SCHOOL OF HUMANITIES AND SOCIAL SCIENCES

THE SIGNIFICANCE OF INNOVATION AND TECHNOLOGY IN TRANSFORMING FOOD SECURITY IN EAST AFRICA.

MBAE WINJOY MUKAMI
NO: 647523

A Thesis Submitted to the School of Humanities and Social Sciences (SHSS) in Partial Fulfillment of the Requirement for the Degree of Master of Arts in International Relations

FALL SEMESTER 2017
STUDENT’S DECLARATION

I, the undersigned, declare that this is my original work and has not been submitted to any other college, institution or university other than the United States International University in Nairobi for academic credit.

Signed: ___________________________  Date: ________________________

Winjoy Mukami Mbae

This thesis has been presented for examination with my approval as the appointed supervisor.

Signed: ___________________________  Date: ________________________

Name of the Supervisor

Signed: ___________________________  Date: ________________________

Name of the Dean

Dean, School of Humanities and Social Sciences (SHSS)

Signed: ___________________________  Date: ________________________

Name of the DVCAA

Deputy Vice Chancellor, Academic Affairs (DVCAA)
DEDICATION

I dedicate this thesis to my Father, Eliphas Mbae for his unwavering support, kindness and for making me into the person I am today.
ACKNOWLEDGEMENT
I humbly thank the Almighty God for His blessings in my life and for seeing me through this
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<tbody>
<tr>
<td>ARDP</td>
<td>Agriculture and Rural Development Policy</td>
</tr>
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<td>CAAPD</td>
<td>Comprehensive Africa Agriculture Development Programme</td>
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<td>CET</td>
<td>Common External Tariffs</td>
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<td>COMESA</td>
<td>Common Market for Eastern and Southern Africa</td>
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<td>CU</td>
<td>Customs Union</td>
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<td>EAC</td>
<td>East Africa Community</td>
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<td>EACM</td>
<td>East Africa Common Market</td>
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<tr>
<td>EASTECO</td>
<td>East Africa Science and Technology Commission</td>
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<td>ECOWAS</td>
<td>Economic Community of West Africa States</td>
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<tr>
<td>ERA</td>
<td>Economic Report on Africa</td>
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<tr>
<td>FAO</td>
<td>Food and Agricultural Organization of the United Nations</td>
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<td>FTA</td>
<td>Free Trade Area</td>
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<td>GDP</td>
<td>Gross Domestic product</td>
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<td>GRC</td>
<td>Green Revolution Council</td>
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<td>ICT</td>
<td>Information and Communication Technology</td>
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<td>MDGs</td>
<td>Millennium Development Goals</td>
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<td>MT</td>
<td>Metric Tones</td>
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<td>NEPAD</td>
<td>New Partnership for Africa’s Development</td>
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<td>Abbreviation</td>
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<tr>
<td>NTBs</td>
<td>Non-Tariffs Barriers</td>
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<td>OECD</td>
<td>Organization for Economic Co-operation and development</td>
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<td>RECs</td>
<td>Regional Economic Communities</td>
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<td>RFBS</td>
<td>Regional Food Balance sheet</td>
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<tr>
<td>SDGs</td>
<td>Sustainable Development Goals</td>
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<td>SIT</td>
<td>Science, Innovation and technology</td>
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<td>STS</td>
<td>Structured Trade Systems</td>
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<td>UN</td>
<td>United Nations</td>
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<td>UNCTAD</td>
<td>United Nations Conference on Trade and Development</td>
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<tr>
<td>UNESCO</td>
<td>United Nations, Educational, Scientific and Cultural Organization</td>
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<tr>
<td>USAID</td>
<td>United States Agency for International Development</td>
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<tr>
<td>WB</td>
<td>World Bank</td>
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<td>WRS</td>
<td>Warehouse Receipts Systems</td>
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ABSTRACT
One of the major global concerns historically and in the twenty-first century is providing sufficient, safe and nutritious food to all people. New, existing and emerging technologies can help address the issue of food security in the East Africa region. This research examines the significance of innovation and technology in transforming the food systems in East Africa.

Achieving hunger and improved food systems by 2030 according to the new sustainable development goals, will require new and existing applications of science, technology, and innovations across the food system addressing all dimensions of food security.

This research finds out how food security within the East Africa region can be improved through innovation and technology. The use of various relevant literatures and case study are key in this study incorporation with key relevant theories. This helps in examining the existing gap between policy formulation and implementation in achieving productive food systems within the EAC region.
CHAPTER ONE: INTRODUCTION

1.0 Background to the study

The impact of technology on our everyday lives and economic interactions is undeniable. According to Lester Brown (2012), “the world is in transition from an era of food abundance to one of scarcity. Lester acknowledges also that, over the last decade, world grains reserves have fallen by one third. World food prices have more than doubled, triggering a worldwide land rush and ushering in a new geopolitics of food. Through this, food is seen as the new oil and land being the new gold. Africa has long been a symbol of the continent’s poverty with hundreds of millions of African small holders’ farmers being considered too backward to thrive.

Food security is a condition whereby “all people, at all times, have physical and economic access to sufficient, safe, and nutritious food to meet their dietary needs and food preferences for an active and healthy life” (FAO World Food Summit, 1996). Food is a fundamental human need. Our efforts to secure food have been intimately interwoven with the evolution of many societal structures such as our laws and regulations, our customs and ceremonies, and our trade and commerce arrangements. In addition to serving nutritional needs, food is an important factor in cultural identity; food can reveal relationships between the past and the present, reflect epochal transformation, and mark changing identities of various groups of people through new ways of appropriations (Chan, 2010).

For many people today, and historically for the vast majority, efforts to secure food have dictated our everyday activities of hunting, gathering, farming, ranching and fishing. Such efforts have also driven the way we have exploited (and often over-exploited) natural resources. Driven by the requirement to feed ever increasing human demand, major scientific and technical advances have been made in the production of food. Based on a series of research, development,
and technology transfer initiatives occurring between the 1940s and the late 1970s, the ‘green revolution’ saw agriculture production increase around the world. Rapid advances were seen initially in Mexico, the US and Europe, and then in Asia (Hazell, 2009).

Food security is a state or condition. It is a flexible concept as reflected in the many attempts at definition in research and policy usage (FAO, 2003), and numerous definitions of food security thus exist. Even by 1992 Maxwell and Smith had counted over 200 (spring, 2009), and more are still being formulated (e.g. Defra, 2006). Nonetheless, a commonly-used definition stemming from the 1996 World Food Summit states that food security is met when “all people, at all times, have physical and economic access to sufficient, safe, and nutritious food to meet their dietary needs and food preferences for an active and healthy life”. This definition built on the key work by Amartya Sen (Sen, 1981) in which he demonstrated that famine occurs not only from a lack of food, but from inequalities built into mechanisms for distributing food. So, not only does the definition bring in a wide range of issues related to a fuller understanding of food security, but some key words such as “food production” and “agriculture” – which might have been expected in such a definition – are not included; the emphasis changed from increasing food production to increasing access to food for all. The majority of more recent definitions of food security share the notion of access to food as being the key aspect. These definitions are manifestly valuable in raising the profile of the many factors that contribute to food security in addition to producing food.
A vast food system spreads beyond farm and table to touch almost every aspect of life in every society. Making that system in Africa as robust as possible will not merely prevent starvation. It will also fight poverty, disease and malnutrition; create businesses and jobs; and boost the continent’s economies and improve its trade balances. The Chairman of the assembly of the African Union, President Bingu wa Mutharika (February 2010), speaks of Africa being endowed with vast fertile soils, favorable climates, vast water basins and perennial rivers that could be utilized for irrigation farming and lead to green revolution, and mitigate adverse effects of climate change. He further proposes a slogan on feeding Africans through New technologies. This creates the importance notion on transforming food security in Africa.

Borrowing from Calestous Juma (2011), African agriculture persistent food shortages are now being compounded by new threats arising from climate change. Despite the shortcomings, Africa faces three major opportunities that can help transform its agriculture to be a force for economic growth;

- Advances in science, technology, and engineering worldwide offer Africa new tools needed to promote sustainable agriculture.
- Efforts to create regional markets will provide new incentives for agricultural production and trade.
- A new generation of African leaders is helping the continent to focus on long –term economic transformation.

Through this knowledge, the emergence of Africa’s Regional Economic communities (RECs) provides a unique opportunity to promote innovation in African agriculture in a more systematic and coordinated ways. This study narrows down its focus to regional integration and seeks to find out; how the East Africa community can harness innovation and technology to transform its
food systems. The region has a huge untapped potential to produce enough food for themselves and surplus for trade (United Nations, 2010). Food systems include the governance and economics of food production, its sustainability, the degree to which we waste food, and how food production affects the natural environment. Agriculture is one of the central contributions to the availability of food, and indirectly as a key engine of economic development and hence improved access to food. Thinking of technology, it is already being applied extensively within the food and agricultural industries for both improved efficiency and productivity in the established food systems. The East Africa region needs to focus on food production and productivity, determinants of achieving food production revolve around land access to technology, credit, infrastructure (including water) and markets.

As the global economy becomes more complex and changes rapidly, African governments and development partners are seeking to better anticipate future opportunities and emerging challenges, so that they can respond proactively to them. According to Fagerberg et.al (2005), when thinking about innovation and technology, it is crucial not only because it links people, institutions, and information but also it speeds up these connections in ways that were barely imaginable a few decades ago. In the digital technology, today’s African leaders have a powerful tool they can deploy to help clear away the primary obstacle to progress; the profound isolation of the vast majority of small-holder farmers.

