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RESEARCH ARTICLE

AN ANALYTICAL STUDY OF THE IMPACT OF MOBILE PHONES ON AGRICULTURAL AND RURAL LIVELIHOODS IN RWANDA: A CASE STUDY OF JENDA AND RAMBURA SECTORS

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Abstract

The present study aims to assess the impact of mobile phones on agricultural and rural livelihoods in Rwanda, with the case study of Jenda and Rambura sectors. A total sample size of 68 respondents (34 respondents in each sector) was selected.

A structured questionnaire was used as the main data collection instrument. It was prepared in both English and Kinyarwanda and made of open and closed questions. The data were entered using the Microsoft Excel programme and thereafter results were analyzed using SPSS software.

The three major findings of the study are:

1. The identification of demographic factors influencing the usage of mobile phones by rural households revealed that gender (1.72) has a major influence on mobile phone ownership.

2. The main impact of mobile phones use on farmers is access to market information (1.49) while the main impact of mobile phones use on rural livelihoods is financial efficiency (1.49)

3. Poverty is the main challenge affecting the rate of mobile phone use.

The study has proven that mobile phone is indeed a viable tool for economic development and a facilitator of sustainable livelihoods among those engaged in agricultural based and non agricultural based livelihood activities. Mobile phones promotes agricultural livelihoods by providing access to market information, increasing market participation, increasing productivity and reducing search and transaction costs. Mobile phone also promotes rural livelihoods by reducing transport costs, saving time, providing job opportunities, helping in emergency coordination and allowing financial transactions to be conducted.

In the conduct of the study, some challenges that hinder mobile phones adoption were reported such as poverty, illiteracy and ignorance. The study provided recommendations focus on how to tackle those challenges.

1.1 Background

Most of Rwandans live on agriculture, for a long time. The agriculture sector is the backbone of the Rwandan economy. It employs more than 80% of the population, contributes 32-34% to the GDP, is the main earner of foreign exchange in Rwanda(70%) and provides 90% of national food needs. (RAB, 2013)
The role of agriculture in economic development has long been recognized (Byerlee, de Janvry and Sadoulet 2009). Agriculture plays a unique role in reducing poverty and serves as an important engine for growth in developing countries.
Because of this important economic role, the agriculture sector holds a strategic position within the Government of Rwanda's (GOR) medium and long-term goals as outlined in the Vision 2020 and the Economic Development and Poverty Reduction Strategy (IPAR,2009).
Food security is becoming an issue mostly due to negative impacts of climate change, food price hike in international market and decreasing arable land within the country. In order to ensure domestic food security, increase in production would be the solution.
As farming is becoming a more time-critical and information-intense business; a push towards higher productivity will require an information-based decision-making agricultural system. Farmers must get information at the right time and place.
In this context the use of mobile phones can help farmers in getting information they need on time, which in turn will maximize farm production. Accordingly, selling their products at a justified and fair price will develop their livelihoods in a sustainable way.
A research in Sri Lanka found that the cost of information from planting decision to selling at the wholesale market can make up to 11% of total production costs. The study also found that information asymmetry is an important contributor to overall transaction costs (De Silva and Ratnadiwakara, 2008).
In recent years, there has been a rapid growth of mobile phone networks in developing countries. Currently mobile telephony is the predominant mode of communication in the developing world. At the beginning of the twenty-first century, the average number of mobile phones per 100 inhabitants in Asia, Africa and Latin America and the Caribbean has risen by 100-400% in a span of just five years (Orbicom, 2007). While developing countries are still lagging behind high-income countries in overall ICT usage and applications, the mobile phone has been regarded as a more accessible and less expensive means to close the digital divide (Wade 2004).

The advent of Information Communication Technology (ICT) and its subsequent adoption by both the developed and developing countries ushered in the information age. Consequently, information has become a valuable commodity in the global world (Alleman, 2005).

ICTs are major catalyst for information and knowledge that can create development opportunities and choices for rural communities. These can under certain conditions help to improve the living conditions of the rural poor through better and more sustainable livelihoods strategies (UN, 2004). The application of ICT in different areas of human endeavor has brought about many benefits not only to the individuals but also to the community whether in urban or rural areas. Mobile phone which is an integral part of ICT has become one of the most important media of information communication of our time.

The link between ICTs such as mobile phones, livelihoods and poverty stems from the recognition that information is a critical factor for development purposes. Mobile phones have the potential to amplify the speed and ease, and to introduce new modes with which information is communicated. The phones can enable interactive communication flow unhindered by space, volume, medium or time, thereby influencing the existing communicative ecologies (Tacchi et al., 2003). Accelerated communication of information, in the interplay with other factors, can increase productivity; enhance access to services; widen markets; simplify transactions; substitute for physical transport; prevent crime; improve governance, and create new socio-economic opportunities, among many other benefits. (Butner, 2003).
Despite the growing recognition about the livelihood-improving and poverty-reducing potential of mobile phones, the precise ways and extent to which these technologies contribute to sustainable livelihoods and poverty reduction in developing countries are still debatable. There are still divergent views over the nature and scope of contributions that mobile phones can make to people's livelihoods and their poverty reduction efforts. There are also concerns that evidence from research on the linkages between ICTs (including mobile phones), livelihoods and poverty in

developing countries is still scarce (Braun and Torero, 2006; McNamara, 2008). The present research seeks to fill those gaps.

This study identifies how mobile phones are being used to facilitate access to information, such as market information, especially for buying and selling, enabling efficient coordination during emergencies, and enhancing the administration of agricultural and non-agricultural based development activities among farmers.

1.2. Problem statement

Agriculture plays a great role in reducing poverty and serves as an important engine for growth in developing countries. This is, in part, due to the big number of poor people (More than 80%) engaged in it. (RAB, 2013)
Yet despite the potential role of agriculture in growth, agricultural production and yields have lagged far behind those in developed countries over the past few decades. Stagnating growth in yields could be attributed to various factors, such as resource constraints in land, capital and population growth. The lack of information or asymmetric information coupled with the above cited factors is the cause of poor farmer's livelihoods.
Farmers have different types of information needs during each stage, ranging from weather forecasts, pest attacks, inputs (seeds and fertilizer), improved cultivation practices, pest and disease management and prices. Farmers can obtain information from a number of sources, including, members of their social network, personal travel, radio, newspaper, which can be relatively expensive in the context of limited infrastructure and vast distances.

In many rural regions farmers and small entrepreneurs generally have no way of knowing prices before they travel to the market due to poor communication facilities. They often have to rely on middlemen who take advantage of this ignorance. In particular, small-scale farmers have poor market infrastructure, inadequate marketing experience, and agricultural inputs (Munyua, 2007). According to a study in Sri-Lanka, the cost of information constitutes 11% of the total cost of farmers from the time of deciding what to grow to the time of selling (de Silva, 2008).
As a result, information asymmetries are often an important constraint to adoption in developing countries.

The rapid spread of mobile phone coverage in developing countries provides a unique opportunity to ensure accurate and timely market information, particularly of perishable items, thus reducing transaction and travel costs.
According to Rwanda Utility Regulation Authority (RURA) Rwanda's mobile penetration rate stands at 55% of the country's population of 10.5million (June 2013). This shows how Rwanda is becoming more connected into a global network.
As mobile phone use becomes more prevalent, it is pertinent to ask: is the mobile phone a viable tool for economic development and a facilitator of sustainable livelihoods among those engaged in agricultural based and non agricultural based livelihood activities?

1.3. Objectives of the study

1.3.1. General objective

The aim of this study is to assess the impact of mobile phones use on sustainable livelihoods activities in the district of Nyabihu, Western province.

1.3.2. Specific objectives

The major research objective is further divided into the following specific objectives:

1. To identify the factors influencing the use of mobile phones in the area of study;
2. To discover the impact of mobile phones use on farmers and rural livelihoods
3. To find out the challenges related to the use of mobile phones.

1.4. Hypotheses

The following hypotheses were formulated:

1. The main factor influencing the use of mobile phones is educational level;
2. The main impact of mobile phones use on farmers is access to market information while the main impact of mobile phones use on rural livelihoods is financial efficiency
3. Poverty is the main challenge affecting the rate of mobile phone uses.

1.5. Scope of the study

The focus of this research is to assess the contribution of mobile phones to the socio-economic development of rural farmers in Nyabihu district (Western province) in the sectors of Rambura and Jenda.
Nyabihu district was chosen because the majority of its population (74%) is engaged in agriculture activities ((Nyabihu development plan, 2013). This will help researchers achieve the objectives of the study.
The data collection was conducted within one month from 10th March to 10th of April 2014.

1.6. Work structure

The research study covers five chapters.
Chapter one is the general introduction: it provides background information on agriculture in Rwanda as well as mobile phone use. It discusses the specific role of information in terms of growth and how mobile phones aid the spread of information and knowledge.
The chapter further describes the research statement, the research objectives and the hypotheses. Finally, the chapter explains the scope of work, and ends up by illustrating the entire structure of the study.
Chapter two provides an overview of the existing literature in the area of information technology and economic development, citing both empirical studies and case studies. It provides key definitions terms and concepts.
Chapter three concerns the methodology used to achieve the objective of the study. This chapter briefly highlights the various research methods and how both qualitative and descriptive statistics were applied. It describes the area of the study, the target population, data collection methods and analysis.
Chapter four in this chapter, the researchers document the data as gathered from interviews conducted, existing project and other documentation. It shows the index of data analysis in a scientific way using various tools such as tables and graphs. The researchers also analyze and interpret findings against known practices as elaborated in the literature.
Chapter five concludes and provides recommendations. Conclusions are drawn basing on the research findings and analysis done, and then possible implications are also indicated.

CHAPTER TWO: LITERATURE REVIEW

2.1. Definition of Key words in the study

Rural areas: Although rural areas have been analyzed in many countries for decades, there is no single commonly accepted definition.
The OECD classifies a community as rural when it has less than 150 inhabitants per square kilometer. The International Fund for Agricultural Development (IFAD) defines rural in terms of two main characteristics. Firstly, rural people generally live on farmsteads or in groups of houses containing perhaps 5.000 – 10.000 persons, separated by farmland, pasture, trees or scrublands. Secondly, the majority of rural people spend most of their time on farms.
According to the Small Enterprise Education and Promotion (SEEP network), a rural area is defined as: "an area in which the primary economic activities are small-scale agriculture and livestock rearing, although it also includes small-scale trade, service, and manufacturing activities. It is also characterized, in relative terms, by geographic isolation, low population densities, poorly developed infrastructure, underdeveloped market for goods and services, and high poverty concentration.
Livelihoods: A livelihood is defined as comprising the capabilities, assets (including both social and material resources) and activities required for a means of living. (Carney 1998 p4).
Sustainable livelihoods The sustainable livelihoods idea was first introduced by the Brundtland Commission on Environment and Development, and the 1992 United Nations Conference on Environment and Development expanded the concept, advocating for the achievement of sustainable livelihoods as a broad goal for poverty eradication.
Sustainable livelihoods are livelihoods that enables people to cope with and recover from shocks and stresses (such as natural disasters and economic or social upheavals), maintain or enhance its capabilities and assets, and provide sustainable livelihood opportunities for the next generation; they also contribute net benefits to other livelihoods at the local and global levels and in the short and long term. (Robert Chambers and Gordon Conway 1992).
Mobile phones are portable telephone devices that do not require the use of landlines. Mobile phones utilize frequencies transmitted by cellular towers to connect the calls between two devices. The first mobile

phone operated on an analog service and was developed by Motorola, Inc. Mobile phones have since then grown to be the most widely used portable device in the world.

When the first mobile phones were introduced, all they could do was make calls, and they were so bulky it was impossible to carry them in a pocket. Later on, mobile phones belonging to the Global System for Mobile Communications (GSM) network were capable of sending and receiving text messages.

As these devices evolved, they became smaller and more and more features were added, such as multimedia messaging service (MMS), which allowed users to send and receive images. Most of these MMS-capable devices were naturally equipped with cameras, which allowed users to capture photos with the built-in camera, add captions, and send them to friends and relatives who also had MMS-capable phones. A mobile phone with highly advanced features is called a smartphone, while a regular mobile phone is known as a feature phone. (Cory Janssen, 2014)

Mobile phone coverage is defined as a geographical area, in which a wireless network provider offers cellular service for mobile phone users. Coverage is usually expressed as a percentage of the resident population who could use mobile phones outside their own homes.

Asymmetric information: This is a situation where there is imperfect knowledge. Asymmetric information occurs when one party in a transaction (either the buyer or the seller) has more or better information about the product than the other party. Asymmetric information is one of the main causes of a market failure; it causes markets to become inefficient, since all the market participants do not have access to the information they need for their decision making process.

Nobel Prize winning trinity-Akerlof, Spence &Stiglitz (2001), demonstrated that market may break down completely in the presence of asymmetric information and the three distinct consequences emerging are:

- *Adverse selection:* This is when a market falls apart or stops working due to asymmetric information between the buyers and the sellers.
- *Market failure*: This is a situation when the free market system leads to an inefficient allocation of resources.
- *Moral hazard*: This is a situation when an individual in an economic transaction is willing to take more risks because the costs that could occur from their actions will not be felt by them.

Food security: Food security was defined in the 1974 World Food Summit as: "availability at all times of adequate world food supplies of basic foodstuffs to sustain a steady expansion of food consumption and to offset fluctuations in production and prices"

In 1983, FAO expanded its concept to include securing access by vulnerable people to available supplies, implying that attention should be balanced between the demand and supply side of the food security equation: "ensuring that all people at all times have both physical and economic access to the basic food that they need".

In 1986, the World Bank report "Poverty and Hunger" elaborated the concept of food security in terms of: "access of all people at all times to enough food for an active, healthy life".

The 1996 World Food Summit adopted a still more complex definition:"Food security, at the individual, household, national, regional and global levels is achieved when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life".

This definition is again refined in The State of Food Insecurity 2001:"Food security is a situation that exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life".

Poverty is defined as whether households or individuals have enough resources or abilities to meet their needs (World Bank).

Economists measure poverty in several ways. The most common measures are income, assets (meaning accumulated wealth in the form of money, securities, and real estate), and socioeconomic metrics. (WTO)

Poverty is associated with the undermining of a range of key human attributes, including health. The poor are exposed to greater personal and environmental health risks, are less well nourished, have less information and are less able to access health care; they thus have a higher risk of illness and disability. Conversely, illness can reduce

household savings, lower learning ability, reduce productivity, and lead to a diminished quality of life, thereby perpetuating or even increasing poverty (WHO).

2.2. Literature review

A number of studies have examined the role that mobile phones play in the developing world. The studies described below emphasizes on the role of mobile phones on

- Economic growth
- Rural development and poverty reduction
- Connectivity

The adoption and use of mobile phones is also reviewed.

2.2.1. Economic growth

The first official mobile phone debuted in 1946 (Kumar & Thomas, 2006), and three generations of mobile phones later, they have spread considerably in the developing world.

