

**INFORMATION AND COMMUNICATION TECHNOLOGY (ICT) AND  
VALUE CHAINS IN AGRIBUSINESS IN KIAMBU COUNTY, KENYA**

**By**

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**A RESEARCH PROJECT SUBMITTED IN PARTIAL FULFILLMENT OF THE  
REQUIREMENTS FOR THE AWARD OF THE DEGREE OF MASTER OF BUSINESS  
ADMINISTRATION, SCHOOL OF BUSINESS, UNIVERSITY OF NAIROBI**

**2017**

## **DECLARATION**

This research project is my original work and has not been presented for an award in any other university.

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## **ACKNOWLEDGEMENT**

First I sincerely thank the almighty God, secondly, my supervisor Dr XN Iraki and my Moderator Akelo E.O for their advice and constructive criticism, professional guidance and support as I wrote this research study. To my husband for his support and understanding even when I had to stay up late, I am truly grateful. To my parents and siblings for their unconditional support and encouragements they have been my source of strength through all my study. Lastly to all my friends who offered me endless support and encouragement.

## **DEDICATION**

I dedicate this research project to my husband Simon, who supported and stood by me throughout my research study and writing. To my parents, for their unconditional support throughout my studies.

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## **ABSTRACT**

Agriculture has always been seen traditional and detached from modern technology since most farmers continue to use traditional processes that depend heavily on traditional norms such use of tools like hoes that have not evolved for centuries. Now the barrier of entry into farming technology is dropping as cloud computing, connectivity, open-source software, mobile applications and other digital tools have become accessible and affordable. This study therefore sought to critically examine and establish the relationship between the adoption of ICT and agricultural productivity in Kiambu County and also how ICT in agribusiness has enhanced Value chains and agriculture in general. Also to establish factors that affects adoption of ICT by agribusiness and identifies the key innovations in agribusiness in the County. The study employed cross sectional survey design, targeting 30 ICT and Production managers from each of the 30 sampled agribusinesses. Primary data was collected using questionnaires, analyzed using frequencies, mean, standard deviation, percentages and regression analysis. The results were presented using figures and tables. The findings show a fair level of ICT adoption and usage in agribusinesses in Kiambu County and a positive relationship in agricultural productivity in most agribusinesses that have adopted ICT. Lastly the study established that the use of ICTs have greatly enhanced value chains and agriculture in the County and also the study have been able to identify some of the key ICT innovations that farmers are employing to enhance efficiency and effectiveness of their day to day activities. Further study should however be done on ICT adoption and value chain enhancement by narrowing down to a single category of agribusiness.

## **CHAPTER ONE:**

### **INTRODUCTION**

#### **1.1. The background of the Study**

Agriculture has been the primary driver of economic growth in Kenya, in 2016 the sector accounted for over 26 percent of Kenya's total GDP, 20 percent of employment, and 75 percent of the labor force and over 50 percent of revenue from exports (KNBS, Economic survey, 2017). However despite its importance, it has been predominantly small scale, poorly mechanized, inadequate institutional support and inadequate infrastructure for many years (Agricultural Sector Development Strategy (2010-2020)). The Kenyan government has therefore identified agriculture as one of the most important and crucial industries to deliver the 10 per cent annual economic growth rate conceived under the economic pillar in Vision 2030. And to achieve this growth, there is need to transform smallholder agriculture, from subsistence to an innovative, commercially oriented and therefore modern agricultural industry in critical (GoK, Vision2030, 2008).

Agricultural contribution to Gross Domestic Product (GDP) could be enhanced by improving agricultural operations which include sowing, harvesting storage among others and also by achieving value addition to agricultural products produced by the farmers such an agribusiness course of action paves the way for economic growth, improved technical skills and structural transformation. Furthermore agribusiness would contribute substantially to improved social outcome and poverty reduction (Gok, Vision2030, 2008).

Another approach to implementation of agriculture is use of technology, the modern farmer is becoming more independence on ICTs to not only manage farm operations but

to change the way farmers manage crops and livestock. ICT in agriculture is helping many farmers to buy and sell goods competitively and to change reception of the sector thus attracting more people especially the young innovative and ICT-savvy graduates.

### **1.1.1. Information and Communication Technology (ICT)**

Information and communication technology (ICT) it's term used to refer to communication devices and applications, it refers to technologies that provide information through telecommunications such as print media, radio, television, mobile phone, computer hardware, computer software and network systems as well as the applications associated with them such as video conferencing and distance learning. It encompasses both traditional and new technologies which have converged to give efficiencies in information processing and communication (Litondo, 2013).

Through different studies in various countries it has been demonstrated that investment in Information and Communication Technologies (ICTs) be it mobile technology, internet or fixed line broadband penetration, positively correlates with GDP- Gross Domestic Product (Fuss et al., 2005; Qiang and Rossotto, 2009). In Kenya, the government identified ICT as very important tool for economic growth and therefore it has put in place proper guidelines and regulatory frameworks in order to improve ICTs usage in all sectors of economy by ensuring broadband availability, and connectivity through the implementation of National ICT infrastructure and therefore ICT is an enabler of socio-economic development through enhanced efficiency in connectivity and also through reduced transaction cost and the value of ICT output increased by 11.11 per cent from KSh 280.0 million in 2015 to KSh311.1 million in 2016 (KNBS, Economic survey, 2017).

However there are key factors as identified by Turban et al. (2006) that motivate and also some that inhibit companies in developing countries like Kenya towards the adoption of ICTs. The table 1.0.1 below shows some of the factors identified to be the ones that mainly affect the adoption of ICTs within the perspective of most developing countries

**Table1.0.1 ICT adoption factors in Developing countries adapted from Aleke Bartholomew (2010)**

<b>ICT adoption Motivators</b>	<b>ICT adoption inhibitors</b>
<ul style="list-style-type: none"> <li>• Easier to identify competitors through online marketing</li> <li>• An opportunity to reach worldwide customers</li> <li>• Enhances closer ties with the business partners since the communication is easy and fast</li> <li>• Easier and faster communication among the company stakeholders and their customers</li> <li>• Inexpensive way of marketing and advertising</li> <li>• Inexpensive source of information</li> <li>• Easier to identify competitors through online marketing</li> </ul>	<ul style="list-style-type: none"> <li>• High Cost of ICT services</li> <li>• Inadequate IT support</li> <li>• Fear of Job replacement</li> <li>• Inadequate policy framework to guide ICT usage</li> <li>• Lack of customer loyalty due to reduced personal contact</li> <li>• Reduced/no personal contact thus representing dilution of customer loyalty</li> <li>• Insufficient and lack of properly skilled technical experts</li> </ul>

### **1.1.2. Agribusiness**

Davis and Goldberg (1957) suggest that, agribusiness is all operations involved in the processing and distribution of farm products these operations include storage, transport and sale of agricultural commodities and items made from them. According to Sonka and Hudson (1999) agribusiness makes inputs available to farmers and also connects farmers to consumers through storage, transportation, marketing and distribution of agro-industry products as technology has progressed and markets have become increasingly global, agribusinesses has developed to meet and solve high-tech farming needs and problems.

As farmers learn to compete and remain viable in a global market place, they draw upon business principles and a complex network of agriculture and business professionals this include taking advantage of new advances in farming such as bioengineering mechanization and new breeding practices and deciding how to sell crops whether locally or on a commodities exchange and managing and insuring land in the most profitable manner.

Agribusiness presents good opportunities for economic growth of a country, youth employment, and in addition it also contributes significantly to reduction of poverty. According to World Bank 2012, efficient agribusinesses may enhance strong linkages between them and small holders and thus stimulating agricultural growth and therefore reducing rural poverty.

### **1.1.3. Information and Communication Technologies, value chains and Agribusiness in Kenya**

Value chain is a set of linked activities that a firm or a company in doing business in a specific industry perform in order to create value for their customers (Porter, 1985), they consists of the products, finance and flow of information and knowledge needed to organize producers and communities. Agricultural value chains include farm input supply, development and dissemination of plant and animal generic material, farmer organization, post- harvest handling, processing, provision of technologies of production and handling, grading criteria and facilities, cooling and packing technologies, post-harvest local processing, industrial processing, storage, transport, finance and feedback from markets (Sweeney, 2009).

Value chain approach in agriculture helps most agribusinesses to understand if there are any weak points in their value chain and what they can do to add more value for example in most African countries sorghum has multiple end uses, these uses include snacks, porridge, raw input for production of beer, animal feeds and other products for both human and animal consumption.

As most agricultural yields pass through different stages in the value chain their value increases. Most successful agribusinesses rely on gaining understanding on how to manage complex value chains within the competitive global markets. And therefore most of this agribusiness companies need more skills and training to ensure that the value of their products is of the highest standard and also to ensure that the company will be able to with stand any challenge it may face and also build the capacity to adapt to change in its environment.

Agriculture has always been seen traditional and detached from modern technology since most farmers continue to use traditional processes that depend heavily on traditional norms such use of tools like hoes that have not evolved for centuries. But now most farmers and agribusinesses are interested on how they can improve yields. Now the barrier of entry into farming technology is dropping as cloud computing, connectivity, open-source software, mobile applications and other digital tools have become accessible and affordable. In Kenya a number of farmers especially the youth have infused ICTs into agribusiness by use of various mobile applications and other information systems available linking all the stakeholders and therefore increasing the outreach of their products to consumers. The use of ICTs enable them make objective decisions on profitable enterprises, their niche markets, modern technology and model success stories (Irungu et al., 2015).

