CONTRIBUTION OF THE AGRICULTURAL TEACHING APPROACHES TO FOOD SECURITY: A CASE OF SECONDARY SCHOOLS IN EMBU COUNTY, KENYA

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DECLARATION

This thesis is my original work and has not been presented for a degree in any other university or for any award.

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This thesis is dedicated to my loving husband Justine Njiru, daughter Celine Gracia Marigu and son Austine Njagi.

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LIST OF ABBREVIATIONS/ACRONYMS

4-K - *Kuungana, Kufanya, Kusaidia, Kenya*

ADF - African Development Fund

AGRA- Alliance for a Green Revolution in Africa

ATIS - Agriculture Teachers' Interview Schedule

BOM- Board of Management

CAADP- Comprehensive Africa Agriculture Development Programme

CBC - Competence Based Curriculum

CDE - County Director of Education

COVID- Corona Virus Disease

EAC- East African Community

ENABLE - Empowering Novel Agri-Business Led Employment

ERH - Ending Rural Hunger

FAO - Food and Agricultural Organization

GPS- Global Positioning System

ICT - Information Communication and Technology

IFAD - International Fund for Agricultural Development

IFPRI - International Food Policy Research Institute

KCSE - Kenya Certificate of Secondary Education

KICD - Kenya Institute of Curriculum Development

KNEC - Kenya National Examinations Council

KSEF- Kenya Science and Engineering Fair

MDG - Millennium Development Goal

MoALF - Ministry of Agriculture Livestock and Fisheries

NACOSTI - National Commission for Science Technology and Innovation

NGOs - Non- Governmental Organizations

ODI- Overseas Development Institute

PBL - Problem Based Learning

PQ - Parent's Questionnaire

ROK- Republic of Kenya

SDG - Sustainable Development Goal

SFGDG - Students' Focus Group Discussion Guide

SFI- Severe Food Security

SMEs - Small and Medium Enterprises

SPSS - Statistical Package for Social Sciences

UN - United Nations

UNESCO - United Nations Educational Scientific and Cultural Organization

UNFAO – United Nations Food and Agriculture Organization

UNICEF - United Nations Children's Fund

USAID - United States Agency for International Development

VIF - Variance Inflation Factor

WFP -World Food Programme

WFS - World Food Security

WHO - World Health Organization

YFC - Young Farmers' Club

LIST OF NOMENCLATURES

Agricultural teaching approaches- they referred to the processes of attending to agriculture students' needs, experiences and feelings both theoretically and practically and making appropriate interventions to help them develop relevant skills for food security.

Community influence- this encompassed such aspects as the financial position of the community, community environment such as urbanization and public facilities available, educational status, communication and support given to schools such as donations, child care as well as unity and cooperation among the community people. This has the potential of causing a change in food security trend.

Constraints- in the context of the study, they referred to the challenges faced by the agriculture teachers and students in teaching and learning of the subject in secondary schools.

Contribution- the term has been used to refer to the input the various teaching approaches employed in secondary agriculture classes to enhance food security in the country. This is in regard to skill development upon the students as well as the effect of the skills developed to achieve the four pillars of food security namely: availability, accessibility, utilization as well as stability.

Effect- it referred to the result or outcome of the use of the various agricultural teaching approaches in developing skills for food security.

Food security- it referred to the ability of every individual to have access to adequate and quality food supply in a steady, stable and in an economical way. Its four pillars are availability, access, utilization and stability (WFP, 2019).

Home-based factors- these referred to the physical, human and financial resources used by families in adopting the skills acquired by the students.

Manual- It referred to a standardized measurement tool which was used by agriculture teachers as a guide in teaching and assessment as they applied the various approaches in teaching agriculture for food security.

Practical sessions- in the context of the current study, they referred to the period of time when agricultural skills could be developed through hands-on-experiences or with human intervention using equipment, tools or technology, requiring guidance.

Relationship- it referred to the connection or association between the agricultural teaching approaches and food security.

Relevance- in the context the current study, it referred to the suitability of the approaches employed in teaching secondary school agriculture in developing skills for food security.