Waverman, Meschi and Fuss (2005) note that "mobile phones substitute for fixed lines in poor countries," and that "mobile telephony has a positive and significant impact on economic growth." The researchers found that a ten percent increase in the mobile penetration levels of developing countries increased the growth rate by 0.6 percent.

In an earlier study by Roller and Waverman (2001), fixed line telecommunications raised growth in output among OECD nations by one-third. A ten percent increase in the telecommunications penetration rate (both mobile and fixed-line telecommunications) was associated with a 1.5 percent increase in the growth rate.

African studies carried out by Sife et al (2010), Jagun et al (2008), Molony (2007) and Overa (2006) demonstrate that users of mobile phones are able to enhance (or make more productive use of) their pre-existing social and economic networks.

Norton (1992) found that the growth of telecommunication penetration is a statistically significant predictor of economic growth, and vice versa: indicators of economic growth are significant predictors of telecommunication investment. Telecommunication is thus considered to be a cause and consequence of economic growth.

Samuel et al., (2005) examined the socioeconomic impacts of mobiles communication in South Africa, Tanzania and Egypt. Respondents to the study identified a large number of impacts from using mobiles phones. Some of these were social in nature, while others concerned employments or business.

The social impacts were very important in South Africa and Tanzania. Greater contacts and improved relationships with family and friends was one of the most significant benefits.

According to Donner (2008), mobile telephony can serve as a development tool to the extent that it accelerates and interacts with the process of economic development in general.

Because communication within and between institutions responsible for making livelihood decisions is substantially enhanced, those who are served by these institutions benefit by the improvement of local capacities enabled by the acquisition and exchange of information (FAO, 2003).

2.2.2. Rural development and Poverty reduction

Researchers (Hudson, 2006; Jagun, Heeks, &Whalley, 2007) have speculated that information and communication technologies (ICTs) can aid greatly in rural development and poverty reduction within developing countries due to an increase in local people's ability to obtain information for sound decision-making.

Woverman et al., (2006): Information for Development Studies; Lustig and Stern, (2000) have separately shown that Information Communications Technologies (ICT) such as mobile phones can have an impact on rural livelihoods and thereby on poverty in rural communities in developing countries. InfoDev outlines several areas where information and communications technologies such as mobile phones can have an impact on livelihoods and thereby on poverty in developing countries. They state that information and communications technologies can contribute greatly to improvements in the following fields:

- Increased opportunities to access resources and use capabilities through improved access to information.
- Empowerment through information about choices that affect themselves.
- Decreased vulnerability to risk due to the possibility to send and receive information (InfoDEv, 2006).

2.2.3. Connectivity

Rowan-Campbell and Tandon (2009) identified the use of mobile phones to increase economic opportunities among farmers and traders through allowing them to access buyers who were not previously accessible due to boundaries imposed by traditional social network linkages and geographic constraints. The connected rural community, according to Rowan-Campbell and Tandon, provides benefits of not only connecting the farmer to a greater network of buyers and consumers but also providing the ability to lobby for more resources by being connected to decision and policy makers (2009, p. 2)

2.2.4. Adoption and use

The mobile phone, because of its low cost relative to landline telecommunications and infrastructure, is more easily adopted by the sub-Saharan population. In fact, the number of mobile phone subscriptions in Africa jumped from 16 million in 2000 to 376 million in 2008 (International Telecommunications Union, 2009). The adoption of the cell phone has been important in improving agricultural labor market efficiency and increasing producer and consumer welfare. Moreover, mobile phones reduce information asymmetry by allowing better access to and use of information, by reducing search costs, and by improving coordination among agents (Aker &Mbiti, 2010). Cell phones aided firms in managing their supply chains and streamlining production processes by improving communication between firm and supplier.

Burrell (2008), studying the impact of mobile phones in Uganda, expanded mobile telecommunication attributes of efficiency, effectiveness, equity, and reach within resource-constrained environments. Burrell uncovered nine reasons for adoption and use to aid in supporting sustainable livelihoods, some of which are unique to the study. They are: " (1) emergency coordination; (2) organization of domestic remittances between family members living in different parts of the country; (3) reduction in transportation and transaction costs in trade (e.g., coordinating trade by phoning other farmers and traders to discuss produce marketability and market prices); (4) monitoring transactions and security enhancement (e.g., people who sent money through intermediaries used the phone to inform recipients and confirm arrival); (5) reduction of downtime (e.g., a taxi driver could be contacted during transportation and thus was able to receive increased requests for services and increased income); (6) ability to increase networking and building of social capital; (7) consultation, ability to keep people in touch with expert advice (e.g., an HIV+ woman was able to phone doctors to receive reassurances and instruction when she fell ill); (8) coordination function through text messaging (e.g., local counselors were notified to attend a training session); and (9) the ability for data storage (e.g., a boat operator used his address book to keep track of debts)" (pp.16-17).

The impacts of an innovation tend to vary per individual and social system (Rogers, 2003, p.442). According to Leung and Wei (2000), the uses of mobile phones are linked to different demographic characteristics. Individuals engaged in business are more likely to use the mobile phone for productive purposes such as obtaining information for sound decision-making rather than solely for social reasons. Within the study, mobility and immediate access were perceived as unique advantages provided by the mobile phone. The relative advantage of mobility, immediacy, and instrumentality of the mobile phone versus previous techniques were observed as the strongest predictors of mobile phone adoption and use (Leung & Wei, 2000, p. 316).

Another study from a poor remote area with difficult terrain shows relatively high adoption rates by poor farmers such as an 80 percent ownership rate within the sample reported by Kameswari et al (2011) for the Indian Himalayan region. Similarly, two empirical studies based on a representative sample of phone users demonstrated that greater distance of farmers from markets (i.e., greater remoteness) implied greater intensity of phone use (Katengeza, Okello&Jambo, 2011;Lwasa et al, 2011). Katengeza et al (2011) found that greater distance from markets was correlated with greater intensity of phone use, which supports findings set out previously.

In common with Muto &Yamano, phone use was found to have greater impact when travel costs were higher – for markets that were more remotely located and unconnected by paved roads (Burrel&Matovu, 2008; Kithuka et al, 2007).

In addition, a study by Aker and Mbiti (2010) details the channels through which the adoption and use of mobile phones in sub-Saharan Africa has affected economic growth and development. For instance, in Ghana, cell phones are used to keep in touch with relatives, as well as learn about corn and tomato prices (Aker &Mbiti, 2010). In Niger, cell phones are used to learn about job opportunities. Cell phones and text messages also remind users to take prescribed medications on time, and even report violent conflicts. Aker and Mbiti suggest that the mobile device is more than just a simple communication tool; it is an agent of change that can transform lives.

Goodman (2005) examined the linkage between mobile phone ownership and use to social capital in rural South Africa and Tanzania. The results indicates that mobiles phones were facilitating participation in social networks

helping to maintain both strong and weak links, including participation in community group activity. They were thus enabling people to invest in and draw on social capital.

The re-invention of the use of the mobile phone in Rwanda, as reported by Donner (2005), is specific to local context and needs. Donner found that Rwandans had uncovered a way to maximize the benefits of mobile telephony while minimizing the costs through a technique referred to as "beeping." Beeping occurs when an individual places a call to a mobile subscriber and hangs up before the call is answered. The beep from the missed call is used to indicate pre-negotiated messages and is a free application to both sender and receiver. This unique application has demonstrated the mobile phone's ability to be a viable tool to those in resource-constrained environments (Donner, 2005).

2.2.5. Historical overview of telecommunications in Rwanda

According to Kabayiza's (1999), the historical overview of telecommunications in Rwanda is as follows:

1930: The telegraph is introduced in Rwanda. The first wireless telegraphy station (TSF) is established to link Kigali and Bujumbura.

Between 1956 and 1962: Rwanda and Burundi set up their own provincial administration, and the first local telephone networks, served by small manual telephone exchanges, were established. In Rwanda, these stations were set up in Gisenyi, Butare and Kigali. First successful attempt to forward telephone messages directly to Europe without routing them through Belgian Congo, via a connection between Bujumbura and Kinshasa. In 1959, an aerial line between Kigali and Butare was installed.

The period after Rwandan independence in 1962: The country's telecommunications system operated within the Common Telecommunications Agency of Burundi and Rwanda (ATCBR). Telegraph, telephone and telex services opened between Kigali and Brussels in 1963. The same year saw the installation of an international telex network and a manual telephone switchboard centre with 75 numbers in Kigali, and the country began serving its first manual table telex customers.

Late1970s and early 1980s Further expansion and changes in Rwanda's telecommunications network went on. As an illustration, the switchboard centre at Kigali was extended from 2,000 to 3,000 customers in 1977, and in 1979, the extension was increased from 3,000 to 5,000 customers.

In 1979, according to the African Internet Service Providers Association (AfrISPA), 10th installation of an automated telex centre and the inauguration of the Ecole Nationale Mixte des Postes et Telecommunications in Kigali took place.

In 1980, fourteen linkages for a rural telecommunication network were established, and in November of the following year a high-frequency connection between Kigali and Ruhengeri was replaced. In the late 1980s, a new TSF station was opened at Karengeri, and a new automated switchboard at Kigali was established.

In March 1982, the first Intelsat tests on the Nyanza-Kicukiro Terrestrial Station were performed.

In the early 1990s, Rwanda's domestic telecommunications network consisted of twenty-six telegraph stations, twelve automated telephone switchboard centres, and the telex centre at Kigali

for connections between Rwanda and the rest of the world via telex, telegraph and telephone. Two earth stations for satellite communications, one Intelsat and one Symphonie, both located in Kigali, had been commissioned.

3 January 1993: Rwandatel was founded on, the sole fixed-line telephony operator in Rwanda offering voice, data and internet services.

In 1995, it became Rwandatel SA13 when the PTT was separated into a post and telephone unit. One year later, the company already had 12,000 subscribers, and turnover of USD 6 million.

Before the creation of RURA, the regulator, there was no effective regulation of the telecommunications sector in Rwanda. Rwandatel was given multiple roles: it had to act as a policy maker, regulator and operator. This resulted in inefficient use of scarce resources like frequencies.

Compared to other African telecommunications service providers, Rwandatel's market penetration has been exceptionally low, with only 0.27 fixed lines installed per 100 people in 2005. This was among the lowest in Africa. The waiting list for a fixed-line connection was the highest in Africa when measured as a proportion of fixed lines installed, while as a percentage of population it was the highest in Africa with the exception of Kenya. In such a situation, privatisation was an urgent need.

1998: The history of mobile telecommunication companies was pioneered by MTN Rwandacell which received a licence to provide GSM services for both post and prepaid subscribers. At the time, Prices and tariffs of both

mobile phones and calling respectively were high and thus MTN had less number of subscribers.

MTN's mobile telecommunication monopoly in Rwanda lasted for 10 years after which Rwandatel (80% owned by LAP Green networks of Libya) joined the mobile market. Rwandatel's introduction of 3G networks before MTN did quickly attracted subscribers reaching over 100,000 in less than 2 months of operation. At this time, Revolution into Rwanda's mobile communication had just begun, with faster data communications and internet through handheld PCs and mobile phones.

Late 2009: Third to enter the mobile communications market was Millicom named Tigo (owned by Luxembourg) which was licensed to carry operations. With intensive marketing (public transport buses were painted Tigocolours with overwhelmingly cheap call costs of 300Rfr per 24 hours) and rapid coverage of networks countrywide, Tigo has secured 1,523,825 as of November 2011.

In April 2011, Rwandatel had its license revoked by Rwanda's telecom regulator RURA due to a failure to meet license obligations such as coverage, planned investment targets and quality of service.

Late 2011: BhartiAirtel (Indian owned) secured a license to provide 2G and 3G cellular services. The company planned to invest over USD100 million over the next three years, including USD30 million for the purchase of the operating license.

2.2.6. Current Overview of mobile phones in Rwanda

With the recent development of communication facilities, the large majority of Rwandan population has continuously adopted the use of mobile phone as one of the technology platform to share information. Within this move, the mobile phone penetration has impressively increased across the whole country.

According the third EICV (Integrated Survey on Life Conditions), the percentage of households with at least one mobile phone which was 6.2 per cent in 2005/2006 has increase by 39 per cent to reach 45.2 per cent among the general population in 2010/2011.

The percentage of households which own at least a mobile phone also increased in urban areas (from 26.5% in 2005/2006 to 71.5% in 2010/2011) as well as in rural areas (from 2.2% in 2005/2006 to 40.6% in 2010/2011). In terms of gender, the households headed by female accuse a low percentage in owning at least one mobile phone in 2010/2011 with 35.1% against 49% of households headed by male. In terms of mobile phone subscribers, the number has also increased from 2009 to 2011. The number of subscribers was 2,429 thousand in 2009 and 4,842 thousand in 2011, which is a growth rate of 99.34%. (EICV 3

Table 1: ownership of Mobile Telephones by Province

Province	Percentage
Kigali City	79.6%
Southern Province	35.0%
Western Province	40.4%
Northern Province	41.9%
Eastern Province	48.4%

Source: Secondary data, EICV3 (2010-11)

Countrywide, Kigali recorded a great different vis-à-vis other provinces with a rate of 79.6% of household owning mobile phone followed by the Eastern province with 48.4%. The three provinces which have a low percentage of mobile users are namely Northern, Western and southern provinces with a proportion of 41.9%, 40.4% and 35% respectively. (EICV 3, 2010-11)

The ownership of mobile telephones in all provinces of the Rwanda could be attributed to the increase in value-added services such as the money transfer as this provides advantages for even those that previously owned mobile telephones. Secondly one cannot forget to mention the role of operators 'network roll out in all parts in the whole country (RURA, 2012).

According to the Rwanda Utilities and Regulatory Agency, in June 2013, the major players in mobile telephony include MTN Rwandacell, TIGO Rwanda Ltd and AIRTEL Rwanda Ltd.

Table 2: Active mobile phone subscribers, June 2013

Operators	**Active subscribers**		**Fixed Teledensity**	**Mobile Teledensity**	**General teledensity**
	Mobile Active subscribers	**Fixed Telephony subscribers**	**0.40%**	**60.9%**	**61.3%**
MTN Rwanda	3,599,540	10,925			
TIGO Rwanda	1,900,693				
AIRTEL RWANDA LTD	915,110				
RWANDATEL	**-**	31,875			
Total	**6,415,343**	**42,800**			

Source: Secondary data, RURA operators' returns (June 2013)

The above table indicates that mobile penetration rate reached 60.9% as of June 2013 against 57.3% on March 2013. This is mainly due to the increase in mobile telephone subscriptions.

