	dmrsmarwchil
1.0000	-0.0265	0.0860	-0.0789	-0.1114	dmrswoutchil
	1.0000	-0.7262	-0.2591	-0.1654	dednoschool
		1.0000	-0.4188	0.1161	dedhighschool
			1.0000	0.0107	dedsomecol
				1.0000	Landhec
		income	dtelenet	dradnet	
		-0.0809	-0.0914	-0.1669	Age
		0.0427	0.0106	-0.0077	Familysize
		0.0497	0.1094	0.0918	Dgend
		-0.0158	-0.0598	0.0215	Dmrssingle
		0.1691	0.2448	0.2018	dmrsmarwchil
		-0.1560	-0.2168	-0.1243	dmrswoutchil
		-0.1654	-0.3219	-0.0790	dednoschool
		0.0690	0.0957	-0.0019	dedhighschool
		0.0999	0.3044	0.1476	dedsomecol
		0.7230	0.3905	0.3734	Landhec
		1.0000	0.6439	0.3936	Income
			1.0000	0.4091	Dtelenet
				1.0000	Dradnet

Source: Own calculated by using gretl (2011)

**Illustration:** *Age*: age of the respondent, *Gender*: gender of the respondent, *MSsing*: marital status of single household, *MwithChild*: marital status of married with child, *MSwoutchil*: marital status of married without child, *Noschool*: respondent with no education, *Mhighschool*: respondent with maximum high school, *Msomecol*: respondent with maximum of some college level schooling, *Income*: income level of the household, *Telenet*: telecom network usage by respondent and *Radnet*: radio network usage by respondent.

Table 2A: Reasons for involvement of intermediaries

Reasons	Number	%
Lack of market information including price level	59	94%
Low infrastructural Facilities/transport and communication	62	98%
Distance from the product market	34	54%
Distance from input market	48	76%

Source: Own constructed based on survey result (2011)

Table 3A: Barriers in using internet Service either in a computer or mobile

Reasons	Number	%
Lack of access for internet service	58	58%
Poor internet service over mobile	20	20%
Low quality of existing network	14	14%
Lack of knowledge	79	79%
Electricity	100	100%
Cost of installing internet/computer and mobile service charge	46	46%
Other	21	21%

Source: Own constructed based on survey result (2011)

Table 4A: Main ICT infrastructure existed in the area

Infrastructure	Number	%
Telecom Network	100	100 %
Radio Network	100	100 %
TV Network	100	100 %
Electricity	0	0 %

Source: Own constructed based on survey result (2011)

Table 5A: Illustration of variable names in the regression model

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Variables	Names
$x_{1i}$	Age of the individual
$x_{2i}$	Family size of the individual
$x_{3i}$	Dummy for household with husband reference person
$x_{4i}$	Dummy for marital status of single individual
$x_{5i}$	Dummy for educational level of an individual without any background
$x_{6i}$	Dummy for educational level of individual with maximum of high school
$x_{7i}$	Total available farm land in hectare by the individual
$x_{8i}$	Dummy for crop production of teff by the individual
$x_{9i}$	Dummy for crop production of wheat by the individual
$x_{10i}$	Dummy for crop production of bean by the individual
$x_{11i}$	Dummy for the availability and use of telecom network by the individual
$x_{12i}$	Dummy for the availability and use of radio network by the individual
$\varepsilon_i$	The stochastic error term

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Table 6A: Constraining Factors Affecting ICT Expenditure in Rural Households of Ethiopia  
(The Dependent Variable is ICT Expenditure by rural Household)

VARIABLES	(1) ictexpe	(2) ictexpe	(3) ictexpe	(4) ictexpe	(5) ictexpe
Age	-7.594 (5.286)	-2.304 (6.161)	2.673 (5.849)	-0.351 (3.935)	2.040 (2.422)
Family size	23.88 (29.10)	25.37 (28.28)	-3.789 (25.13)	-13.61 (23.49)	-18.33 (15.02)
Dummy for household with husband reference person		221.5 (151.9)	85.84 (131.6)	105.6 (102.3)	-9.270 (77.20)
Dummy for marital status of single individual		-144.0 (274.7)	-324.7** (152.5)	-440.0** (201.6)	<b>-278.3*</b> (162.5)
Dummy for educational level of an individual without any background		- 617.4*** (167.1)	- 503.9*** (166.1)	-343.0** (145.7)	-99.75 (116.0)
Dummy for educational level of individual with maximum of high school		-246.3 (167.0)	-242.3 (160.9)	-170.8 (136.5)	-40.65 (111.6)
Total available farm land in hectare			452.6*** (63.04)	323.4*** (56.23)	<b>234.7***</b> (48.73)
Dummy for crop production of teff				170.5** (80.96)	17.08 (57.96)
Dummy for crop production of wheat				396.6*** (100.7)	<b>139.5*</b> (80.03)
Dummy for crop production of bean				-189.0** (84.38)	<b>-116.0*</b> (65.77)
Dummy for the availability and use of telecom network by the individual					<b>597.7***</b> (78.58)
Dummy for the availability and use of radio network by the individual					<b>234.4***</b> (55.84)
Observations	100	100	100	100	100
R-squared	0.017	0.146	0.438	0.596	0.778