The use of ICTs in agribusiness industry in Kenya has played a very important role with different types of ICTs having different advantages and disadvantages when applied. The use of ICTs improves the performance and profitability of agricultural activities, provides access to information and services essential for farmers and their organizations to link to integrated value chains and it also allows mitigation of inherent risks. Farmers of different sectors can now employ ICT applications and tools to manage their farming activities, from crop selection to the monitoring of production (World Bank, 2011).ICTs help in the efficient use of key farm inputs therefore help in reducing wastage of resources such as water, land and other farm inputs thus helping in increasing farm productivity (Deloitte, 2012).



The growth of agribusiness sector in Kenya also ensures significant growth to the rest of the country's economy by ensuring that the required raw materials are available, and also by providing a greater demand for processing and service industry. Agricultural productivity in Kenya helps to tackle poverty by: increasing productivity and the incomes of farmers in rural areas, reducing food prices and creating spillover effects for the rest of the economy (Agricultural Sector Development Strategy (2010-2020)). The Strengthening of the agribusiness sector in Kenya help in creating employment to surplus youth labor force and entrepreneurial opportunities. However due to lack of inputs such as seeds, chemicals, inadequate technology and poor storage for produce the agribusinesses are faced with so many issues which include low agricultural productivity.

Kenya has become more gradually visible as an ICT hub in East Africa by being the pacemaker in innovative ICT technology. It is one of the top African countries that has fastest mobile money innovations and applications and also the fastest telecommunication infrastructure for example the Mpesa mobile transfer service provided by Safaricom which has put Kenya on the world map, the growth of Mpesa has enhanced change in most financial institutions in Kenya. A number of ICT-savvy youth in Kenya have therefore come up with various software applications and mobile based applications such as Mfarm, Kuza Doctor, icow among others to assist farmers to increase their agricultural yields and also their skills. Microsoft Office for word processing and spreadsheets for farming and trading record keeping are the most frequently used tools. Mobile phones for short messages (SMS) and voice messages are also commonly used for accessing timely market information on prices reaching customers, sharing accurate information about financial transactions and production.

#### **1.1.4. Kiambu County**

Kiambu County is located in the central part of Kenya; it occupies 2,543 square kilometers with the total population stands at 1,623,282. The economic activities in Kiambu County include manufacturing, farming, food processing as well as general trade. In this county agriculture is the predominant economic activity and majority of its residents depend on the subsector for their livelihood, as the sector is estimated to be employing over 1.3 million people directly or indirectly and it generates hundreds of billion shillings in export every year.

The agriculture sector in this county includes floriculture, horticulture, poultry farming, pig farming, dairy and fish farming. It is not a must for one to own land in this County in order to run agribusiness since there are large tracks of lands that are available for leasing for a period of time and they always give good returns. Over the last one year the county government embarked on an ambitious training project that sort to train over 2,000 farmers on conservation agriculture that includes minimum soil disturbance and tillage, permanent crop cover and use of clean certified seeds. The farmers in this region have also embraced new technology as it helps them produce more on small pieces of land.

#### **1.2. Research Problem**

The ability of ICT to improve human lives in developing countries and especially those of famers is yet to be realized. It is evident that although the use of ICTs in agribusiness in Kenya is growing, the farmers' motivation for using these ICTs platforms provided and effectiveness of using information sharing tools to increase their productivity and enhance their value chain, have not been studied widely and extensively. For a long time Kenyan Agricultural incomes are seasonally related to rainfall and harvest cycles,

insufficient innovations have led to dependency on traditional and arduous labor based production techniques. Mishra and Park (2005) suggest that the use of ICTs in agribusiness represents innovative change. Sh.Al-Rimari et al. (2006) further noted that it also represents significant challenges to farmers and other stakeholders of agribusiness companies. The technology requires intensive investment in ICT tools and software, tailoring to match the niche markets and clients' needs, extensive training of users before final commissioning

The availability of ICT tools is not widespread and technology is not packaged simply and is not easily accessed. ICT tools need to be simple and affordable (Irungu et a., 2015). He further noted that ICT tools need to be simple and affordable. Content should be relevant, valuable, treasured and dependable. Bunte (2009) also identifies that there is demand for new ICT applications in agribusinesses. This study will investigate the status of ICT in agribusiness and how farmers use different ICT innovations to make their work easier and whether these innovations help them increase their yields.

Due to underutilization of ICTs the flow of information on production and marketing of agricultural produce has been hampered and therefore it is important and essential to digitize all agricultural processes and marketing into web based resources to improve information flow and to connect people within the rural areas (Njenga et al.,2012; international institute for communication and Development 2013).This study therefore sought to explorer more on how ICT can enhance agricultural productivity, smoothen supply chain and increase the contribution of agriculture to the GDP

### **1.3. Research Objectives**

The general objective of this study was to:

- (i) Establish the relationship between the adoption of ICTs and agricultural productivity in Kenya.
- (ii) Establish how ICT in agribusiness has enhanced value chains and agriculture in general
- (iii) Establish the factors that affect adoption of ICTs by agribusinesses in Kiambu County
- (iv) Identify the key ICT innovations in agribusiness in Kiambu County.

### **1.4. Value of the study**

ICTs have the capacity to help even the small scale farmers to prevent and avoid any losses after making investments by identifying and controlling diseases and pests, improving resource use and receiving timely weather information. ICTs also helps in making more accurate projections and make better plans for the future (World Bank 2011).The research established the relationship between the adoption of ICTs and agricultural productivity. It will help in answering questions such as how can farmers use ICTs to increase agricultural productivity? And thus enabling all the players in Agribusiness industry gain understanding on the importance of incorporating ICTs in their daily activities for them to gain a wider outreach of information and to position them competitively globally.

Since agriculture is the most prominent, important and dominant industry. This study will therefore be useful to the government since it will be interested to know what is hindering farmers to adopt ICTs for purposes of policy formulation and therefore the policy makers informed by the outcome of this study will be able to make more informed decisions on how to improve the ICT infrastructures in the agribusiness industry.

This research also established the current levels of ICT adoption and key innovation in agribusiness in Kenya. It is therefore important to Key decision makers in this industry in identifying possible areas they need to invest more resources in ICTs in order for them to remain profitable and relevant in the market. Lastly, this study will contribute to ongoing research in the use of ICTs in agribusiness

## **CHAPTER TWO**

### **LITERATURE REVIEW**

#### **2.0. Introduction**

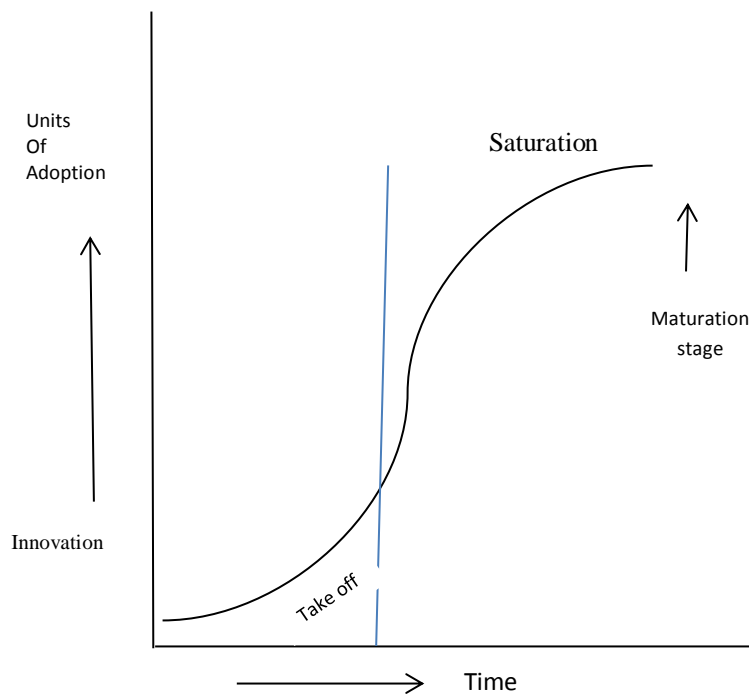
The following main research areas are reviewed in this chapter. Firstly it focused on diffusion of innovation, ICTs adoption and agricultural services and also on various agribusiness innovations. Secondly, it highlighted on opportunities and factors that affects adoption of ICTs in agribusiness in a developing Economy. And lastly, it presented a comprehensive review of various models used by previous researchers in facilitating the information content concerned with farmers in retrieving the information needed in their decision making process

#### **2.1. Theoretical Framework**

##### **2.1.1. Diffusion of innovation and ICTs adoption**

For more awareness and understanding of technology adoption, many researchers use Rogers' diffusion of innovation theory. In this theory Rogers (2003) views diffusion of innovation as a social process where new ideas are communicated through certain channels to a particular group through time, and as a result the innovation is adopted or rejected by individuals or organizations. The most noticeable feature of diffusion theory is that for most members of a population, the innovation decision depends heavily on the innovation decision of the other members of the system. Despite its limitations the theory is more robust in explaining the adoption/rejection of ICT than any other.

Figure 2-1 below is a classic diffusion of innovation pathway based on Rogers (2003) diffusion of innovation model. As depicted in the figure initially the takeoff rate of technology innovation is not prompt therefore it is slow as very few of potential adopters have any knowledge of its existence and the benefit of such innovation. As more firms, organizations and individuals begin to use the innovation and in the process become more successful in achieving their business goal, the adoption rate accelerates and it finally peaks and a greater number of potential adopters have implemented the technology thus reaching saturation stage. At this stage there is need for a renewed focus on the sustainability of the innovation to enable continuous diffusion of innovation.