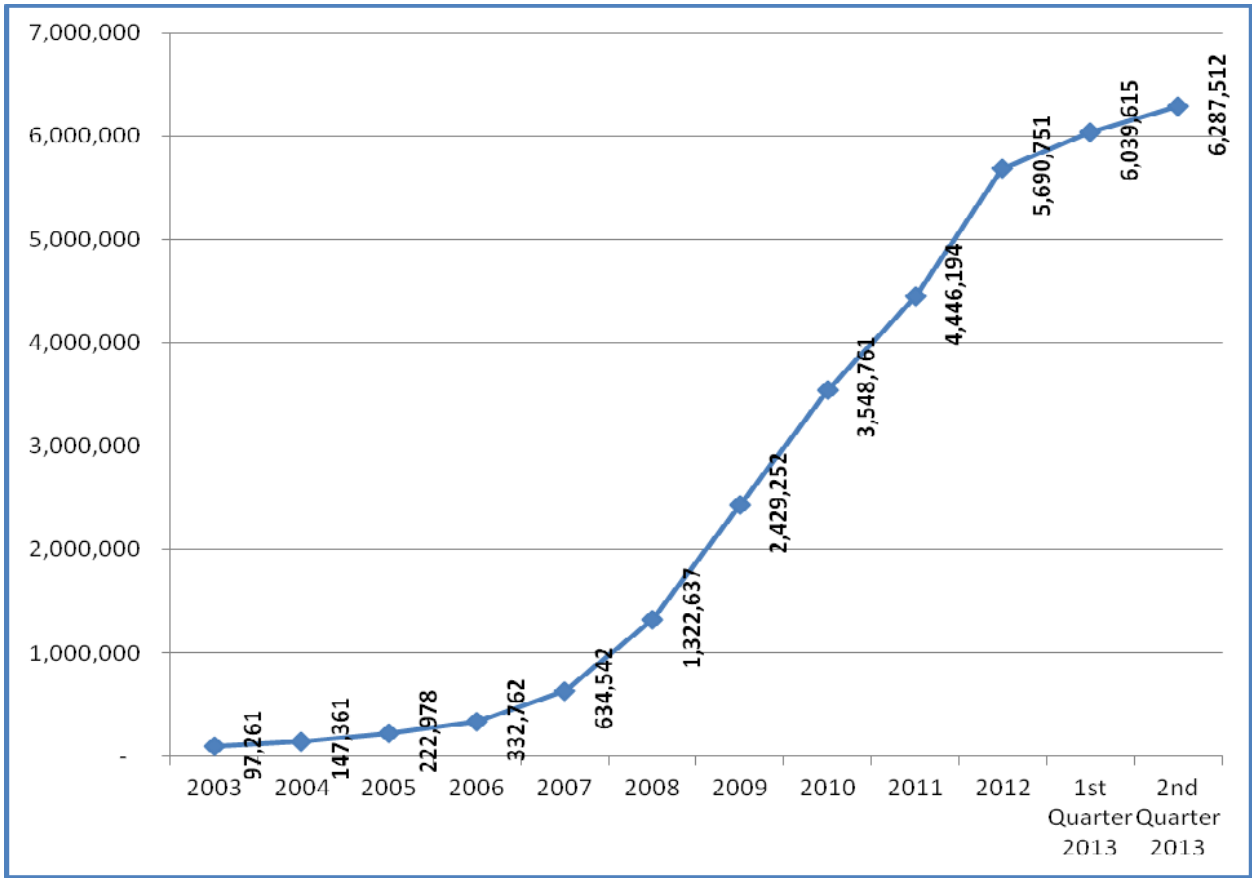

Figure 1: Development of mobile telephone Subscribers as of June 2013. (Source: Secondary data, RURA operators' returns).

MTN Rwanda is still leading in terms of mobile subscribers with 56% of the market share followed by Tigo which has 30%, Airtel Rwanda has the lowest market share of 14%.

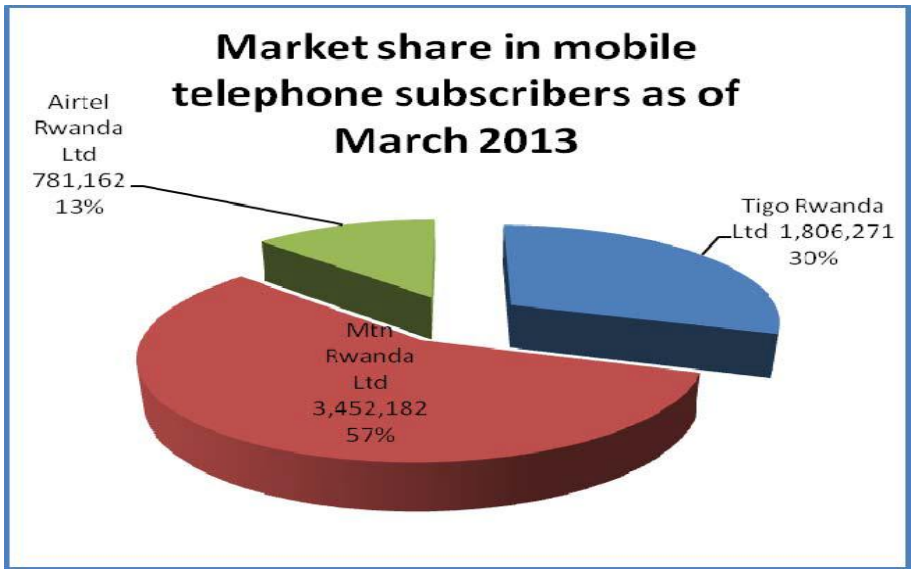

Figure 2: Market share in mobile telephone subscribers March 2013 (Source: secondary data, RURA)

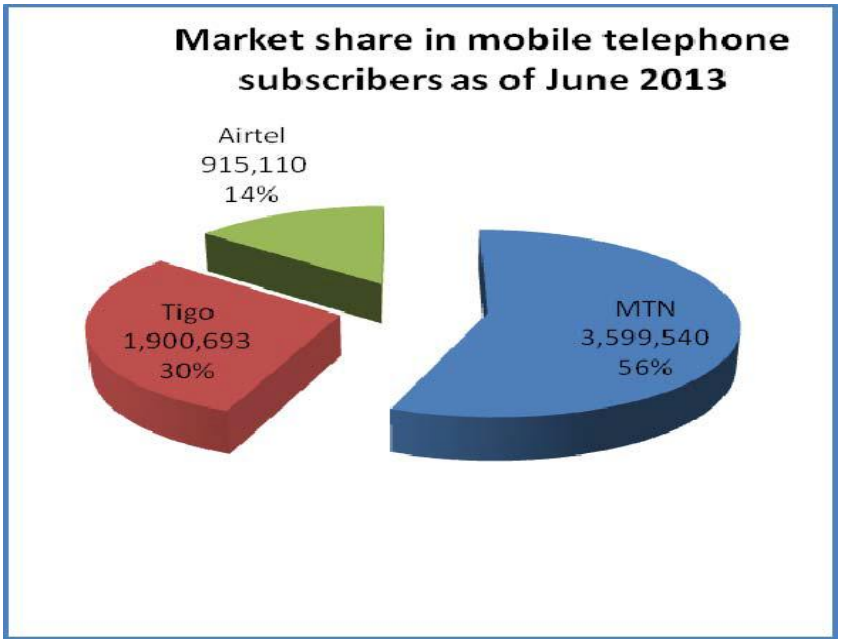

Figure 3: Market share in mobile telephone subscribers June 2013.

(Source: Secondary data, RURA)

According to the Rwanda Utilities and Regulatory Agency (RURA), in September 2013, MTN Rwanda had the biggest increment of active mobile subscribers.

In the nine months range(January-September 2013), MTN Rwanda active mobile subscribers grew from 3,454, 270 to 3.363,976 subscribers, followed by Millicom International Cellular owned -Tigo Rwanda doubling from 1, 877, 621 to 2,099, 807 and Bharti Airtel Rwanda which grew from 570, 739 to 973, 000 subscribers.

The total growth rate of active mobile subscribers of all telecommunication companies in Rwanda, grew from 5,902, 630 to 6,709,783 subscribers in the nine months range in 2013.

Table 3: Active mobile subscribers (90-days revenue generating subscribers) as of April 2014.

Operators	Jan-14	Feb-14	Mar-14	Apr-14
MTN Rwandacell	3,560,234	3,547,411	3,525,227	3,530,162
TIGO Rwanda	2,211,179	2,248,866	2,295,342	2,357,589
AIRTEL Rwanda	989,942	1,004,229	1,015,404	1,013,103

Total	6,761,355	6,800,506	6,835,973	6,900,854

Source: Secondary data, RURA (April 2014)

2.2.7. Uses of mobile phones in Rwanda

Back in the days, mobile phones were only used to make calls and receive or send short messages (sms). However now days the mobile phone is used for different purposes:

- Banking(money transfer and saving)
- news reading,
- emails,
- Recording and playing music and movies,
- Listening to the radio,
- Watching the television,
- Picture shooting,
- Playing games,
- internet connectivity,
- advert and publicity

2.2.8. Factors determining the spread of mobile phones coverage

The spread of mobile phones across the developing world has been dramatic. Between2000 and 2011, the number of mobile phone subscriptions in developing economies increased from 250 million to 4.5 billion (ITU, 2011b). Improvements in communication, through mobile phones as well as associated services such as mobile money and mobile internet, have the potential to knit even remote villages into the global economy. Although mobile phones can generate large efficiency gains (Jensen, 2007; Aker, 2010; Jack and Suri, 2011), their allocations are likely to be inefficient due to network effects.

The growth of mobile phone coverage across Africa has shown a strong positive correlation with population density, but other factors matter as well. Using a spatially disaggregated dataset of mobile phone coverage and geographic characteristics, Buys, Dasgupta, Thomas and Wheeler (2009) find that the probability of having a mobile phone tower in a particular location is strongly and positively associated with potential demand factors, such as population density and per capita income, as well as the competitiveness of the mobile phone sector within the country. They also find that factors associated with higher costs namely, higher elevation, steeper slopes, and distance from a main road and major urban centers are negatively associated with mobile phone coverage.

2.2.9. Socio economic impacts of mobile phones

There are five potential mechanisms through which mobile phones can provide economic benefits to consumers and producers in Sub-Saharan Africa.

- Mobile phones improve access to and use of information, thereby reducing search costs, improving coordination among agents and increasing market efficiency.
- The resulting increased communication improves firms' productive efficiency by allowing them to better manage their supply chains.
- Mobile phones create new jobs to address demand for mobile-related services
- Mobile phones facilitate communication among social networks in response to shocks, thereby reducing households' exposure to risk.
- Mobile phone-based applications and development projects—sometimes known as "m-development"—have the potential to facilitate the delivery of financial and agricultural, services.

2.2.9.1. Reduction of Search Costs and Improvements of Market efficiency

Sub-Saharan Africa markets are characterized by imperfect and asymmetric information. As a result, households and firms use numerous avenues to search for information: input prices, output prices, potential buyers and sellers, new technologies. Traditional search mechanisms include personal travel, radio and, to a much lesser extent, newspapers and television. Of these, personal travel has often been the most common mechanism used—primarily

due to limited access to other alternatives. In Niger, for example, 89 percent of grain traders surveyed preferred obtaining price information by visiting weekly grain markets, rather than listening to the weekly radio program (Aker, 2008). However, personal travel requires transport and opportunity costs, which can be relatively high with a combination of long distances and poor roads.

The rollout of mobile phones in sub-Saharan Africa over the past decade has introduced a new search technology that offers several advantages.

- **Information search cost reduction**: Mobile phones greatly reduce search costs. While mobile phones require an initial fixed cost, the variable costs associated with their use are significantly lower than equivalent travel and other opportunity costs. In Niger, for example, an average trip to a market located 65 kilometers away can take 2-4 hours roundtrip, as compared to a two-minute call. Using a local daily wage of 500 CFA francs ($1 U.S.) per agricultural laborer in Niger, mobile phones reduce search costs by 50 percent as compared with personal travel. (Aker, 2008).

De Silva &Ratnadiwakara (2010) randomly sampled 300 farming households in Sri Lanka across four traded vegetable markets, and attempted to understand information search costs for core operations along the agricultural-farmer value chain. They found that 70 percent of all transaction costs related to information search costs (the transaction costs themselves were recorded as 15 percent of the total costs incurred).

Similarly, Furuholt&Matotay (2011) view the mobile phone as a means whereby the high transaction costs associated with information market failures and inefficiencies in the business environment can be reduced, thus overcoming costs incurred in the coordination of economic activities related to: a) accessing inputs (infrastructure; production technology, knowledge, finance, materials, learning/training, etc) and, b) reaching output markets (either directly or through market intermediaries) as well as monitoring financial transactions and consulting with experts.

Typically, the studies surveyed view search costs and the asymmetric relationships that govern price setting as the most significant informational impediments producers face (e.g., Islam &Gronlund, 2011; Martin & Abbott, 2011). Such high costs normally add to the market price of products and affect competitiveness in the market.

In the agricultural sector, Egyir et al (2011) identified mobile phones as the pre-dominant communication technology amongst farmers in Ghana, measuring an increased speed of price transmission in maize markets. Whilst 80 percent of traders and 48 percent of farmers surveyed used mobile phones to access information, traditional means of collecting and exchanging information had not changed (such as travelling to the market) but use of phones speeded up pre-existing processes. For mobile users, this led to the trading of larger volumes, better prices and slightly larger margins – but only marginal increase in transaction costs (due to an increase in the net cost due to the costs of mobile ownership and use).

Abraham (2007) studied the effect that mobile phones had on the fishing industry in India. Although telecommunications were considered a luxury in India, there were about 156 million mobile phone subscribers by 2007. After conducting a survey of Indian fisherman, he found that 80 percent of the respondents thought mobile phones useful. He concluded that because fisherman could take mobile phones with them to sea, they could more easily access market information, including selling prices and demand. Fishermen could then decide how much fish to catch, which reduced the amount of the catch that was dumped or used as fertilizer. Additionally, the fisherman could better communicate at sea, enabling them to catch more fish if a large shoal appeared in neighboring waters. The increased availability of information reduced the risks and uncertainty of the volatile fish market. Mobile phones thus reduced search costs, reduced waste and improved quality of life, as they allowed fishermen to communicate with their families and those on shore about bad weather forecasts like storms and other problems like engine failure.

Another study of the impact of cell phones in Uganda suggests that the mere expansion of mobile phone coverage, as opposed to the possession of mobile phones at the household level, allows an increase in information flow, inducing the market participation of farmers who produce perishable crops like bananas in areas far away from a district center (Muto &Yamano, 2009). Using panel data from household and community surveys in Uganda, Muto and Yamano estimate the determinants of mobile phone network coverage, household possession of mobile phones, and banana and maize market participation. According to the study, the increase in information flow reduces the

marketing costs of crops, including transportation costs, and reduces the amount of wasted produce caused by spoilage. The study, however, is limited in its consideration of producers, rather than traders and consumers.

- **Ease of use, accessibility and reliability of information**: Mobile phones allow people to obtain information immediately and on a regular basis, rather than waiting for weekly radio broadcasts or newspapers. Mobile phones also allow individuals and firms to take an active role in the search process, enabling them to ask questions and corroborate information with multiple sources. Finally, mobile phones are more accessible than other alternatives in terms of cost, geographic coverage and ease of use. While radios can be used across all segments of the population (over 55 percent of sub-Saharan African households listen to the radio weekly), they generally provide a limited range of information. On the other hand, newspapers are primarily concentrated in urban areas, they are expensive and are inaccessible to illiterate populations

- **Market efficiency**: Search theory predicts that lowering search costs for output prices will change market agents' reservation prices and increase the number of markets over which consumers and producers search (Baye, Morgan, and Scholten 2007; Reinganum, 1979; Stahl, 1989; Aker, 2008). In general, the sequential search models of Reinganum (1979), Stahl (1989) and Aker (2008) predict that a reduction in search costs will decrease the variance of equilibrium prices, thereby improving market efficiency.