School - community linkage – this referred to the connection between the various individuals and groups to the school as an institution through agriculture projects that are initiated for the welfare of the school and its community i.e. the neighbourhood and municipalities served by the school.

School-based factors- these referred to the physical, human and financial resources used by schools in promotion of skills development among the agriculture students.

Secondary school Agriculture- included all agricultural practices and processes taught in secondary school which add value to the participatory practical learning between the school and society.

Skills development- it referred to the process of identifying the agricultural students' skills gap and honing them to enable them execute their practical ability in various agricultural activities.

Theory- it referred to generalized explanations of agriculture principles without inclusion of any practical.

ABSTRACT

Continued food insecurity is a major global concern especially in Africa and Kenya in particular. The threats of the desert locust and the novel Corona Virus (Covid-19) pandemic have further accelerated this challenge. Despite her vast productive land, Kenya has been importing staple food particularly maize while her citizens have been pleading with the government to provide food especially maize flour. The youth on the other hand, cannot adequately employ the agricultural skills developed for food security despite the continued teaching of agriculture at various levels of education. The purpose of this study was to establish the contribution of the agricultural teaching approaches in secondary schools in solving the problem of food insecurity in Kenya. The study employed a descriptive survey design for objective one where qualitative data were collected and correlational research design for objectives two, three and four where both qualitative and quantitative data were obtained. A total of 198 schools in Embu County, 46,340 students, 235 agriculture teachers and 46,340 parents/guardians were targeted. The Krejcie and Morgan sample size determination procedure was employed to reach a sample size of 68 schools, 376 students, 111 agriculture teachers and 323 parents/guardians. Purposive sampling, stratified random sampling, systematic random sampling, simple random sampling as well as proportionate sampling were adopted for the county, the schools, agriculture teachers, the parents/guardians as well as the students in their focus groups respectively. Data were collected using a Students' Focus Group Discussion Guide, an Agriculture Teachers' Interview Schedule and a parents/guardians' questionnaire. It was then analysed using descriptive and inferential statistics. Content validity was established through expert judgment and a pilot study while Cronbach's alpha was calculated using SPSS version 23 to measure the reliability of the instruments. The key study findings revealed that it is the practical based agriculture teaching approaches that have major contributions to skills development for food security. Though a teaching method, digital learning was not mentioned as a standalone approach used in agriculture classes. The findings further showed that there are major constraints in the teaching and learning of secondary school agriculture that negatively impact on skills development for food security. The study concluded that agricultural teaching approaches should mainly be practical based emphasizing on the psychomotor domain. The major recommendations are that the study findings should guide the Kenyan education policymakers to develop a guideline on incorporation of agriculture practical sessions on secondary school timetables, school-community based agriculture projects and holiday-based field attachments for students for better skills development as targeted by the Competence Based Curriculum (CBC). When incorporated into the theory, the approaches can be avenues for enhanced skills development for food security emanating from the secondary school level.

CHAPTER ONE

INTRODUCTION

1.1: Introduction

This chapter is a presentation of the background to the study which has been divided into thematic sections namely: the global, regional, national and Embu County food security situations. It entails an explanation of the main concepts that form the key variables in the study and some research gaps in the area. Following closely are the main components of the chapter that include the statement of the problem, research objectives, a research question and the hypotheses. A brief justification of the study's significance, the assumptions of the study, the scope and the study limitations are also included.

1.2: Background to the Study

1.2.1: The Concept of Food Security

Food security as a concept originated in the mid-1970s in the discussions of international food problems at a time when there was a global food crisis (Overseas Development Institute (ODI, 1997). The four pillars of food security are its availability, accessibility, utilization and stability (World Food Programme (WFP, 2019). Initially, the focus was on food supply whose attention was primarily on ensuring the availability and to some degree, the price stability of basic foodstuffs at the international and national level (ODI, 1997). Many definitions have been suggested, but the most agreed upon is; when all people have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life at all times (Food and Agriculture Organization (FAO, 2008; WFP, 2019; WHO, 2018). According to FAO (2019) and the International Food Policy Research Institute (IFPRI, 2019), the definition of food security goes beyond hunger and mal-nutrition by also incorporating overweight and obesity.