Innovations and technology are significant in making connections possible, transferring of information instantaneously and can help build virtual communities even among widely separated communities in ensuring food security. The process of technological innovation involves interactions among a wide range of actors in society, who form a system of mutually reinforcing learning activities. These interactions and the associated components constitute
dynamic “innovation systems.” Innovation systems according to Hall et.al (2006), can be understood by determining what within the institutional mixture is local and what is external. Open systems are needed, in which new actors and institutions are constantly being created, changed, and adapted to suit the dynamics of scientific and technological creation. According to Samberg (2005), the innovation systems within countries can vary across localities. Local variations in innovation levels, technology adoption and diffusion, and the institutional mix are significant features of all countries. An innovation system can be defined as a network of organizations, enterprises, and individuals focused on bringing new products, new processes, and new forms of organization into economic use, together with the institutions and policies that affect their behavior and performance. The innovation systems concept embraces not only the science suppliers but the totality and interaction of actors involved in innovation. It extends beyond the creation of knowledge to encompass the factors affecting demand for and use of knowledge in novel and useful ways.

1.1 Statement of research problem
Various literatures have acknowledged that, the East African community region is frequently affected by food shortages and pockets of hunger. According to Omiti, et al (2011), this is due to a complex mix of factors including; unstable social and political environments, microeconomics imbalances in trade, natural resources constraints, natural disasters, and poor food distribution network within the member countries. The countries also experience high weather variability which has been compounded by climate change and absence of good governance. To achieve transformed food systems and achieve food security in East African region, there is need to refocus our targets on the relevant tools that will enhance the success. With various policies formulated in line with achieving food security, they are still hanging with no clear mechanisms of achieving food security in the region. This study is focused on filling the gap on innovating
these food systems and ensuring that, with the use of relevant technologies food security is achieved in the East Africa region. The research is intended to complement the existing literature that explores the impact of innovation and technology in transforming the East African region food systems, but which does not explicitly explore the implications of improved food systems.

1.2 Objectives of the Study
1. What is the current state of East Africa food security?
2. How is innovation and technology significant in transforming food security in the East African region?
3. What is the role of EAC in improving the regional food security through innovation and technology?

1.3 Research questions
1. To assess the current state of East African food security.
2. To find out how innovation and technology aid in transforming food security in the East African region.
3. To examine the role of EAC in improving the regional food security through innovation and technology.

1.4 Hypothesis
Innovations and technology are key in revolutionizing the East African region food security.

1.5 Significance of the Study
The launching of the East African Common Market in July 2010 represented a significant milestone in the steady process of deepening Africa’s economic integration. It is a trend that complements similar efforts in other parts of Africa. It also underscores the determination among African leaders to expand prospects for prosperity by creating space for economic growth and technological innovation. A lot of policies and systems have been laid to fight against food
insecurity in the region but still the region in unable to feed its people. In various literatures offered, innovations and technologies, policies and institutions will be key for a new global food system that can achieve multiple SDGs, including the goals related to ending hunger, malnutrition and poverty. In this reasoning, the study will keenly invest in various knowledge to realize the significance of innovation and in transforming the food security within the East Africa region. The overall information gathered from the study, is relevant to national and regional community, academic and research institutions.

1.6 Scope of the study
This study critically involves reviewing what is known from the existing literature and other resources so as to facilitate better targeted regional- level research and technical analysis. This study is relevant in presenting an understanding on how harnessing innovation and technology can impact upon regional- level food security. Finally, it is relevant in providing an operational framework for assessing the outcome of the past policies, and predicting the consequences of future initiatives, on regional food security. The study was consolidated within a period of four months.

1.7 Limitations and delimitations of the study
This study involves technical analysis of existing literatures with a focus on the innovation and technology as a tool in improving the East Africa food security. With this at hand, the findings are only based on the analysis derived from literature but with more focus on what the regional integration is doing to recover the situation within the region. The researcher did not indulge on the field to gather data since the data that is already existing is credible enough to bridge the gap and also fit the study within the expected duration. It calls for keen look at the East Africa treaty, appropriate case study and other relevant reports that are present from key bodies within the
region. This ensures the reliability of findings by also applying descriptive case study analysis with qualitative research methods.

1.8 Conclusion
Chapter one has introduced the study by way of looking at the research, outlining the objectives, defining concepts, stating the scope of the study and explaining the justification or rationale behind the research.

While food systems have been slow to benefit from innovative technologies, especially in the developing countries with a key focus on the East Africa region, a recent acceleration of innovation effort make the future adoption of technologies feasible. The innovation will be key while addressing food security challenges facing the EAC region.

The next chapter expounds further by looking at the various literatures focusing on innovation, technology and food security.
CHAPTER TWO - LITERATURE REVIEW

1.0 Introduction
The literature review covers information from existing publications on ICT and food security. The review specifically looks at the significance of innovation and technology in transforming food security in the East Africa community. The aspect of stability of the food security in the region is key through innovation and technology.

2.1 Literature review
2.1.1 Current food security state in the East Africa Community
The East African Community (EAC) is a regional intergovernmental organization of six (6) Partner States, comprising Burundi, Kenya, Rwanda, South Sudan, Tanzania and Uganda, with its headquarters in Arusha, Tanzania. EAC is a regional intergovernmental organization founded in 1967. The work of the EAC is guided by its Treaty (2000) which established the Community. The East African Community (EAC) has been among the fastest growing regions in sub-Saharan Africa in the past decade or so. Nonetheless, the recent growth path will not be enough to achieve middle-income status and substantial poverty reduction by the end of the decade—the ambition of most countries in the region. According to the facts presented on EAC (2010), the region comprises of Burundi, Tanzania, Uganda, Kenya and Rwanda as outlined above. It is located between 5030°N 120S and 28045°E 410 50” E. The region has a total surface area of about 1,817,945 square kilometers. Tanzania and Kenya border the Indian Ocean coastline, while Burundi, Rwanda and Uganda are landlocked. The EAC has approximately 130 million inhabitants.
The East African Community (EAC) is an inter-governmental organization mandated by the governments of Burundi, Kenya, Rwanda, Uganda and Tanzania to spearhead the East African economic, social and political integration agenda. The areas of cooperation are specified in the Treaty for the Establishment of the East African Community that entered into force in July 2000.

The region is one of the fastest growing areas on the African continent providing potential for investments, business and other opportunities. The EAC geography and ecology were shaped by the tectonic forces that created the Great Rift Valley. The region has abundance of wildlife, forests, wetlands, fisheries and crops. It is one of the mega-biodiversity regions of the world. It has exceptional diversity of ecosystems and species, high levels of endemism and high concentrations of species.

The economies of the EAC are largely founded on its ecology and biodiversity in particular. They are based on agriculture and tourism. Agriculture accounts for at least a third of the Gross Domestic Product (GDP) of the EAC and offers employment to 50 per cent of the region’s population. It is a key driver of economic growth and improvements in the livelihoods of the people of the region. Agriculture also accounts for a significant proportion of trade among the five countries. The five countries’ agricultural systems are similar and based on cash crops such as coffee, sugarcane, cotton and tea.

Amidst all the good description about the East Africa Community, there is still much to unfold that leads the researcher to critically indulge in and lay the relevant information in this study. Generally, all the 5 Partner States of the EAC are young but emerging democracies. The levels of
political development are arguably different. In many ways, each of the countries is afflicted by episodes of instability arising from their political and colonial history. In 2008, Kenya was shaken by post-election violence on a scale never envisaged before. The 1994 genocide in Rwanda annihilated not only its human victims but also the civil and public service institutions that are the foundation of scientific and technological progress. The half a century of conflict in Uganda led to death of thousands of Ugandans, the fleeing of professionals including science professionals and the near collapse of key state institutions. Since independence in 1961, Burundi has been plagued by tensions between its two main ethnic communities. In 1993 to 2005, Burundi suffered a brutal armed conflict which led to the deaths of an estimated 300,000 people.

The region is still facing persistent and chronic food insecurity and various policies are being put in place to counter the situation. The population within the region continue to expand rapidly and as a result, the number of people living in poverty rises. With this in mind, expectations are rising. According to (UN 2015), all developing regions except Africa have reached the Millennium development goals (MDGs) of having poverty between 1990 and 2015. This means that, the attention will shift to the new global development goals (SDGs) which include the ambitious target of eradicating poverty worldwide by 2030. With this study, the research will look at what the East Africa regional integration is doing to ensure the food systems are improved and that, the population can feed and live a healthy life. Borrowing from (World Bank 2007; Calestous, 2011 and IAC, 2004) which is a large body of research existing on the role of agriculture in stimulating growth, decreasing poverty and improving food security in the region. Agriculture in eastern Africa is dominated by large numbers of smallholder farmers producing only barely or less than their average household consumption needs under rain-fed conditions,
making them highly vulnerable to a range of shocks – weather, price, government policy shifts, and other threats. These farmers mainly produce staple foods (crops and livestock) that are widely consumed in the region. In a synthesis paper for COMESA, Maputo and Mozambique (2010), it is estimated that staple foods comprise between 50 and 75 percent of the caloric intake by consumers, who spend 40 to 70 percent of household budgets on these commodities. Because the livelihoods of such large numbers of food insecure households in rural areas are based on agriculture, improving agricultural productivity and increasing farmers’ incomes are keys to achieving food security.

2.1.1.1 Lessons from achieved success stories in Ghana and China. According to Calestous (2011), Ghana has made consistent progress in reducing poverty and hunger. Between 1991–92 and 2006, Ghana nearly halved its poverty rate from over 51% to 28%. Ghana is also the only African country to reduce its Global Hunger Index by more than 50%. The success can be attributed to a better investment climate, policies, and commodity prices. The agricultural sector’s rate of growth was higher than both overall GDP and the service sector between 2001 and 2005. Increased land use and productivity among smallholders and cash crop growers in cocoa and horticulture—particularly pineapples—drove growth and welfare improvement. The case of Ghana is not the best above all others but it outlines some milestones that the East Africa community can learn from in ensuring food security within the region.