Aker (2008) investigated the impact of cell phones on grain markets in Niger identifying positive arbitrage (reduced grain price dispersion and variations across markets) resulting from a reduction in search costs and hence transaction costs, as well as lower grain prices (3.5% reduction from 2001 to 2006). The primary mechanism through which mobile phones improve market efficiency is a change in traders' (middlemen) marketing behavior: traders operating in mobile phone markets search over a greater number of markets, sell in more markets and have more market contacts as compared with their non-mobile phone counterparts (Aker, 2008).
These studies also identify a 'network effect' meaning that cell phones have higher impact (on price dispersion, for example) once more markets are covered by the network – with Aker (2008) suggesting diminishing returns over and above 75 percent network coverage.

- **Welfare**: Lower search costs could improve traders' welfare as they take advantage of spatial arbitrage opportunities. Similarly, in markets where traders have local monopoly pricing power, increased access to information could improve consumer welfare by disrupting this monopoly power, but reduce traders' welfare.

Although the evidence on Africa is quite recent, an emerging body of literature assesses the role of information technology on market efficiency in developing countries, primarily in agricultural markets (Abraham, 2007; Jensen, 2007; Aker, 2008; Aker, 2010; Muto and Yamano, 2009; Goyal, 2010). These studies primarily focus on the relationship between mobile phone coverage and specific outcomes, such as price dispersion across markets (Overa, 2006; Jensen, 2007; Aker, 2010), market agents' behavior (Aker, 2008; Muto and Yamano, 2009) and producer and consumer welfare (Jensen, 2007; Aker, 2008).

Jensen (2007) and Aker (2008, 2010) both exploit the staggered introduction of mobile phone coverage to estimate the impact of mobile phones on agricultural markets in developing countries. Examining the effect of mobile phones on the fisheries sector in Kerala, India, Jensen finds that the expansion of mobile phone coverage leads to a significant reduction in the dispersion of fish prices across markets, as well as a decline in waste. He shows that this leads to important welfare improvements for both fishermen and consumers; fishermen's profits increased by 8 percent, consumer prices declined by 4 percent and consumer surplus increased by 6 percent. With improved access to information via mobile phones, fishermen are better able to take advantage of spatial arbitrage opportunities, thereby improving allocative efficiency.

Examining the impact of mobile phones on grain markets in Niger, Aker (2010) finds that the introduction of mobile phones reduces dispersion of grain prices across markets by 10 percent.
The effect is stronger for those market pairs with higher transport costs, namely, those that are farther apart and linked by poor quality roads. The effect is also stronger over time, suggesting that there are networks effects similar to those found by Brown and Goolsbee (2002). While the effect is smaller in magnitude as compared to Jensen (2007), it is perhaps because grains are a storable commodity.

Aker (2008) also finds that the introduction of mobile phones is associated with increased trader and consumer welfare. The introduction of mobile phones led to a reduction in the intra-annual coefficient of variation, thereby subjecting consumers to less intra-annual price risk. Mobile phones also increased traders' welfare, primarily by increasing their sales prices, as they were able to take advantage of spatial arbitrage opportunities. The net effect of these changes was an increase in average daily profits, equivalent to a 29 percent increase per year.

- **Market participation**: Muto and Yamano (2009) similarly estimate the impact of mobile phones on agricultural markets in Uganda, focusing on farmers' market participation rather than market efficiency. Using a panel dataset on farm households between 2003 and 2005, they find that mobile phone coverage is associated with a 10 percent increase in farmers' probability of market participation for bananas, although not maize, thereby suggesting that mobile phones are more useful for perishable crops.

- **Labor market search cost reduction**: Mobile phones similarly reduce search costs in labor markets. Labor market search theory predicts that a reduction in search costs should increase workers' reservation wage, increase the job arrival rate, and reduce unemployment. Mobile phones should therefore decrease the equilibrium dispersion of wage offers and could potentially increase equilibrium wages and productivity if they raise the reservation match quality of both employers and workers (Autor, 2001).

Klonner and Nolen (2008) assess the effect of mobile phone coverage on rural labor market outcomes in South Africa. Similar to other countries in sub-Saharan Africa, South African labor markets are characterized by low wages, high rates of under- and unemployment and significant search costs. They find that the introduction of mobile phone coverage is associated with a 15 percent increase in employment, with most of the effect due to increased employment by women.
They also find a significant shift in occupational patterns: with the availability of mobile phone coverage, employment shifts away from agricultural occupations, with no significant shifts between self-employment and wage-employment.

- **Reduction in vulnerability** Kameswari et al (2011) surveyed 132 farmers across 8 villages in 4 districts of the Indian Himalayan region and found wide variations between districts (and villages) in terms of crops grown, scale of production, water supply, types of soil, etc. This gives rise to diverse vulnerability contexts and differing needs for information-related services often between districts and settlements in quite close proximity, and which are more or less active in information seeking.

2.2.9.2. Improvement of Coordination among Firms

Information technology has the potential to increase productivity growth in Africa, especially of small-scale firms.
By improving communication between firms and their suppliers, mobile phones can enable firms to manage their supply chains more effectively, streamline their production processes and engage in new activities (Hardy, 1980; Roller and Waverman, 2001). This would reduce stock-outs and interruptions in production, which are of particular concern for small-scale firms in rural areas with limited supply options.
Qualitative research in South Africa and Egypt suggests that mobile phones were associated with increased profits, significant time savings and improved communication with suppliers for small-scale firms. (Samuel, Shah, and Handinham, 2005).

2.2.9.3. Employment Generation

One of the most direct economic impacts of mobile phones in Africa is through job creation. Mobile phones can create more jobs by increasing the demand for mobile-related services. With an increase in the number of mobile phone operators and greater mobile phone coverage, labor demand within these sectors has increased. Formal sector employment in the private transport and communications sector in Kenya rose by 130 percent between 2003 and 2007 (CCK, 2008), suggesting that mobile phones have contributed to job creation.
The mobile phone sector has also spawned a wide variety of business and entrepreneurship opportunities in the informal sector. Small shops that have traditionally sold dietary staples and soap now sell mobile phone credit (airtime), particularly in small denominations.
Young men and women are often found selling airtime cards in the streets. Numerous small-scale (and often informal) firms have also opened shops to sell, repair and charge mobile phone handsets. (Klonner and Nolen 2008).

Klonner and Nolen (2008), for example, found that the introduction of mobile coverage in South Africa was correlated with a 15 percent increase in employment. Using panel data from annual labor force surveys in South Africa and data from a mobile network provider, Klonner and Nolen construct a fixed effects model to measure the effect of mobile network coverage on labor market outcomes. In addition to finding a positive and significant relationship between mobile coverage and employment, the study also concluded that employment among young men shifts away from agriculture as a result of the introduction of mobile phones. Employment among women increased as well.

2.2.9.4. Risk Reduction

Sub-Saharan Africa is an inherently risky environment. Covariate shocks, such as natural disasters, conflicts and epidemics, routinely affect households.

At a basic level, mobile phones improve communications among members of a social network both within a country and across international boundaries. The reduction in communication costs can increase the speed of information flows within the network, thereby allowing them to respond better to shocks. Mobile phones also allow households to obtain information about potential shocks, allowing them to use such information to make planting and harvesting decisions, which can have important effects on yields (Rosenzweig and Binswanger, 1993).

Improved communications among members of a social network can also affect social learning, which can in turn influence the rate of technology adoption, especially of cash crops (Bandiera and Rasul, 2006; Conley and Udry, 2009).

2.2.9.5. Services and Innovative Development Projects

Mobile phone technologies facilitate the development of many mobile services that may enhance market efficiency. An emerging trend is the development of mobile phone-based services and products that go beyond basic voice calls and text messaging. Mobile financial applications known as mobile banking and mobile money have emerged in a variety of developing countries.

Mobile banking creates business and entrepreneurship opportunities (Aker &Mbiti, 2010). Ivatury and Pickens (2006) discuss the impact of mobile banking in South Africa, finding that m-banking increases the availability of money and other financial services to poor people. Because banking can be done electronically, people no longer need to devote time and money to traveling to distant bank branches. With mobile banking, individuals can make payments, transfer money, and buy prepaid electricity and mobile airtime. They can also make balance inquiries and deposit and withdraw cash.

Market-driven mobile payment services are also providing potential for poor communities to benefit from faster and more secure financial transactions (Duncombe&Boateng, 2009; Heyer& Mas, 2009; Jack &Suri, 2009). Infrastructure and service platforms are sufficiently scaled (e.g., through Globe Telecom's GCash in the Philippines, Wizzit in South Africa, and Safaricom's M-PESA in Kenya, MTN mobile money, Tigo cash and Airtel money in Rwanda) to enable small farmers to receive money, send or save, with the potential for the unbanked in poor communities to access formal banking services.

CHAPTER THREE. RESEARCH METHODOLOGY

3.1. Introduction

This chapter provides information on the research methodology used to determine the impact of mobile phones on the rural and agricultural livelihoods.

The four purposes of this chapter are

- To describe the research methodology of this study,
- To explain the sample selection,
- To describe the procedure used in designing the instrument and collecting the data, and
- To provide an explanation of the statistical procedures used to analyze the data.

The credibility of findings and conclusions extensively depend on the quality of the research design, data collection, data management and data analysis. Therefore, this chapter is dedicated to the description of the methods and procedures done in order to obtain the data, how they were analysed, interpreted and how the conclusion was made.

3.2. Description of the study area

The impact of mobile phones on the rural and agricultural livelihoods was assessed in 2 sectors of Nyabihu district: Rambura and Jenda.
Jenda sector is composed of a population of 28,713 individuals and 6,935 households. Rambura sector is composed of a population of 28,554 individuals with 5,621 households.
The total population of Jenda and Rambura sectors is 57,267 individuals and 12,556 households.

3.3. Research design

The descriptive method of research was used for this study. This method is used to describe the nature of a situation, as it exists at the time of the study and to explore the causes of particular a phenomenon. The aim of descriptive research is to obtain an accurate profile of the people, events or situations. Moreover, this method allows a flexible approach, thus, when important new issues and questions arise during the duration of the study, further investigation may be conducted.
The descriptive method is advantageous for the researcher because this method can use either qualitative or quantitative data or both, giving the researcher greater options in selecting the instrument for data-gathering.
The researcher opted to use this kind of research considering the desire to acquire first hand data from the respondents so as to formulate rational and sound conclusions and recommendations for the study.
In terms of approach, the study employed both qualitative and quantitative approaches. The quantitative approach that focuses on obtaining numerical findings was used with the survey method. The interview on the other hand, made up the qualitative approach of the study as this focused on personal accounts, observations, description and individual insights of the respondents. The main point of the quantitative research method is that measurement is valid, reliable and can be generalized with its clear anticipation of cause and effect (Cassell&Symon, 1994).The use of qualitative data gathering method is advantageous as they are more open to changes and refinement of research ideas as the study progresses. This study employed the combined approach so as to overcome the limitations of both approaches.
For this research, two types of data were gathered. These included the primary and secondary data types. The primary data were derived from the answers the participants gave during the survey process. The secondary data on the other hand, were obtained from published documents and literatures that were relevant to the research problem.

3.4. Sample size and sampling techniques

According to Williamson (1982:113) the sample size is a phase of a research, which is crucial because of its major impact on time and money that must go into data collection. Therefore, the selection of respondents from Rambura and Jenda sectors in Nyabihu district was done according to the Kothari formula.

3.4.1. Sample size determination

There are different methods and procedures to determine or to estimate a representative sample. For achieving the objectives of the research, a sampling of respondents to be interviewed will be determined by using the Kothari formula;

$$n = \frac{Z^2 \times p \times q \times N}{d^2(N-1)+Z^2 \times p \times q}$$ Kothari (2006)

Where:
n= sample size
N= Size of Population
Z= Coefficient (Normal distribution)
P= probability of success.
Q= Probability of failure
D= Margin error

For Kothari,

- The margin error (D) varies between 6% and 10%. In this study, we will use the margin error of 10%,
- The confidence level (Z) is $z_{0.5}$=1.65
- The probability of success is p=0.5,
- The probability of failure is q= 0.5
- The size of the population (N) of Jenda and Rambura sector is 57,267individuals.

The total population of Jenda and Rambura is 57,267 individuals. By using the Kothari formula, a sample of the respondents was determined in the following way:

$$n = \frac{Z^2 \times p \times q \times N}{d^2(N-1) + Z^2 \times p \times q} = \frac{(1.65^2)x(0.5)^2x57267}{(0.1)^2(57266) + (1.65)^2(0.5)^2} = 67.9 \approx 68$$

Therefore, the number of individuals to be interviewed is 68 among which 50 who possess mobile phones were taken into account for hypotheses testing.

Determination of sample size at each targeted level

In order to determine the sample size at each level the following formula was used:

$$ni = \frac{Ni \times n}{N}$$

Source: Kothari (2006)

Where:

ni= the sample size proportion in the stratum;

Ni= the population proportion in the stratum;

n= the sample size;

N= the total population.

Jenda sector

The population proportion in the stratum (Ni) = 28,713

The sample size (n) = 68

The total population (N) =57,267

$$ni = \frac{28,713 \times 68}{57,267} = 34.09 \approx 34$$

Rambura sector

The population proportion in the stratum (Ni) = 28,554

The sample size (n) = 68

The total population (N) =57,267

$$ni = \frac{28,554 \times 68}{57,267} = 33.9 \approx 34$$

Table 4: Sample size

Sector	Population	Sample size
Jenda	28,713	34
Rambura	28,554	34
Total	57,267	68

3.5. Data Collection

3.5.1. Primary data

For effective and flawless data collection, the technique that was used under descriptive method is the normative survey approach and evaluation, which is commonly used to explore opinions according to respondents that can represent a whole population. The survey is appropriate in this study because it enables the researcher in formulation of generalizations.

Specifically, two types of direct-data survey are included in this study: the questionnaire survey and interview.The direct-data type of survey is a reliable source of first-hand information because the researcher directly interacts with the participants.

The questionnaire was divided into two main sections: a profile and the survey proper. The profile contains demographic characteristics of the respondents such as age, gender, marital status, household size, education level and profession. The survey proper contains the contribution of mobile phones on the rural and agricultural livelihoods.