Food security is crucial for economic transformation and for it to happen, upgraded skills set across the whole agricultural value chain are needed (Maiga, 2016). When

linked to Agricultural education, the four pillars can be achieved by imparting the relevant knowledge and skills through the application of the appropriate teaching approaches. In the context of the current study, with all players taking a role, food insecurity can be massively reduced. The use of practical oriented approaches to teach agriculture can develop the students' hands-on-experiences that are transferable to the society. The benefits from such skills can be reaped year in year out, making the communities, food secure. Such approaches include demonstration, class projects, tours and field trips, problem solving as well as digital learning.

1.2.2: The Global Food Security Situation

Food security is a global concern since reaching and feeding every individual is the goal of every government. In its report on population dynamics and hunger FAO (2018) indicated that nearly one billion people around the world in both developed and developing countries annually suffer from chronic food insecurity. The number of hungry people in the world has risen from 804 million people in 2016 to 821 million people in 2017 (FAO, 2018). The global demand for food is rising drastically while the growing world population and climate change are already affecting farming practices and productivity (United States Agency for International Development (USAID, 2018). This return to levels not seen in almost a decade ago sends a clear warning that more must be done and urgently if the Sustainable Development Goal number two (SDG2) of Zero Hunger is to be achieved by 2030 (FAO, 2018).

The newly introduced second indicator for monitoring Sustainable Development Goal of Moderate or Severe Food Insecurity (SFI) has raised the total to over 2 billion people worldwide who do not have regular access to safe, nutritious and enough food (IFPRI, 2019). The current global threats to food security namely the novel Corona virus (Covid 19) and the desert locust pandemic cannot also be underestimated. Achieving SDG2-Zero Hunger by 2030 will require strong political will and both public and private investment (IFPRI, 2019).

The current global average age for farmers is over 60 years (FAO, 2018), yet the world needs to be fed in the future with the current trend of youths migrating to urban areas and disengaging in agriculture. Many young people are shying away from work related to the agriculture sector, which they perceive as outdated,

unprofitable and involving a lot manure labour (IFPRI, 2018). The world is rapidly urbanizing and over 50% of the global population lives in cities, a figure expected to rise to two-thirds by 2050, with up to 90 percent of the growth occurring in Africa and Asia (IFPRI, 2019).

Through the international freedom from hunger campaigns and the World Food Security (WFS) summits, the hunger issue has been kept constantly high on the international agenda. In their joint effort, the heads of the United Nations (UN), FAO, the International Fund for Agricultural Development (IFAD), the UN Children's Fund (UNICEF), WFP and WHO warned that alarming signs of increasing food insecurity and high levels of different forms of malnutrition are a clear sign that a lot needs to be done to make sure that everyone is on the same road achieving the Sustainable Development Goal on food security as well as improved nutrition (IFPRI, 2017).

1.2.3: The Regional Food Security Situation

Despite the marked improvements in nutrition over the past two decades, many Africans are food insecure **(**Siba & Signé, 2017). The continued dependence on foreign aid and budget inefficiencies is threatening sustainability of food-security interventions**.** For example, Ghana heavily relies on external resources to support a number of ongoing agricultural growth programs and social protection. Uganda too relies on foreign aid overshadowing the government's investment in agriculture (WFP, 2017). Since the declining donor support raises concerns about the sustainability of food security interventions, building self-reliance and self-sufficiency in such countries through secondary school agriculture can be an eye opener for sustainable food security.

A crucial challenge facing the achievement of food security in Africa is the proliferation of policies that are only partly implemented and not well connected with the reality on the ground (Siba & Signé, 2017) leaving a wide gap between the global initiatives and their practical realization. In addition to their national strategies, most African countries have adopted international agendas such as the Sustainable Development Goals and regional policies such as the Comprehensive Africa Agriculture Development Programme (CAADP) (Siba & Signé, 2017).These

programmes are aimed at ending hunger through increasing agricultural productivity and building resilient economies (Siba & Signé, 2017). In the context of the current study, resilience in efforts to promote food security is very critical if developing nations have to eradicate hunger and achieve their developmental goals.

