TECHNOLOGICAL INNOVATION AND COMPETITIVENESS OF AGRIBUSINESS FIRMS IN KENYA

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DECLARATION

This is my original work and has not been presented to any institution or university for an award.

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This Research Project has been submitted for examination with my approval as the University Supervisor.

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DEDICATION

I dedicate this research paper to my parents Mr. Simon Kariuki and Mrs. Ruth Mukundi, my sisters: Grace, Beth and Ann, and comrades for being my constant support and source of inspiration and strength.

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ABSTRACT

The objective of this study was to determine the effects of innovation on competitiveness in the agribusiness firms in Kenya. The research aimed to establish the extent to which technological innovations are used by the firms, to determine the relationship between technological innovations and competitiveness in the firms, and to establish the challenges facing the technological innovations and competitiveness in the firms. The study adopted a cross sectional survey research design. Data was collected from the firms that produce and export coffee, tea and horticultural produce using a questionnaire that was designed in Google Forms and administered through phone interviews. The data was analyzed using descriptive statistics for the first and third objective while regression analysis was used for the second objective. Focusing on the extent to which technological innovations are used by the agribusiness firms, the research established that virtual market innovations were used by 37.8% of the firms, virtual pricing innovations were used by 17.8% of firms, and mobile money innovations were used by 11.1% of the firms. The farmer library innovations were available in only 4.4% of firms. The horticultural sector exhibited the greatest depth in diffusion of innovations. Overall, there was moderate use of technological innovations in the agribusiness firms involved in the study. On the relationship between technological innovation and competitiveness of the agribusiness firm's data on the quantity and value of exports were sort over the last three years. The average price of exports for 31.1% of the firms was reported to be higher price than the global price, 53.3% reported no difference, while 15.6% reported lower prices compared to the global price. Overall 33.3% of the firms were more competitive while 15.6% were less competitive. The horticulture industry was the most uncompetitive where only 1 firm sold at a higher price compared 6 firms in the tea sector and 7 firms in the coffee sector. The firms view the influence of technological innovations on pricing to be small for 51.1% of firms and much for 8.9% of firms. Overall, the study found small to moderate effect of technological innovations on competitiveness of agribusiness firms in Kenya. Ordinal regression analysis resulted in the model fitting information that would correctly predict the output up to 77.77% being significant at 5% confidence interval where p is 0.004. The goodness of fit model produced p at 0.994 of the null hypotheses rejecting it and indicating that the model was good fit for the data. The pseudo r-square was recorded at 0.419 indicating variable could be explained at 41.9%. On the challenges facing the adoption of technological innovations in the agribusiness firms, the cost of technologies was seen as the greatest challenge being reported by 68.9% of the firms while changes in government regulations and standards was cited by 15.6% there was no citation of multilateral and bilateral trade agreements. The greatest challenge facing creation of strategic competitive advantage for the agribusiness firms was changes in standards required for export goods in 44.44% and changes in government regulations in 37.78% of the firms.

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ABBREVIATIONS

BI	Balassa Index
EAC	East Africa Community
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
GDP	Gross Domestic Product
IFC	International Finance Corporation
IMF	International Monetary Fund
KALRO	Kenya Agricultural & Livestock Research Organization
KARI	Kenya Agricultural Research Institute
KNBS	Kenya National Bureau of Statistics
USAID	United States Agency for International Development
USDA	U.S Department of Agriculture

CHAPTER ONE: INTRODUCTION

1.1 Background of the Study

Agriculture is a concept that brings together the prefix agri which means related to land and the suffix culture which in Latin was spelt as *cultura* meaning cultivation. Therefore, agriculture is defined as the science and art of cultivating land to grow plants and rear farm animals. The term agriculture is often used synonymously with farming, a concept which means growing crops of keeping animals for food and raw materials in a specified area called the farm. There are three main types of farming that include arable farming, livestock farming, and mixed farming which brings together both arable and livestock farming.

The USDA appreciates agriculture as a best prospect industry in Kenya while FAO indicates that agriculture continues to play a critical role in Kenya's rural economy. According to FAO, Kenya's agricultural industry contributes 26%of the GDP and another 27% indirectly through linkages with other sectors. The USDA placed the contribution of agriculture to GDP at 25 per cent. The FAO also recorded that the agricultural sector employs 40 per cent of the entire population in Kenya and that in rural areas, agriculture employs about 70 per cent of the population. Further, FAO and the USDA report that agriculture contributes about 65 per cent of the foreign exchange earnings, making the sector the single major source of foreign exchange in the country. The findings by FAO and the USDA are consistent with those of the CBK which holds the position that agriculture remains the main foreign income earner and also consistent with data from the KNBS which has consistently demonstrated that agriculture as a sector of the economy contributes the highest proportion to the GDP. Similar findings were confirmed by Makini

et al. (2018) who terms agriculture as the backbone of Kenya's economy and as a major source of both formal and informal employment.

The lack of notable improvements in agricultural practice and output over the years is a worrying trend. Besides the country struggling to engage its youthful population in agriculture (Mkulima Young, 2018), Kenya's agricultural sector faces diverse challenges making it weak and uncompetitive (Makini et al., 2018). Among many others, the challenges facing the agricultural sector include the non-adoption of new and improved technologies, an indication that farmers are still stuck with old production methods (Sample, 2017). The implications are a farming population that perennially complains of high costs of production and low prices of produce (Gachukia, 2014). This research posits that the agricultural industry is downright uncompetitive.

Focusing on productivity, food security, and involvement of the youth in agriculture fails to capture the most important principle of business which is the creation of value. Value creation takes place when the farmers are able to incur low costs of production, access markets for the produce, and attract high returns from the investment (Adenle, Manning, &Azadi, 2017). To attain value creation, the agricultural sector must adopt technological innovation and enhance competitiveness. The following section discusses technological innovations.

1.1.1 Technological Innovation

Innovations are about people, technologies, and knowledge in a particular practice. It involves the adoption of new ideas, methods, and products. Innovation also entails the

change of cultures relating to a particular practice in order to achieve improvements in outcomes and processes (Kilelu, Klerkx, Leeuwis& Hall, 2011).

Since the turn of the millennium, the rise of the internet and worldwide web has changed the way agricultural activities are conducted. Access to information on improvements of seeds and breed varieties, improvements in inputs and mechanization of agriculture, and improvements in the management of agricultural practice, produce, and market share among areas that have experienced growth through innovations (Haggblade, 2011). If adequately adopted, the general and specific innovations should help the agricultural sector to gain competitiveness (Kilelu, Klerkx, Leeuwis& Hall, 2011).

Kenya has had a fair share of innovations in agriculture. The USAID outlined a variety of innovations targeting agriculture in Kenya. The innovations include: mobile money transfer through Mpesa®, which is a mobile money tool that enables farmers to access funding and engage in transactions. Virtual markets are an innovation that seeks to influence the youth to participate actively in agriculture with a good example being Mkulima Young®. There are other innovations such as iCow® which is a farmer library that provides information on the management of livestock and M-Farm® a virtual pricing platform which focuses on big data for the improvement of agricultural produce (USAID, 2018). Where adopted, technological innovations greatly improve productivity and competitiveness of agricultural practice. The concept of competitiveness in discussed in the following section.

1.1.2 Competitiveness

Neary (2006) in an IMF working paper stated that competitiveness is an elusive concept. Krugman (1994) called competitiveness "a dangerous obsession." Further, Neary cited Michael Porter who highlighted competitive advantage as the key to superior performance by firms, industries and economies as a whole.

Business Dictionary defines competitiveness as the ability of a firm or a nation to offer products that meet and exceed the quality standards of local and world markets at prices that are better and provide adequate returns on the resources employed or consumed in producing them. Competitiveness, therefore, is the capability an entity has, to achieve superior profitability in relation to its competitors.

Competitiveness refers to the ability of a firm to provide products and services more effectively and efficiently than the relevant competitors (Porter & Kramer, 2018). Competitiveness is also the ability to match or beat the world's best firms in cost and quality of goods or services. At the industry level, competitiveness is defined as the ability of the firms in the industry to achieve sustained success against foreign competitors without protection or subsidies (Porter & Kramer, 2018).

Diaz-Bonilla, Orden and Kwieciński (2014) defined competitiveness in agriculture as increasing mechanization, commercialization, composition of crops, and intensification. Babu and Shishodia (2017) indicated that a competitive agribusiness sector is characterized by efficiency in land markets and management of agricultural risks, wide access to markets and, technology adoption and innovation. According to Diaz-Bonilla et al. (2014),

increasing the application of technology results in increased competitiveness hence the view of a positive relationship between technology innovation and competitiveness.

The defining factors of competitiveness are an illustration of how complex it can be to measure competitiveness. The same complexity is embodied in the Global Competitiveness Index 4.0 which captured a total of 99 indicators of national competitiveness. This research did not intend to complicate the understanding of competitiveness and as such it employed the Balassa index of competitiveness which allows the computation and comparison of a nation's competitiveness against other nations (Balassa, 1965; Gnidchenko & Salnikov, 2015).