**Figure 0-1: ICT innovation Diffusion Pathway adapted from Rogers (2003)**

### **2.1.2. Technology acceptance Model (TAM) and Unified Theory of Acceptance and Use of Technology (UTAUT)**

Technology Acceptance Model such as Unified Theory of Acceptance Use of Technology (UTAUT) attempt to justify the degree of acceptance of the use of Information and Communication Technology (ICT), they usually evaluate whether the users will accept new technologies and his/her ability to deal with it. This model helps management to evaluate the accomplishment of technology introduction to the organization and so they motivate the users to accept the systems. Unified Theory of Acceptance and use of Technology was formulated by Venkatesh et al (2003), it provides a view of how the determinants of intention and behavior evolve over time.

The theory assumes that there are four main constructs i.e., Performance Expectancy, Social Influence, Facilitating Conditions and Effort Expectancy. These concepts are independent variables which influence dependent variables, behavioral and usage. Gender, age, experience, and volunteers of system use have indirectly influenced the dependent variables via the four main concepts. Behavioral intention is seen as a critical predictor of technology use (Venkatesh et al., 2003).

### **2.1.3. Theory of change and Value chain analysis**

The theory of change represents an understanding of how improvement in access to finance, markets for various products and infrastructure can unlock a virtuous cycle of productivity, improved resilience and reduced risk that in turn leads to positive impact on companies, communities and ecosystem. With many stakeholders working at different levels of the agricultural value chain, this theory helps to create a shared vision for how these efforts combine to promote smallholders' prosperity and environmental



stewardship, and recognizes that trust and shared value among value chain actors is paramount to ecosystem development.

In 1985, Professor Michael porter introduced the concept of value chain analysis and its relevance has not diminished during its over 30 years of existence. Value chain analysis is a strategic and decision support tool that shows and highlights where companies can create value for their customers. The framework can also be used to identify sources of competitive advantage for firms.

## **2.2. Innovation in Agribusiness**

The future of agribusiness requires great focus on sustainability and digital transformation, the industry faces various challenges as well as new and exciting opportunities. New ICT technologies that connect the players in the industry bring opportunities for growth and innovation. There has been significant rise in budgets spent on agricultural technology over the years and more are expected in the future. For example in Mozambique, Innovation for Agribusiness ( InovAgro I, II ) program facilitates the multiplication of new varieties of soya bean seeds, therefore enhancing the access to certified seeds and other inputs to farmers, it has also enhanced the linkages between the private seed companies and Government Seed Multiplication Agency (World bank, 2015).

In Kenya there are several applications and ICT enabled tools and services that the ICT innovators have come up with and are used in agriculture sector for data collection purposes. The table below provides a summary of some of the ICT applications and tools.

**Table 0.1 New ICT-based tools and services commonly used in agriculture sector in Kenya**

<b>Applications`</b>	<b>Description</b>
M-Farm	Owned by M-farm Ltd a software solution and Agribusiness Company which provides up-to-date market prices to farmers and links them to buyers through their marketplace and current agro-trends (Macharia, 2013). This mobile application gives the farmers the opportunity to sell their yields collectively and also to buy farm inputs by use of mobile phones or their website. The software also provides market prices to the farmers
iCow	This is an agricultural web platform that provides important information to livestock farmers on their products through mobile phones. It helps the small scale dairy farmers to manage their dairy cows inorder to have greater profits
KUZA Doctor	It’s a mobile based application that help farmers receive critical information on how to increase their production and their incomes through their “KUZA DoctorsSM” a mobile based SMS tool.
Kilimo Salama	Its run by Syngenta and it offers farmers crop insurance against extensive rains or drought. Helps to collect significant information about serious weather changes that may reduce yields and it sends the reports through SMs to the farmers.
M-kilimo	This is a mobile based service that build a virtual information system that link all stakeholders in the agricultural sector and connects them to significant agricultural information and also empowers them on good agricultural practices
M-pesa	It is a mobile phone money transfer system that helps farmers make and receive payments for the farm inputs and their crops from their customers also linking farmers to other financial institutions therefore making it easier for farmers to get access to loans
Fishward.com	A free tool for fish farming that helps the farmers to monitor their fish production and profitability. This tool guides fish farmers through the whole production cycle from stocking the ponds, feeding, grow-out, harvesting, post-harvesting and marketing
iprocare	An application that provides virtue warehouse services to agro input. It provides farmers with procurement and distribution services, thus helps them to improve their supply chain services.

The use of ICTs enable agribusiness stakeholders make objective decisions on profitable enterprises, their niche markets, modern technology and model success stories and thus brings about social and economic development by creating and enabling environment.

### **2.3. The value and impact of ICTs on agricultural productivity within value chain**

The use of ICTs in agribusiness industry has played a very important role with different types of ICTs having different advantages and disadvantages when applied. The use of ICTs improves the performance and profitability of agricultural activities, provides access to information and services essential for farmers and their organizations to link to integrated value chains and it also allows mitigation of inherent risks. Farmers of different sectors can now employ ICT applications and tools to manage their farming activities, from crop selection to the monitoring of production (World Bank, 2011).ICTs help in the efficient use of key farm inputs therefore help in reducing wastage of resources such as water, land and other farm inputs thus helping in increasing farm productivity (Deloitte, 2012).

ICTs affect productivity of any firm that use them for example according to Bresnahan and Trajtenberg (1995), ICTs can be applied to several production processes thus allowing continuous improvements and experimentation and thus facilitating innovation in the sector. The productivity-enhancing effects of ICT are not usually direct but are usually mediated by development of other technologies that are specific to the ICT-user sector.The adoption of ICTs in agricultural industry is of great significance to the whole world and more so to the developing countries. For example the use of ICT has greatly improved the efficiency of livestock rearing and meat production in some African

countries, significantly increasing production because of more affordable costs e.g. the Namibian Livestock Identification and Traceability System (NamLITS). The Namibians observed that this traceability system employed by large scale farming industries and its downstream role players unlocked wealth along the entire value chain (World Bank, 2012)

In Egypt the intensified utilization of ICT has increased their irrigation efficiency. This country rely on the Nile River almost exclusively for its water supply and for irrigation and thereof the use of ICT In managing irrigation. Their Ministry of Water resources and irrigation use an Integrated Water Resource Management action plan. The purpose of this plan is to improve irrigation and the drainage systems, this plan targets to improve irrigation and drainage systems and also the water management institutional structure. Thus observing that the existing ICT systems employed by farmers have really helped in reducing water wastage and has aided in generation of larger profits to farmers (Kora and Kassem, 2010).

However if most farmers didn't face the following issues in the value chain they could expand their gains immensely from their potential markets if the solutions were found. These issues include poor quality seeds, insufficient training and finance for improved post-harvest management, poor quality of product at harvest, heavy taxation by the county governments, insufficient skills to improve efficiency in production, poor financing for expansion of startups and lack of access to land etc. This surely restricts the capacity for farmers to add value to their existing products through improved quality or diversify and into more new markets for higher-value products.

#### **2.4. Opportunities and factors affecting adoption of ICTs in Agribusiness**

Mishra and Park (2005) observed that the use of information, communication and technologies ICTs in agribusiness represents an innovative change. This is mainly encountered by agribusiness businesses operating in developing economies where computer tools and applications are still moderately felt, (Ellis et al ,2007). ICT application in agriculture could increase farmers' participation in market and would help to achieve the food security issues Asset poverty which encompassed lack of human, financial capital and poor infrastructure was prevalent factors in small holder production system, Okello et al (2010).

Maumbe and Okello (2010) compared the application of ICT in agriculture and rural development of South Africa and Kenya. They concluded that vast accomplishment in application and adoption of ICT in agriculture can be achieved by addressing obstructions to adoption and diffusion. Such hinderances in the use of ICTs included lack of ICT awareness, ICT infrastructure deficiencies, Illiteracy, cultural and language barriers.

Lwoga et al (2011) investigated the application of ICTs in the improvement of farming activities in rural areas of Tanzania. The researcher's relevant issues were information and knowledge needs, their access and use. He found out that, the major sources of agricultural information were local medium i.e. neighbors, families and friends, followed by public extension services. Although at a lower rate advanced technologies and printed materials were also used in spite of their existence

Aleke et al (2011) critically evaluated the impact of socio augmented parameters i.e. lifestyle, age and gender, on the effective adoption of ICT by small scale agribusiness operations in south east Nigeria. The major issues with agriculture in Nigeria were low

productivity which was caused by factors such as social factors, low ICT adoption, inefficiencies in supply chain etc. the study discussed adoption of ICT that imparted the shortening of supply chain, the models were discussed by the researchers include DOI (diffusion of innovation), SNT (social network theory and TAM( technology acceptance model. This study found out that ICT adoption process was greatly influenced by social imperatives.

Bunte (2009) discussed on the impact of new ICT applications on the food economy in Netherlands. The study is detailed on the importance of the ICT revolution for the food economy. The researcher related the development of new technologies to innovation and adoption processes and economic growth and to concepts of open innovations and living labs. The researcher found out there are challenges such as companies collect a lot of data most of which are not used and also the companies are not ready to process all data available and thus the researcher concluded that managers, employees and models they work with are not fully prepared for the knowledge economy as yet.