Of course with success come challenges and lessons learned: inequality has increased, suggesting that the benefits of this growth have not been evenly distributed and that more attention needs to be paid to the rural north. Also, unsustainable environmental degradation and natural resource usage threatens to reverse progress in agriculture and affect other sectors. But the global financial, food, and fuel crises are negatively impacting the agricultural sector and the
poor. Prices of inputs and crops have risen by anywhere from 26% to 51% between 2007 and 2011 in real terms. Although cocoa prices are still high for exporters, shea nut prices have fallen—a major source of income for women in the Savannah region. Social safety net programs (such as cash transfers, school feeding, and national insurance), though, are providing some buffer against the current crises’ effects on income and consumption. Ghana’s story helps show the importance of locally owned policies and political commitment to sustain agricultural gains and welfare improvement.

On the other Case of China, borrowing from OECD Report (2010; cited in Calestous, 2011) outlines that China’s inspirational success in modernizing its agriculture and transforming its rural economy over the last 30 years provided the basis for rapid growth and a substantial improvement in prosperity. From 1978 to 2011 China’s economy grew at an annual average rate of about 9%. Its agricultural GDP rose by about 4.6% per year, and farmers’ incomes grew by 7% annually. Today, just 200 million small-scale farmers each are working an average of 0.6 hectares of land feed a population of 1.3 billion. In the meantime, China was able to limit population growth at 1.07% per year using a variety of government policies. Even more remarkable has been the rate of poverty reduction. China’s poverty incidence fell from 31% in 1978 to 9.5% in 1990 and then to 2.5% in 2008. Food security has been dramatically enhanced by the growth and diversification of food production, which outstripped population growth. Agriculture’s role in reducing poverty has been three times higher than that of other sectors. Agriculture has therefore been the main force in China’s poverty reduction and food security.

With population in check, China’s grain production soon outstripped direct consumption, and policy attention shifted to agricultural diversification and improvement of rural livelihoods. The process was driven by a strong, competent, and well-informed developmental state that could set
clear medium and long-term goals and support their implementation. Despite the historical, geographic, political, social, educational, and cultural differences between China and Africa, there are still many lessons from China’s agricultural transformation that can inspire Africa’s efforts to turn around decades of low agricultural investment and misguided policies. An African agricultural revolution is within reach, provided the continent can focus on supporting small-scale farmers to help meet national and regional demand for food, rather than rely on expansion of export crops.

2.1.1.2 **Addressing the policy dilemma of food insecurity**

Policies in response food and nutrition security have been taken by countries in the region. These can be grouped into three main groups I) Trade-oriented policy responses that use policy instruments, such as reducing tariffs and restricting exports to reduce prices and/or increase domestic supply. ii) Consumer-oriented policy responses that provide direct support to consumers and vulnerable groups in the form of food subsidies, social safety nets, tax reductions and price controls, among others; and iii) Producer-oriented policy responses intended to support farmers to increase production, using measures such as input subsidies and producer price support programs to facilitate implementation of food security policies as well as promote agricultural growth (FAO, 2009)

On the consumer oriented measures, the increasing public food stocks and providing consumer subsidies are a common measure taken in the region. However, these have had limited influence on the grain markets because of the amounts made available through the national grain reserves. All the countries in the region have reduced or eliminated food tariffs or taxes with the exception of Rwanda. The impact of tariff reduction on food prices depends on the extent of the reduction, however generally tariffs have been declining as a result of multilateral, regional and bilateral
agreements. Kenya and Rwanda have put prices controls in an attempt to keep the price low for consumers. Enforcing price controls is costly and difficult in case there is no adequate public stock or imported supply to meet demand at government-fixed prices. Prices fixed at low levels are also likely to discourage domestic production and create a black market. Social safety nets have been used to dampen the social impact of the crisis and to avert starvation and malnutrition of most vulnerable groups in both urban and rural areas, usually in form of targeted cash-based transfers and food access-based approaches. Food assistance includes direct food transfer, food stamps or vouchers and school feeding. The latter has been used to keep children in school.

Looking at the Production oriented measures include, initiatives to support producers through non-market and market mechanisms such as introduce or expand input supply (mainly fertilizer) subsidy programs. In the region as earlier, highlighted fertilizer use is still low thus production is constrained by the high cost of fertilizer making it unaffordable and inaccessible especially to smallholders. As a result in the region, together with the private sector projects have been set up to increase the access to inputs by supporting stock list right at the local level a good example is the Kilimo Biashara project in Kenya (Moa, 2010). Market information and extension service are provided for farmers by the respective government ministries and Non-governmental organizations to boost production and productivity. Crop and livestock insurance is a new initiative in the region where private insurance companies are now providing weather based insurance portfolio for a variety of crops.

On trade oriented measures, the most commonly used trade measure in the region is the export bans this practice results in the separation of surplus food production zones from the deficit markets. A report by the World Bank on maize marketing in East Africa, showed that the export bans lead to lost opportunities for farmers and traders, and as a result there was reduced
investment in production in subsequent seasons leading to an overall reduction in food production. The EAC is in the process of development, of a regional legal, regulatory and institutional framework for EAC SPS Protocol. The principal objective of the EAC SPS Protocol is to enforce sanitary and phytol sanitary measures in order to promote trade.

2.1.2 Innovation and technology in transforming food security in the East Africa region

The impact of technology on our everyday lives and economic interactions is undeniable. In conjunction with megatrends such as globalization, climate change, urbanization and aging populations, ICT is helping to transform our society and the economic structures that have formed the basis of industries since the industrial revolution. ICT is already being applied extensively within the food and agricultural industries for both improved efficiency and productivity in the established food systems. In addition, digital technologies are being increasingly applied to disrupt and completely reform the established industrial structure of food by increasing the numbers of industry players across the globe. Digital technologies may hold the key to the successful coordination of a more sustainable food system.

The Sustainable Development Goals and other international efforts to achieve food security involve new technologies as an indispensable tool for eradicating hunger. To harness science and technology for the various dimensions of food security, it is necessary to make the food system itself more innovative. This includes, among other things, defining a research agenda that focuses on smallholder farmers, investing in human capacity, enabling infrastructure for food systems, putting appropriate governance structures in place for agricultural innovation and strengthening knowledge flows between farmers and scientists. According to a report by (UNCTAD 2017), new technologies will make it possible for sustainable agriculture to become the global and standard not exploitation; the main factors resisting change are political will, lack of policy coherence at many levels, financing, governance and human behavior. Early action is
important but more support and better mechanisms are needed for long-term thinking and action including strengthening public research and development, human resource development and institutional change.

ICT has a significant role to play in the future of food and agriculture. In the face of rising pressure from climate change, rising populations and decreasing crop yields, the region must confront the critical challenge of efficiently delivering sustainable and healthy diets to its populations. The diagram below illustrates the role of ICT in improving food systems and eventually leads to achieving food security. The researcher borrows the data demonstrated below from a research conducted in Imperial College, London.
The figure above illustrate that ICT is required to successfully combine secure sustainable food systems, through the application of innovative digital technologies that take into account the interactions between food and agriculture systems, with broader industrial systems. With this awareness of the relevance of innovation and technology, food and agriculture systems are therefore likely to continue the drive towards new technology solutions and organizational forms across the Networked Society. This calls for the East Africa region integration to rise above the norm of overloaded existing policies and tap upon the new digital era if there is hope to transform the food systems within the region.

2.1.3 Role of EAC in improving the regional food security through innovation and technology
The article 105 of the East Africa community Treaty on agriculture and food security states that, the overall objectives of cooperation in this agricultural sector are the achievements of the food security and rationale agricultural produce within the community. Partner states undertake to adopt a scheme for the rationalization of agricultural production with a view to promoting complementarity and specialization in and the sustainability of national agricultural programs in order to achieve;

a) A common agricultural policy
b) Food sufficiency within the community.

c) An increase in the production of crops, livestock, fisheries and forest products for domestic consumption, exports within and outside the community and inputs to agro-based industries within the community
d) Post-harvest preservation and conservation and improved food processing.

Specifically in article 110 of the treaty on the food security it states that the partner shall;
a) Establish a mechanisms for exchange of information on demand and supply surpluses and deficits, trade, forecasting and state of food nutrition.

b) Harmonize quality and standards of input and products including food additives.

c) Develop modalities to have timely information on market prices.

d) Harmonize food supply, nutrition and food security policies and strategies.

e) Initiate and maintain strategic food reserves

f) Develop marine and inland aquaculture and fish farming

This document will be of great guidance in this study by providing credible support within the research. The above treaty consolidate the partner states to what is well known as East Africa community and this helps in achieving common goals together in issues affecting the region. Some of these issues are food security, human security and peace, globalization among others.

One of the major objectives of the EAC as stated out in the treaty is the achievements of the food security and rational agricultural production. In line with achieving this goal, the East Africa came up with the EAC Food Security Action Plan (2011-2015). This Action Plan was developed to address food insecurity in the region. The document forms the initial step of implementing the provisions of the EAC treaty as set out in chapter 18 of Articles 105-110. The EAC Food Security Action Plan was to guide coordination and implementation of the joint programs and projects emanating from this plan.

Within the EAC Partner States, the Executive supported by the public service technical agencies are the main drivers of the regional integration process. At the moment, there is no evidence to suggest that the legislatures of the Partner States play a significant decision making role in the decision-making process of the Community. Indeed, all the key decision organs of the
Community – the Summit, the Council of Ministers and the Coordination Committee draw their membership from the members of the Executive and the public service. The commitment to regional integration creates a new political dynamic that fundamentally affects the governance of science, technology and innovation in the Community. This is because the different levels of integration: customs union, monetary union and ultimately political federation will fundamentally alter the decision making structures of the Partner States in all areas of development endeavor including in matters of science, technology and innovation.