1.1.3 Agribusiness Firms

Agribusiness refers to the business of agricultural production. The agribusiness concept refers to agricultural activities conducted strictly on the basis of commercial principles. It encompasses the entire value chain that includes agrochemicals and farm inputs, farm machinery and equipment, breeding seeds and animals, crop and animal production, distribution, processing, marketing and retail sales. Agribusiness therefore takes place for the primary objective of returning a profit (Barnard, Foltz, & Yeager, 2016).

Agribusiness firms can be described as any type of firm in the agribusiness value chain. This includes the producers of crop and animal produce, firms that make and sell agrochemicals, farm inputs, equipment and machinery, and firm that consolidate market, distribute, and sell the farm produce. The key requirement for the firms is that they are formally organized (Walton &Grishin, 2018).

The study focused on competitiveness of agribusiness firms dealing in Kenya's agricultural exports; specifically, the firms that directly produce and export farm products. Agricultural produce is Kenya's leading export and foreign exchange earner. Improving competitiveness of the agricultural industry would be seen in the competitiveness of agricultural exports, before being experienced elsewhere in the economy.

The Central Bank of Kenya ranks three agricultural exports as the principal exports. These include coffee, tea, and horticultural produce. This research focused on competitiveness of Kenya's principal agricultural exports. The research hypothesized that competitiveness of Kenya's agricultural sector would be portrayed best by the competitiveness of the principal agricultural exports (Central Bank of Kenya, 2018).

The research focused on data collected from 45 firms that directly produced and exported any of the three principal agricultural exports which include coffee, tea, and cut flowers. Fifteen firms were selected for each of the crops. By limiting, the scope of the study to only those firms that directly produce and export the three crops, the study ensured meeting of set research objectives, principally describing the effects of innovation on competitiveness in the agricultural industry in Kenya.

1.2 Research Problem

There is limited research on the effect of technological innovation on competitiveness of agribusiness in Kenya. Sample (2017) indicated that agribusiness competitiveness in African countries had not received adequate attention because countries struggled to improve agricultural productivity, instead of agricultural competitiveness. In Kenya, there were increases in research focusing on areas such as improving food security while a little

bit of coherent research attempted to focus on how to engage the youth in agriculture. Kenya's research hardly focused on competitiveness of the agricultural sector in comparison, which is why this research was important.

Research that links innovation and competitiveness in the agricultural sector was scarce in Kenya and African in general. Sample (2017) indicated that agribusiness competitiveness had not received adequate attention because countries struggled to improve agricultural productivity. KARI and KALRO have been at the forefront of agricultural research and "competitiveness" was a word never missing in their research reports. KARI even weighted competitiveness potential in its research on agricultural value chain (Miruka, Okello, Kirigua, & Murithi, 2012). However, the research organizations barely defined competitiveness indicators and no single research specifically focused on competitiveness. Instead, competitiveness was often obscured by more definitive concepts such as productivity, returns, and costs, yet evidence has continually demonstrated difference of productivity from competitiveness. Productivity would be an indicator of competitiveness but not definitive of competitiveness on its own.

There were contradicting views on the competitiveness of the agricultural sector in Kenya with some researchers finding a positive relationship between technological innovations and competitiveness of agribusiness whereas other researchers found a negative relation. Makini et al. (2018) found the agricultural sector to be weak and uncompetitive because it failed to adopt new and improved technologies. On the other hand, Babu and Shishodia (2017) found Kenya's agricultural sector to rank high on agribusiness competitiveness and agricultural productivity but low on food security. With the difference of only one year

between the two studies, there should not have been two different opinions on competitiveness of the agricultural sector, assuming all factors were held constant. This created the need for further research to determine the competitiveness of agribusiness in Kenya.

Lastly, a gap exists on the adoption of technological innovations by agribusiness firms despite various efforts to develop technologies targeting the agricultural sector in Kenya. The USAID listed several innovations targeting or influencing the agricultural sector (USAID, 2018). Key areas of technological development include farmer libraries, mobile money, virtual markets, and virtual pricing technologies. Research, on the other hand, indicated the lack of adoption of these innovations in the agricultural sector. Failure to adopt agricultural innovations created the need for research with the objective of determining the cause of the gap between the innovations and the needs for attainment of competitiveness in the sector. This research considered this gap as an opportunity gap that would be researched intensively and extensively. This research focused on answering the research question on the effects of innovation on competitiveness in the agribusiness firms in Kenya.

1.3 Research Objectives

The objective of the research was to determine the effects of innovation on competitiveness in the agricultural industry in Kenya. To attain the objective, the research focused on the following specific research objectives:

i. To establish the extent to which technological innovations are used by Kenyan agribusiness firms targeting export markets.

ii. To determine the relationship between technological innovation and competitiveness of agribusiness firms in Kenya.

iii. To establish challenges facing technological innovations and competitiveness of agribusiness firms in Kenya.

1.4 Value of the Study

This research focused on both the contribution of knowledge to existing literature on Kenya's agricultural sector and on solving the problem of competitiveness through policy recommendations. Consequently, the research would benefit the researcher and academics who may develop the findings of this research. It would also be of significance to the policy makers with a duty to create policies enabling improvement of Kenya's competitiveness. Lastly, the research would be of great importance to farmers directly affected by competitiveness concerns of Kenya in the global market for agricultural produce. The research demonstrates whether it creates value to adopt new technologies in agribusiness and whether there are opportunities that the farmers could tap.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

Chapter two provided the review of literature focusing on both theoretical literature and empirical literature. Under theoretical literature, the research focused on the competitive advantage theory, the comparative advantage theory, and diffusion of innovation theory. Under empirical literature, the research focused on both innovations in agriculture and competitiveness in agribusiness.

2.2 Theoretical Review of Literature

2.2.1 Comparative Advantage Theory

The comparative advantage theory was proposed in the 18th century by David Ricardo, an economist (Leamer, 1984). The theory surmises that a country boosts its economic growth by focusing on the industry in which it has the most substantial comparative advantage. Comparative advantage is when a country produces a good or a service for lower opportunity cost than other countries. Opportunity cost, as applied in comparative advantage, is a tradeoff for the production of a good or service in which a country has comparative advantage since the benefits of producing the good outweigh the disadvantages. Similarly, another country reaps more benefits from the purchase of goods produced by a country with comparative advantage in those countries that are producing the goods locally (Levchenko, & Zhang, 2016).

Comparative advantage theory is best demonstrated through an example. Countries that produce oil have comparative advantage in the production of petrochemicals, as compared to countries that do not produce oil because, the oil producing countries have the primary resource for the production of petrochemicals while any other country would need to incur

additional cost in order to produce petrochemicals. In the international markets, the country with comparative advantage in the production of petrochemicals offers lower prices than the country that does not have comparative advantage (Baldwin, 2017). The latter can clearly not compete in such an environment.

Comparative advantage theory asserts that nations should specialize in the production of the goods in which they have comparative advantage while importing the goods in which they do not have comparative advantage, or rather import goods with comparative disadvantage. This allows the nation to reap maximum benefits from international trade (Hall, 2001).

The application of this theory in this research would help in the determination of whether Kenya has comparative advantage in any of the agricultural exports. Ideally, when the Balassa Index was developed, it was considered to provide statistical data on comparative advantage (Gnidchenko & Salnikov, 2015).

2.2.2 Competitive Advantage Theory

The second theory of interest in this research was the competitive advantage theory. The theory is important since it does not stop at the point of determining comparative advantage. Rather, it advances the discourse to the point of how a nation, or business, can gain competitiveness. Porter (1985) asserted that just because a country has comparative advantage today, it does not mean that it was forever. Countries and firms do lose competitive advantage and they can also gain competitive advantage.

Porter (1985) defined competitive advantage as the strategic advantage that a country or a company has over its rivals within the competitive industry. If a country produces goods at a lower cost and sells at a higher price than the competition, then it can be considered to have competitive advantage.

Porter emphasized that countries should pursue policies that create high quality goods to sell at high prices in the market. The theorist also indicated that productivity growth should be the focus of a national strategy. The theory departs from the comparative advantage notion that asserts the importance of cheap labor and natural resources as the primary sources of comparative advantage. Labor is ubiquitous and natural resource endowment is not necessarily good for the economy as these may lead countries to specialize in exporting primary goods and raw materials that trap countries in low-wage economies due to the terms of trade (Porter & Kramer, 2018). When a country has competitive advantage, instead of just comparative advantage, then it can maximize scale economies and garner premium prices (Madsen & Walker, 2015).

There are three sources of competitive advantage, according to Porter (1985). These include cost leadership, differentiation, and focus. Cost leadership means that countries can provide high quality at a lower cost than any other country. Countries attain cost leadership by enhancing efficiency in production activities (Porter & Kramer, 2018). The second factor is differentiation which the provision of goods and services that are unique and better than what any other country can offer. Differentiation enables a country to charge premium prices for its exports. The last factor is focus, which means that a country must understand its target markets (Madsen & Walker, 2015).