The questionnaire includes questions designed to secure information about:

- Individual and household characteristics (i.e., gender, age, education level, profession,)
- Livelihood descriptors (i.e., social networks, engagement in business, when the mobile phone was adopted)
- Individual and household use of mobile telephony for agricultural and non-agricultural based purposes

- Perceived value/impact of productive agricultural-based uses of mobile phone for livelihoods

The semi-structured interviews are guided by a predetermined theme and questions; however, flexibility in the order or form of questions is encouraged to reveal deeper insight into respondents' experiences (Kvale& Brinkmann, 2008). Semi-structured in-depth interviews were conducted individually within households.
To ensure the reliability of the results, special care was taken to ensure that the questions were clear and easy to answer. Where needed, certain concepts were explained to ensure that there could be no mistake to what was meant. To ensure the validity of the results, special care was taken to ensure that the collected information really reflects the phenomenon that is studied. To ensure the representativeness of the results, special care was taken to ensure that the data and the research methods, together with conclusions derived from data analysis, are broader in their application than the sample of respondents studied.

3.5.2. Secondary data

The secondary data was derived from articles and books, published journals, reports, papers, articles and online information.

3.6. Data processing and Data analysis

After gathering all the completed questionnaires from the respondents, total responses for each item was obtained and tabulated for statistical analysis. The questions and responses were coded and entered in the computer using Microsoft Excel software. Required analysis was done with the aid of Statistical Package for Social Sciences 17.0 Version. Statistical techniques were used to quantify the data and to put those data in representative interpretation like tables and graphics. These make data more understandable to readers and easier for the researchers to make conclusions.

3.6.1. Editing

Editing was done in two phases; the first was accomplished when the researchers were in the field collecting data and the second phase was done after the fieldwork. After the interviews, answered questionnaire were cross – checked to ensure that all answers collected were coherently and logically recorded to provide sufficient data. This process went on during the whole period of data collection. After thoroughly editing the data, the researcher processed to the coding stage.

3.6.2. Coding

The answers acquired were coded and used to determine the frequencies of each response. Similar responses were grouped according to their different categories.

3.6.3. Tabulation

After coding, the researchers summarized the data by constructing tables of answers provided to each theme. In addition, the data collected and tabulated in the research process was analyzed.

3.7. Ethical Considerations

As this study required the participation of human respondents, certain ethical issues were addressed. The consideration of these ethical issues was necessary for the purpose of ensuring the privacy as well as the safety of the participants. Among the significant ethical issues that were considered in the research process include consent and confidentiality. In order to secure the consent of the selected participants, the researchers relayed all important details of the study, including its aim and purpose. By explaining these important details, the respondents were able to understand the importance of their role in the completion of the research. The respondents were also advised that they could withdraw from the study even during the process. With this, the participants were not forced to participate in the research. The confidentiality of the participants was also ensured by not disclosing their names or personal information in the research. Only relevant details that helped in answering the research questions were included.

In the conduct of the research, the survey forms and interview methods were drafted in a very clear and concise manner to prevent conflicts among respondents. People who participated in the research were given an ample time to respond to the questions posed on them to avoid errors and inaccuracies in their answers.

1.8. Limitations of the study

During the conduct of the study, two constraints were faced:

- Respondents' unavailability: Given that interviews were conducted during week days; it was hard to find respondents as they had gone for work.
- Weather conditions: The period in which the survey was conducted was rainy. This resulted in the survey period being extended as fewer interviews were conducted per day.

CHAPTER FOUR: RESULTS PRESENTATION, ANALYSIS AND DISCUSSION

Table 5: ownership of Mobile Telephones by Province

Province	Percentage
Kigali City	79.6%
Southern Province	35.0%
Western Province	40.4%
Northern Province	41.9%
Eastern Province	48.4%

Source: Secondary data, EICV3 (2010-11)

Table 6: Active mobile phone subscribers, June 2013

Operators	**Active subscribers**		**Fixed Teledensity**	**Mobile Teledensity**	**General teledensity**
	Mobile Active subscribers	**Fixed Telephony subscribers**	**0.40%**	**60.9%**	**61.3%**
MTN Rwanda	3,599,540	10,925			
TIGO Rwanda	1,900,693				
AIRTEL RWANDA LTD	915,110				
RWANDATEL	**-**	31,875			
Total	**6,415,343**	**42,800**			

Source: Secondary data, RURA operators' returns (June 2013)

The above table indicates that mobile penetration rate reached 60.9% as of June 2013 against 57.3% on March 2013. This is mainly due to the increase in mobile telephone subscriptions.

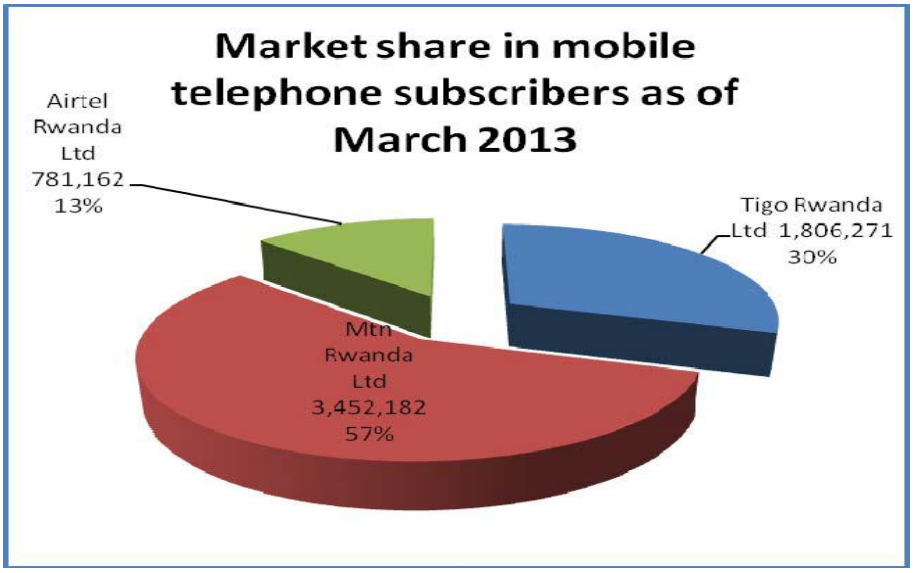

Figure 4: Market share in mobile telephone subscribers March 2013 (Source: secondary data, RURA)

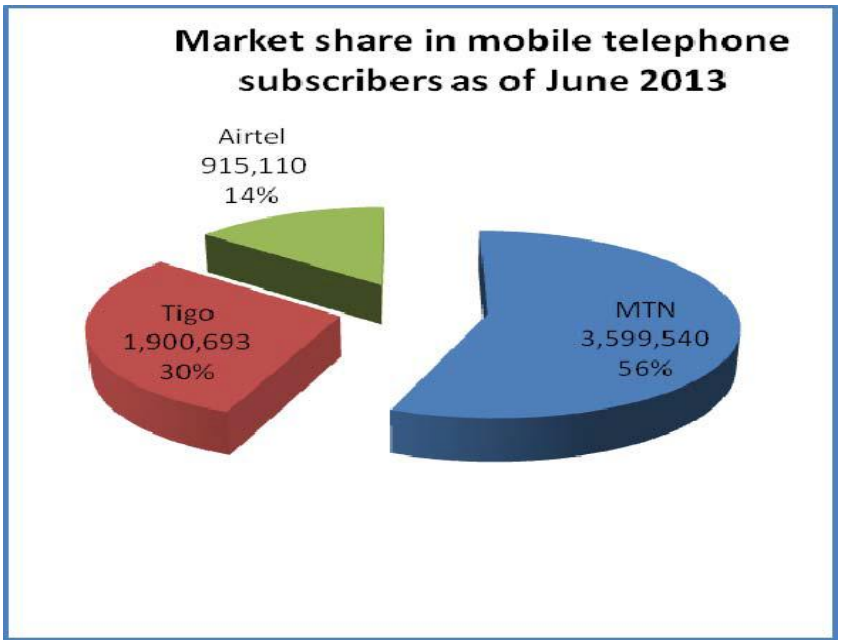

Figure 5: Market share in mobile telephone subscribers June 2013.

Table 7: Active mobile subscribers (90-days revenue generating subscribers) as of April 2014.

Operators	Jan-14	Feb-14	Mar-14	Apr-14
MTN Rwandacell	3,560,234	3,547,411	3,525,227	3,530,162
TIGO Rwanda	2,211,179	2,248,866	2,295,342	2,357,589

AIRTEL Rwanda	989,942	1,004,229	1,015,404	1,013,103
Total	6,761,355	6,800,506	6,835,973	6,900,854

Source: Secondary data, RURA (April 2014)

The present chapter is devoted to the interpretation, analysis and discussion of results from the study according to fixed objectives. The results are analyzed through Excel and SPSS programs, and they are illustrated with graphs. The results are logically presented in subsections that follow each other according to the objectives.

4.1. Results presentation and discussion

4.1.1. Demographic characteristics of respondents

The demographic characteristics of respondents including gender, age, marital status, educational level, household size, profession are given below.

4.1.1.1. Distribution of respondents according to Gender of respondents

Gender is the demographic cultural relationship between males and females.

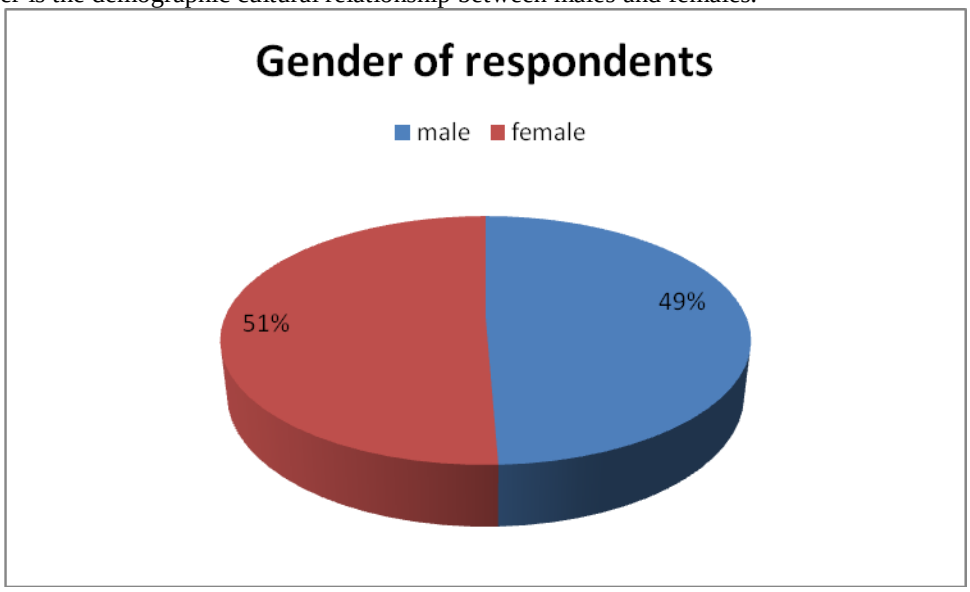

Figure 6: Gender of respondents (Source: Primary data, 2014).

The survey sample was dominated by females (51%) in comparison to males (49%). This inequality is explained by the presence of solely female widows (18%) in the sample.

The present situation is in accordance with the fourth population and housing census (2012) that found that from a population of 295,580 individuals in Nyabihu district; females (157,536) outnumber males (138,044) by 19,492 individuals. Therefore, 53.2% of the total population of Nyabihu district is represented by females.

4.1.1.2. Distribution of respondents according to Age

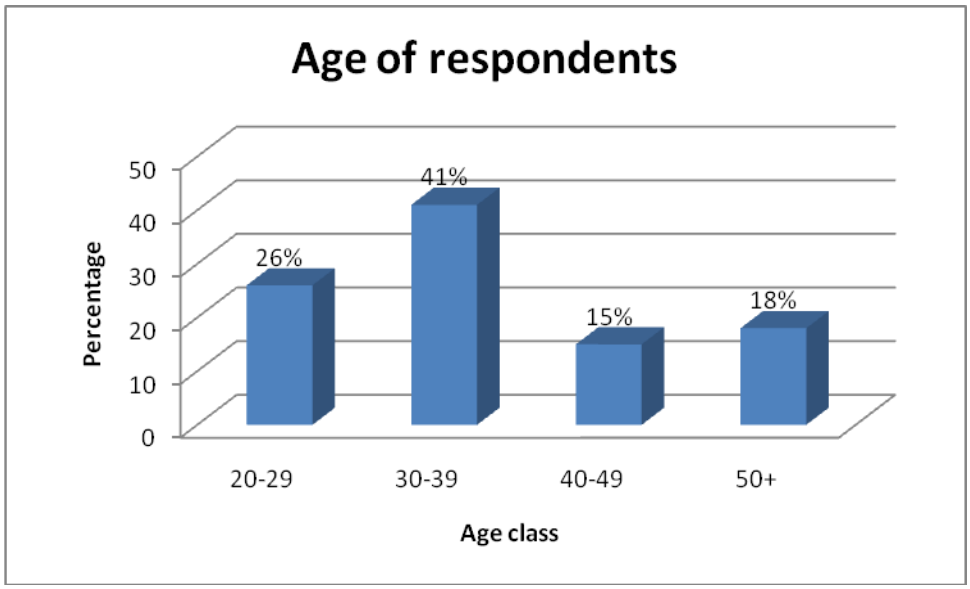

Figure 7: Age of respondents (Source: Primary data, 2014).

The majority of respondents are comprised between 20-39 years. This is in accordance with the EICV3 (2010-11) that found that the majority (83.6%) of the Nyabihu district population is aged less than 40 years.

4.1.1.3. Distribution of respondents according to marital status

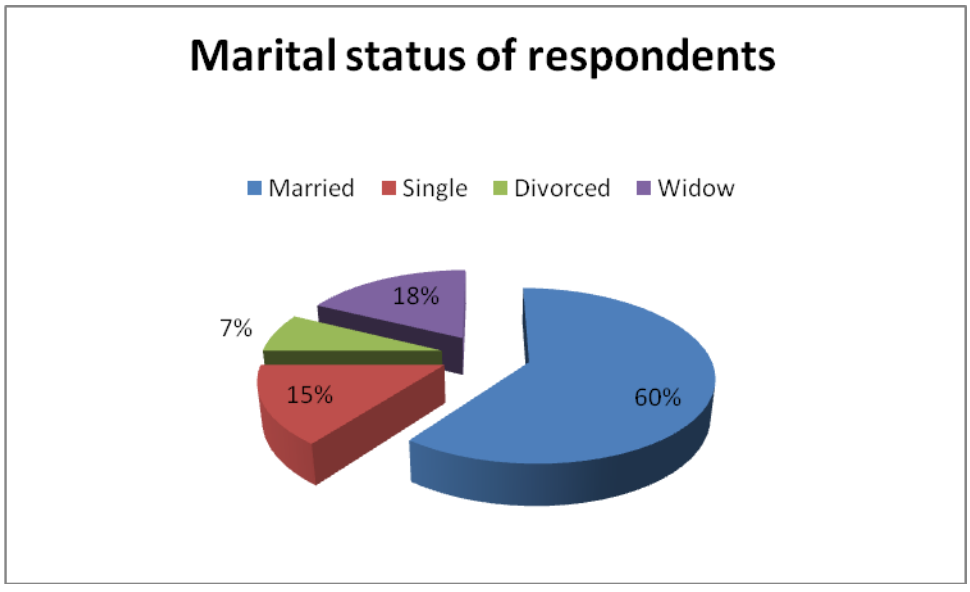

Figure 8: Marital status of respondents (Source: Primary data, 2014).