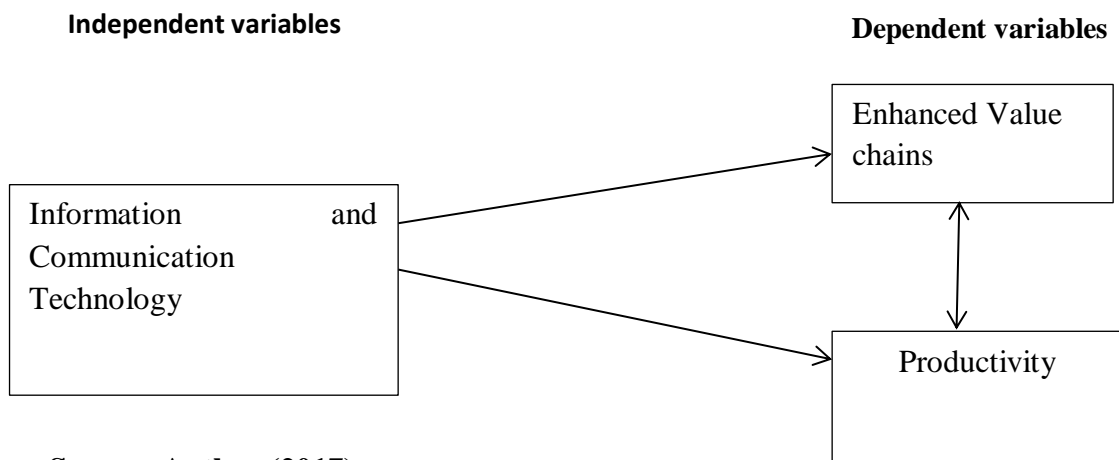
## **2.5. Knowledge Gap**

The literature review provided insights of other researches and scholars on innovation diffusion and opportunities and factors affecting ICTs adoption in agribusiness. In conclusion various researches seem to point to different directions with regard to innovation diffusion and ICT adoption in agribusiness. They do not clearly indicate if there is any relationship between the adoption of ICT and agricultural productivity, which is very important for the players in the agribusiness industry in order for them to acknowledge that they cannot effectively forge ahead with their economic agenda without putting in place an appropriate ICT framework. Also they do not show clearly

how ICT in agribusiness has enhanced value chains and agriculture in general and so this research will inform on how ICT in agribusiness has enhanced value chains and agriculture in general and thus very important to farmers since they need to be more informed on market prices to negotiate better.

Lymer (1997) stresses that the organizations that implement ICT have the potential to increase productivity level and reduce costs. The commonly used measures of productivity are labor productivity which is usually measured in terms of gross output or the value added and total factor productivity. The conceptual model below consists of one main concept information and Communication Technology (ICT) which is the independent variable that influence the dependent variables. Capital, labor and type of information have indirectly influenced the dependent variable productivity via the main concept. It is therefore expected that the market information accessed by agribusinesses through ICTs will impact their incomes, quantities of products marketed, prices and adoption of new crops and new technologies among others.

**Figure 0-2: Conceptual Model:**



**Source: Author (2017).**

## **CHAPTER THREE**

### **RESEARCH METHODOLOGY**

#### **3.1. Research design**

The researcher used a cross sectional survey design in this study, this particular research design takes a snapshot of a specified population at a certain time, allowing conclusions about phenomena across a wide population to be drawn (Bryman & Bell, 2001). This allowed the researcher to focus on the population groups therefore understanding the wider picture.

#### **3.2. Target population**

The researcher carried on the study on the following agricultural sectors of i.e. poultry, dairy industry, floriculture, plantations and horticulture (fruits and vegetables) companies. An estimated population of 30 agribusinesses in Kiambu county was identified for research as follows, as of march 2017 the Kenya Flower Council (KFC) listed 102 as registered flower farms in Kenya 10 of those farms are located in Kiambu County, according to fresh produce exporters association of Kenya (FPEAK) there are around 5 horticultural companies, According Kenya dairy board there are 5 dairy companies located in this county and also from Kenya poultry farmers association (KEPOFA) 5 large scale poultry companies/farms were also be identified by the researcher. The targeted respondents were ICT managers or the Production Managers of the sampled companies.



### 3.3. Sampling Design

The sampling frame was categorized into groups that formed the basis of stratified sampling. The strata consisted of horticulture companies, dairy industry, floriculture, poultry and plantations. To get out sample size a simplified formula for proportions (Yamane, 1967) was employed:

$$n = N/(1 + N(e)^2)$$

Where  $N$ =population and  $e$  = desired precision level (5%)

$$n = 30/(1 + 30(0.05)^2) = 27.9$$

The target of the sample was therefore be 28 of the population. The sampling fraction was  $27/30 = 0.93$  (93%). The elevation factor is  $30/28 = 1.071$  (Each unit represents 1.1 other units). The sample size in each stratum was calculated using the formula:

$$n = n * Ni/N$$

Where  $n$  = total sample size,

$Ni$  = population in strata

$N$  = total population

#### Sample size

Strata	Population	sample
Dairy industries	5	$28*5/30=5$
Horticulture (fruits and vegetables)	5	$28*5/30=5$
Poultry large scale companies	5	$28*5/30=5$
Plantations (coffee and Tea)	5	$28*5/30=5$
floriculture	10	$28*10/30=9$
<b>Total</b>		29

The samples were grouped this way because of the different approach to project implementation or execution. Stratified random sampling also strengthens the external validity of the sample.

### **3.4. Data collection**

For this research, the researcher collected data with the help of a questionnaire. The questionnaire comprised of close ended questions items, close-ended questions provide a choice for alternative answers from the respondent are asked to choose by ticking. The questionnaire will have four sections A-E with Section A focusing on the general information of the company/farm, Section B focusing on the Extent of ICT Adoption in the different agricultural farms in Kenya and how ICT adoption has affected their productivity, Section C focusing on how ICT has enhanced value chains and agriculture in general and Section D focusing on factors that limit adoption of ICTs by agribusinesses in Kiambu County section E focusing on key ICT innovation. In each of the sampled companies, a questionnaire was administered to the ICT managers using “drop and pick later” approach.

### **3.5. Data analysis**

Once received, the completed questionnaires were checked for completeness and data cleansing was carried out. Data analysis was then done in line with the different sections using statistical package for social sciences (SPSS). This analysis was based on quantitative approach using descriptive statistics. Univariate analysis was used to help in examining variables one by one. The variables characteristics of distribution, central tendency and dispersion will be determined. To evaluate the relationship between the adoption of ICTs and agricultural productivity simple linear regression will be used.

<b>Research objective</b>	<b>Data measure</b>	<b>Analysis method</b>
The relationship between the adoption of ICTs and agricultural productivity	Likert scale	Regression/Correlation (Variable- impact type)
How ICT in agribusiness has enhanced value chains	Likert scale	Regression/Correlation (Variable - ICT type)
factors that affect adoption of ICTs by agribusinesses in Kiambu County	Likert scale	Regression/Correlation
Key ICT innovations in agribusiness	Nominal scale	univariate

## CHAPTER FOUR

### DATA ANALYSIS

#### 4.1. Introduction

This chapter presents the findings and the data analysis from the data collected using questionnaires administered to the respondents. Out of thirty (30) questionnaires distributed to target respondents, 28 responded and returned fully completed questionnaires, thus contributing to a response rate of 93.33%. According to Mugenda and Mugenda (1999) a response of more than 70% and over is excellent and so this response rate was sufficient and representative.

#### 4.2. General Information

This section of the questionnaire focused on the general information of the respondents and the agribusinesses. The table 4.2 below gives a breakdown of sector represented in this study; the sectors included the plantation (Tea and coffee), horticulture, Dairy industry, poultry industry and floriculture.

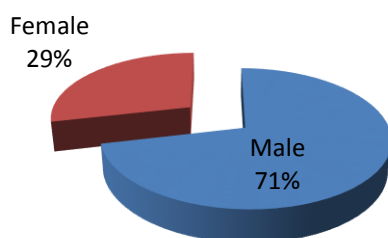
Type of Business	Frequency	Percent	Cumulative Percent
Plantation(Tea/Coffee)	5	17.9	17.9
Horticulture	5	17.9	35.7
Dairy Industry	5	17.9	53.6
Poultry	5	17.9	71.4
Floriculture	8	28.6	100.0
Total	28	100.0	

**Table 4.2: The type of business**

### 4.2.1. Gender

The study sought to establish the distribution of respondent's gender. The figure 4.2.1 below gives a summary of gender representation

**Figure 4.2.1: Respondent's Gender**

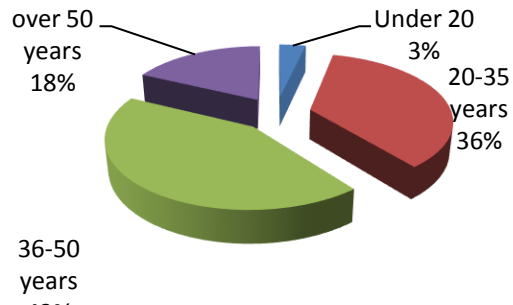


**Source: Fieldwork (2017)**

From the findings as illustrated in the figure 4.2.1 above the majority of respondents at 71.4% were males while females were 28.6%. SOFA 3 Team and Cheryl Doss(2011) observed that across all regions, countries there is a significant heterogeneity in the role of women and their participation in agriculture and other economic activities. The degree of gender inequality differs by assets and location, the underlying causes include social norms, household duties that create time constraints and asset complementarities for example having access to land, which helps with access to credit. These gender inequalities affect the productivity of women negatively. To motivate women, their rights should be protected so that they fully enjoy all rights that are also being enjoyed by men counterparts (AU, 2003)

#### 4.2.2. Age

Figure 4.2.2: Respondent's Age



Source: Fieldwork (2017)

From the findings as illustrated above most respondents at 42.9% were aged between 36-50 years. This indicates that majority of the respondents are within the economic active age group, have good work experience and more knowledge of agriculture and agribusinesses. It is also due to the fact that most young people in Kiambu County and Kenya as a whole are embracing agriculture and are gradually leaving the safe world of suits behind for the unpredictable one of farm fields and factories. This new generation of farmers has made farming more appealing since they want to innovate and practice smart farming.