Cost leadership, differentiation, and focus do not necessarily require the country to have natural resources and low cost of labor (Porter & Kramer, 2018). Rather, innovation ensures that a country achieves competitiveness in a new way that is different from the traditional understanding of comparative advantage (Amde, Chan, Mihretu & Tamiru, 2009). A country that has superior technological innovations would be able to produce petrochemicals than those produced by a country that actually produces oil.

The importance of competitive advantage theory in this research was demonstrating that through innovation Kenya would be able to drive competitiveness of her agricultural products (Porter & Kramer, 2018). There have been complaints about exporting raw goods, a problem highlighted by Porter (1985) and reimporting the same goods at higher prices. Kenya would thus appear to have comparative advantage in the production of such agricultural goods but lack competitive advantage in the global markets over the same goods.

2.2.3 Diffusion of Innovation Theory

The third theory of consideration in this research is the theory of innovation diffusion (Rogers, 1962). The theory explains how innovations are accepted in the society to the point of attaining mass adoption. The theory indicates that innovations go through five stages of adoption. Innovation is the first stage of adoption where the technology is created and quickly accepted by those in the society that are highly venturesome and enthusiastic towards innovations. The second stage is early adoption where those people who consciously anticipate and accept changes adopt the innovations. The third stage is the early majority stage followed by late majority stage and finally the laggards (Rogers, 1962).

In its application to this study, the innovation diffusion theory helps in explaining how technologies were adopted in the different segments of the agricultural exports from Kenya. The research sought to demonstrate, using the innovation diffusion theory, the extent to which innovations were adopted by the agricultural industry in Kenya with a focus on the export markets for agricultural produce. The issue of critical importance in the study was the adoption of the technology in the principal exports of the country that include horticultural produce, tea and coffee as ranked by the Central Bank of Kenya (2018).

2.3 Empirical Literature

2.3.1 Technological Innovation in Agriculture

Comparative advantage, from the aspects of natural resource endowment, was a driver of competitiveness in the past. The rise in technological innovations, specifically agribusiness technologies, is the new source of competitiveness in the agricultural sector (Haggblade, 2011). The developed economies have been pursuing technological innovations to drive the competitiveness of the food sector through the creation of seed varieties that are resistant to harsh weather, pests and diseases (Eric, Njehia, Wolf, &Karani-Gichimu, 2015). The technological innovations focusing on agriculture also focus on reduced dependence on farm chemicals in favor of organic farming (Kibiego, Legate, &Bebe, 2015). Additionally, the developed nations appreciate that arable land is scarce and through innovation, they are able to conduct agricultural activities in land that is arid and with desert features.

Developed nations, especially in Europe rank highest on the competitiveness of the agricultural sector (Kilelu, Klerkx, Leeuwis, & Hall, 2011). The adoption of new and

improved technologies has been the strongest reason for the growing competitiveness of agribusiness. Considering that the region conducts meaningful agriculture for only two seasons a year, the fact that it emerges as the most competitive region should raise questions on what are the challenges in Africa, Kenya and all regions that are endowed with conducive climatic conditions for the conduct of agricultural activities all year round (Kibiego, Lagat, &Bebe, 2015).

Kenya is at a prime time for technological innovations. Research demonstrates that there is an increase in technologies focusing on the agricultural sector. Innovations such as Mkulima Young®, iCow®, and M-Farm® are just a few of the technologies that are targeting agriculture in Kenya. This research however posits that the levels of innovation are still limited and may not have targeted all the sections of the agricultural value chain and most importantly, the available innovations have not targeted the agricultural produce marked for export. The implications are that exports have remained largely unchanged despite the notable changes in technology.

The proposed research considers that agribusiness innovations that would best demonstrate competitiveness are those innovations that have focused on the export market. Competitive advantage in the agricultural sector must be considered from the aspect of how innovations affect the competitiveness of Kenya's exports in agricultural produce (Kibiego, Lagat, &Bebe, 2015). Clearly, there has not been any research focusing on the competitiveness of Kenya's agricultural exports. Instead, all available research studies on agricultural competitiveness have focused on the local agricultural activity with no links to the international markets (Hack, Meijl, Gaasbeek, &Vlieger, 1998). Comparative advantage as

considered by David Ricardo and competitive advantage as considered by Michael Porter all related to comparisons in the international markets and not just within a single economy.

The mobile money platform such as Mpesa was started as a pilot program for the growth of financial markets of the unbanked individuals within East Africa (USAID, 2018). With funding from Department for International Development (DFID) and partnership with Safaricom the platform was a great commercial opportunity. The invention of using a mobile phone for money transactions has greatly improved the operations of the industry. The platform moves small amounts of money than the bank would service. The response and adoption by the farmers has been unprecedented. Millions of transactions are carried out daily, this saves time as well as reduces the baggage of carrying loads of money. However, this innovation has its equal share of challenges.

A virtual market is a mobile application platform where producers, business people and customers in the agricultural value chain interact e.g. Mkulima Young (USAID, 2018). It is a virtual platform that connects buyers and sellers of agricultural products. It was invented to encourage the youth to engage in agricultural activities. In addition, it was to reprieve the young farmers who were faced with the issues affecting their productivity and marketing resulting in the emergence of intermediaries who offer low prices for the products and delayed the payments and increase in the cost of farm inputs (USAID, 2018).

A farmer library is an application that can be accessed through the internet and also mobile phones. iCow is an example that has revolutionized the interaction among smallholder farmers through its various platforms like smart tools, the application equips the farmer with tools that helps them to understand their soil type, identify the problem on crops and

also select the appropriate seeds according to the area of farming (USAID, 2018). Through that crisis management is more viable for the farmer and enables them to be more productive and sustainable.

Farmer library is an offline platform where a lot of information and knowledge on farm activities are made available all the time (USAID, 2018). The farmer needs to search for any content related to their farm by typing the country short code and receive the valuable content through a message easily and effectively. The farmer can write the content and save it for future reference.

Kalenda are a variety of calendars that remind farmers on the actions to take in a certain value chain (USAID, 2018). For the livestock there are gestation and growth kalends, this help them reduce the potential risks and remind them on important things like vaccinations, artificial insemination, pregnancy diagnostic and brooder temperatures.

Mashauri has content from national agricultural research institutions which advices farmers and potential farmers on subject choice (USAID, 2018). Upon registration to Mashauri three-month content is received through short message service this enables the farmer to create their own agricultural manuals. The product was as a result of the lack of permanent access to production knowledge for the smallholder farmers.

Mfarm is one such tool that provides up-to date market prices of agricultural products (USAID, 2018). This provides transparency to the farmers reducing the dependence on middlemen. This linked the farmers and the market directly through a message that informs them of the retail price of their products. It also offers a group selling, this gets farmers to

team up and deliver produce to particular point and prompt the system via a message of what they are selling. A study in central Kenya showed that 600 farmers doubled their sales by using this platform.

2.3.2 Competitiveness in Agriculture

Africa has wealth of natural resources including many precious minerals and, all year-round sunshine. The extractive industry for minerals is robust but agriculture remains a major component of the gross domestic product (GDP) of many countries. The challenge is that competitiveness in the agricultural sector is at its lowest (Adenle, Manning, &Azadi, 2017).

Africa heavily relies on trade agreements with the buying countries, mostly in Europe and the North Americas. These trade agreements have been under threat recently with the cancellation and renegotiation of trade pacts (Geoffrey, Hillary, Antony, Mariam, & Mary, 2014). The trade agreements mainly affect the agricultural exports from Africa. However, the trade agreements are not the only challenge that the African farmers are facing; the demand for high value foods is on the rise. Despite agriculture being her forte, Africa feels threatened by the demand for phytosanitary requirements on foods (Webber &Labaste, 2009).

Africa's problems with the phytosanitary requirements on foods demonstrate that Africa's produce is not competitive or rather; it lacks the competitive advantage that would raise its demand in the global markets' foods (Webber &Labaste, 2009). The implications are Africa sells limited quantities of agricultural produce, with majority going to waste. The produce is sold in raw form meaning that it attracts less than satisfactory prices in the

market. It is even worse to contemplate that Africa still has to reimport the same produce after it has been processed in Europe or in another part of the world.

Researchers agree that agribusiness competitiveness in Africa is in a wanting state. The researchers also agree that competitiveness in the agricultural sector needs to improve. The challenge, however, is the fact that there is no single indicator to track competitiveness of the agricultural sector; an indicator that would be considered objective and not subject to human judgment (Rikken, 2011).

Walton and Grishin (2018) in an article published by the International Finance Corporation (IFC) indicated that agricultural competitiveness in emerging markets, including Malawi and Brazil, was a major challenge. The researchers went on to recommend strategies for the improvement of agricultural competitiveness. The research asserted that the importance of moving from agriculture to agribusiness. The difference in the two concepts is competitiveness where agribusiness requires competitive production. Often, agricultural activities in Africa and also in Kenya are not considered for purpose of profit hence no incentive to enhance competitiveness (Reardon, Codron, Busch, Bingen & Harris, 1999). Other than that, the research recommending the enhancement of competition and competitiveness. The report asserted that erratic and arbitrary regulatory policies in input and output markets, including export and import policies, were an important concern for the competitiveness of the agricultural sector. Other factors affecting competition included a lack of smallholder access to necessary skills, technology, and finance (Geoffrey, Hillary, Antony, Mariam & Mary, 2014). There was also the challenge of weak infrastructure and high transport costs, and the lack of secure land rights. Similar challenges are notable in

the Kenyan context especially with the control over inputs such as fertilizers and farm chemicals, which are supplied by the government agencies, and the prices in the output markets where the prices are set and regulated by the government (Odhiambo, 2012). These factors contribute to the lack of competitiveness in the agricultural sector.