The EAC Treaty is in many ways a framework with “best endeavor clauses”, statements of intent on issues and areas that the Partner States intend to cooperate on. The finer details of the cooperation are to be developed through the Treaty implementation processes. There are a number of initiatives to promote the implementation of various STI provisions of the Treaty. These include the process to establish the East African Science and Technology Commission (EASTECO) whose remit is to promote regional integration in the development, management and application of STI in the Community. The EASTECO is expected to be the main regional agency through which the Partner States will develop and implement common STI policies and programs.

2.1.4 Theoretical Framework

This study seeks to establish how innovation and technology can be harnessed to improve the food security in the East Africa community. It examines the role of East Africa community in improving the food security and the challenges and path ahead in achieving improved and transformed food security systems.

Exploring the issue of food security demand an integrated assessment approach that considers the interaction of ecosystems and social systems to account for food security (Harper 2003).
Looking at the Techno-ecology theory, (Berry and Cline 1979; Boserup 1965; Simon 1998) the Techno-ecologists take a more optimistic approach, arguing that ominous scenarios for the planet are oversimplified. They believe that technology and human ingenuity are the greatest resources available and are not being threatened with scarcity. Thus, as has been the case in the past, future challenges confronting the world's carrying capacity will be met. Techno-ecological perspectives are linked most closely with food availability and the importance of adapting agricultural methods to produce enough food. This was the whole philosophy behind the "Green Revolution" and the spread of new technology to LDCs where food is needed most. Fertilizer use and the intensification of agriculture, for example, are associated with human adaptation (Boserup, 1965).

Also, this study embraces the process of technological innovation that involves interactions among a wide range of actors in society, who form a system of mutually reinforcing learning activities. Looking at an innovation system which can be defined as a network of organizations, enterprises, and individuals focused on bringing new products, new processes, and new forms of organization into economic use, together with the institutions and policies that affect their behavior and performance is key. The innovation system according to Hall (2006) is a concept that embraces not only the science suppliers but the totality and interaction of actors involved in innovation. It extends beyond the creation of knowledge to encompass the factors affecting demand for and use of knowledge in novel and useful ways. Hall et.al (2006) explains the innovation systems concept as one derived from direct observations of countries and sectors with strong records of innovation. It has been applied to agriculture in developing countries only recently, but it appears to offer exciting opportunities for understanding how a country’s
agricultural sector can make better use of new knowledge and for designing alternative interventions that go beyond research system investments.

2.1.5 Conclusion
Chapter two has covered various literatures intensively in line with the study objectives and also provided the theoretical framework. The deepening of the regional integration is of much importance to the EAC in achieving key policy priorities. The mechanism of innovation and technology in enhancing food security is key in the region backed up by appropriate criteria to ensure food security in the region.
CHAPTER THREE - RESEARCH METHODOLOGY

3.0 Introduction
This chapter outlines the methodology of research that will be relevant in carrying out this study.

The research is based on secondary data with a great back up of various existing literatures. Research is the search for knowledge through objective and systematic method of finding solution to a problem. The study is organized in the below listed methodology outline.

3.1 Research design
This research uses descriptive case study design that will apply qualitative research method. A case study research design is an approach that seeks to achieve an in-depth understanding of a phenomenon, event or occurrence within its real-life context. A case is a bounded system with parts that work together. A case could be a person, an organization, a social group or any other entity that operates as a system. Instead of using a rigid protocol to examine a limited number of variables derived from a sample, a case study involves an in-depth, longitudinal examination of the whole unit or instance. It provides a systematic way of rigorously observing a broad range of factors within the selected case, collecting and analyzing data and interpreting the results within a specific context.

3.2 Target population
The target population for this study entirely comprises of the East Africa community. The researcher gives a critical analysis on the various East Africa institutions in line with the focus topic and their contributions in improving the food security within the region. The East Africa community is a regional intergovernmental organization of six (6) partner states, comprising Burundi, Kenya, Rwanda, South Sudan, Tanzania and Uganda, with its headquarters in Arusha Tanzania. This study focuses on this region as a whole in line with finding out the significance of innovation and technology in transforming the Region’s food security.
3.3 Sampling
This research is basically a technical analysis of the East Africa community. This research gives a look at East Africa food security systems and the major roles of EAC in improving food security in the region. The sampling selected in this research comprises of the partner states within the region, the Green Council, the EAC treaty, Governments policy documents, the World Bank, CAADP, and other relevant existing institutions that deal with the issue of food security and ICT in ensuring food security within the region. The data was gathered in various existing literatures, reports, case study and verified statistics in line with the research topic.

3.4 Data collection procedure
The data collection will cover the East Africa region. The researcher uses relevant and credible data gathered from various literatures. The researcher ensured that, the materials used in this study are relevant and credible. This involved comparing data from different sources to ensure it is necessary and feasible.

3.5 Data analysis
This research is majorly based on secondary data and applies qualitative data analysis. Content analysis of key documents focusing on food security, agriculture and ICT were relevant in this study. Data such as reports and statistics which were of key importance in this study were verified by the researcher by consulting the appendix and references provided. On the other hand, qualitative data gathered was analyzed through content analysis and results presented in verbatim. The findings were presented inform of text majorly.

3.6 Ethical considerations
This research is very critical since it depends mostly on the existing information in various literatures provided, reports, statistics and case study. Acquiring this involved gathering the existing data in line with the study topic and comparing the data from different sources to ensure
it necessity and feasibility after which it will be analyzed. With this type of secondary research, the researcher upholds integrity throughout the study by ensuring that the credibility of the information coming from the internet or library books, journals and reports are verified. It involved giving the correct citations in line with the information borrowed from the materials in order to maintain the right standards expected during this study.

3.7 Conclusion
The relevance of the above outlined research methodology in this chapter is a key foundation to the next chapter while analyzing the key data in this research. To uphold the credibility of this data, the researcher used relevant data that surfaced clear findings on the research.
CHAPTER FOUR - RESEARCH FINDINGS AND DISCUSSIONS

4.0 Introduction
This chapter consists of data interpretation and analysis reflecting themes under discussion. The data findings were presented in line with the study objectives. Analyzing the key data gathered from various literatures and key documents in this research aids in reaching certain conclusions that evidently joined the gap existing in line with the research topic

4.2 FINDINGS BASED ON RESEARCH OBJECTIVES

4.2.1 Food security state in the East Africa community
Despite the advances in science and technology achieved over the last century, close to one billion people in different parts of the world are still not assured of their most basic need - food. Famine, malnutrition or in the short-term, hunger, remain some of the most intriguing challenges facing mankind in the 21st century. Food insecurity is a global problem, but particularly affects much of the third world. The countries that fall within the East African Community (EAC) trade block - Kenya, Uganda, Rwanda, Burundi and Tanzania- are in a region prone to debilitating and widespread effects of hunger and famine. The region is particularly characterized by entrenched poverty, recurrent droughts, crop failures and environmental degradation. These conditions are partly caused by declining land productivity, soil degradation, desertification, loss of biodiversity, livestock and crop diseases, declining fisheries, poor development and trade policies, among other problems. As a result, it has become difficult to produce sufficient food, trapping people in a vicious cycle of food insecurity. Paradoxically, many of the local communities living in this unique and vast natural resource rich region, are among the poorest and most food insecure in the world.

The world food summit in 1996 defined food security as existing when “all people at all times have access to sufficient, safe and nutritious food to maintain a healthy and active life.” The
The concept of food security is defined as including both physical and economic access to food that meets people's dietary needs as well as their food preferences. Food security therefore implies the provision of safe, nutritious, quantitatively and qualitatively adequate food as well as access to it by all people.

The East African Community (EAC) is one of the eight African regional economic Communities (RECs) that are currently operational. It is an intergovernmental body which comprises five countries: Kenya, Uganda, Tanzania, Rwanda and Burundi. South Sudan and Somalia have also expressed interest to join. The EAC is characterized by the diversity of countries’ economic sizes and overlapping memberships.

The EAC was re-launched in July 2000 by its founding members Kenya, Uganda and Tanzania. These countries had had some cooperation since 1890s. For example, there was the construction of the Kenya-Uganda railway between 1897 and 1901, the establishment of the East African Currency Board (1905) and the East African High Commission (1947-1961) (Mugisa et al., 2009). In 1967, the three countries established the EAC for the first time but it collapsed in 1977 following disagreements among the founding countries. The vision of the revived EAC is to create wealth, raise the standards of living of all people of East Africa and raise the competitiveness of the region through increased production, trade and investment (EAC Development Strategy 1997-2000; Mugisa et al., 2009).

The EAC countries consider a customs union as an entry point for future integration into a political federation. The Community wanted to reach a fully-fledged Customs Union between 2005 and 2010, a Common Market by July 2010 and a Monetary Union by 2012. Currently, the step of a Customs Union has been reached with a program that led to a gradual reduction of internal tariffs on asymmetrical basis (that is, the gradual preferential tariff reductions on
different commodities were offered by each country on country-to-country basis), Establishment of a Customs Management Act, elimination of non-tariff barriers (NTBs) and trade facilitation; harmonization and development of EAC standards and the application of the Common External Tariff (CET) and the EAC Rules of Origin. Rwanda and Burundi joined the EAC in July 2007 and started implementing the EAC Customs Union (EAC CU) protocol in July 2009.

The EAC member countries formed the Customs Union to liberalize and promote intraregional trade. Article 3 of the Protocol establishing the EAC CU gives the objectives of the Customs Union as furthering intra-regional trade liberalization, promotion of efficient production within the Community; enhancement of domestic, cross-border and foreign investment in the Community and promotion of economic development and diversification in Industrialization in the Community (EAC, 2004).