The majority of respondents are married because the respondent's distribution per age is dominated by individuals above 21 years, which corresponds to the legal marriage age in Rwanda. This supports the fourth population and housing census (2012) that found that the percentage of married individuals increases from 0.5% between 20-24 years, to a maximum of 82% between ages of 35-39; before decreasing down to 37% due mainly to widowhood.

The 18% widows are solely females and this is explained by the fact that widowhood is more common among females due to their greater longevity, while males tend to live in union than females. According to the Nyabihu district development plan (2013), 53.2% of households in Nyabihu district are headed by women.

4.1.1.4. Distribution of respondents according to Education level

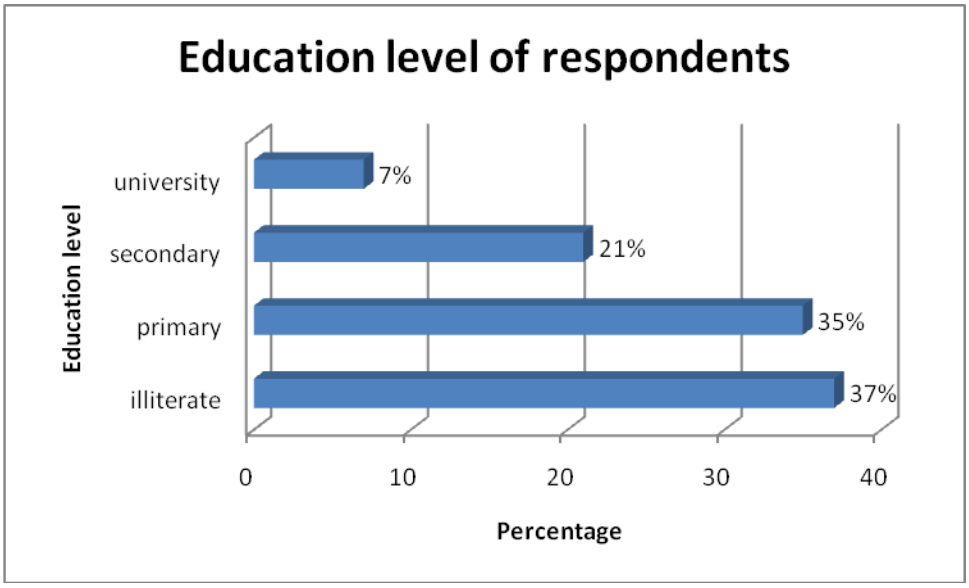

Figure 9: Education level (Source: Primary data, 2014).

The majorities of respondents are illiterate or had primary education due to poverty and a strong dependence of the household income on traditional practices in agriculture.

- The literacy rate is still low in rural areas: According to the EICV3 (2010-11) the literacy rate is 82.6% in urban areas against 67.3% in rural areas. According to the fourth population and housing census (2012) the literacy rate in Nyabihu district is 69% and the illiteracy rate is 29% in rural areas against 14% in urban areas.
- There is high respondent's attendance to primary education than secondary education (35% against 21%). This is supported by the Nyabihu district development plan (2013) that found that in the western province, the primary school attendance rate is 87.9%, while the secondary school attendance rate is 20.2%. In Nyabihu district, the enrollment in secondary education is very low with a net attendance rate of 19.9%. The remainder 80.1% does not follow high school after primary school and take the way of agricultural fields.

- The adult literacy program is still low in rural areas. This is supported by the Nyabihu development plan (2013) that found that the adult literacy program attendance is only 32% from individuals of 15 to 65 years.

4.1.1.5. Distribution of respondents according to household size

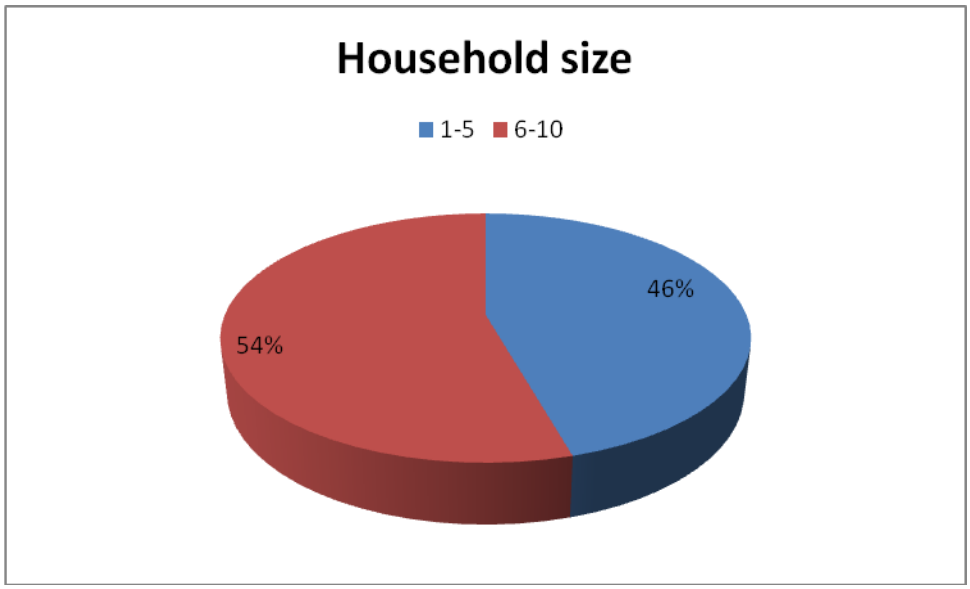

Figure 10: Household size (Source: Primary data, 2014).

The number of household members is high (54%) due to the following factors:

- Low family planning: Rural areas in Rwanda are characterized by low family planning in comparison with urban areas. This is supported by the fourth population and housing census (2012) who found that the general fertility rate (number of births per 1000 women) is 130, 6 in the western province while it is 98.9 in Kigali. According to the Nyabihu district development plan (2013), Nyabihu district has an average fertility rate of 4.9% which is higher than the national average of 4.6%.

- Ignorance: Education is known to have a significant impact on reproductive behaviors. The higher the level of education, the fewer the children a woman have. This situation is supported by the findings from the distribution of respondents per education level, who demonstrate that the majority of the respondents are illiterate. They are therefore likely to have many children.

4.1.1.6. Distribution of respondents according to Professions

Nyabihu district is characterized by the majority of the population engaged in agriculture activities. However, other activities, at a much lesser extent are as well conducted.

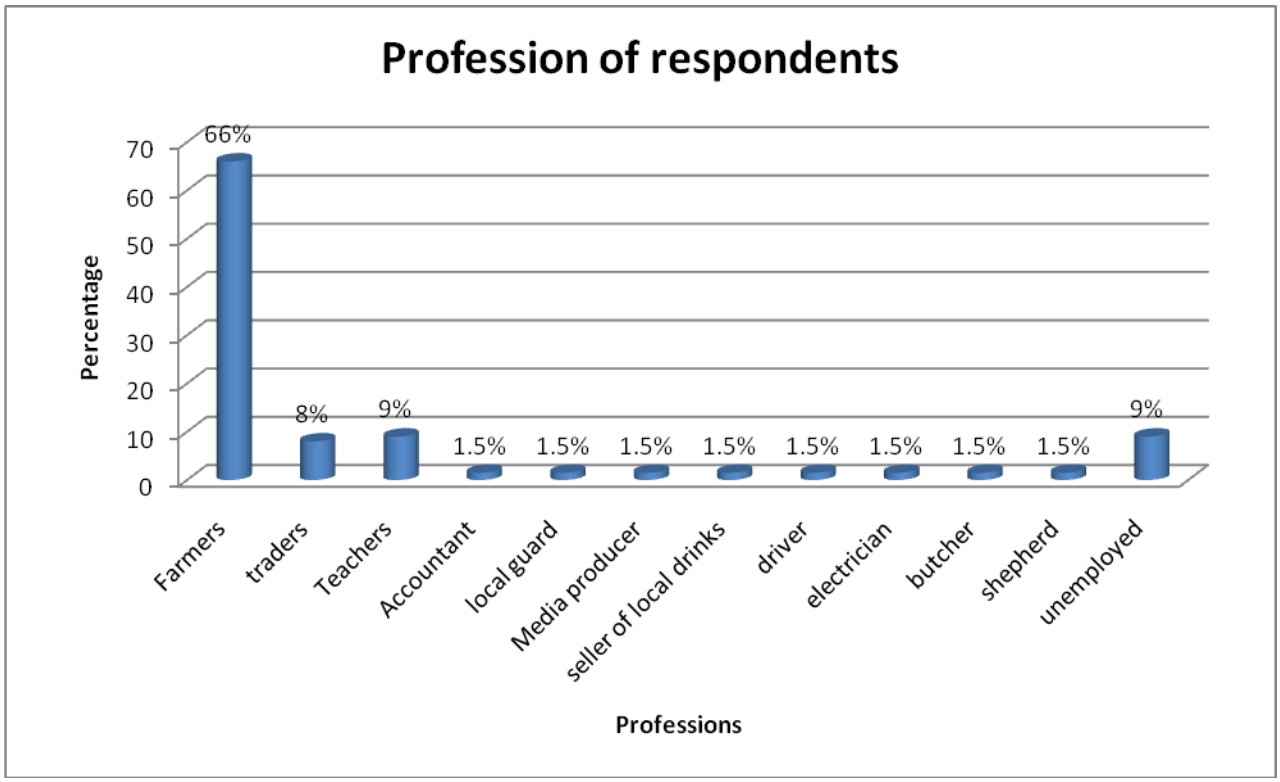

Figure 11: Professions of respondents (Source: Primary data, 2014).

The majority of respondents (66%) are farmers. This is due to the following factors:

- Nyabihu district's soil is very fertile and its agro-climatic conditions are favorable to agriculture activities.
- The majority of the Rwandan population lives in rural areas and more than 80% of the population is engaged in agriculture (RAB,2013).
- In Nyabihu district, approximately 74% of the population derives their income from agriculture (Nyabihu development plan, 2013).
- Moreover, agriculture can as well be combined with other activities.

4.1.2. Uses of mobile phones per demographic characteristics

4.1.2.1. Mobile phones per gender of respondents

Gender, as demographic characteristic, allowed researchers to determine the gender that has the most adopted and used the mobile phones.

Table 8: Mobile phones per gender of respondents

Gender	Gender							
	Male				Female			
	Frequency	Percentage	Mobile phone owners	Percentage	Frequency	Percentage	Mobile phone owners	Percentage
	33	49%	29	88%	35	51%	21	60%

Source: Primary data (2014)

Out of 100% representing 33 males, 88% representing 29 males possess mobile phones. While, out of 100% representing 35 females, 60% representing 21 females possess mobile phones.

This indicates that although the number of females is greater than males, males have the most adopted mobile phones (88% against 60%). This is due to the rural areas mentality, whereby males are considered as household providers (they are outwardly oriented, hence have a great need of mobile phones) while women are most of the time housewives and therefore they do not feel concerned with the ownership and use of mobile phones.

4.1.2.2. Mobile phones per age of respondents

Age, as demographic characteristic, allowed researchers to determine the age range that has the most adopted and used the mobile phones.

Table 9: Mobile phones per age of respondents

	Age class							
Age class	20-29		30-39		40-49		50-59	
	Population	Mobile phone owners	Population	Mobile phone owners	Population	Mobile phone owners	Population	Mobile phone owners
Frequency	18	14	28	21	10	10	12	5
Percentage	26%	76%	41%	75%	15%	100%	18%	42%

Mobile phone ownership is dominated by respondents comprised in the interval of 20-49 years because they constitute the active labor force; therefore they are able to earn an income allowing them to purchase their own phones.

4.1.2.3. Mobile phones per marital status of respondents

Marital status, as demographic characteristic, allowed researchers to determine the marital status that has the most adopted and used the mobile phones.

Table 10: Mobile phones per marital status

	Marital status							
Marital status	Married		Single		Divorced		Widows	
	Population	Mobile phone owners	Population	Mobile phone owners	Population	Mobile phone owners	Population	Mobile phone owners
Frequency	41	31	10	9	5	3	12	7

Percentage	60%	76%	15%	90%	7%	60%	18%	58%

Source: Primary data (2014)

Out of 100% representing 41 married individuals, 60% representing 31 individuals possess mobile phones. Out of 100% representing 10 single individuals, 90% representing 9 individuals possess mobile phones.

Out of 100% representing 5 divorced individuals, 60% representing 3 individuals possess mobile phones. Out of 100% representing 12 widows, 58% representing 7 individuals possess mobile phones.

Mobile phone ownership is dominated by single respondents because these individuals have less expenditure related to household needs; therefore they can allocate their resources efficiently to maximize their needs. Married individuals come next because a husband and a wife can pull their resources together in order to purchase a mobile phone. Divorced and widows have less mobile phones because of many charges and responsibilities that abound to them.

4.1.2.4. Mobile phones per education level of respondents

Education level, as demographic characteristic, allowed researchers to determine the education level that has the most adopted and used the mobile phones.

Table 11: Mobile phones per education level of respondents

	Education level							
Education level	Illiterate		Primary		Secondary		University	
	Population	Mobile phone owners	Population	Mobile phone owners	Population	Mobile phone owners	Population	Mobile phone owners
Frequency	25	8	24	23	14	14	5	5
Percentage	37%	32%	35%	96%	21%	100%	7%	100%

Source: Primary data (2014).

Out of 100% representing 25 illiterate individuals, 32% representing 8 individuals possess mobile phones. Out of 100% representing 24 individuals with primary education, 96% representing 23 individuals possess mobile phones. Out of 100% representing 14 individuals with secondary individuals, all of them possess mobile phones. Out of 100% individuals representing 5 individuals with mobile phones, all of them possess mobile phones.

Mobile phones have been mostly adopted by those with primary, secondary and university education because:

- They are aware of the necessity of mobile phones
- They are engaged in lucrative businesses requiring them to use mobile phones.
- Those lucrative businesses provides them financial means enabling them to purchase mobile phones
- They have the functional literacy enabling them to make appropriate use of mobile phones.

The illiterate own mobile phones less because of poverty and ignorance with regards to the necessity of mobile phone use.

However, it has been observed that those who do not have any formal literacy (32%) are able to access the mobile phone interface by memorizing the signs or symbols instead of the letters. This at least enables them to perform basic operations of the mobile phones.