Dlamini, Kirsten and Masuku (2014) in a study focusing on Swaziland tracked competitiveness by looking into the unavailability of professional labor in agriculture, high cost of supplies/inputs, incompetence of public sector personnel, ineffective public sector personnel and the size of the local market. On the enhancing factors to competitiveness, the researchers focused on production of affordable high-quality products, availability of water for industrial purposes, and affordable cost of unskilled labor. The indicators of competitiveness addressed by researchers were all subjective and cannot be applied uniformly to the agricultural sector in any country. As an implication, the factors researched would not be effective in measuring competitiveness over time.

Kenya's agricultural sector competitiveness has been sparingly considered in past research. Gachukia (2014) focused on the competitiveness of the horticultural sector and demonstrated weakening competitiveness of the sector. The finding is consistent with other research studies focusing on agriculture in Africa and other frontier and emerging economies. The challenge, however, is the inconsistent and subjective approach to the measurement of competitiveness. The researcher focused on capabilities, incentives, and natural endowment as the measures of competitiveness. The challenge is, as Porter (1985) asserted, these factors are ubiquitous. Kenya's agricultural endowment is not significantly different from that of many other African countries. The implications are that natural

endowment cannot be a measure of competitiveness in the agricultural sector. Rather, factors that differentiate Kenya's agricultural sector from the same sector in any other country would be the most important source of competitiveness.

2.4 Regulations and Trade Agreements

The government has the responsibility of making decisions on policies and regulations. The printed documents are availed in the media to facilitate easy sharing of the information as well as implementation of the policies. This helps in the realization of the government objectives in relation to the agricultural industry. A list of the Agricultural policies is beneficial where content of the policy is well understood, and easy execution evident. The government is finalizing on the development of the Agricultural Sector Development Strategy (ASDS), which will strategically make the agricultural sector a key driver for achieving the maximum GDP under the set pillars of the vision 2030. This would transform the sector into a profitable activity capable of attracting investment from investors and equally so providing employment to the youth in the country.

The supply related policies are grants on farm inputs through involvement of government boards in importing and distribution of the inputs. The policies facilitate the improvement of research and extension services, the development of rural agricultural markets and agri-business skills among the youth. Additionally, the policies promote competitive advantage by allowing the imports of goods for which the country does not have a competitive advantage. Prices related policies outline the roles and involvement of national boards in the purchasing price of goods from farmers, subsidization of retail prices and levels of food reserves in the country.

The income from agricultural produce is contributed to the social amenities that benefit the low-income earners by increasing their income allowing them to have extra money to spend. The transfer of money to the grassroots helps the local communities meet the development needs in the counties while at the same time creating jobs for the youth. The establishment of producer and marketing associations for farmers is an avenue to exploit the economic skill of the industry.

Kenya is a member of the World Trade Organization since 1995. A conference held in 2015 led to the adoption of the Nairobi package which is a series of six ministerial decisions on agriculture, cotton and issues related to less developed countries. With membership in EAC and COMESA imports and exports within member countries is easy as preferential rates are given among the countries. A unique framework and partnership is often established in the region. The exports from Kenya into the EU enjoy duty reduction as well as freedom from all quota restrictions. As a result of multi-lateral agreements Kenya qualifies for duty free access to the US until 2025, products such as textiles, apparels and handicrafts enjoy the benefit. The export is made possible through the African Growth and opportunity Act. In addition, Kenya has signed bilateral agreements with various countries.

2.5 Knowledge Gap

The understanding of what competitiveness actually entails is not just a Kenyan problem. The challenge in tracking competitiveness in agribusiness lies in designing a theoretically sound and systematic approach to measure and analyze competitive performance. Rooyen and Boonzaaier (2017) found that while researchers focusing on competitiveness in the agricultural sector had focused on competitiveness, there were still major controversies on

how to measure competitive performance in the agribusiness firms. This demonstrated the need not only to conduct further research but also to follow a robust and objective model of measuring competitiveness of the agricultural sector (Karanja, 2013). This study submitted that using the Balassa Index to measure competitiveness of the agricultural sector would help in resolving the methodological challenge in the measurement of agribusiness competitiveness (Balassa, 1965).

2.6 Conceptual Framework

The conceptual framework represents the relationship between the independent and dependent variables. Innovation has a direct impact on the competitiveness of agricultural produce. Competitiveness is however affected by intervening factors such as regulatory environment. From this relationship, a conceptual framework is developed as illustrated in Figure 2.1.

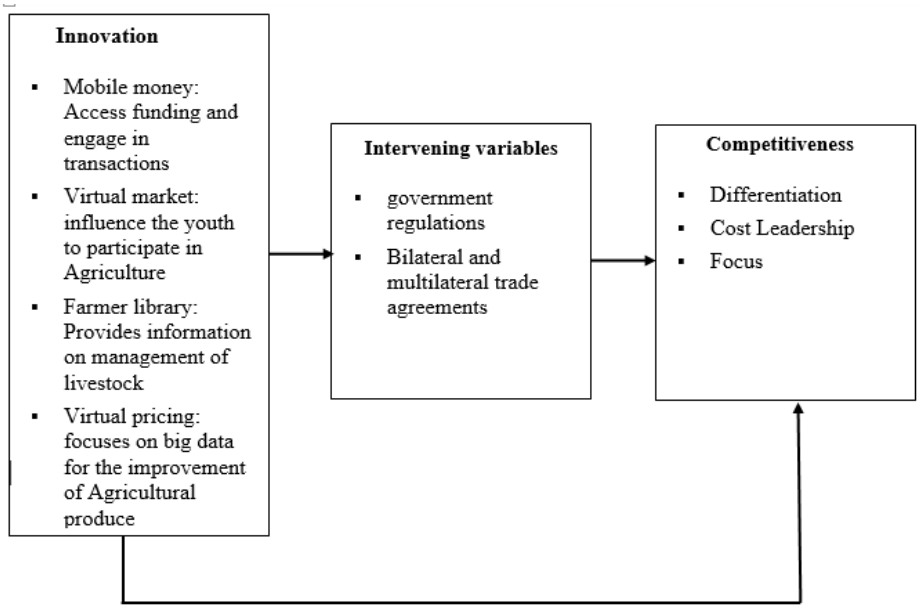

Figure2.1: Conceptual Framework

Source: *Author, 2019*

2.7 Summary

The objective of the research was to determine the effects of innovation on competitiveness in the agricultural industry in Kenya. In this chapter, the focus was on the review of both theoretical and empirical literature. Comparative advantage theory, competitive advantage theory, and diffusion of innovation theory were used in the research. The review of empirical literature indicated that there was an agreement among researchers that the agricultural sector in emerging markets, Africa, and in Kenya lacked competitiveness. The challenge however, was that the measures of competitiveness adopted by past researchers were not objective and could not be replicated uniformly across different nations. This led to the use of the Balassa Index in measuring competitiveness (Balassa, 1965). The index focuses on two indicators of competitiveness and these include the quantity of exported goods and the value.

CHAPTER THREE: RESEARCH METHODOLOGY

3.1 Introduction

Chapter three of the study provides the research methodology. The chapter covers the research design, population and sampling, data collection and data analysis. The chapter also provides details of research procedures.

3.2 Research Design

The research adopted a survey design. The design allowed the researcher to use procedures in quantitative research for the administration of a questionnaire to a sample or the entire population for purposes of collecting data that describes the attitudes, opinions, behaviors, and characteristics of the population.

This research specifically followed the cross-sectional survey research design. Cross-sectional surveys are used when not necessary to track the variable over extended period and when the purpose is to describe the phenomenon of research at a particular point in time. The design has its primary weakness being that findings of the study are only relevant to the particular period when the study was conducted. In this research, the cross-sectional research design was used in describing the competitiveness of Kenya's agricultural exports.

3.3 Population

The research focused on Kenya's top-three agricultural exports that include tea, coffee, and horticultural produce, mainly cut flowers. The three agricultural commodities are mainly exported through firms in Kenya. The population of the research were the firms that produce and export any of the three agricultural commodities. The population excluded firms that were only traders in the products of study since such traders lack the incentives

to bring forth innovations that directly target the production of the agricultural commodities. The implications were that the firms had to be primary producers and exporters.

The research targeted a sample of 45 firms to participate in the research. This included 15 firms that produced and exported tea, 15 firms that produced and exported coffee, and 15 firms that produced and exported horticultural produce. A sample of 45 firms was considered appropriate to meet the objectives of the study, allow for statistical testing of the data, and was representative of agribusiness firms in Kenya especially for the three crops.