Increasing agricultural productivity is critical to accelerating economic growth and improving the wellbeing of both rural and urban people in East Africa. Indeed, many strategies have been pursued in an attempt to increase agricultural productivity and enhance food security in East Africa. However, despite these numerous strategies, East Africa is repeatedly caught up in the vicious cycle of food insecurity which perpetuates poverty.

According to P.D Williams and Haacke (2006), the facilitation of regional cooperation is emerging as a basis for diversifying economic activities in general, and leveraging international partnerships in particular. Many of Africa’s individual states are no longer viable economic entities; their future lies in creating trading partnerships with neighboring countries. Their future economic prospects depend on being part of larger regional markets. Increased regional trade in agricultural products can help them stimulate rural development and enhance their technological competence through specialization. Existing RECs offer them the opportunity to benefit from
rationalized agricultural activities. They can also benefit from increased harmonization of regional standards and sanitary measures.

The EAC being the key focus in this study has developed a road map that includes the use of a common currency and creation of single federal state. EAC Report (2006) outlines the July 2010 EAC launching of its Common Market by breaking barriers and allowing the free movement of goods, labor, services, and capital among its member states. The EAC Common Market has a combined GDP of US$76 billion. Through a process that began with the establishment of the EAC Customs Union, the Common Market is the second step in a four-phase roadmap to make the EAC the strongest economic, social, cultural, and political partnership in Africa. EAC’s economic influence extends to neighboring countries such as Sudan, Democratic Republic of the Congo, and Somalia. The Common Market will eliminate all tariff and nontariff barriers in the region and set up a common external tax code on foreign goods. It will also enhance macroeconomic policy coordination and harmonization as well as the standardization of trade practices. It is estimated that East Africa’s GDP is will grow 6.4% in 2011, making it the fastest growing region in Africa.

Despite the importance of agriculture to East Africa’s economy, the region has low agricultural yields and is still largely prone to food insecurity. This is largely as a result of the traditional and small scale nature of Agriculture in Eastern Africa characterized by reliance on rain fed agriculture; low diversification; low usage of modern technology; poor water management systems; land fragmentation; and high post-harvest losses among others. This coupled with an underdeveloped Agricultural sector, climate change effects, high population growth and low government commitment to agriculture further aggravates the problem. Remedies such as increased investment in agriculture, improved seed and farm management techniques, integrated
water management techniques, engendering agriculture, addressing climate change and population growth among others are proposed. If East Africa leaders truly commit to implementing the already known remedies, then food insecurity will be unheard of in East Africa.

Despite stakeholder consultations, plans of actions, commitments and declarations, food insecurity in the region remains at unacceptably high levels. Over the years, it has become clear that Africa is neither short of diagnosis nor prescriptions but implementation of already well known remedies and sustained application of adequate and focused effort and resources to the food security challenges. The countries in the region import food to meet domestic demand. Some of these are sought as food aid). An increased food import bill tends to be the opportunity cost for other imports such equipment or investments in research and technology. And the same time tends to hinder the developments of food markets (Barrett, 1999; Yu et al, 2010).

Population growth is a salient and critical factor that will have implications on food availability; there are implications for national planning and socio-economic development including food security. No effective policies are in place to cope with the unprecedented pressure in the region. Natural resources especially land and water are increasingly diminishing, implying that technology and innovation will have a big role to play in ensuring that agricultural commodities are produced at higher yield per unit of land, water, energy and time (Omiti, et.al., 2011).

Average per capita food production in most countries of the region has not been enough to feed growing human population. The level of productivity for the different food crops is critical since the food basket is a mix of essential foodstuffs, where sources of energy (cereals) are critically important.
4.2.2 Innovation and technology in transforming food security in the east Africa region.

The relevance of Science and Technology (S&T) to the sustainable food production in any society has taken a central position in public policy-making and implementation worldwide. This interest and increasing concern had risen in response to both the growing awareness; and, fear about the environmental degradation initiated by rapid industrialization as well as the increasing pressures on resource demands resulting from population growth. It is envisaged that due to the two major factors mentioned above, efforts should be made to increase food production to meet future needs among the population must not only efficiently, but effectively with minimum inputs. The development and application of innovations in science and technology become very significant if Africa desires to achieve sustainable food security. The concept Sustainability implies the “attempts to achieve simultaneously the goals of an improved environment, a better economy and a just and participative society, rather than trading off any one of these against the other” (George, 2010; cited in Illesanmi, 2010, Coker et al., 2013). Further enthused that sustainable development that is socio-ecologically focused, is the ability to fulfill “human needs while maintaining the quality of the natural environment indefinitely” (Jiboye, 201; cited in Coker et al., (2013). Sustainability in food production is a major problem of Africa. There are a number of reasons for this problem has been explored in this study, alongside suggested solutions. One of these solutions is the systematic application of appropriate Science and Technology innovations to Agriculture in Africa.

There are 793 million people globally who are undernourished or food insecure according to the Food and Agriculture Organization of the United Nations (FAO). Weather, conflict, labor markets, food supply systems, nutrition, livelihoods, and social inclusion combine to hinder their ability to acquire enough food to meet the daily minimum dietary energy requirements. ICT is
helping to transform our society and the economic structures that have formed the basis of industries since the industrial revolution. Digital technologies allow new organizational forms to emerge within and outside of industrial boundaries, thereby challenging our traditional notions of economic organization in markets. Where once size was an important driver of success, now many smaller companies are able to compete both locally and globally. Where firm, strongly defined boundaries and clearly defined economic roles were necessary, now the ability to dynamically participate in a variety of networks is key to a resilient corporate strategy. ICT is transforming the rules of our world’s economic value systems, and industries are being transformed as a result.

It is not possible to provide a deep dive into every industry covered within this series. Instead, each report investigates the role of ICT in creating productivity improvements and industrial disruption with a view to gaining a broad perspective on the overall transformation the world is undergoing. The concept “technology” like science may be variously understood. For instance, technology may be taken “as that form of cultural activity, devoted to the production or transformation of material objects or the creation of procedural systems in order to expand the realm of practical human possibility” (Lukpata et al., 2014). Its’ input consists of raw or already processed materials and bodies of information; its characteristic internal or transforming resources are know-how (methods, procedure and techniques) and knowledge of properties of its input's resources; its characteristic's nonintellectual resources include: “energy, information, tools and perceptual and neuromuscular skills” (Lukpata et al., 2014) In short, technology is the application of scientific and other organized knowledge to solve practical tasks in the society.

The food security interventionist programs initiated by governments of developed countries, alongside conscious development and application of science, technology and innovation has
tended to make the difference in assessing food for their citizens with those of the developing ones. Food security has three aspects: namely; “food availability, food access and food adequacy” (Rosegrant et al, 2005). According to Mwaniki (2005), food availability implies that the supply of food should be in sufficient quantity, and access to food should be on demand. In fact, food access must be adequate not only in quality but also in quantity, and quality. For Mwaniki, it should ensure an adequate consistent and dependable supply of energy and nutrients through sources that are affordable and socio culturally acceptable to them at all times. It has been observed that over seventy percent of African population are food in-secured (Andersen, 2002). The situation is so acute for rural dwellers because food is produced by only “small holder’s farmers, which make up over 90% of the continent’s food supply. The rest of the food unsecured population consists of landless poor in the rural areas (30%) and the urban poor. Because over 70% of the poor live in rural areas, where also the largest population of food insecure live. It is evident that we cannot significantly and sustainably reduce food insecurity without transforming the living condition of these areas. The pertinent question then is, how can East Africa community achieve food security? The solution lies in increasing food availability, food access and food adequacy for all. Sometimes this involves adopting new technologically developed means of agricultural production as already explained. However, because the food insecurity is directly correlated with poverty, it is necessary not only alleviate poverty but also create wealth for the largest population.

The Green Revolution played a critical role in helping to overcome chronic food shortages in Latin America and Asia. The Green Revolution was largely a result of the creation of new institutional arrangements aimed at using existing technology to improve agricultural productivity. African countries are faced with enormous technological challenges. But they also
have access to a much larger pool of scientific and technical knowledge than was available when
the Green Revolution was launched in the 1950s. Technological innovation is not all composed
of radical discoveries, and much of what is relevant to African agriculture relates to the ways in
which incremental improvements in processes, products, inputs, or equipment’s are needed to
adapt existing technologies to the local environment in ways that enhance productivity and lower
costs. The ability to adapt, therefore, is a significant step in technological empowerment, which
over a period of time, can lead to the creation of knowledge generation capabilities amongst
actors that are demand-driven rather than simply those that aim to replicate the successes of other
regions of the world.

Declining agricultural productivity in many developing countries can be reversed through
building what are called agricultural innovation systems that provide the enabling framework not
only for the adoption of existing technologies and the development of new ones that are suited
for African needs. Agricultural innovation systems denote the network of economic and non-
economic actors, and the linkages amongst these actors enable technological, organizational and
social learning of the kind needed to devise context-specific solutions. The dissemination of
already existing technologies from outside could help this endeavor, but a major challenge
relates to the ways and means in which innovation that is relevant to African agriculture could be
promoted.

However, the ability of the agricultural innovation system to be able to access, use and diffuse
knowledge embedded in agricultural technologies depends on the presence of an enabling
framework that supports the emergence of technological capabilities by strengthening existing
linkages, promoting new linkages and fostering inter-organizational learning that leads to capital
accumulation and technical change. Such an enabling environment, by definition, is one that strengthens the absorptive capacity of local actors while protecting their interests through a policy framework that recognizes their legal rights and privileges, linkages, socio-cultural norms and historical context. An enabling environment for technology and innovation in agriculture as one that provides the actors, skills, institutions and organizations required to promote the use, dissemination, diffusion and creation of knowledge into useful processes, products and services.