4.1.3. Uses of mobile phones

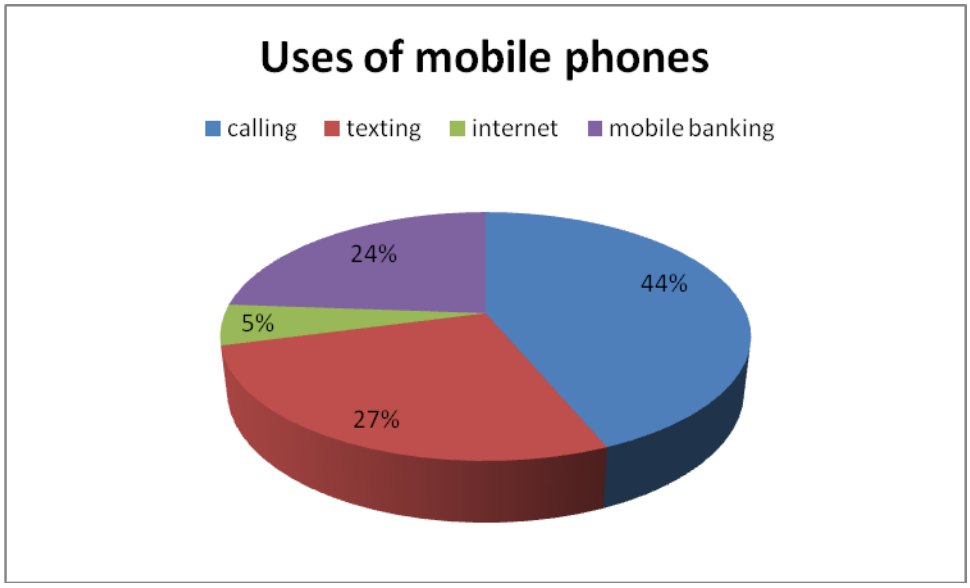

Figure 12: Uses of mobile phones (Source: Primary data, 2014).

The above figure indicates how respondents try to maximize the use of mobile phones by integrating all its functions:

- Calling(44%) is done to a greater extent because it is the primary function of mobile phones and it is the easiest function to integrate even for the illiterate,
- Texting (27%) use is limited due to high illiteracy rates (37%) in the rural population of the study. Individuals who are illiterate can ask others who are literate to interpret or write SMS messages. However, if the information is private, an individual may be hesitant to ask for help.
- Mobile banking (24%) is mostly used due to its ease of use as well as the expensiveness of other banking institutions.
- Internet (5%) use is still low, and its users are solely businessmen who use it to get news and different information. The remainder gets informed through the radio.

4.1.4. Purchasing cost of mobile phones

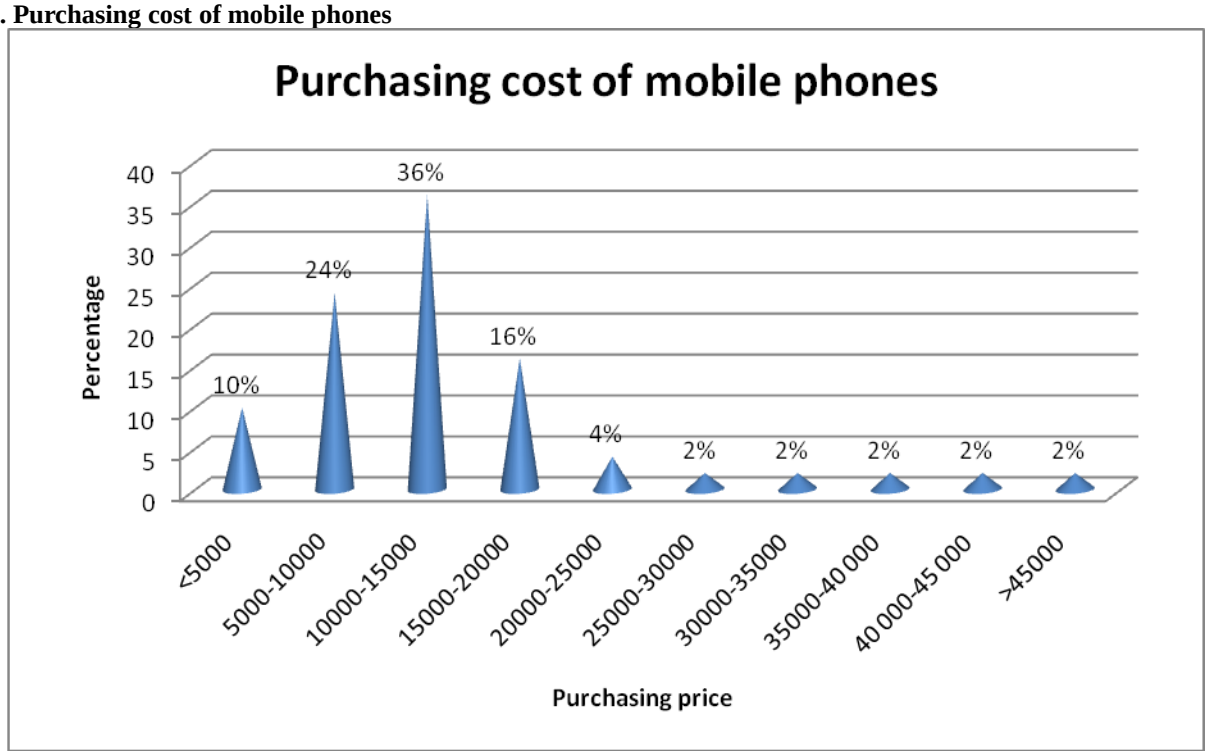

Figure 13: Purchasing cost of mobile phones (Source: Primary data, 2014).

The above figure shows that there are variable prices of mobile phones and this makes them affordable to different segments of the respondents. This is due to the increasing competition among the three telecommunication companies (MTN, Tigo and Airtel) that results in the provision of various services and products at affordable prices. The majority purchase cheap phones (less than 20.000RWF) because their incomes are low; the minority who purchase expensive mobile phones are the small portion involved in high income earning activities.

4.1.5. Mobile phones and agriculture

4.1.5.1. Main crops cultivated

In order to assess the demographic impact of mobile phones on agricultural livelihoods, it was necessary to know the main crops cultivated.

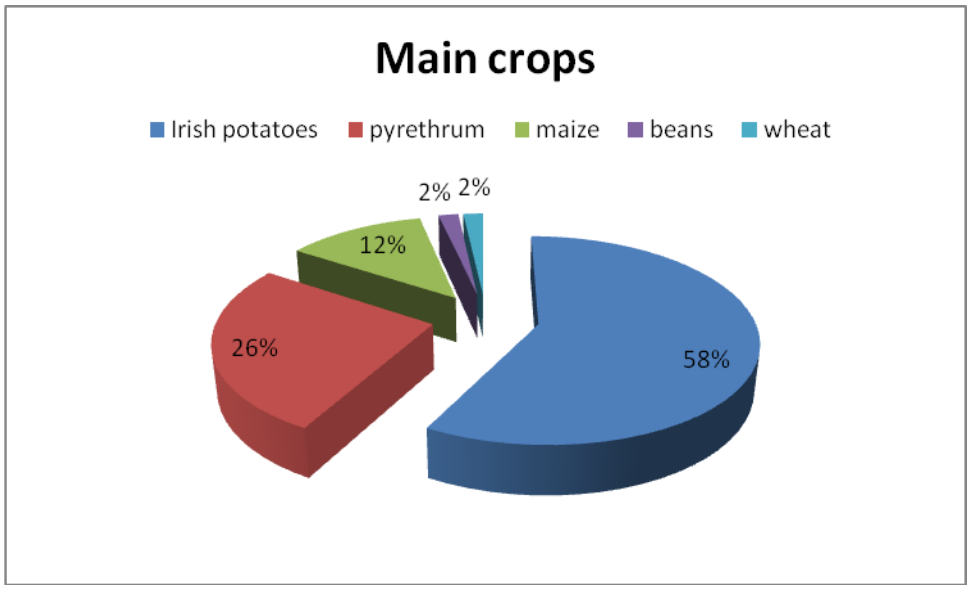

Figure 14: Main crops cultivated (Source: Primary data, 2014).

The study has shown that the majority of respondents grow Irish potatoes (58%) and Pyrethrum (26%). This is due to the agro-climatic conditions of Nyabihu district that favors the growth of the two crops; as well as the intercropping program that alternates the two crops in a planting season.

The intercropping program is the result of a conflict between cultivators of Irish potatoes and Sopyrwa in increasing pyrethrum production. The conflict was raised by the fact that farmers are very interested in Irish potatoes (grown at 83.7% in the whole Nyabihu district) than pyrethrum cultivation whose cultural space was not raised like other products in the six passed years. (Nyabihu development plan, 2013).

4.1.5.2. Impact of mobile phones use on farmers

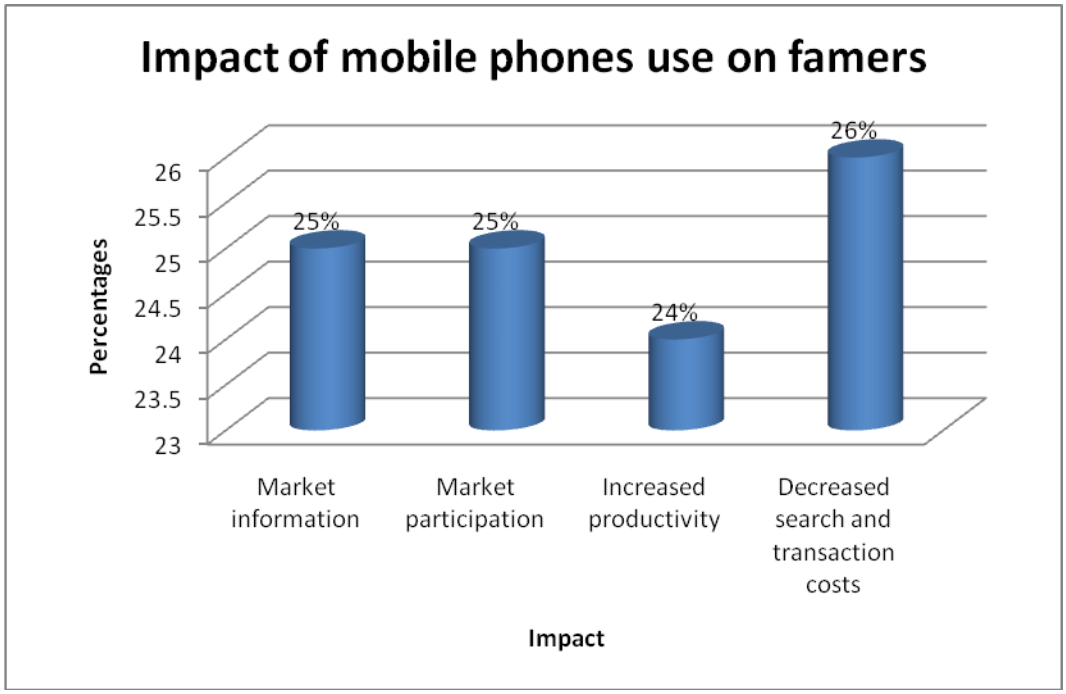

Figure 15: Impact of mobile phones use on farmers (Source: Primary data, 2014).

- Over 25% of the respondents indicated that the use of mobile phones had a positive impact on market information and participation. Respondents reported that they had been using mobile phones to directly discuss prices with buyers and crosscheck prices for their produce, instead of relying on middlemen or a few buyers. Mobile phones were also reported as being of great help when making decisions on the best time to sell crops and animals as farmers could have instant information about prices. These findings suggest that mobile usage enables rural farmers to access to better markets and prices for their produce and were able to overcome the problem of being cheated by middlemen. This supports the study of Aker and Mbiti (2010) that found that mobile phones reduce information asymmetry by allowing better access to and use of information.
- Over 24% of the respondents indicated that the use of mobile phones had a positive impact on productivity. The mobile phone enabled farmers to increase their productivity by giving them access to better and cheaper seeds, fertilizers; as well as agronomist services in case of diseases or for follow-up.
- Over 26% of the respondents indicated that the use of mobile phones had a positive impact on search and transaction costs.
  The mobile phone enabled famers to make appointments, and arrangements with clients in terms of price and quantity prior going to the market. This reduces high transaction and search costs that are normally characteristics to markets. This is in accordance with the study of De Silva &Ratnadiwakara (2010) who found that 70 percent of all transaction costs are related to information search costs (the transaction costs themselves were recorded as 15 percent of the total costs incurred).

4.1.5.3. Impact of mobile phone use on rural livelihoods

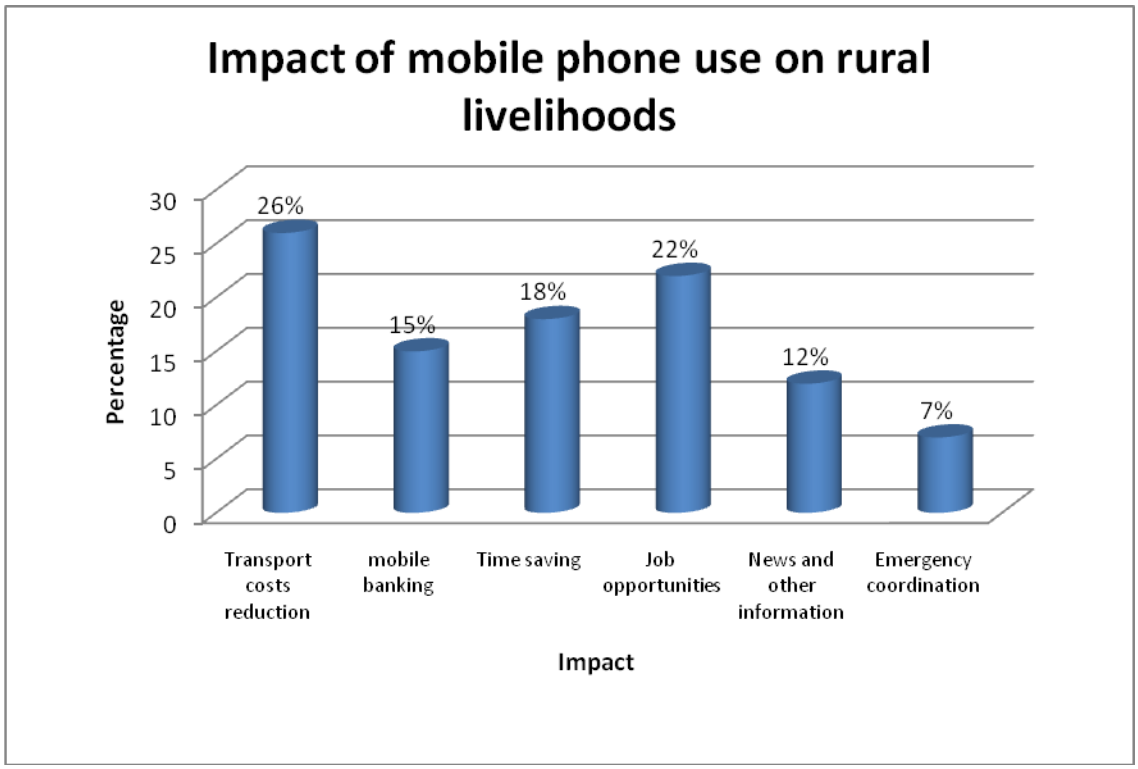

Figure 16: Impact of mobile phones use on rural livelihoods (Source: Primary data, 2014).