3.4 Data Collection

Data was collected using a questionnaire. The design of the questionnaire encompassed the three research objectives, which included establishing the extent to which innovations is use by agribusiness firms in Kenya targeting export market, to determine the relationship between innovation use and agribusiness competitiveness in agribusiness firms in Kenya, and to establish challenges facing innovation and competitiveness of agribusiness in Kenya.

The questionnaire was administered electronically using Google Forms. The process of administration involved calling the firms identified for the study and mailing the questionnaire. The research did not gather any identifying information including the names and address of the firms. Where necessary and upon request, the firms involved in the study were provided with a copy of the research findings. It is considered that the research would

benefit the firms in understanding the competitiveness of the industry and the findings help significantly improve agribusiness in Kenya.

3.5 Data Analysis

The data was analyzed quantitatively using descriptive statistics and other statistical tests for hypothesis testing. Analysis of the extent to which technological innovations are used by Kenyan agribusiness firms targeting export markets was completed using descriptive statistics. The data collected was on ordinal scale. Consequently, the measures of descriptive statistics included mean and mode. The results of analysis were presented in tables and graphs as shown in table

Table 3.1: Data Analysis Methods

	Scales of Measurement	Analysis Methods
Research Objective 1	Nominal, Ordinal	Descriptive Statistics (mode, frequency tables)
Research Objective 2	Ordinal	Ordinal Regression Analysis, Correlation analysis
Research Objective 3	Nominal, Ordinal	Descriptive Statistics (mode, frequency tables)

In determining the relationship between technological innovation and competitiveness of agribusiness firms in Kenya, the analysis used regression analysis. Ordinal regression analysis was used since the data collected was ordinal in measurement. The regression model was important in determining the nature of the relationship between technological innovation and competitiveness and the extent to which the variables selected would explain the extent of technological innovation in the firms. Hypothesis testing was completed at 95% confidence interval.

The analysis of competitiveness included the use of Balassa Index. Following theory on Balassa index, competitiveness is considered both from the perspectives of changes in quantity exported and from changes in the value of the exports. The general Balassa equation provides the ratio of actual-to-expected export as the measure of competitiveness and holds that if $X \geq X^E$ (actual export value is higher than expected export value) then the nation has comparative advantage on the specific good or product being exported (Balassa, 1965).Firms that demonstrate significant improvements either in quantity or value of exports would be considered more competitive than firms that have not had significant improvements in either of the two measures as well as firms that have reported reductions. The assumption was that competitiveness is the main factor resulting in improvements of quantity and value of exports. Balassa index essentially provides descriptive data on competitiveness of the agribusiness firms and will help in determining any prevalent differences in competitiveness of the firms in agribusiness.

The last major analysis focused on establishing the challenges facing technological innovations and competitiveness of agribusiness firms in Kenya. Based on the review of literature and subsequently the questionnaire, the data collected on the challenges was on a nominal scale and partly on ordinal scale. Consequently, the data was analyzed using descriptive statistics mainly the mode. The data was presented using Tables and cross-tabulation linking challenges to the presence or lack of innovation as the case may apply.

Lastly, the research used correlation analysis to demonstrate the linkages between technological innovations and competitiveness of agribusiness as well as the linkages between the extent of innovation and the challenges faced by agribusiness firms. The

importance of correlation was used mainly to demonstrate the strength of the relationships therein and also to demonstrate where possible causation may exist for future testing and research.

CHAPTER FOUR: RESULT AND DISCUSSION OF FINDINGS

4.1 Introduction

The objective of the research was to determine the effects of innovation on competitiveness in the agricultural industry in Kenya. A survey was conducted on 45 firms in the coffee, tea, and horticultural production and exports business. Chapter four presents the results of the study and discussion of findings.

4.2 General Information

A survey was conducted on 45 firms out of which 16 firms (35.6%) produce and export coffee, 14 firms (31.1%) produce and export tea, and 15 firms (33.3%) produce and export horticultural products. The target sample was 45 firms hence the study managed 100% response rate. The frequency table shows the distribution of the firms studied by the crops they produce and export.

Table 4.1: Crops Produced

		Frequency	Percent	Cumulative Percent
Valid	a. Coffee	16	35.6	35.6
	b. Tea	14	31.1	66.7
	c. Horticultural Products	15	33.3	100.0
	Total	45	100.0	

4.3 Target Export Markets

Europe is Kenya's main market for horticultural products given mentions by 64.44% mentions on export markets by horticultural products firms. Netherlands and the UK are top destinations for the horticultural products. The products also sell in Germany, Italy, France, Switzerland, and Sweden among other European countries. The remaining 35.56% of horticultural products is sold to Australia and Russia with 4 mentions each. This is

followed by the US market with three mentions, Middle East with 2 mentions, and finally Canada, China, and Japan with one mention each. The data is important in directing the firms on where more target should be whether it is for market development of pursuit of more trade agreements.

Table 4.2: Target Countries for Horticultural Products

Country/Region	Percentage
Middle East	5%
Japan	2%
China	2%
Canada	2%
USA	7%
Russia	9%
Australia	9%
Europe	64%

Focusing on tea, the main markets are in the Middle East which takes a total of 63% of the market. The major countries to which Kenya exports tea in the Middle East are Pakistan, which was mentioned as many times as the UK. Egypt is also a significant market, the UAE, and Yemen. Other countries in the Middle East where Kenya exports tea are Afghanistan and Kazakhstan. The Table4.3 shows the summary of export markets for tea.

Table 4.3: Target Markets for Tea

Country/Region	Percentage
Middle East	63%
UK	21%
Sudan	9%
Russia	3%
USA	2%
Netherlands	2%

The main target markets for coffee are in Europe with the UK leading as the target destination followed by Netherlands and Germany in the European market. It total, European countries received 55% of the mentions in the analysis. The Middle East follows

with 22% of the market and the USA comes third with 11%. Other countries include Uganda, Tanzania, and Rwanda. The Table4.4 summarizes the target markets for coffee.

Table 4.4: Target Markets for Coffee

Country/Region	Percentage
USA	11%
Europe	55%
Middle East	22%
Uganda	4%
Tanzania	4%
Rwanda	2%
India	2%

4.4 Use of Technological Innovations in Agribusiness Firms

The first objective of the study was to establish the extent to which technological innovations are used by Kenyan agribusiness firms targeting export markets. The objective was pursued by focusing on whether crop production was mechanized. Findings of the study indicated that no firm recorded mechanization to a very great extent. Three firms (6.7%) recorded that they had mechanized production to a great extent while 19 firms (42.2%) recorded mechanization of production to much extent. On a scale of 1 to 5 where 1 is very small extent and 5 is very great extent, 49.9% of firms mechanized production of the crops on a measure of 3 to 4 while the rest recorded small (33.3%) to very small extent (17.8%).

Table 4.5: Mechanization of Production

		Extent of Mechanization of Production					Total
		Very great extent	Great extent	Much extent	Small extent	Very small extent	
Crops	a. Coffee	0	1	6	7	2	16
	b. Tea	0	2	9	3	0	14
	c. Horticultural Products	0	0	4	5	6	15
Total		0	3	19	15	8	45

The mechanization was analyzed further by crop produced. The data indicated that there was more mechanization in the production of tea than in the production of horticultural produce and coffee produce. Table4.6 shows the mechanization of production in the three crops.

Table 4.6: Extent Mechanization of Production

		Frequency	Percent	Cumulative Percent
Valid	a. Very great extent	0	0	0
	b. Great extent	3	6.7	6.7
	c. Much extent	19	42.2	48.9
	d. Small extent	15	33.3	82.2
	e. Very small extent	8	17.8	100.0
	Total	45	100.0	

The study also considered the use of technology in the production of the crops. Consistent with the data on mechanization, there was more application of technology in tea firms than in horticultural and coffee firms. Table4.7 shows the use of technology in production of coffee, tea, and horticultural products.

Table 4.7: Use of Technology in Production

		Frequency	Percent	Cumulative Percent
Valid	a. Very great extent	0	0	0
	b. Great extent	6	13.3	13.3
	c. Much extent	6	13.3	26.7
	d. Small extent	19	42.2	68.9
	e. Very small extent	14	31.1	100.0
	Total	45	100.0	

The study focused on the most recent technology applied by the firm. Various interesting findings were noted in the study. The study began with a focus on four technologies that included mobile money transfer, virtual market, farmer library, and virtual pricing platform. From the four technologies, virtual market technologies were used by 37.8% of the firms. Virtual pricing technologies were used by 17.8% of the firms and mobile money transfer was used by 11.1% of the firms. Farmer libraries were recorded in only 2 firms, representing 4.4%.

One of the most interesting observation is the list of other technologies that were used by the firms involved in the study. These include conveyor belts for transportation, automated drip irrigation, bar code reader systems, among other technologies shown in Table4.6. The mix of technologies was especially noted from the horticultural produce firms. Further, the technologies used mainly targeted the irrigation of the horticultural products considering the extent to which drip irrigation, hydroponic system, and water recycling systems appeared on the list of other technologies.