Creating an enabling environment for technology and innovation is an essential requirement to enable African countries to address the following constraints that impede their agricultural development:

Declining investment: most developing countries already had investment deficits in agriculture well before the onset of the current financial crisis in mid-2008. The long decades of neglect of the agricultural sector in the Africa region are partly a consequence of the policy of strict fiscal austerity imposed on African countries, which has severely curtailed state support of agriculture. The perception that investment has merely to do with the provision of agriculture research has exacerbated the situation further. This has resulted in poor rural infrastructure, low coverage of extension services, reduced provision of subsidies for inputs and finance for farmers, and reduced investment in research and development in the agricultural sector.

As a result, farmers in Africa are now poorly equipped to deal with the new challenges that they face, which include climate change, desertification, competition from cheap imports, and highly concentrated global value chains dominating the world’s commodity markets. Investing in activities that promote new forms of partnerships, use of local knowledge (including traditional
agricultural knowledge), practices and preferences, as well as policy-driven demand-based approaches have been missing to promote the African response to its agricultural challenges.

Land tenure and credit access: access to credit is another fundamental institutional constraint that circumscribes the ability of African farmers to cope with the rising prices of land, seeds and other agricultural inputs. However, this clearly needs to be accompanied by an enabling framework that guarantees better physical and scientific infrastructure of relevance to African agriculture, and improved market access and demand forecasts. Guaranteed land tenure could be vital to accessing credit and investing in the medium and long-term productivity of the land. A focus on small farmers: focusing on smallholder farmers has proven an effective means to contribute to a country’s economic growth and food security.

Advocates of scientific and technical research in developing countries have found champions in the innovation platforms of nanotechnology, biotechnology, information and communication technology (ICT), and geographic information systems (GIS). Through these four platform technologies, Africa has the opportunity to promote its agenda concurrent with advances made in the industrialized world. This opportunity is superior to the traditional catching-up model, which has led to slower development and kept African countries from reaching their full potential. These technologies are able to enhance technological advances and scientific research while expanding storage, collection, and transmission of global knowledge. Building locally relevant research and innovation priorities: African agricultural research has not been weak, but it has lacked the right impetus to bridge ongoing research with product development initiatives.

There has been a tendency to focus on applying international models of agricultural development without questioning their applicability to local circumstances.
An accompanying attitude that looked down on regional research, as against international research (where the latter was considered to be far more superior), has been entrenched since colonial times. In reality, patterns of knowledge change are related to the increasing convergence in the different areas of science and technology, and indigenous capabilities of countries matter. The benefits attending to convergence include new organizational production structures, advances in communication apart from global trade. This calls for policies that help re-orient actors towards local sources of technology and learning, and address the negative perception towards local research.

Amongst options available, international cooperation can potentially be a strong factor in helping relevant new technologies be adopted, adapted and diffused throughout host economies. In particular, a handful of South-South cooperation models have already proven their worth as mechanisms for ensuring the right technological tools are made available to African farmers. So-called triangular cooperation, where a Northern neighbor signs on as a sponsor to South-South technology sharing efforts, has also shown promise as a model for the international diffusion of technologies.

It is important to realize that there are no quick fixes. This can be seen in the case of other developing countries which are now benefiting from public and private investments that were made into the development of agricultural technologies and innovation capacity since decades. Brazil, for example, has achieved its current leading position in tropical agriculture technology and increased agricultural productivity as a result of more than three decades of public and private investment in the development of technological packages tailored to its own soil and local agro-ecological conditions.
Amongst options available, international cooperation can potentially be a strong factor in helping relevant new technologies be adopted, adapted and diffused throughout host economies. In particular, a handful of South-South cooperation models have already proven their worth as mechanisms for ensuring the right technological tools are made available to African farmers. So-called triangular cooperation, where a Northern neighbor signs on as a sponsor to South-South technology sharing efforts, has also shown promise as a model for the international diffusion of technologies.

On this basis, when the new African Agriculture Revolution is eventually implemented, it is likely to be built on Africa’s own indigenous technology and knowledge requirements, and the nutrition and food security needs of its people. Building capabilities for science, technology and innovation of relevance to local agriculture however, is the only path to achieve this. Building innovation capabilities in African agriculture Regardless of the theoretical viewpoints on the kind of approach best-suited to promoting agricultural development, the fundamental issue for a policy maker is how such an approach can be used to devise an agriculture development strategy. The innovation systems framework can be useful to help identify areas of weakness that could ideally be addressed through national policy action. A key issue is how to promote capabilities among African farmers and develop more effective innovation systems for agriculture at the national and sub-national levels. A number of technologies can play a role in addressing concerns related to the four dimensions of food security (Table 1). New and existing technologies to combat biotic and abiotic stresses, raise crop and livestock productivity, improve soil fertility and make water available can potentially increase the amount of food produced. Storage, refrigeration, transport and agro-processing innovations can address the dimension of food accessibility. Science to produce high-nutrient staple crops can combat malnutrition,
improving food utilization and use. Finally, STI for change mitigation and adaptation, including precision agriculture, index-based insurance and early warning systems, can address food instability.

<table>
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<tr>
<th>FOOD SECURITY</th>
<th>CHALLENGE</th>
<th>EXAMPLE OF SCIENCE, TECHNOLOGY AND INNOVATION</th>
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| Food availability | Biotic stresses | • Disease or pest-resistant crops  
• Pest resistant wheat varieties  
• Pesticides  
• Herbicides  
• Tilling machines |
| Food availability | Abiotic stresses | • Salt tolerant crops (for example potato)  
• Climate resistant crops |
| Food Availability | Improving crop productivity (in general) | • Conventional breeding  
• Tissue culture and micropropagation  
• Marker-assisted breeding  
• Advanced genetic breeding |
| Food availability | Improving livestock agriculture (in general) | • High nutrient, low cost, animal fodder  
• Liquid nitrogen and low-cost alternatives for animal semen preservation.  
• Low-cost diagnostic toolkits for livestock veterinarians. |
|-------------------|---------------------------------------------|----------------------------------------------------------------------------------|
| Lack of water availability (Contributions by the Government of the United States of America) | • Water storage technologies (subsurface water technologies, aquifers, ponds, tanks, low-cost plastic water tanks, natural wetlands, reservoirs)  
• Canal irrigation  
• Micro-irrigation technologies, drip irrigation, bubbler irrigation, micro sprinkler irrigation  
• Water lifting (hand-powered mechanical pumps, treadle pumps, solarpower) |
irrigation pumps, hydrogen-powered pumps, electric and fossil fuel pumps)

- Fungal seed and plant treatment for water-related stress
- Stabilized silicic acid for drought tolerance
- Irrigation scheduling systems and decision-support systems
- Planting technology for increased water efficiency
- Water pads (water-buffering technology)
- Rainwater harvesting mechanisms
- Water desalination technologies
- Wastewater reuse
- Conservation agriculture
- Portable sensors for
| Soil | • Synthetic and organic fertilizers  
|      | • Biogas digesters  
|      | • Slurry separation systems  
|      | • Zero or conservation tillage  
|      | • Soil microorganisms  
|      | • Natural nitrogen fixation  
|      | Point-of-use kits for evaluating soil nutrient content |
| Need for precise integration, scheduling of inputs for increased yield | • Imaging and associated analytics  
• Drones  
• Internet of things  
• Big data  
• Farm management software and applications |
| --- | --- |
| Farming in urban environments | • Indoor farming  
• Vertical farming  
• Aquaponics  
• Low-cost greenhouses |
| Power and control-intensive operations | • Tractors  
• Robotic technologies  
• Animal-drawn implements |
Borrowing from the table above, there is emphasis on continuity to ensure food stability. On the aspect of food use and utilization, there is need to think on how to counter the challenge on lack of nutritious foods, especially staple crops. This can be enhanced by having high nutrient staple crops, vitamin A- enriched cassava, maize, orange-fleshed sweet potato and iron and zinc-fortified rice, beans, wheat and pearl millet quality maize. The other aspect on the lack of information on healthy diets can countered by dissemination of nutrition information (for example, health mobile applications).

Finally food stability in line with the challenge of inability to predict when and how farming is achieved by weather- forecasting technologies, in framed sensors for detecting crop stress and
hyperspectral imaging based on drones and satellites. On the other hand, the challenge on the lack of financial mechanisms to ensure income can be settled by applying index–based insurance (crop and livestock. This is the overall importance of science, technology and innovation. This can be of much relevance to the East Africa region in achieving improved food security mechanisms and ensuring a well-fed and stable population. Science, technology, and innovation can play a critical role in producing more food by creating plant varieties with improved traits, as well as optimizing the inputs needed to make agriculture more productive.

To harness science and technology for the various dimensions of food security, it is necessary to make the food system itself more innovative. This includes, among other things, defining a research agenda that focuses on smallholder farmers, investing in human capacity, enabling infrastructure for food systems, putting appropriate governance structures in place for agricultural innovation and strengthening knowledge flows between farmers and scientists. The design of innovative food systems should ideally support pro-poor and frugal agricultural innovations, promote the participatory engagement of smallholder farmers, recognize local and traditional knowledge systems, facilitate gender equity and be clearly linked to economic empowerment and livelihoods. There is an urgent need to increase investment in high-quality research that is coherent with production models adapted to the needs of smallholder farmers. The constantly changing ecological, environmental and biodiversity contexts require continuous research and development to produce inputs and disseminate knowledge that maximizes agricultural yields while safeguarding the environment. Research – at the national and international levels – must address a more complex set of objectives: on the one hand, the new challenges (climate change, renewable energy and energy efficiency, biodiversity and resource
management), and on the other hand, the old challenges (productivity growth and production quality), as well as the promotion of diversification.