- Over 26% of the respondents indicated that the use of mobile phones had a positive impact on travelling and transportation costs. The mobile phone has enabled respondents to get the information they need without having to travel for it. Mobile phones were used to cut down the need to travel or simplify travelling and transport arrangements, thereby saving time (18%) and money. In addition, using mobile phones to make travel and transport arrangements makes travel time more productive. This supports the study of Aker (2008) that found that although mobile phones require an initial fixed cost, the variable costs associated with their use are significantly lower than equivalent travel and other opportunity costs.

- Over 22% of the respondents indicated that the use of mobile phones had a positive impact on job provision. The mobile phone is a medium through which job connections are made. This supports the study of Klonner and Nole (2008) who found that the introduction of mobile phones is correlated with an increase in employment.
- Over 15% of the respondents indicated that the use of mobile phones had a positive impact on financial transactions through mobile banking. Mobile banking serves as a partial substitute for the formal banking system. Prior to the introduction of Mobile banking, most Africans were excluded from modern financial services. This supports the study of Beck et al. (2007) who, using data ranging between 2001 and 2005, showed that African countries lagged in financial access. Mobile banking services allow customers to use their phone like a bank account and a debit card, thus providing potential for poor communities to benefit from faster and more secure financial transactions.
- Over 12% of the respondents indicated that the use of mobile phones had a positive impact on access to information and news. The mobile phone enables respondents to get first hand information and news about various factors influencing their daily lives. This supports the study of (Rosenzweig and Binswanger, 1993) who found that mobile phones allow households to obtain information about potential shocks, allowing them to use such information to make planting and harvesting decisions, which can have important effects on yields.
- Over 7% of the respondents indicated that the use of mobile phones had enhanced their ability to deal with emergencies. The mobile phone, by virtue of its ease of use, rapidity and reliability of information is an asset in emergency coordination.

  These findings confirm earlier studies (Idowu et al., 2003; Souter et al., 2005; Gordon, 2007; de Silva and Zainudeen, 2007) which cited mobile phones as very important devices for communicating emergencies in a wide range of situations. Generally, mobile phones are regarded as a safety value in the moments of shocks.

4.2. Analysis of results

Hypothesis testing

A. The main factor influencing the use of mobile phones is educational level

The use of mobile phones is influenced by many demographic factors among which gender, age, marital status and profession.

In order to test the above hypothesis, the study uses SPSS software.

Table 12: Statistic test.

N	50
Chi-Square	79.772
Df	3
Asymp. Sig.	.000

Source: SPSS

The statistic test indicates that the P value (0.000) is less than α (0.005). The hypothesis is therefore rejected. In other words, the education level is not the main factor influencing the use of mobile phones.

In order to determine which demographic factor among the above cited influences the use of mobile phones, the Friedman test will be applied. The Friedman test ranks the means of each demographic characteristic. The characteristic with the lowest mean rank is the one who influences the most the use and ownership of mobile phones.

Table 13: Mean rank.

	Mean Rank
mobile phones per gender	1.72
Mobile phones per age	2.90

Mobile phones per education level	3.30
Mobile phones per marital status	2.08

Source: SPSS

Results from the above table indicate that gender (1.72) influences the most the mobile phone use and ownership in Nyabihu district.

Other demographic factors influence as well the ownership and use of mobile phones in the following order:

- Marital status (2.08),
- Age (2.9) and
- Education level (3.30).

The result from the hypothesis testing confirms the findings in the distribution of mobile phone per gender, whereby there is a big gap between males' (88%) and females' (60%) mobile phone use. This has a positive impact on rural livelihoods because in rural areas, males are the household providers and they can use the mobile phone efficiently to increase the household livelihood. The situation also presents a negative impact because females feel less concerned with the ownership of mobile phones, as they rely on their husband's mobile phone.

B. The main impact of mobile phones use on farmers is access to market information while the main impact of mobile phones use on rural livelihoods is financial efficiency.

B.1. The main impact of mobile phones use on farmers is access to market information

The impacts of mobile phones use on farmers are:

- Access to market information that leads to increased market participation
- Increased agricultural income: Through increased productivity and reduction of search and transaction costs.

The statistic test gives the following results:

Table 14: Statistic test.

N	61
Chi-Square	1.000
Df	1
Asymp. Sig.	.317

Source: SPSS

The statistic test indicates that the P value (0.317) is greater than α (0.005). Therefore, the hypothesis is accepted. This means that the main impact of mobile phones on famers is access to market information.

The Friedman test further confirms the above hypothesis.

Table 15: Mean rank.

	Mean Rank
Market information	1.49
Increased agricultural income	1.51

Source: SPSS

Results from the above table indicate that market information (1.49) is the biggest outcome of mobile phones use on farmers in the study area.

B.2. The main impact of mobile phones use on rural livelihoods is financial efficiency

Impacts of mobile phones use on rural livelihoods are**:**

- Financial efficiency: Through mobile banking, job opportunities and reduction of transport costs
- Information generation: Through access to news and other information, emergency coordination and time saving

The statistic test gives the following results:

Table 16: Statistic test.

N	72
Chi-Square	.111
Df	1
Asymp. Sig.	.739

Source: SPSS

The statistic test indicates that the P value (0.739) is greater than α (0.005). Therefore, the hypothesis is accepted. This means that main impact of mobile phones use on rural livelihoods is financial efficiency.

The Friedman test further confirms the above hypothesis.

Table 17: Mean rank.

	Mean Rank
Financial efficiency	1.49
Information generation	1.51

On basis of mean ranks, the above table indicates that financial efficiency (1.49) is the main impact of mobile phones use on rural livelihoods.

C. Poverty is the main challenge affecting the rate of mobile phone use

The respondents reported some challenges associated with the ownership and use of mobile phones such as poverty, illiteracy and ignorance.

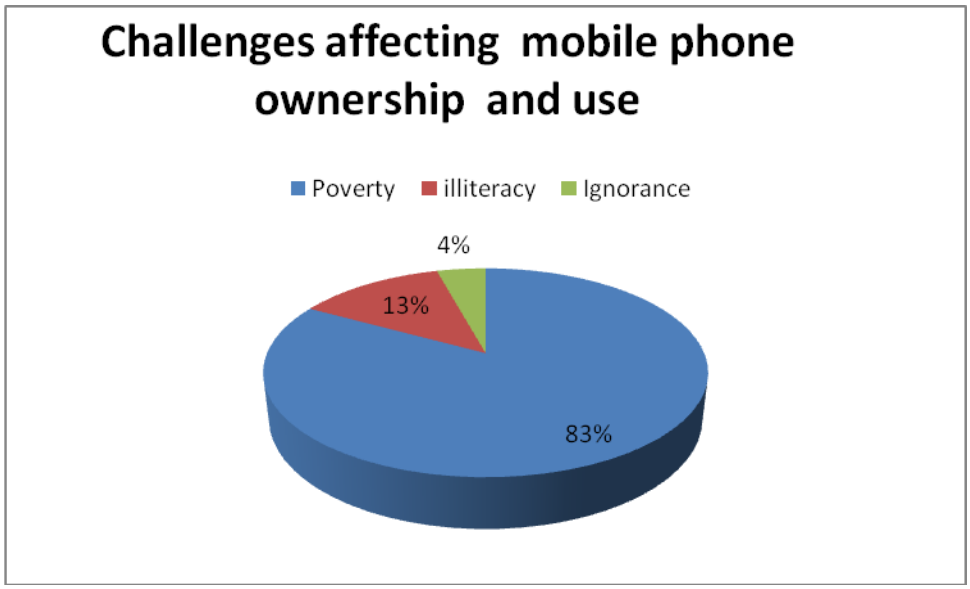

Figure 17: Challenges affecting mobile phone ownership and use (Source: Primary data, 2014).

The above figure indicates that poverty (83%) is the biggest challenge preventing the ownership of mobile phones. Therefore the hypothesis is accepted. This is due to the fact that the majority of respondents are farmers depending on the characteristics of agriculture such as seasonality of agricultural production, volatility of agriculture prices and uncertainty in yields. This renders mobile phones unaffordable to these respondents.

The majority of the respondents are illiterate (37%). Even though it has been observed that those who do not have any formal literacy are able to access the mobile phone interface by memorizing the signs or symbols instead of the letters and that can enable them to perform basic operation of the phones; illiteracy is a concern for the 13% who cannot be able to use the mobile phone properly by memorizing the signs or symbols.

Few respondents (4%) do not see mobile phones as a priority due to ignorance that prevents them from acknowledging the necessity of mobile phone use.

4.3. Discussions of findings

The findings from hypotheses testing allowed researchers to achieve both the objectives of the research and to answer the problem statement.

The mobile phone is indeed a viable tool for economic development and a facilitator of sustainable livelihoods among those engaged in agricultural based and non agricultural based livelihood activities.

This problem statement is supported by the following factors deriving from the hypotheses testing:

1. By providing accurate, timely and appropriate market information; mobile phones participate in economic development by increasing farmer's livelihoods through efficient decision making, improved negotiation power, improved productivity, increased income, reduced logistics and transportation costs and improved farm business management.

- Efficient decision making: Market information enables farmers to make better decisions about what to produce and where to sell their output in order to maximize their revenues.
- Improved negotiation power: The ability to compare prices increases farmers' bargaining position vis-à-vis traders. It also enhances farmers' ability to change the time and place of marketing to capture a better price.
- Improved productivity: Mobile phones can improve famer's capacity to raise yields by enabling them to make more informed decisions about which inputs are better or cheaper to buy, when and where to best obtain them and how to use them.
- Increased income: Mobile phones help farmers in increasing their income by finding new sources of demand, improving their ability to adjust supply and quality to market conditions and learning about quality grades.
- Reduced logistics and transportation costs: Farmers obtain the latest information with a phone call instead of making a long trip to the market. This results in a decrease of transport costs. Farmers can also coordinate with other local farmers to use one large truck rather than several smaller ones to deliver their products, thus reducing logistics costs.

- Improved farm business management: Farmers can become better managers through better information about which inputs to use, new knowledge about grades and standards for produce and increased interaction with traders and other farmers.

2. The structural weaknesses in the formal financial industry in rural areas, limits access to money transfer services, especially for low-income people. The cost of transfer, usually charged as a percent of the amount sent, is considered expensive for small amounts for both local and international transfers.
   On the other hand, Mobile banking with reference to its ease of use, rapidity and cost effectiveness has a clear edge over banks and has therefore changed the savings behavior, the pattern of remittances, resulting in increased rural livelihoods.

- Mobile banking plays a great role in poverty reduction, risk management and mitigation by enabling individuals to transfer money instantly, securely, and inexpensively. Mobile banking reduces the costs of making remittances from one individual to another, especially across large distances
- Increased Saving: Given that individuals do not need to withdraw or send balances immediately, they are also able to accumulate savings on their mobile accounts over time. Thus Mobile banking has become a savings instrument, as well as a means to send money.

Other impacts of mobile phones that participate in economic development are:

- Increased job opportunities: Mobile phones serves as a medium through which job connections are made. The majority of respondents have seasonal job, therefore the mobile phone is vital for them as it represents a tool through which they get information related to future employment. Mobile phones also participate in job creation directly by increasing the demand for mobile-related services and indirectly through the creation of business activities such as shops selling mobile phones, airtime...
- Emergency coordination: Mobile phones enable individuals to respond to shocks in more timely manners therefore mitigating or lowering losses caused by unpredictable shocks. The mobile phone also has a great effect on poverty reduction during vulnerable shock experiences by driving down costs associated to the shock through better financial management and coping with the situation, incurring lower travel costs, more efficient action and improved access to information.

CHAPTER FIVE. CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

The main objective of this study was to assess the impact of mobile phones on the rural and agricultural livelihoods.
Over time, the number and variety of mobile phones uses increased among all users. Even those who originally adopted mobile phones for social purposes only embraced agricultural and non agriculture uses over time, indicating that mobile phones will be adopted for a few key purposes, but that uses will be added or reinvented to changing needs.

The three major findings of the study are:

- The identification of demographic factors influencing the usage of mobile phones by rural households revealed that gender has a major influence on mobile phone ownership
- The main impact of mobile phones use on farmers is access to market information that leads to an increase in market participation while the main impact of mobile phones on rural livelihoods is financial efficiency through mobile banking, reduction of transport costs and job opportunities
- Poverty is the main challenge affecting the rate of mobile phone uses.

In general, the findings in this study have shown that mobile phones provide rural households with fast and easy modes of communication, thereby increasing their ability to access livelihood assets, undertake diverse livelihoods strategies, and overcome their vulnerabilities.
The mobile phones contribute to reduce poverty and improve rural livelihoods through a number of ways.

- First, by expanding and strengthening social networks; by increasing people's ability to deal with emergencies and to work together thereby reducing costs and increasing productivity.

- Secondly, mobile phones enable rural people to cut down travel costs; to minimize physical risks and to maximize the outcomes of necessary journeys; as well as to increase temporal accessibility; to amplify efficiency of activities; and to send and receive money.

The above cited contributions of mobile phones further resulted into improvement in health insurance, wellbeing, farming techniques and school fees payment.
In brief, mobile phones in Rambura and Jenda sectors are not solely used for social purposes, but rather as a tool that allows farmers to respond more efficiently to external economic opportunities and threats.

However, there are some constraints encountered and the following recommendations are given in order to target high ownership and use of mobile phones.

5.2. Recommendations

To the Government

- The Government should conduct some trainings and enlightenment programmes on the benefits of using mobile phones,
- The Government should provide mobile phones subsidies to those who cannot afford them,
- Illiterate farmers should be mobilized to attend adult education programs,
- The Government should improve the capacity of rural communities to utilize the mobile phones through the provision of rural telecentres at cheap call rates,
- The Government and other stakeholders such as the service providers should expose rural communities to business opportunities that abound with the adoption and usage of mobiles,
- It may be advantageous to develop a mobile phone application that can match farmers and buyers beyond the local market through the coordination of local farmers' contact with bulk buyers, coordination of collection of multiple farmers' produce for selling in bulk and coordination of transportation of bulk produce,
- Applications of mobile phones for development purposes should emphasize voice-based communication and user interfaces that can be used by those with low literacy.
- In addition, incorporating functional literacy and mobile phone training, in particular SMS training, into agriculture training sessions is recommended
- It might be beneficial for development practitioners to train women on how to use mobile phones to 1) access and compare markets for sound decision making and 2) coordinate with others in the area to combine resources,

To farmers

- Farmers should learn and copy from their neighbors with mobile phones
- Farmers should integrate more the mobile phone in their profession (for instance by contacting the agronomist) in order to increase their agricultural productivity.
- Female farmers should step out and adopt mobile phones instead of relying on their husband's mobile phones
- Farmers should view more the mobile phone as an opportunity provider rather than emphasizing on its social aspect.

To future researchers

Future research should include concrete economic impacts of mobile phone uses over time measured in monetary terms. This may provide a better understanding of the potential of mobile phones as tools of economic development.

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