Further observations indicated that no single firm in the coffee industry uses technologies outside those considered in the study. In the coffee industry, the virtual market platform was most conspicuous, considering it is used by 11 out of the 16 firms in the study. This

was followed by the virtual pricing platform and lastly by mobile money transfer. Similar trends were observed in the tea industry where virtual market and virtual pricing were also the dominant technologies. The summary is as shown in Table 4.8.

The firms were asked to rate the most important technologies for the firm. Consistent with the findings above, virtual market emerged as the most important technology with 33.3% of the firms citing its importance. This was followed by virtual pricing platform with a support of 15.6%. Together the two technologies were supported by 48.9% as the most important technologies. Mobile money transfer came third with a support of 6.7% while farmer library was not rated by any of the firms as important.

Table 4.8: Most Recent Technology Purchased by the Firm

		Frequency	Percent	Cumulative Percent
Valid	a. Mobile money transfer	5	11.1	11.1
	automated drip irrigation	1	2.2	13.3
	automated drip system	1	2.2	15.6
	b. Virtual market	17	37.8	53.3
	bar code system to trace the product	1	2.2	55.6
	c. Farmer library	2	4.4	60.0
	Conveyor belt for transportation	1	2.2	62.2
	d. Virtual pricing platform	8	17.8	80.0
	drip irrigation	1	2.2	82.2
	Hydroponic system	1	2.2	84.4
	internal controls	1	2.2	86.7
	NFC powered electronic systems	1	2.2	88.9
	packing system	1	2.2	91.1
	SAP System	1	2.2	93.3
	Tracking software	1	2.2	95.6
	Water recycling system	1	2.2	97.8
	Weighing systems	1	2.2	100.0
	Total	45	100.0	

Analyzed by crop, the most important technologies for coffee industry were virtual market and virtual pricing technologies. Other important technologies are tracking and transportation technologies.

In the tea industry, virtual market and virtual pricing technologies were considered the most important. Other technologies included processing, blending, packaging, and electronic weighing equipment.

In the horticultural produce industry, the most important technologies were water management technologies including hydroponic systems, drip irrigation systems, water

recycling, and reverse osmosis technologies. These technologies reflect the diverse nature of the three technologies that make Kenya's principal exports.

Table 4.9: Most Important Technological Innovation

		Frequency	Percent	Cumulative Percent
Valid	a. Mobile money transfer	3	6.7	6.7
	automated movable vents and fans	1	2.2	8.9
	b. Virtual market	15	33.3	42.2
	Bar code reader	1	2.2	44.4
	Blending equipment	1	2.2	46.7
	conveyor belt transportation	1	2.2	48.9
	custom internal controls to agricultural export markets	1	2.2	51.1
	d. Virtual pricing platform	7	15.6	66.7
	Electronic weighing solutions	1	2.2	68.9
	Grading system	1	2.2	71.1
	hydroponic system	1	2.2	73.3
	Hydroponic system	1	2.2	75.6
	N/A	1	2.2	77.8
	packaging equipment	1	2.2	80.0
	Processing system	1	2.2	82.2
	reverse osmosis	1	2.2	84.4
	time in time out	1	2.2	86.7
	Tracking system	2	4.4	91.1
	transportation	1	2.2	93.3
	Transportation	1	2.2	95.6
	Water recycling system	1	2.2	97.8
	Weather system	1	2.2	100.0
	Total	45	100.0	

4.5 Relationship between Technological Innovation and Competitiveness

The second objective of the study was to determine the relationship between technological innovation and competitiveness of agribusiness firms in Kenya. Competitiveness is demonstrated when the firm is able to export more in terms of quantity or export at a better price than the competition. Consequently, the research pursued the questions on quantity and value of exports over the last three years, average price of exports over the last three years, and how the prices compared to the global prices.

Analysis of average prices in comparison with global prices indicated that 31.1% of the firms reported selling at prices higher than the global prices. 53.3% of the firms recorded no differences while 15.6% of the firms sold at lower prices compared to global prices. Considering price as an indicator of competitiveness, the 33.3% of firms were strategically more competitive than the average firm while 15.6% of the firms were less competitive.

Table 4.10: Firm Price Compared to Global Prices

		Frequency	Percent	Cumulative Percent
Valid	a. Higher Price	14	31.1	31.1
	b. Lower Price	7	15.6	46.7
	c. No difference	24	53.3	100.0
	Total	45	100.0	

The data was analyzed further based on the crops exported. The most uncompetitive industry was found to be the horticultural products industry where only 1 firm recording selling the products at a price higher than the global average. In the tea industry there were 6 out of 14 that sold at prices above the global average. For the coffee industry, 7 firms out of 16 sold at prices higher than the global average.

Further analysis focused on the extent to which the firms considered technology to influence the prices of the products. Data from the study indicated that 51.1% viewed technology as having only a small extent on the prices with a further 8.9% recording a very small extent. No firm considered that technology was important to a very great extent when it comes to pricing 31.1% recorded a great extent with the last 8.9% recoding much extent. The overall view was that there were other factors that were more important in influencing the price and value of exports that the use of technology.

Table 4.11: Contribution of Technological Innovations to Price Difference

		Frequency	Percent	Cumulative Percent
Valid	a. Very great extent	0	0	0
	b. Great extent	4	8.9	8.9
	c. Much extent	14	31.1	40.0
	d. Small extent	23	51.1	91.1
	e. Very small extent	4	8.9	100.0
	Total	45	100.0	

The firms were asked whether they believed that Kenya had competitive advantage in the production of the crops. The responses indicated that 91.1% of the firms believed that Kenya has competitive advantage in the production and export of the agricultural products. Only 1 firm indicated that Kenya did not have competitive advantage and the firm was in the horticultural sector.

Further, the study focused on determining whether the firms derived strategic competitive advantage from technology. Findings of the study indicated that only one firm derived strategic competitive advantage from technology to a very great extent. Four firms derived strategic competitive advantage from technology to a great extent while 35.5% of the firms were moderate about technology being a source of strategic competitive advantage.

Majority of the firms considered that technology contribute to the strategic competitive advantage of the firm only to a small or very small extent.

Table 4.12: Technology as a Source of Strategic Competitive Advantage

		Frequency	Percent	Cumulative Percent
Valid	a. Very great extent	1	2.2	2.2
	b. Great extent	4	8.9	11.1
	c. Much extent	16	35.6	46.7
	d. Small extent	22	48.9	95.6
	e. Very small extent	2	4.4	100.0
	Total	45	100.0	

4.5.1 Regression Analysis

The study tested the relationship between the extent to which firms considered technological innovations as a source of strategic competitive advantage against the extent of mechanization, extent to which technology is used by the firms, and the contribution of technology to price difference in comparison to global prices. The variables in the test were al ordinal as shown in table 4.3, hence ordinal regression model was used in the analysis. All variables were analyzed on a five-level ordinal scale that includes very great extent, great extent, much extent, small extent, and very small extent.

Table 4.13: Variables for Ordinal Regression Analysis

Frequency and Marginal Percentage	Very great extent	Great extent	Much extent	Small extent	Very small extent
Technology as a Source of Strategic Competitive Advantage	1	4	16	22	2
	2.20%	8.90%	35.60%	48.90%	4.40%
Mechanization of Production	0	3	19	15	8
	0.00%	6.70%	42.20%	33.30%	17.80%
Use of Technology	0	6	6	19	14
	0.00%	13.30 %	13.30%	42.20%	31.10%
Contribution of Technology to Price Difference	0	4	14	23	4
	0.00%	8.90%	31.10%	51.10%	8.90%

The ordinal regression analysis resulted in the following model fitting information. The model fitting information the probability of correctly predicting the views of the firms about technology being a source of strategic competitive advantage based on the intercept only, based on the factors included in the analysis. In the study, the model would correctly predict the output by up to 77.77% probability. The final model is statistically significance at 5% confidence interval given the p value was recorded at 0.004.

Table 4.14: Model Fitting Information

Model	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	77.773			
Final	53.333	24.439	9	.004
Link function: Logit.				

The ordinal regression analysis proceeded to the analysis of the goodness of fit for the ordinal regression model. The analysis produced a p value of 0.994 for the null hypothesis that the model lacks goodness of fit. Effectively the null hypothesis was rejected indicating that the model was a good fit for the data. This was consistent with the observations made from case summaries on how firm's views strategic competitiveness related to extent of application of technological innovations.

Table 4.15: Goodness of Fit

	Chi-Square	df	Sig.
Pearson	41.504	67	.994
Deviance	35.207	67	1.000
Link function: Logit.			

The last component of the analysis is to explain the pseudo r-square generated from the model. Table 4.6 summarizes the r-square. The Cox and Snell pseudo r-square was recorded at 0.419 indicating that the variables in the study could only explain 41.9% of the

movements in competitiveness of the firm. The Nagelkerke pseudo r-square was higher at 0.465 while the McFadden pseudo r-square was recorded at 0.235. Effectively, the study found that adoption of technological innovations by the agribusiness firms explained competitiveness only to a limited extent. Nonetheless, technological innovations are important for the agribusiness firms herein studied.