The aspect of Infrastructure also enables many of the scientific and technical applications that address aspects of the food system. More people having access to improved water sources and sanitation facilities, and affordable access to water may provide a means to increase the percentage of arable land equipped for irrigation. Ensuring access to affordable, reliable, sustainable and modern energy for all is also important for reducing greenhouse gas emissions while maintaining agricultural productivity. Inclusive, resilient and sustainable development within cities may help build up local markets, provide a means for people to travel to nearby markets to buy agricultural goods and open up new export and import markets.

4.2.3 Role of EAC in improving the regional food security through innovation and technology
Agriculture and food security are inextricably linked. Agriculture is the only source of food both for direct consumption and as a raw material for refined foods. Agricultural production therefore determines food availability. During the colonial period, the policies favored cash crops at the expense of subsistence crops. Soon after attaining independence, African countries thus gave primary focus to agriculture in their development strategies. The focus of agricultural modernization was on increasing productivity and enhancing food security. This was considered a prerequisite to Africa’s economic take-off as increased productivity would lead to better incomes for peasant farmers and expand the markets. However, in the 1980’s, changes took place caused by ideological shifts, the debt crisis, SAPs and liberalization policies. The new policies aimed to have private stakeholders assume responsibility for the revival of agricultural production. This however was not successful and instead there was an increase in food deficits.
The overall objective of the EAC Treaty regarding cooperation in agriculture and rural development is the achievement of food security and rational agricultural production. Further, the EAC Agriculture and Rural Development Policy (EAC ARDP) aims at attaining food security through increased agricultural production, processing, storage and marketing.

The EAC Agriculture and Rural Development Policy (EAC-ARDP) recognizes the importance of eliminating hunger and ensuring sustainable food security within the region as a necessary first step to poverty eradication and consequently a stimulus for rational agricultural development and realization of the aspirations of the Treaty establishing the EAC. However, before and since the signing of the Treaty, the ability of the Partner States to achieve individual and collective durable food security status has been elusive. This has been further compounded by the negative impacts of Climate Change.

The EAC ARDP guides the development of strategies and programs and projects for realization of the above goals of the EAC in line with CAADP Nepad principles. This action plan has been developed to guide the implementation and actualization of a regional food security objective.

In this connection EAC Head of States directed that the EAC Food Security Action plan and EAC Climate Change Policy be developed to address food insecurity and adverse effects of climate change in the region.

In the East Africa region, Agriculture is the engine of economic growth and cornerstone of poverty reduction. The sector is dominated by small holder mixed farming of livestock, food crops, cash crops and fishing among others. Approximately 70% to 80% especially in the rural areas rely on agriculture as their primary source of livelihood. Small-scale farmers are responsible for more than 90% of Africa’s agricultural production. It accounts for 24 to 48%
Gross Domestic Product (GDP) in the East African Community (EAC) and almost 60% of its total export earnings. Agriculture has a high multiplier effect on the economy as it contributes indirectly to other sectors such as manufacturing.

Agriculture in East Africa however remains largely traditional and small scale. The nature of East Africa’s agriculture has been characterized by reliance on rain fed agriculture; low diversification; low usage of modern technology and agro inputs; underutilized land; land fragmentation; and high post-harvest losses among others. This leads to low yields trapping the farmers in a cycle of poverty and food insecurity. The World Development Report (2008) on Agriculture and Development estimated that the rate of use of improved varieties in SSA was about 24%, use of chemical fertilizer stood at only 13%, and use of appropriate water control systems for agriculture covered only 4% of the cultivated land.

The EAC Food Security Action Plan (2011-2015) was adopted by the 9th Extra-Ordinary Summit of Heads of State held in Arusha, Tanzania on 19th April, 2011. The Plan proposed preparation of a Regional Food Balance Sheet (RFBS) as a key policy tool for management of food availability in the EAC region. Enhancing a comprehensive food inventory that reflects the regional food situation is imperative in this era of globalization and regional integration. Having a regional or common food balance sheet is in line with the framework of EAC’s economic development agenda as articulated in the EAC Development Strategic Plan 2006-2010. The benefits of developing a common food balance sheet in East Africa are numerous and include the need to fast track and harmonize regional policies for the interests of all the member states.

The quest for a regional food balance sheet was premised on the fact that each EAC Partner State runs its own food balance sheet for monitoring food availability. The Free Trade Area (FTA) in the EAC, which has been concretized through elimination of import duty on intra-regional trade,
sets a trading platform for food to move freely from surplus countries to deficit countries. This implies that Food deficit EAC countries can rely on food availability in surplus EAC countries.

The reality of this expectation is underscored by increase in food trade since 2005 when EAC Customs Union was launched.

In response to various regional challenges and opportunities discussed in this study, the U.S. Government has developed a five-year, feed the future strategy that addresses key regional issues. It is not an agglomeration of bilateral strategies, nor will it duplicate activities best managed on a country-by-country basis. Rather, the strategy looks across the region to identify those challenges that can be most effectively and efficiently tackled at the regional level and that will add value to the national CAADP investment plans and country feed the Future strategies. Regionally supported activities will complement activities at the national level, shaping the regional dimension to them. The East Africa Feed the Future strategy will support the development of seamless cross-border supply chains that will catalyze increased regional trade and food production, including trade in fortified staple foods, promote regional food security and food safety, and encourage greater regional integration.

4.2.4 What next for the Regional strategy in ensuring stability in food security?
The goal of the regional Feed the Future strategy is Increased Access, Availability, and Utilization of African grown staple foods in Regionally Integrated Markets on the Northern and Central Corridors. The planned activities will most directly affect availability, the total quantity of food available. Nevertheless, outcomes and impact on increased access through incomes, and with improved utilization through safe and nutritious foods, will be monitored. The key regional issues are further discussed below;
- **Transformational Focus Area: Increase Trade Flows of Staple Foods in the Region**

  The regional investment activities to implement the strategy will be organized within this focus area. The core investment areas are organized into activities under three Intermediate Results; Integrated national and regional markets, Improved regional access to technologies and inputs, an Increased private sector investment in regional agriculture and nutrition-related activities.

- **Support Area: Support Strategic Partnerships with African Regional Institutions**

  Investments in the focus area will be implemented in close collaboration with African regional institutions in both the public and the private sectors linked with CAADP. Capacity building and technical assistance, in coordination with activities of other development partners, will build the long-term sustainability of the regional integration agenda.

- **Support Area: Provide Regional Services**

  USAID/East Africa provides some core operational services to bilateral missions including legal, financial management, environmental compliance, information and communications technology (ICT), Global Development Alliances and support to strategic planning and monitoring and evaluation (M&E). In addition, as part of Feed the Future, an expanded regional team will provide technical services on focused topics to missions in the focus countries, and to both regional and bilateral partner organizations, to build coordination and synergies.

  Giving a more focus on the East Africa Food Action Plan (2010-2015), the region food production, processing and preparation sector remains a key sector in the economies of the member states. It is estimated that range of 70% to 80% of the labor force of the EAC is involved in the food sector in one way or another. Between 24% and 48% of the GDP of the member countries, is attributed to the agriculture sector. These figures may be an under-estimate because they often do not take into account of livestock, fisheries and other food supply systems. The
2009 Economic Report on Africa (ERA, 2009), explicitly recognized the potential regional agricultural value chains supported by agribusiness and agro processing as a basis for linking especially the smallholder producers to markets for food and other agricultural products. Therefore, the East African Common Market (EACM) provides the best opportunity for building such value chains, because it provides a framework for exploiting economies of scale in the production and supply of food.

4.3 Conclusion
Looking at the various literatures keenly, the region has great opportunities of gaining stability in food security. East Africa has an annual surplus of over 3 million metric tons (MT) of maize with almost 70% of the grain grown by smallholder producers. Yet trade of surplus staple foods in East Africa is disorganized, fragmented and largely informal. Structured Trade Systems (STS) – formal contracts, price discovery mechanisms such as commodity exchanges, financial products like warehouse receipt systems (WRS), certified warehouse operators and collateral managers, insurance and other quality control mechanisms to mitigate risks, and contract farming - are building blocks that can help the region to move from fragmented to formal trade. With access to formal markets and trading systems, the region’s smallholder producers can increase their incomes, better participate in cross-border trade, and ultimately improve regional food security. Investment in agriculture and improving resilience among farmers remain key to providing sustained access to food for all and reducing vulnerability to price volatility and natural disasters such as drought and floods. Improved seeds and farm management techniques, as well as irrigation and fertilizer that sustainably increase productivity and reduce production risk must be delivered to farmers especially smallholders by both the private and the public sector. The regions Governments must ensure that a transparent and predictable regulatory environment is in place, one that promotes private investment and increases farm productivity. Food losses should
also be reduced in the region by boosting investment in the entire value chain, especially post-
harvest processing. More sustainable management of the natural resources, forests and fisheries
are critical for the food security of many of the poorest members of society especially the rural
areas.

The East African Common Market Protocol is an important instrument of Ensuring Food
potential regional agricultural value chains supported by agribusiness and agro-processing as a
basis for linking especially the smallholder producers to markets for food and other agricultural
products. Therefore, the Common Market provides the best opportunity for building such value
chains, because it provides a framework for exploiting economies of scale in the production and
supply of food.

The realization of a regional economic bloc encompassing five countries leading to a combined
population of over 120 million, land area of 1.85 million km2 and a combined GDP of US$ 73
billion, is an opportunity for enhancing food security that should be used with all the priority it
deserves.
CHAPTER FIVE

5.0 General conclusion
Africa’s leaders have registered food security as a priority but very little has been achieved. The biggest challenge in achieving food security is the lack of will to implement the proposed strategies and solutions. In calling for African Green Revolution, H.E Kofi Anan while speaking at a special meeting of African heads of state and leading policymakers organized by the Ethiopian Government and the Hunger Task Force of the UN Millennium Project remarked that “the knowledge required for Sub-Saharan Africa to achieve its own green revolution is not lacking, what is lacking as ever, is the will to turn this knowledge into practice..” The importance of political will and the context of the international political economy are two recurring themes and it is therefore upon Governments in the region to have the political will to implement the already known strategies and initiatives in order to achieve food security and end the cycle of poverty in East Africa.