### 4.2.3. Work experience

The study also sought to establish how long the respondents had worked in that specific farm

Years Worked	Frequency	Percent	Cumulative Percent
0-10years	16	57.1	57.1
11-20 years	10	35.7	92.9
over 20 years	2	7.1	100.0
Total	28	100.0	

**Table 4.2.3 Respondent's work experience**

From the table 4.2.3 above most of the respondents at 57% have worked for 0-10 this can be explained either by the fact that most of the respondents had previously worked in other companies which mostly weren't agribusinesses or the fact that most young people are more attracted to farming as a way of making a living rather than getting white collar jobs after college graduation.

### 4.2.4. Age of the Company/Farm

Age of the company/farm	Frequency	Percent	Cumulative Percent
1-20 years	10	35.7	35.7
21-40 years	8	28.6	64.3
over 40 years	10	35.7	100.0
Total	28	100.0	

**Table 4.2.4: Age of the Company/Farm**

With the respect to the duration which most agribusinesses have been in existence, the study established that most at 36% have been in existence for a period of between 1-20 years and over 40 years. This implies that the majority of agribusiness has been in existent between the age of 1-20 years and over 40 year. The majority of the companies

that have been in existence between 1-20 years can be explained by the fact that many young people have recently started agribusiness as illustrated in the table 4.2.2. as most respondents at 42.9% were aged between 36-50 years. However the other 35.7% of companies aged 40 years and above can be explained by the fact that most tea/coffee plantations in Kiambu County have been in existence since 1950's before independence.

#### **4.2.5. Budget allocated to ICT**

The study also sought to establish the percentage of the entire budget allocated to ICT as this could be an indicator of the management's commitment towards ICT adoption

<b>ICT Budget</b>	<b>Frequency</b>	<b>Percent</b>	<b>Cumulative Percent</b>
0-2%	17	60.7	60.7
3-5%	4	14.3	75.0
6-8%	2	7.1	82.1
over 10%	3	10.7	92.9
no idea	2	7.1	100.0
Total	28	100.0	

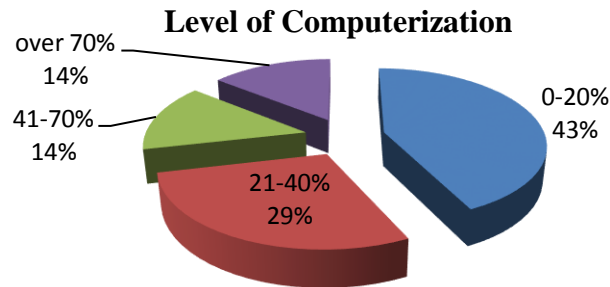
**Table 4.2.5: ICT budget allocation**

From the study findings as illustrated above most (61%) of the respondents indicated that the entire companys/farm's budget allocated to ICT was between 0-2%. This is low although ICT spending depends mostly on company's size. This can be explained by the fact that most of this agribusinesses especially horticulture and poultry are small and have not concentrated much on developing their ICT infrastructure.



#### 4.2.6. Level of computerization in the Companies/Farms

Figure 4.2.6: Level of Computerization in the Companies



Source: Fieldwork (2017)

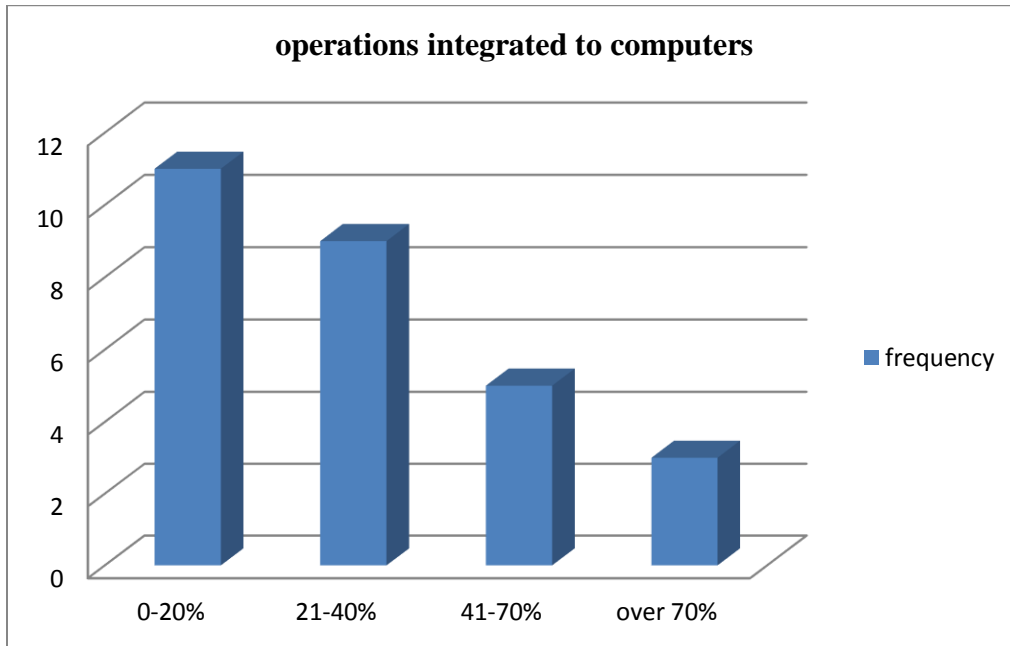
A new trend in the agribusiness is to replace the conventional farming devices with computerized farming devices however, as illustrated in the findings above in table 4.2.6 majority (43%) of the respondents indicated that the level of computerization in their farms was between 0-20 percent. This indicates or implies that the majority of the agribusinesses in Kiambu County have low levels of computerization. Most agribusiness are yet to adopt the new farming technologies such as computerized irrigation and fertigation

#### 4.2.7. Operations integrated through computerization

Operations integrated through computerization	Frequency	Percent	Cumulative Percent
0-20%	11	39.3	39.3
21-40%	9	32.1	71.4
41-70%	5	17.9	89.3
over 70%	3	10.7	100.0
Total	28	100.0	

Table 4.2.7: Operations Integrated to Computerization

**Figure 4.2.7: Operations integrated to Computerization**



From the findings presented in the above table 4.2.7 majority of respondents 39% indicated that the percentage of operations in the farms that were interrelated through computerization were between 0-20%, 32% indicated that it was between 21-40% , 18% indicated that it was between 41-70% and 11% indicated that it was over 70%. These results can be explained by the fact agribusinesses are still practicing old methods of agriculture and have not yet embraced technology fully in their day to day activities

### 4.3. How ICT in agribusiness has enhanced value chains

The study also sought to establish how the use of ICT in agribusiness have enhanced value chains

**Table 4.4.1.: The extent to which ICTs have enhanced value chains**

Types of ICTs	Mean	Std. Deviation
a. Internet for marketing	3.50	1.347
b. Sms services	3.46	1.374
c. Mobile applications (apps) services	3.71	1.117
d. Internet for information awareness	3.93	.900
e. GIS/ GPS technologies for mapping and remote sensing	2.68	1.634
f. Information dissemination through leaflets, newspapers, brochures or pamphlets	3.11	1.571
g. Telephone communication	4.29	.854
h. Radio broadcasting	2.00	1.440
i. Television broadcasting	1.96	1.290

From the table 4.4.1 above majority of respondents agreed to a very great extent that ‘Telephone communication’ play a very great deal in enhancing their value chain with a mean score of 4.29. This can be explained by the low cost of mobile phone devices and calling rates and also good network provided by the service providers around the County. Internet for information awareness is also commonly used by agribusinesses to enhance their value chain since it is easier for them get more information on market prices, newly informed farming practices and technologies etc. this in return help in increasing their efficiency and effectiveness.

Internet for marketing and Mobile applications (apps) services is also popular since most farmers are using applications such as Facebook, whatsapp, as Mfarm, Kuza Doctor, icow among others to advertise their produce, improve social interaction between farmers and they also provide improved market access for produce since this applications also provide a cheap platform of connecting with potential buyers thus reducing delivery time and waste.

#### 4.4. Factors that affect adoption of ICTs by agribusinesses in Kiambu County

The extent to which the farms have faced the following issues in ICT adoption in their farms

	Mean	Std. Deviation
a. Fear of loss of data/information confidentiality	1.93	1.120
b. Fear of loss of data/information control	2.14	1.325
c. Lack of a clear ICT strategy	2.21	1.258
d. Insufficient internet connectivity and bandwidth	2.25	1.404
e. Lack of security and proper Service Agreement Levels (SLAs)	2.07	1.359
f. Cost of ICT tools deployment	2.00	1.247
g. Technical capability of the staff members	2.11	1.343
h. Inability to quantify ICT benefits	1.93	1.274
i. fear of overdependence on ICT	2.39	1.166
j. Fear of dealing with viruses, trojans, malware, phishing etc	1.93	1.331
k. Unpopularity among workers over loss of jobs	1.44	.847

**Table 4.4: Factors that affect adoption of ICTs by agribusinesses in Kiambu County**

From the findings as illustrated in the table 4.5.1 above majority of the respondents agreed to a great extent that the biggest obstacle in ICT adoption in their agribusinesses is ‘fear of overdependence on ICT, insufficient internet connectivity and bandwidth, lack of clear ICT strategy, Fear of loss of data/information control and technical capability of the staff members’ as shown by the mean scores of 2.39, 2.25, 2.21, 2.14 and 2.11 respectively.