Table 4.16: Pseudo R-Square

Cox and Snell	.419
Nagelkerke	.465
McFadden	.235
Link function: Logit.	

4.6 Challenges Facing Technological Innovations

The last objective of the study was to establish challenges facing technological innovations and competitiveness of agribusiness firms in Kenya. In this area, the study began by asking about the firms' generic competitive advantage from a list of two that included cost leadership. 44% of the firms reported using differentiation while 33.3% of the firms reported using cost leadership as the main generic strategy. A cross-tabulation of the data further indicated that differentiation strategy was the dominant strategy in the horticultural industry. In the tea industry the dominant strategy was cost leadership while differentiation was dominant for coffee.

Table 4.17: Generic Competitive Strategy

		Generic Competitive Strategy			Total
		Cost leadership	Differentiation	None of the above	
Crops	a. Coffee	6	8	2	16
	b. Tea	8	5	1	14
	c. Horticultural Products	1	7	7	15
Total		15	20	10	45

Bilateral and multilateral trade agreements between Kenya and her trade partners were found to be important in influencing the export market. However, the firms do not really consider the trade agreements as important in influencing the competitiveness and price of the exports. Nonetheless, firms in the industry monitor the developments in the trade agreements.

Focusing on the challenges facing the creation of strategic competitive advantage in the firms, changes in standards required for export products was the greatest challenge affecting 44.4% of the firms. A further 37.8% cited changes in government regulations as the greatest challenge. Other challenges included cost of technologies, internal controls, lack of government help, changes in the seasons, lack of local subsidies, high cost of production and low return. Table 4.18 summarizes the findings on challenges impeding creation of strategic competitive advantage in the firms.

Table 4.18: Challenges Impeding Creation of Strategic Competitive Advantage

Challenges to Creation of Strategic Competitive Advantage	Crops			Total
	Coffee	Tea	Horticultural products	
Changes in government regulations on agricultural produce for export markets	3	9	5	17
Changes in standards required for export goods	13	3	4	20
Bilateral and multilateral trade agreements between Kenya and her trade partners	0	2	0	2
Changes in the seasons	0	0	1	1
High cost of production and low return	0	0	1	1
Internal controls	0	0	2	2
Lack of government help in enabling the production and export of flowers	0	0	1	1
Local subsidies	0	0	1	1
Total	16	14	15	45

The last major focus was on the challenges facing adoption of technologies in the firms. An overwhelming 68.9% cited cost of technologies as the greatest challenge. Changes in government regulations and changes in standards were cited by 15.6% each as shown in table 4.19. No citations were made to multilateral and bilateral trade agreements.

Table 4.19: Challenges Impeding Technological Innovations

	Challenges to Technological Innovations			Total
	a. Changes in government regulations on agricultural produce for export markets	b. Changes in standards required for export goods	d. Cost of technologies	
Coffee	4	3	9	16
Crops Tea	1	2	11	14
Horticultural	2	2	11	15
Total	7	7	31	45

4.7 Discussion of Findings

Findings of the study were consistent with the competitive advantage theory as well as comparative advantage theory. Under comparative advantage theory, the study indicated that Kenya has comparative advantage for the three principal products under the study. Comparative advantage emanates from endowment of natural resources, mainly the climatic condition. From the competitive advantage theory, some of the firms recorded being able to sell the produce at a higher price than the global prices. This was an indication of competitiveness of the produce. The study considered the technological innovations had a moderate role in the creation of competitive advantage in the sector. Based on the diffusion of technology theory, the analysis depth in the horticultural sector considering the variety of technologies noted in the sector. Technological innovations in the sector

included reverse osmosis systems, hydroponic systems, and recycling systems among other technologies.

Findings in this study reveal enlightening trends on competitiveness of the agribusiness firms in Kenya. Gachukia (2014) had recorded weakening of competitiveness of the horticultural sector despite increased adoption of technologies in the sector. This study confirmed that while the horticultural sector reported the greatest mix and depth of technological innovations used, the sector also reported the weakest relationship between use of technological innovations and strategic competitiveness of the firm. This is further explained by the fact that use of technological innovations explains only 23% to 46% of strategic competitiveness of the industries under the study.

In the words of Porter (1985) the ubiquity of various firm capabilities cannot be a source of strategic competitive advantage. Source of strategic competitive advantage must be rare and inimitable. The case with the technologies identified in this study was that the technologies are either highly shared, ubiquitous, or imitable. The virtual market place and virtual pricing technologies, for instance, are used by nearly all firms in the commodities markets where coffee and tea sells. As a result, such technologies are not a source of strategic competitive advantage for the firms though they may help in market access and price discovery. Beyond these applications the technological innovations do not enhance competitiveness of the firm. Similarly, the water saving technologies are highly common for the horticultural industry. As a result, the technological innovations are not considered a source of competitive advantage for the industry.

Findings of the study confirmed that when seeking technological innovations for strategic competitive advantage the VRIO framework is necessary for appraisal of the technologies.

The technologies must be valuable, rare, inimitable, and organized towards gaining strategic competitive advantage. Such technologies are mostly disruptive in their impact for them to cause significant differences in the creation of competitive advantages for the firm. The findings are consistent with the theory of generating strategic competitive advantage for the firm.

Geoffrey, Hillary, Antony, Mariam and Mary (2014) noted that cost of technologies and lack of financing as the leading factors on the adoption of technological innovations in agribusiness firms. In this study, the cost of technology was observed to be the greatest hindrance to adoption of technological innovations. It is further considered that with cost of technological innovations being high, the level of innovation is lower hence resulting in little to no firm engineered technological innovations. Instead, firms simply adopt market-available technological innovations, which then puts all the firms at par with the innovations in the market.

Odhiambo (2012) noted the regulation by government as a major hindrance to the creation of strategic competitive advantage in agribusiness. Findings of this study consistently established that regulations have remained a key stumbling block in the adoption of technological innovations as well as in the creation of strategic advantage in the industry. Effectively, one of the possible solutions to this limitation would be the involvement of industry players in design of policies and regulations affecting the industry in order to streamline industry challenges with the regulatory environment for purposes of creating an enabling environment for creation of strategic competitive advantage by the industry.

Overall, the findings of the study are consistent with past research, which pointed to weak competitiveness of Kenya's agricultural sector. The findings are also consistent with

theoretical background of strategic competitive advantage to the extent that technological innovations should be valuable, rare, inimitable, and organized in order to generate strategic competitive advantage for the firm. At the same time, findings of the study are consistent with past research to the extent that technological innovations are not the sole source of strategic competitive advantage for the firm; technological innovations explain only 23% to 46% of strategic competitive advantage in the firm. Overall, the cost of technological innovations and government regulations are the greatest challenges towards the adoption of technological innovations as a source of strategic competitive advantage for the agricultural sector in Kenya.

4.8 Chapter Summary

In summary, Chapter Four presents the results and discussion of findings. The study reveals that there is moderate adoption of technological innovations by agribusiness firms targeting the export markets. The study also shows that technological innovations have a limited impact on the competitiveness of the agricultural produce in the export markets. The cost of technology is the greatest impediment to the adoption of technological innovations by the firms while changes in government regulations is the greatest impediment to the creation of strategic competitive advantage in the production and export of Kenya's leading agricultural produce. Overall, firms involved in the study considered that Kenya has competitive advantage in the production of the crops in this study. However, there is the need to advance the competitiveness of the industry.

CHAPTER FIVE: SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This is the last chapter in the study. The goal of the chapter is to recap the lessons learnt in the study by focusing on the objectives of the study, findings, and conclusions. The chapter also highlights the limitations and delimitations of the study and finally the recommendations.

5.2 Summary

The objective of the research was to determine the effects of innovation on competitiveness in the agricultural industry in Kenya. The study was conducted through the survey research design in which the focus was on Kenya's principal exports that include coffee, tea, and horticultural products. A total of 45 firms participated in the study. All firms produce and export any or all of the three principal agricultural exports. For each crop the target was to survey 15 firms.

The first specific objective was to establish the extent to which technological innovations are used by Kenyan agribusiness firms targeting export markets. The analysis found that technological innovations are moderately used by the agricultural firms in the study. The nature of the specific sectors in which the firms operate is labor intensive considering handpicking of coffee, handpicking of tea, and hand-preparations of the horticultural products for the markets. The nature of technological innovations used in the firms includes technologies in the upstream side of the value chain for coffee and tea where the dominant technologies are virtual marketing and virtual pricing technologies. Particularly this applies because of the existence of commodity markets for coffee and tea, a feature that lacks in the horticultural produce market due to the perish ability of the produce. In the horticultural

products industry, the use of downstream technologies in the irrigation of the crops was the most dominant finding. Systems such as hydroponic water systems, water recycling, reverse osmosis, drop irrigation, and many similar technologies were noted. This indicated depth in the technologies used. It is important to note that virtual farmer libraries which we one of the technologies targeted in the study were conspicuously missing in all the firms studied.