Robust standard errors in parentheses

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1

Table 7A: The Interaction Effects of Telecom Network with Other Variables  
(The Dependent Variable is ICT expenditure by rural Household)

VARIABLES	(1) ictexpe	(2) ictexpe	(3) ictexpe	(4) ictexpe	(5) ictexpe	(6) ictexpe
Age	-7.594 (5.286)	-2.304 (6.161)	2.673 (5.849)	-0.351 (3.935)	2.040 (2.422)	1.203 (2.192)
Family size	23.88 (29.10)	25.37 (28.28)	-3.789 (25.13)	-13.61 (23.49)	-18.33 (15.02)	-7.892 (15.13)
Dummy for household with husband reference person		221.5 (151.9)	85.84 (131.6)	105.6 (102.3)	-9.270 (77.20)	13.41 (69.57)
Dummy for marital status of single individual		-144.0 (274.7)	-324.7** (152.5)	-440.0** (201.6)	-278.3* (162.5)	-113.9 (142.5)
Dummy for educational level of an individual without any background		- 617.4***	- 503.9***	-343.0** (201.6)	-99.75 (162.5)	-72.75 (142.5)
Dummy for educational level of individual with maximum of high school		-246.3 (167.1)	-242.3 (166.1)	-170.8 (145.7)	-40.65 (116.0)	-32.29 (114.4)
Dummy for the availability and use of telecom network by the individual					597.7*** (78.58)	568.2*** (123.9)
Dummy for the availability and use of radio network by the individual					234.4*** (78.58)	246.7*** (123.9)
Dummy for crop production of teff				170.5** (80.96)	17.08 (55.84)	36.22 (48.28)
Dummy for crop production of wheat				396.6*** (80.96)	139.5* (57.96)	-84.80 (58.71)
Dummy for crop production of bean				-189.0** (100.7)	-116.0* (80.03)	-19.19 (62.41)
Total available farm land in hectare			452.6*** (63.04)	323.4*** (56.23)	234.7*** (48.73)	227.8*** (46.22)
Interaction between being single and telecom network						-299.5 (245.7)
Interaction between wheat production and telecom network						374.3*** (245.7)
Interaction between bean production and telecom network						-183.9 (135.0)
						(116.0)
Observations	100	100	100	100	100	100
R-squared	0.017	0.146	0.438	0.596	0.778	0.799

Robust standard errors in parentheses

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1

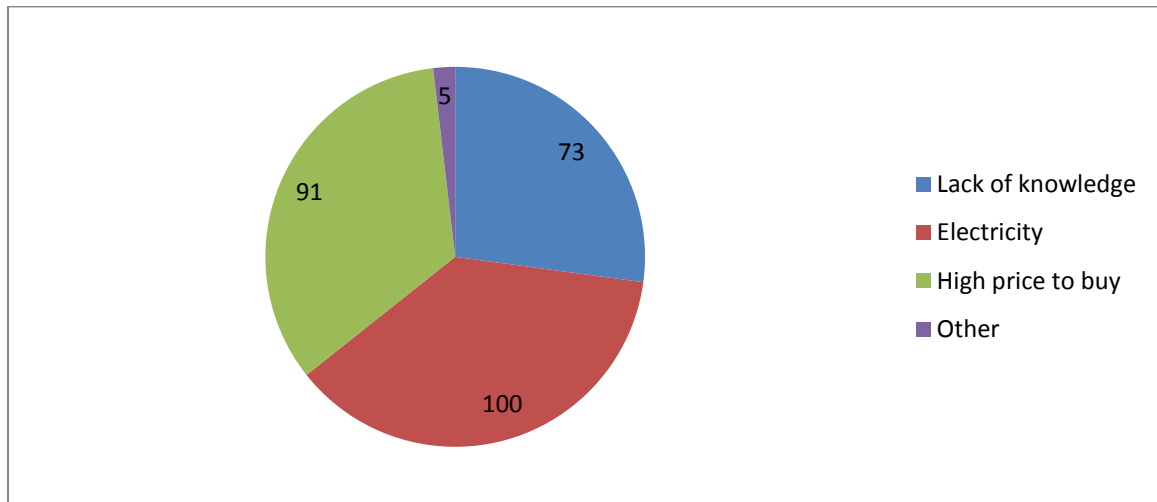
Table 8A: The Interaction Effects of Radio Network with Other Variables  
(The Dependent Variable is ICT expenditure by rural Household)