From the findings this obstacles did not highly hinder the use of ICT by the surveyed agribusinesses. Fear of overdependence on ICT and lack of a clear ICT strategy is highly expected when new technologies are introduced. Insufficient internet connectivity and bandwidth is due to lack or poor investment in ICT infrastructures. These findings can only be explained by the fact that most people are ignorant about the importance of and need of ICTs, poor infrastructural support system in rural areas which include inefficient electricity, data cables and telephone systems.

#### 4.5. Key ICT Innovations used by agribusinesses in Kiambu County

Key Innovations in Agribusiness		Frequency	Percent
• ICT controlled irrigation systems	yes	10	34.5
• Computerized storage and refrigeration systems	Yes	12	41.4
• Remote monitoring of soil moisture (sensor technology)	Yes	4	13.8
• Computerized packing systems	Yes	4	13.8
• Use of robots and drones to monitor crops	Yes	3	10.3
• Fertigation systems	Yes	1	3.4
• Computerized planting systems e.g. teff planting machine	Yes	2	6.9
• Computerized weighing systems	Yes	2	6.9
• Computerized hatching and brooding machines	Yes	2	6.9
• Computerized capons processing (slaughter facility)	yes	1	3.4
• Computerized milking machines	Yes	1	3.4
• Computerized artificial insemination (AI) services	yes	1	3.4
• Video monitoring of animals or plants	yes	11	37.9
• wireless tracking systems to monitor livestock activity	yes	6	20.7

**Table 4.5 Key ICT innovations used by agribusinesses in Kiambu County**

New ICT technologies that connect the players in the industry bring opportunities for growth and innovation. Although at a low rate most of the floricultural, tea/coffee plantations and horticultural agribusinesses in the County commonly use the following innovations

- ICT controlled irrigation systems
- Computerized storage and refrigeration systems

- Remote monitoring of soil moisture (sensor technology)
- Computerized planting systems e.g. teff planting machine
- Use of robots and drones to monitor crops
- Fertigation systems
- Computerized packing systems
- Computerized weighing systems
- Video monitoring

The poultry farms in the County are also slowly adopting the following innovations

- Computerized hatching and brooding machines
- Computerized capons processing (slaughter facility)

The dairy farms in the County have also adopted the following innovations

- Computerized milking machines
- Computerized storage and refrigeration systems
- Computerized artificial insemination (AI) services
- Low cost wireless tracking systems to monitor livestock activity
- Video monitoring of animals/livestock

#### **4.6. The Relationship between the Adoption of ICTs and Agricultural Productivity**

This section of the questionnaire sought to address the first objective of the study focusing on different ICTs applications adopted in different agribusinesses and their level of usage by the agribusinesses and how this affect or relate to Agricultural productivity

#### 4.6.1. ICT Type and the level of usage in the companies/farms

	Mean(usage 1-Low, Std. 2-fair, 3-Good, 4- High)	Std. Deviation
a. Internet and emails	3.07	1.215
b. Office procurement and accounting automation systems such as sage pastel, dynamics Navision	2.79	1.197
c. Computerized planting systems e.g teff planting machine	1.64	1.062
d. Computer storage and servers	2.50	1.262
e. Automated packing systems	1.75	1.206
f. Computerized irrigation and fertilization systems	1.79	1.228
g. Computerized storage and refrigeration systems	2.14	1.297
h. Field operations applications e.g. scarab for pest and disease monitoring	1.86	1.239

**Table 4.6.1: ICT Type and Level of usage in the Companies**

ICTs help in the efficient use of key farm inputs therefore help in reducing wastage of resources such as water, land and other farm inputs thus helping in increasing farm productivity (Deloitte, 2012). From the data on the table 4.3.1 above it is clear that in Internet and Emails and Office procurement and accounting automation systems such as sage pastel, dynamics Navision and Computer storage and servers were the widely adopted and applied ICT applications in the majority of farms this can be explained by the fact that most farms have computerized record keeping and most communicate using emails which can also be easily accessed by use of mobile phones.



Most farms though, have not yet embraced computerized farming machines such as Computerized planting systems e.g teff planting machine, Computerized irrigation and fertilization systems and Field operations applications e.g. scarab for pest and disease monitoring. This may be because of the high cost of buying the said machines also it can be contributed by poor maintenance and repair culture in which spare parts and technical experts are mostly imported whenever the technologies breakdown this leads to more costs and waste of resources

#### 4.6.2. Impact of ICT on Agricultural productivity

Impact type		Frequency	Percent	Cumulative Percent
Percentage decrease of waste since you adopted ICT	Yes	24	85.7	85.7
Percentage decrease of waste since you adopted ICT	Yes	24	85.7	85.7
Improved farm management practices due to easier access to information on research, pests and diseases	Yes	24	85.7	85.7
Increased household income due to better market price information	Yes	24	85.7	85.7
Improved market access for produce (close linkage between sellers and buyers)	Yes	26	92.9	92.9
Increased access to financial services	Yes	26	92.9	92.9
Increased market-driven production due to improved market information	Yes	28	100.0	100.0
Reduced dependency on agriculture extension services	Yes	21	75.0	75.0
Improved social interaction between farmers which contributes to efficiency	yes	25	89.3	89.3
Increased adoption of newly informed farming practices and technologies	Yes	26	92.9	92.9

**Table 4.6.2: Percentage Impact of ICT on agricultural Productivity**

ICTs affect productivity of any firm that uses them for example according to Bresnahan and Trajtenberg (1995), ICTs can be applied to several production processes thus allowing continuous improvements and experimentation and thus facilitating innovation in the sector. The productivity-enhancing effects of ICT are not usually direct but are usually mediated by development of other technologies that are specific to the ICT-user sector. From the study findings in the above table 4.6.2., more than 75% of respondents believe that ICT have had more positive impact on the agricultural productivity of their agribusinesses.

The majority of respondents agreed that the use of ICT have greatly increased Market-driven production due to improved market information, they also highly agreed that the use of ICTs in their businesses have improved market access for produce (close linkage between sellers and buyers), increased adoption of newly informed farming practices and technologies and it has also increased access to financial services such as use of Mpesa, Mshwari, pesa pap among others by use of their mobile phones and online banking.

### 4.6.3. Coefficient of correlation

**Table 4.6.3: Correlation analysis**

correlation

		Age of company	ICT_Budget	Level_of_computerization	Operation_interrelated_to_computers	ICT_Impact_on_Delivery_time	ICT_Impact_on_decrease_of_waste	ICT_Impact_on_farm_management_practices	ICT_Impact_on_Household_income	ICT_Impact_on_market_access	ICT_Impact_on_financial_services_access	ICT_Impact_on_Market_driven_production	ICT_Impact_on_reduced_dependency_on_extension_services	ICT_Impact_on_improved_farmers_social_interaction	ICT_Impact_on_adoption_of_newly_informed_practices
Age_of_company	Pearson Correlation	1	0.16	0.04	0.042	0.164	0	0	0.242	0.164	0.164	. <sup>a</sup>	-0.293	0	0
	Sig. (2-tailed)		0.415	0.842	0.831	0.404	1	1	0.216	0.404	0.404	.	0.131	1	1
	N	28	28	28	28	28	28	28	28	28	28	28	28	28	28
ICT_Budget	Pearson Correlation	0.16	1	.532**	.406*	-0.188	-0.122	-0.276	-0.199	-0.083	-0.188	. <sup>a</sup>	-0.266	0.028	-0.188
	Sig. (2-tailed)	0.415		0.004	0.032	0.339	0.537	0.154	0.31	0.676	0.339	.	0.172	0.887	0.339
	N	28	28	28	28	28	28	28	28	28	28	28	28	28	28
Level_of_computerization	Pearson Correlation	0.04	.532**	1	.902**	-0.259	-0.286	0	-0.191	-0.13	-0.259	. <sup>a</sup>	-0.154	0	-0.259
	Sig. (2-tailed)	0.842	0.004		0	0.182	0.14	1	0.33	0.511	0.182	.	0.433	1	0.182
	N	28	28	28	28	28	28	28	28	28	28	28	28	28	28
Operation_interrelated_to_	Pearson Correlation	0.042	.406*	.902**	1	0	-0.102	0	-0.204	-0.139	-0.277	. <sup>a</sup>	-0.165	-0.115	-0.277