The second specific objective of the study was to determine the relationship between technological innovation and competitiveness of agribusiness firms in Kenya. A weak positive relationship between technological innovations and competitiveness of agribusiness firms was noted. The findings were interpreted to mean that technological innovations were largely an enabler for the production of the produce and access to the markets. However, they were not considered to significantly improve the competitiveness of the crop produce in the market with competitiveness being assessed with respect to the volume of exports and the value of exports. The implications are that technological innovations for the firms were viewed as a source of upstream efficiency which entails efficiency in cost and efficiency in the use of water. The technological innovations also significantly contribute to efficiency in access to markets and in pricing. Consistent with this finding, firms in the study overwhelmingly reported that the prices that their produce attracted were not significantly different from the global prices for the produce. Any variations in the prices was due to the target markets with prices for produce sold in the Middle East being slightly different from that of produce sold in Europe and the price of the produce sold in the USA. The implications are that the target market dynamics played an important role in the realization of value for the agribusiness firms in the study.

The last specific objective of the study was to establish challenges facing technological innovations and competitiveness of agribusiness firms in Kenya. Findings of the study indicated that cost of technologies was the main challenge impeding adoption of technological innovations in the agribusiness firms. The firms considered that the lack of subsidies on the technologies as a major challenge that fueled the costs of the technologies. Further, the study established that changes in government regulations on exports and changes in export standards impact the creation of strategic competitive advantage for the firms in the production of the three principal exports. Despite the challenges, the firms considered that Kenya has strategic competitive advantaged in the production and export of the three crops in the analysis.

5.3 Conclusions

The study concluded that technological innovations impact the competitiveness of Kenya's leading agricultural exports only to a limited extent. The firms involved in the study reported that the use of technological innovations had moderate to low impact on competitiveness of the products in the export markets. The findings of the study confirmed that use of technological innovations and extent of mechanization only explained up to 46% of the strategic competitive advantage in the export markets.

The study established that firms in the industry have adopted technological innovation on a moderate to high extent. The horticultural produce industry has the highest rates of using technological innovations with the technologies mainly focusing on water usage. The technologies highly cited by the industry included the use of hydroponic systems, water recycling technologies, reverse osmosis technologies, and drip irrigation systems, all of which cover the use of water by the horticultural industry. In the tea and coffee industry

the technologies are mainly virtual market systems and virtual pricing systems supported by the commodification of the two products. These technologies mainly affect access to market and not the competitiveness of the produce in the export markets. The tea industry also cited technologies such as blending, packaging, weighing, and blending technologies. The lowest application of technologies was in the coffee industry.

Finally, the study concluded that cost of technologies was the greatest hindrance or challenge to the adoption of technological innovations in the industry. Firms involved in the study overwhelmingly cited high cost of technologies citing the need for subsidies that would encourage the adoption of technological innovations. With respect to challenges facing derivation of strategic competitive advantage for the firms in the industry, the greatest challenges was found to be changes in government regulations especially where the regulations affect the exportation of the agricultural produce. The second challenge to derivation of strategic competitive advantage was the changes in standards for export produce.

5.4 Recommendations for Improvement

The study established that changes in government regulations on agricultural produce for export markets was a great hindrance to both the generation of strategic competitive advantage and adoption of technological innovations. Effectively, the study recommends enhanced stakeholder engagement on policy and regulations targeting the produce for export markets. Enhanced involvement of the firms would result in better understanding of policy, more support for policy, and at the same time policy would reflect the interests and challenges faced by the industry. Overall, collaborative development of policy between the

government and the industry would result in smoother adoption of technological innovations.

The study also recommends subsidies on investments in technological innovations. The recommendation is based on the finding that cost was the greatest impediment to adoption of technological innovations. By providing subsidies on the technologies the government would encourage adoption of innovations, lower the costs of production, and enhance the competitiveness of the agricultural produce in the export markets.

5.5 Limitations and Delimitations

The research focused on four main technologies based on reviewed literature. The four technologies include virtual market technologies, virtual pricing technologies, mobile money technologies, and virtual farmer libraries. A firm without any of the four technologies would be limited on the responses. To delimit the study, the researcher asked the respondents to indicate the firms' major and most important technology in the "other" response. The study was therefore able to gather detailed insights on the variety of technologies applied by the firms in the value chains of Kenya's principle exports.

5.6 Suggestions for Further Studies

The researcher asked the firms to identify problematic areas that required further research in the specific industries. There were various suggestions on areas for further research. Marketing systems and transportation emerged as the areas where further research is most required. There was also the request for further research in mechanization of flower firms, tracking systems, cargo consolidation, and warehousing. Additionally, the role of lobby groups in innovations, blending innovations, and product costing were also mentioned as areas requiring further research.

Based on the analyses of data in this study, further research should address the areas mentioned by the firms but most attention should be directed to marketing innovations and innovations in transportation logistics. The dominance in the mention of the two areas for further research was an indication of bottlenecks.

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APPENDIX

Appendix 1: Questionnaire

PART 1: INTRODUCTION

My name is Virginia Mukundi, a student at the University of Nairobi pursuing a Master of Science in Operations and Technology Management. I am conducting a study on agribusiness firms in Kenya. This questionnaire is designed for a study titled *Technological Innovation and Competitiveness of Agribusiness Firms in Kenya.*

Your firm has been sampled for voluntary participation in the study. There are no right or wrong, correct or incorrect, responses. The participant is requested to provide truthful responses and to the best of their knowledge. Please respond to the questionnaire only if your firm produces and exports either coffee, tea, or horticultural products.

PART 2: GENERAL INFORMATION

2.1 Which of the following crops does your firm produce?

a. Coffee
b. Tea
c. Horticultural Products
d. Others, Specify……

2.2 Does your firm export the crop(s) above?

a. Yes
b. No

2.3 Which are the main export markets for your crop(s)?

…….

PART 3: EXTENT TO WHICH INNOVATIONS ARE IN USE BY AGRIBUSINESS FIRMS IN KENYA TARGETING EXPORT MARKET

3.1 To what extent has your firm mechanized the production of the crop(s) in Q2.1 above?

a. Very great extent
b. Great extent
c. Much extent
d. Small extent
e. Very small extent

3.2 To what extent do you use technology in production of the crop in Q1 above?

a. Very great extent
b. Great extent
c. Much extent
d. Small extent
e. Very small extent

3.3 Which is the most recent technology that your firm invested in to improve the value chain of the crop(s) above?

a. Mobile money transfer
b. Virtual market
c. Farmer library
d. Virtual pricing platform
e. Others, specify

3.4 Which is the most important technological innovation in the value chain of the crop(s) above?

a. Mobile money transfer
b. Virtual market
c. Farmer library
d. Virtual pricing platform
e. Others, specify

PART 4: RELATIONSHIP BETWEEN INNOVATION USE AND AGRIBUSINESS COMPETITIVENESS IN AGRIBUSINESS FIRMS IN KENYA

4.1 What was the annual quantity and value of your exports over the last ten years?

Year	Quantity (tons)	Annual Value (Ksh.)
2008		
2009		
2010		
2011		
2012		
2013		
2014		
2015		
2016		
2017		
2018		

4.2 What was the average price of your produce over the last ten years?

Average …….

4.3 On average, does your produce attract a price that is higher or lower than the global prices for the commodity?

a. Higher Price
b. Lower Price
c. No difference

4.4 To what extent does technology contribute to the price difference indicated in question 4.3 above?

a. Very great extent
b. Great extent
c. Much extent
d. Small extent
e. Very small extent

4.5 In your opinion, does Kenya have comparative advantage in the production of the crop(s) identified above?

a. Yes
b. No

4.6 To what extent does your company derive strategic competitive advantage from technology with respect to the value chain system of the crop(s) identified above?

a. Very great extent
b. Great extent
c. Much extent
d. Small extent
e. Very small extent

PART 5: CHALLENGES FACING INNOVATION AND COMPETITIVENESS OF AGRIBUSINESS IN KENYA

5.1 Which of the following generic competitive strategies does your firm pursue?

a. Cost leadership
b. Differentiation

c. None of the above

5.2 Does your firm export the agricultural produce on the basis of bilateral and multilateral trade agreements between Kenya and her trade partners?

a. Yes

b. No

5.3 To what extent do bilateral and multilateral trade agreements influence the quantity of exports?

a. Very great extent

b. Great extent

c. Much extent

d. Small extent

e. Very small extent

5.4 To what extent do bilateral and multilateral trade agreements influence the price of exports?

a. Very great extent

b. Great extent

c. Much extent

d. Small extent

e. Very small extent

5.5 Which of the following challenges are the greatest impediments to creation of strategic competitive advantage in the firm?

a. Changes in government regulations on agricultural produce for export markets

b. Changes in standards required for export goods

c. Bilateral and multilateral trade agreements between Kenya and her trade partners

d. Cost of technologies

5.6 Which of the following challenges are the greatest impediments to technological innovations in the firm?

a. Changes in government regulations on agricultural produce for export markets

b. Changes in standards required for export goods

c. Bilateral and multilateral trade agreements between Kenya and her trade partners

d. Cost of technologies