Poor political and economic governance are twin root causes of much of the malaise that afflicts Africa. They create general political and economic uncertainty, an unpredictable environment for business, political unrest and, sometimes, even war that make pursuit of economic growth difficult. Poor Governance also undermines formulation and implementation of policies and laws that can accelerate the process of economic growth and development. In the specific case of agriculture and rural development, improvements are sorely needed to adapt to changing market conditions new innovations and technology and food security priorities. Policy, regulatory and institutional shifts are required to enable all levels of farming practice to have a stable engagement with natural resources and markets.
The radical change of approach required is to link emergency food aid to long-term development. This is because trends show that while one part of a country or sub-region suffers from food shortage and is receiving food aid from developed countries, another part of the country or sub-region is forced to abandon bumper harvests to rot in the field for lack of a market. This kind of approach will increase the capital flow to help food producing households and communities build up their asset base to be able to effectively deal with their own emergencies in the future.

The initiation of the African-led Comprehensive Africa Agriculture Development Programme (CAADP) by the African Union’s NEPAD constitutes a significant demonstration of commitment and leadership. Since 2003, CAADP has been working with the RECs and through national roundtables to promote sharing, learning, and coordination to advance agriculture-led development. CAADP focuses on sustainable land management, rural infrastructure and market access, food supply and hunger, and agricultural research and technology. As of 2011, ECOWAS and 26 countries had signed CAADP “compacts”. The compacts are products of national roundtables at which priorities are set and roadmaps for implementation are developed. The compacts are signed by all the key partners.

African countries have adopted numerous regional cooperation and integration arrangements, many of which are purely ornamental. The roles of bigger markets in stimulating technological innovation, fostering economies of scale arising from infrastructure investments, and the diffusion of technical skills into the wider economy are some of the key gains Africa hopes to derive from economic integration. In effect, science and innovation are central elements of the integration agenda and should be made more explicit. There is widespread awareness of rapid
scientific advancement and the availability of scientific and technical knowledge worldwide. This growth feeds on previous advances and inner self-propelling momentum. In fact, the spread of scientific knowledge in society is eroding traditional boundaries between scientists and the general public. The exponential growth in knowledge is also making it possible to find low-cost, high-technology solutions to persistent problems.

The integration, growth and competitiveness of the economies of the East African Community (EAC) depend on science, technology and innovation (STI). If the five Partner States of the EAC do not make strategic, systematic and significant investments in the generate and application of new knowledge and technological innovations, their ambitions to grow their economies, achieve Millennium Development Goals (MDGs) targets, deepen economic and political integration and attain sustainable development will not be realized. The EAC States have been undergoing a series of constitutional reforms to agree on minimum political and governance agendas. Evidence from these constitutional reforms clearly shows that there is a growing tendency to include specific constitutional commitments on STI. Looking at the various national constitutions, the Uganda Constitution adopted in 1995 made explicit references to technology and industrial development. The preamble to the constitution of Rwanda promulgated in 2003 declares that “the people of Rwanda are determined to develop human resources, to fight ignorance, to promote technological advancement and the social welfare of the people of Rwanda.” On the other hand, the Kenyan constitution which was just approved in 2010 makes extensive provisions on science, technology and innovation. These include: promotion of all forms of national and cultural expression; enactment of legislation which recognizes and protects the ownership of indigenous seeds and plant varieties; protection and enhancement of intellectual property in, and indigenous knowledge of, biodiversity and the genetic resources of
communities. These trends clearly show increasing convergence between the political discourse and public policy making in the area of science, technology and innovation.

Life sciences are not the only areas where research could contribute to development. Two additional areas warrant attention. The continent’s economic future crucially depends on the fate and state of its infrastructure, whose development will depend on the contributions of engineering, materials, and related sciences. It is notable that these fields are particularly underdeveloped in Africa and hence could benefit from specific missions that seek to use local material in activities such as road construction and maintenance. Other critical pieces involve expanding the energy base through alternative energy development programs. This sector is particularly important because of Africa’s past investments, its available human resources, and its potential to stimulate complementary industries that provide parts and services to the expansion of the sector. Exploiting these opportunities requires supporting policies.

Advances in science and technology will therefore make it possible for humanity to solve problems that have previously been in the realms of imagination. This is not a deterministic view of society but an observation of the growth of global knowledge and the feasibility of new technical combinations that are elicited by social consciousness. This view would lead to the conclusion that Africa has the potential to access more scientific and technical knowledge than the more advanced countries had in their early stages of industrialization.

The EAC is in a unique position because there is generally less power asymmetry among the EAC Partner States. The only notable exception is Kenya which is presumed to hold a stronger economic position and the other Partner States are concerned about its potential economic hegemony within the Community. Other sources of asymmetry such as the size of area and population are compensated for by the presumed benefits of integration. Most importantly,
differences in STI capabilities and readiness are not so pronounced to affect the balance of power among the Partner States. Consequently, deepening cooperation in STI presents a unique opportunity for the EAC countries to mitigate the potential negative impacts of power asymmetry.

5.1 Recommendations
The East Africa community has achieved some success since its formation in the Agriculture, food security and technology advancements as noted in the study discussions. Despite all this, the road that lies ahead is still wide to cover and requires clear incentives and realistic goals put in place. There are already many existing policies set towards achieving a food secure region but still inactive. Various challenges have been outline in various literatures that have led the region into food insecurity. Just to outline a few of them which include; Persistent slow or rather inadequate growth of the agricultural sector, most soils in the region are infertile due to prolonged and intensive land use, shortening fallow periods that used to restore fertility and productivity and the production systems practiced in the region are highly dependent on rainfall and are reliant on traditional factors of production (land, labour and capital) among many others discussed previously in the study.

The region’s food systems have excluded the vast majority of those involved in producing food and feeding people from formulating food and agriculture policies - women, smallholder farmers, indigenous people, migrants, fishermen, agricultural and fishery laborers, pastoralists and forest dwellers. It is vital that the people have a voice in determining policies that affect everyone's lives on such a fundamental level as the right to food. Increased investment in agriculture must include targeted investment in small scale farming, and in particular providing incentives to women small-scale farmers, building the entrepreneurship capacity of women to engage in agribusiness and grow cash crops, and ensuring that state investments in social
protection are not sacrificed. Further, there is need to create national food balance sheet committees in the East African countries to ensure data on food security is up to date and readily available, there is need to carry out joint data validation exercises on a regular basis and the need to facilitate regional food trade by linking food needy and food surplus areas and populations. Updated food balance sheets will ensure that this data is readily available. Areas that require further research include production per hectare per crop, local vs. Imported certified seed production and use, market size trends for farmers and consumers, yields vs. post-harvest losses among others. The huge contributions of innovation and technology cannot be ignored. This will ensure improved measures on mitigating climate change, improved infrastructures, improved machines for tilling, planting, harvesting and post harvesting among others. The challenges of food security cannot therefore be addressed without addressing the effects of climate change. Mitigation efforts include use of improved/appropriate technologies and inputs that are adaptive to climate change impacts which should be enhanced including fertilizers, chemicals, farm machinery, high yielding, drought tolerant and disease resistant seed varieties etc. The region should support construction of a regional fertilizer processing plant to lower costs.

The issue of population growth should be addressed for Africa to address food insecurity. Population increase is critical when it is linked with socio-economic factors. An increase in population when there is no subsequent increase in social services leads to over burdening of service provision which limits the attainment of these services. Further, increased population leads to environmental concerns and subsequent shortage of food due to limited land for agricultural production. Poverty and land fragmentation leads to division of land into small parcels which leads to over exploitation of land and coupled with inadequate soil and water conservation practices, the yields are low. In order to improve agricultural productivity in the
region, small holder farmers should consolidate parcels of land and focus on utilizing enhanced farming methods so as to improve productivity. The governments should strive to improve the allocation and investments to the Agricultural sector if Agricultural development and food security is to be achieved. This will be in line with the international commitments and declarations made including the Maputo declaration on allocating at least 10% of national budgets to the Agricultural sector. Most countries in the region have not been able to achieve this target and Governments should therefore make it a priority to do so and commit to implementing both regional and global strategies that are targeted on improved agricultural production and food security.

Food security is therefore closely linked to the economic and social health of a nation, society and individual. Improving rural livelihoods, market opportunities and access will increase access to well-functioning markets for high-value agricultural products and equally important component is ensuring that smallholder producers particularly women, have the capacity to take advantage of this increased access at the community level.

The East African Common Market Protocol is an important instrument of Ensuring Food Security in the Region. The 2009 Economic Report on Africa (ERA, 2009) recognized the potential regional agricultural value chains supported by agribusiness and agro-processing as a basis for linking especially the smallholder producers to markets for food and other agricultural products. Therefore, the Common Market provides the best opportunity for building such value chains, because it provides a framework for exploiting economies of scale in the production and supply of food.
In conclusion, the realization of a regional economic bloc and use of relevant science, technology and innovation is an opportunity for enhancing food security that should be used with all the priority it deserves.
Bibliography


Article 11(2) of the Constitution of Kenya, Revised Edition 2010 Published by the National Council for Law Reporting with the Authority of the Attorney General.


Chan, S. C. 2010. Food, Memories and Identities in Hong Kong. Identities,


East Africa Community Treaty (1999); Arusha, Tanzania.


Retrieved from: http://www.org. FSA.