correlation

		Age of company	ICT_Budget	Level_of_computerization	Operation_interrelated_to_computers	ICT_Impact_on_Delivery_time	ICT_Impact_on_decrease_of_waste	ICT_Impact_on_farm_management_practices	ICT_Impact_on_Household_income	ICT_Impact_on_market_access	ICT_Impact_on_financial_services_access	ICT_Impact_on_Market_driven_production	ICT_Impact_on_reduced_dependency_on_extension_services	ICT_Impact_on_improved_farmers_social_interaction	ICT_Impact_on_adoption_of_newly_informed_practices
computers	Sig. (2-tailed)	0.831	0.032	0		1	0.605	1	0.297	0.482	0.153	.	0.402	0.558	0.153
	N	28	28	28	28	28	28	28	28	28	28	28	28	28	28
ICT_Impact_on_Delivery_time	Pearson Correlation	0.164	0.188	-0.259	0	1	.679**	0.283	0.283	.462*	-0.077	. <sup>a</sup>	0.16	0.352	.462*
	Sig. (2-tailed)	0.404	0.339	0.182	1	0	0.144	0.144	0.013	0.697	.	0.416	0.066	0.013	
	N	28	28	28	28	28	28	28	28	28	28	28	28	28	28
ICT_Impact_on_decrease_of_waste	Pearson Correlation	0	0.122	-0.286	-0.102	.679**	1	.417*	.417*	0.283	-0.113	. <sup>a</sup>	.471*	.519**	0.283
	Sig. (2-tailed)	1	0.537	0.14	0.605	0	0.027	0.027	0.144	0.566	.	0.011	0.005	0.144	
	N	28	28	28	28	28	28	28	28	28	28	28	28	28	28
ICT_Impact_on_farm_management_practices	Pearson Correlation	0	0.276	0	0	0.283	.417*	1	.417*	0.283	-0.113	. <sup>a</sup>	.707**	.519**	0.283
	Sig. (2-tailed)	1	0.154	1	1	0.144	0.027	0.027	0.144	0.566	.	0	0.005	0.144	
	N	28	28	28	28	28	28	28	28	28	28	28	28	28	28
ICT_Impact_on_Household_income	Pearson Correlation	0.242	0.199	-0.191	-0.204	0.283	.417*	.417*	1	.679**	-0.113	. <sup>a</sup>	0.236	.519**	0.283
	Sig. (2-tailed)	0.216	0.31	0.33	0.297	0.144	0.027	0.027	0	0.566	.	0.227	0.005	0.144	

correlation

		Age of company	ICT_Budget	Level_of_computerization	Operation_interrelated_to_computers	ICT_Impact_on_Delivery_time	ICT_Impact_on_decrease_of_waste	ICT_Impact_on_farm_management_practices	ICT_Impact_on_Household_income	ICT_Impact_on_market_access	ICT_Impact_on_financial_services_access	ICT_Impact_on_Market_driven_production	ICT_Impact_on_reduced_dependency_on_extension_services	ICT_Impact_on_improved_farmers_social_interaction	ICT_Impact_on_adoption_of_newly_informed_practices
	N	28	28	28	28	28	28	28	28	28	28	28	28	28	28
ICT_Impact_on_market_access	Pearson Correlation	0.164	-0.083	-0.13	-0.139	.462*	0.283	0.283	.679**	1	-0.077	.a	0.16	0.352	.462*
	Sig. (2-tailed)	0.404	0.676	0.511	0.482	0.013	0.144	0.144	0		0.697	.	0.416	0.066	0.013
	N	28	28	28	28	28	28	28	28	28	28	28	28	28	28
ICT_Impact_on_financial_services_access	Pearson Correlation	0.164	-0.188	-0.259	-0.277	-0.077	-0.113	-0.113	-0.113	-0.077	1	.a	-0.16	-0.096	-0.077
	Sig. (2-tailed)	0.404	0.339	0.182	0.153	0.697	0.566	0.566	0.566	0.697		.	0.416	0.627	0.697
	N	28	28	28	28	28	28	28	28	28	28	28	28	28	28
ICT_Impact_on_Market_driven_production	Pearson Correlation	.a	.a	.a	.a	.a	.a	.a	.a	.a	.a	.a	.a	.a	.a
	Sig. (2-tailed)	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	N	28	28	28	28	28	28	28	28	28	28	28	28	28	28
ICT_Impact_on_reduced_dependency_on_extension_services	Pearson Correlation	-0.293	-0.266	-0.154	-0.165	0.16	.471*	.707**	0.236	0.16	-0.16	.a	1	0.333	.480**
	Sig. (2-tailed)	0.131	0.172	0.433	0.402	0.416	0.011	0	0.227	0.416	0.416	.		0.083	0.01
	N	28	28	28	28	28	28	28	28	28	28	28	28	28	28

correlation

		Age of company	ICT_Budget	Level_of_computerization	Operation_interrelated_to_computers	ICT_Impact_on_Delivery_time	ICT_Impact_on_decrease_of_waste	ICT_Impact_on_farm_management_practices	ICT_Impact_on_Household_income	ICT_Impact_on_market_access	ICT_Impact_on_financial_services_access	ICT_Impact_on_Market_driven_production	ICT_Impact_on_reduced_dependency_on_extension_services	ICT_Impact_on_improved_farmers_social_interaction	ICT_Impact_on_adoption_of_newly_informed_practices
ICT_Impact_on_improved_farmers_social_interaction	Pearson Correlation	0	0.028	0	-0.115	0.352	.519**	.519**	.519**	0.352	-0.096	. <sup>a</sup>	0.333	1	0.352
	Sig. (2-tailed)	1	0.887	1	0.558	0.066	0.005	0.005	0.005	0.066	0.627	.	0.083		0.066
	N	28	28	28	28	28	28	28	28	28	28	28	28	28	28
ICT_Impact_on_adoption_of_newly_informed_practices	Pearson Correlation	0	-0.188	-0.259	-0.277	.462*	0.283	0.283	0.283	.462*	-0.077	. <sup>a</sup>	.480**	0.352	1
	Sig. (2-tailed)	1	0.339	0.182	0.153	0.013	0.144	0.144	0.144	0.013	0.697	.	0.01	0.066	
	N	28	28	28	28	28	28	28	28	28	28	28	28	28	28

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

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

The research aimed at assessing the relationship or lack of it between the frequencies of ICT adoption, reduction of delivery time, increased access to financial services, as well as improved market access for produce and the budget allocation. The analysis was aimed at understanding the impact of either of these factors on possibility of predicting the ICT adoption on agricultural productivity.

The table 4.6.3 above shows the results of a bivariate correlation analysis that was run assessing a relationship between the variables age of company, ICT budget, level of computerization, operations interrelated, impact on delivery time, impact on decrease of waste, impact of management practices among others. Notably ,there was a positive strong correlation which was statistically significant between ICT budget allocation and the level of computerization(CI= 99%, Pearson correlation (r) = 0. 532, p = 0.004);Operations interrelated through computerization( and level of computerization(CI= 99%, Pearson correlation (r) = 0. 902, p = 0.000);ICT impact on household income and market access(CI= 99%, Pearson correlation (r) = 0. 679, p = 0.000);.

There was a weak relationship but of statistical significance between ICT budget and level of computerization (CI= 99%, Pearson correlation (r) = 0. 406, p = 0.032); ICT impact on farm management practices and decrease of waste (CI= 99%, Pearson correlation (r) = 0. 417, p = 0.027);ICT impact on adoption of newly informed practices and reduction of delivery time(CI= 99%, Pearson correlation (r) = 0. 462, p = 0.013); as presented in figure below.

## **CHAPTER FIVE**

### **SUMMARY, CONCLUSION AND RECOMMENDATIONS**

#### **5.1. Introduction**

This chapter presents summary of the findings of the study and derives conclusions that provide recommendations for further studies

#### **5.2. Summary**

The first and the second objective were to establish the relationship between the adoption of ICTs and agricultural productivity and how these ICTs in agribusiness enhance value chains and agriculture in general in Kiambu County. There is a great potential for agribusinesses in Kiambu County and Kenya as a whole to fully utilize ICT to increase their productivity and enhance their value chains. From the research findings there is a clear observation that the higher the use of ICTs in the agribusiness industry the higher the impact realized. In order for farmers to fully adopt ICT in their agribusinesses there is need to emphasize on continuous capacity building and provision of support services to ensure sustainability and relevance.

The study identified that Internet and Emails, Office procurement and accounting automation systems such as sage pastel, dynamics Navision and Computer storage and servers, computerized storage and refrigerated systems, field operations applications e.g scrab for pest and diseases, computerized irrigation and fertilization systems, automated packing systems and computerized planting system especially in floriculture, tea and



coffee plantations as the most used and widely adopted types of ICT applications in most agribusinesses in Kiambu County

The study established that the use of 'Telephone communication' play a very great deal in enhancing their value chain. Also the use of internet for information awareness, mobile application services, internet for marketing, Sms services and information dissemination through leaflets, newspapers, brochures or pamphlets, GIS/GPS technologies and Television broadcasting enhance this agribusinesses value chains to a great extent.

The third objective of the study was to identify the factors that affect adoption of ICTS by the agribusinesses in Kiambu County. The study identified that although the barriers and issues to ICT adoption and usage have significantly been reduced by growing investments in infrastructure and improved service delivery by various service providers, The study established that fear of overdependence on ICT, insufficient internet connectivity and bandwidth, lack of clear ICT strategy, Fear of loss of data/information control and technical capability of the staff members are more of the ICT adoption issues that most agribusinesses in Kiambu are facing

The forth objective was to identify the Key ICT innovations in agribusiness in Kiambu County and from the study the following are the commonly adopted innovations: ICT controlled irrigation systems, computerized storage and refrigeration systems, Remote monitoring of soil moisture (sensor technology), Computerized planting systems e.g. teff planting machine, Use of robots and drones to monitor crops, Fertigation systems, Computerized packing systems, Computerized weighing systems, Video monitoring, Computerized hatching and brooding machines, Computerized capons processing

(slaughter facility), Computerized milking machines, Computerized artificial insemination (AI) services.

### **5.3. Conclusion**

The first and the second objective were to establish the relationship between the adoption of ICTs and agricultural productivity and how these ICTs in agribusiness enhance value chains and agriculture in general in Kiambu County. The conclusion is that the use of ICTs in agribusinesses shows that the sector is growing as the need to be more effective and efficient in their day to day activities to enhance their value chains and increase their productivity. The study concludes that the majority of respondents were aged 36-50 years and had worked on that company for 0-10 years. Further the majority of the agribusinesses in different sectors have been in existence for a period of between 1-20 years and over 40 years. And most had an ICT budget of between 0-2%, with 0-20% level of computerization and majority of the respondent's farms had 0-20% operations interrelated through computerizations.