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
	ictexpe	ictexpe	ictexpe	ictexpe	ictexpe	ictexpe
Age	-7.594 (5.286)	-2.304 (6.161)	2.673 (5.849)	-0.351 (3.935)	2.040 (2.422)	1.596 (2.320)
Family size	23.88 (29.10)	25.37 (28.28)	-3.789 (25.13)	-13.61 (23.49)	-18.33 (15.02)	-13.18 (16.47)
Dummy for household with husband reference person		221.5 (151.9)	85.84 (131.6)	105.6 (102.3)	-9.270 (77.20)	19.82 (78.47)
Dummy for marital status of single individual		-144.0 (274.7)	-324.7** (152.5)	-440.0** (201.6)	-278.3* (162.5)	145.2 (89.41)
Dummy for educational level of an individual without any background		- 617.4***	- 503.9***	-343.0**	-99.75	-60.36
Dummy for educational level of individual with maximum of high school		(167.1) -246.3	(166.1) -242.3	(145.7) -170.8	(116.0) -40.65	(117.9) -30.08
Dummy for the availability and use of telecom network by the individual		(167.0)	(160.9)	(136.5)	597.7*** (78.58)	583.0*** (76.32)
Dummy for the availability and use of radio network by the individual					234.4*** (55.84)	320.8*** (81.98)
Dummy for crop production of teff				170.5** (80.96)	17.08 (57.96)	23.58 (56.12)
Dummy for crop production of wheat				396.6*** (100.7)	139.5* (80.03)	34.19 (80.59)
Dummy for crop production of bean				-189.0** (84.38)	-116.0* (65.77)	-8.967 (63.83)
Total available farm land in hectare			452.6*** (63.04)	323.4*** (56.23)	234.7*** (48.73)	246.6*** (47.52)
Interaction between single individual and radio network						- 575.6*** (168.3)
Interaction between wheat production and radio network						146.0 (120.5)
Interaction between bean production and radio network						-181.5* (100.0)
Observations	100	100	100	100	100	100
R-squared	0.017	0.146	0.438	0.596	0.778	0.791

Robust standard errors in parentheses  
\*\*\* p<0.01, \*\* p<0.05, \* p<0.1

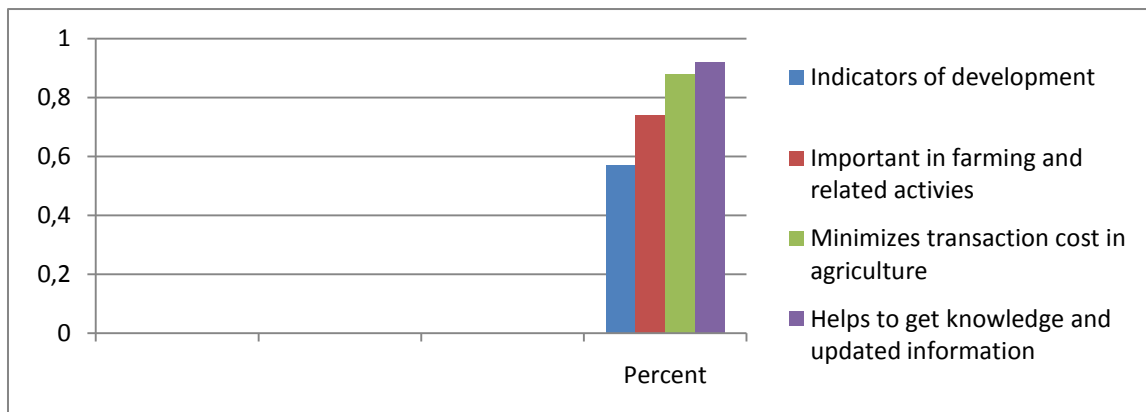
## Appendix B: Lists of Figures

Figure 1B: Barriers in using computer at home by households



Source: Own constructed based on survey result (2011)

Figure 2B: Expected benefits of using various ICT tools



Source: Own constructed based on survey result (2011)

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