Further the study concluded that although the Traditional forms of communications such as radio, televisions broadcasting and newsprint are still being used, most agribusinesses in Kiambu county have embraced the growth of new technologies such the use Telephone communications, use of internet for information awareness, mobile application services, internet for marketing, Sms services, GIS/GPS technologies to enhance their businesses value chains.

Based on the third objective of the study was to identify the factors that affect adoption of ICTS by the agribusinesses in Kiambu County. the study therefore concluded that the fear

of fear of overdependence on ICT, insufficient internet connectivity and bandwidth, lack of clear ICT strategy, Fear of loss of data/information control and technical capability of the staff members, Lack of security and proper Service Agreement Levels (SLAs), cost of ICT tools deployment, Fear of loss of data/information confidentiality, Inability to quantify ICT benefits and Fear of dealing with viruses, Trojans, malware, phishing etc'. Were the common obstacles to ICT adoption faced by most agribusinesses in Kiambu County.

Lastly, although at a low rate the farmers in different sectors of agribusiness have adopted new innovations to enhance their efficiency and effectiveness in their farms and livestock rearing this innovations include ICT controlled irrigation systems, computerized storage and refrigeration systems, Remote monitoring of soil moisture (sensor technology), Computerized planting systems e.g. teff planting machine, Use of robots and drones to monitor crops, Fertigation systems, Computerized packing systems, Computerized weighing systems, Video monitoring, Computerized hatching and brooding machines, Computerized capons processing (slaughter facility), Computerized milking machines, Computerized artificial insemination (AI) services

#### **5.4. Recommendation**

Though agriculture has been the primary driver of economic growth in Kenya and more so in Kiambu county ICT adoption in agribusinesses is still low, the study recommends that its sustainability will greatly depend on investment in technology. Therefore the county government should come up with policies and laws on how to improve the ICT infrastructure in the agribusiness industry. The government should also conduct

sensitization and training agricultural workshops to inform the farmers on new methods of farming using technology in order for them to increase their productivity

ICTs have the capacity to help even the small scale farmers to prevent and avoid any losses after making investments by identifying and controlling diseases and pests, improving resource use and receiving timely weather information. ICTs also helps in making more accurate projections and make better plans for the future (World Bank 2011).Therefore the availability of ICT tools and services should be expanded and organizations contributing to agricultural development in Kiambu County will require their technologies to be packaged simply and posted on websites for easy access.ICT tools also need to be simple and affordable and the content should be relevant to target more people especially youth into agribusiness.

The use of ICT in agriculture according to the findings increased opportunities and thus increased capacity for the farmers to engage in profitable agriculture targeting niche markets. Therefore the stakeholders in agribusiness should collaborate with others who have adopted ICT services, hire adequate IT staff

### **5.5. Limitations of the study**

Due to time and resources constraints, the study evaluated many diverse processes in different agribusinesses wholesomely. It is possible that different functions in different types of agribusinesses may have different levels of ICT adoption and varying ICT budgets.

Further the study administered a single questionnaire per farm/company implying that there was no moderation of biasness. Also the study relied only on primary data and did not take into account secondary data that may have been collected during other previous related studies.

#### **5.6. Recommendation for further research**

Further study should be done on ICT adoption and value chain enhancement by narrowing down to a single category of agribusiness this will assist in identifying the exact factors and ICT applications in different agribusiness categories that inform the decision on what are the best ICT applications to use for a certain type of agribusiness and whether to adopt or not adopt technology in agribusiness in order to enhance value chains.

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## APPENDICES

### Appendix i: List of Agribusiness Companies/Farms

1. floriculture	1 Black petals ltd 2 Lauren International 3 Zena Roses 4 Simbi Roses Ltd 5 RedLands Roses 6 Enkasiti Flowers 7 Valentine Flowers 8 Utee Estate Ltd 9 Africalla lilies Ltd 10 Everflora
2. Dairy industries	11 Fresha Dairy 12 Palm House Dairy Ltd 13 Ndumberi Dairy 14 Nyaara Dairy 15 Gatoka Livestock
3. Horticulture (fresh fruits and vegetables)	16 Lilian Farm 17 Kenfine Properties 18 Waruhiu Farm 19 Blooming Greene 20 Charoza Farm
4. Plantations (coffee and Tea farms)	21 Sasini Coffee And Tea Plantations 22 Karirana/Eden Estate 23 Cianda Tea Plantation 24 Ngorongo/Kenfresh 25 Kibenda Tea Estate
5. Poultry companies	26 Muguku poultry 27 Simon Mundati Farm 28 John Njagi poultry farm 29 Gitumbo Waruingi Farm 30 Kenchic Ltd



**SECTION B: ICT ADOPTION AND THE IMPACT OF ICT ON AGRICULTURAL PRODUCTIVITY**

1. To what extent are the following ICT applications and systems adopted in your company/farm? *(Please tick appropriately)*

	Low	Fair	Good	High
a. Internet and emails	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
b. Office procurement and accounting automation systems such as sage pastel, dynamics Navision	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
c. Computerized planting systems e.g teff planting machine	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
d. Computer storage and servers	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
e. Automated packing systems	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
f. Computerized irrigation and fertilization systems	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
g. Computerized storage and refrigeration systems	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
h. Field operations applications e.g. scarab for pest and disease monitoring	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
i. Others specify..... ..... .....				

**2. Impacts experienced on agricultural productivity after ICT adoption**

(i) Based on the following activities, has the use of ICT had any impact on agricultural productivity? *(please tick appropriately)*

a. Reduction of delivery time

YES  NO

b. Percentage decrease of waste since you adopted ICT

YES  NO

c. Improved farm management practices due to easier access to information on research, pests and diseases YES  NO

d. Increased household income due to better market price information

YES  NO

e. Improved market access for produce (close linkage between sellers and buyers)

YES  NO

f. Increased access to financial services

YES  NO

g. Increased market-driven production due to improved market information

YES  NO

h. Reduced dependency on agriculture extension services

YES  NO

i. Improved social interaction between farmers which contributes to efficiency

YES  NO

j. Increased adoption of newly informed farming practices and technologies

YES  NO

(ii) Have you experienced any negative impact after use of ICT

YES  NO

If **YES** please indicate which one

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-----  
-----

**SECTION C: THE EXTENT TO WHICH ICTS HAS ENHANCED VALUE CHAINS**

1. What extent does the use of the following ICTS has enhance the company's value chains

*(For each issue please tick one where 1-Not extent, 2- Little extent, 3-moderate, 4-great 5-Very great)*

	<b>No extent</b>	<b>Little extent</b>	<b>Moderate Extent</b>	<b>Great Extent</b>	<b>Very great Extent</b>
(i) Internet for marketing	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
(ii) Sms services	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
(iii) Mobile applications (apps) services	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
(iv) Internet for information awareness	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
(v) GIS/ GPS technologies for mapping and remote sensing	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
(vi) Information dissemination through leaflets, newspapers, brochures or pamphlets	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
(vii) Telephone communication	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
(viii) Radio broadcasting	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
(ix) Television broadcasting	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
j. Others specify..... .....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

**SECTION D: Factors that affect adoption of ICTs by agribusinesses in Kiambu County**

Please indicate the extent to which the farm has faced each of the following issues in ICT adoption in your farm. *(Please tick appropriately)*

	<b>No extent</b>	<b>Little extent</b>	<b>Moderate Extent</b>	<b>Great Extent</b>	<b>Very great Extent</b>
a) Fear of loss of data/information confidentiality	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
b) Fear of loss of data/information control	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
c) Lack of a clear ICT strategy	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
d) Insufficient internet connectivity and bandwidth	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
e) Lack of security and proper Service Agreement Levels (SLAs)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
f) Cost of ICT tools deployment	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
g) Technical capability of the staff members	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
h) Inability to quantify ICT benefits	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
i) fear of overdependence on ICT	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
j) Fear of dealing with viruses, trojans, malware, phishing etc	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
k) Unpopularity among workers over loss of jobs	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
l) Others specify.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

**SECTION E: KEY ICT INNOVATION USED BY THE COMPANY**

The following is a list of commonly used innovations kindly ticks appropriately the ones that your company/farm uses. *(please tick appropriately)*

- 1. Remote monitoring of soil moisture (sensor technology)
- 2. Low cost wireless tracking systems to understand livestock activity
- 3. Video monitoring of animals
- 4. ICT controlled Irrigation systems
- 5. Use of robots and drones to monitor crops
- 6. Computerized planting systems e.g teff planting machine
- 7. Computerized storage and refrigeration systems
- 8. Others specify.....  
.....  
.....  
.....  
.....



## **Appendix iii: Research Permit**



**UNIVERSITY OF NAIROBI**  
**SCHOOL OF BUSINESS**

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P.O. Box 30197  
Nairobi, Kenya

DATE 28<sup>th</sup> Sep, 2017

**TO WHOM IT MAY CONCERN**

The bearer of this letter JAHET KANGUCHI KAEWIMBO

Registration No. 061/77177/2015

is a bona fide continuing student in the Master of Business Administration (MBA) degree program in this University.

He/she is required to submit as part of his/her coursework assessment a research project report on a management problem. We would like the students to do their projects on real problems affecting firms in Kenya. We would, therefore, appreciate your assistance to enable him/her collect data in your organization.

The results of the report will be used solely for academic purposes and a copy of the same will be availed to the interviewed organizations on request.

Thank you.

  
**PATRICK NYABUTO**  
**SENIOR ADMINISTRATIVE ASSISTANT**  
**SCHOOL OF BUSINESS**