In many developing countries where food systems face severe difficulties in enabling access to sufficient, safe and nutritious food for all, skills development in agriculture and its application is either absent or inadequate (IFAD, 2014). The recent interlinked food, fuel and financial crises have further aggravated poverty and food insecurity, particularly in the developing world (Alarcón & Bodouroglou, 2011). International food prices have risen in the past half-decade, making food less affordable to many (FAO, 2017). In addition, the technology and agricultural practices in the last forty years have led to the degradation of productive land, large greenhouse gas emissions and extensive water pollution; all of which have threatened the sustainability of food production and its security (Alarcón & Bodouroglou, 2011).

African youths in the Sub-Saharan region do not view agriculture as a profitable opportunity for a livelihood (FAO, 2018). At the same time, even in prosperous times and prosperous societies, too many people are still excluded from fully participating in food systems and securing their benefits (FAO, 2018). In times of crisis, like today's novel COVID 19 and the desert locust pandemic, inclusion is an even greater imperative for protecting the most vulnerable in regards to food security and nutrition (IFPRI, 2020). The current global economic recession will most heavily impact the food security of the poor as they spend a greater proportion of their limited income on food than do other groups (IFPRI, 2020).

African countries have however made deliberate efforts to fight food insecurity; for instance, the use of trade policies to avoid adverse supply and price fluctuations. In mid-2016, Burundi anticipating a long dry season, banned exports of certain foods and called on farmers to put their harvests into public storage to avoid food shortages (FAO, 2017). To address food insecurity and spur agriculture-led growth, the government of Malawi has developed a National Nutrition Policy and Strategic Plan, closely linked to its CAADP plan and the Agriculture Sector-Wide Approach which together coordinate food security programming at the national and community levels

with the main focus being the small-holder farmer (USAID, 2020). Kenya too, in January 2017, fearing food shortages, banned exports of maize in response to the drought. Similarly, the Government of Uganda approved duty-free rice imports to boost supplies and stabilize prices.

In the recent past, there has been growing international consensus over the centrality of small-scale farm holders in improving food security. The necessity to support small-scale farming stemmed from the fact that they are the mainstay of food production in most developing countries (Alarcón & Bodouroglou, 2011). Such efforts can also bear fruits if more investment is made on practical secondary school agriculture as the skilled students would represent small-scale farmers groups outside the school level. Investment on secondary school agriculture curriculum would stimulate the engine of economic growth by transferring farm skills to solve school leaver employment needs and food security issues (Konyango & Asienyo, 2015).

1.2.4: The Kenyan Food Security Situation

Since 2008, the country has been facing severe food insecurity problems as depicted by a high proportion of the population suffering from inaccessibility and right amounts of food (IFPRI, 2012). Further, over 10 million people are food insecure (IFPRI, 2018) with a majority relying on food relief. The situation is exacerbated by households incurring enormous food bills due to the high food prices. Notably, there has been a short supply of maize which is the staple food thus limiting choices to other food stuffs (IFPRI, 2012). Moreover, only about 20 percent of Kenyan land is suitable for farming and in these areas, maximum yields have not been achieved leaving considerable potential for increases in output amidst continued food insecurity (USAID, 2019). Focusing on the needs of rural areas should be one of the most practical ways to achieve the SDGs and address many of the roadblocks encountered in 2018, from climate change to conflict and political instability (IFPRI, 2019).

Food security is one of the big four agenda that the Kenyan government wishes to tackle by the year 2022 vision plans. The Big Four Agenda is streamlined very well within the global, continental and national development contexts. At the global level, the Big Four Agenda is effectively aligned to the 2030 Agenda for Sustainable

Development, upon which the seventeen Sustainable Development Goals (SDGs) are anchored (WFP, 2018). At the continental level, the Big Four Agenda aligns well with Africa's Agenda 2063 themed "The Africa We Want" which sets out Africa's aspirations for development by 2063. Within the national context, the Big Four Agenda are rightly pegged on the Kenya Vision 2030 and well-mainstreamed in the third-Medium Term Plan of the Vision (WFP, 2018). The economic pillar of Kenya's Vision 2030 further identifies agriculture as one of the key sectors to deliver 10% annual economic growth rate. Part of this growth will be achieved through transforming small-scale agriculture from subsistence to innovative, commercially oriented and modern farming (Ministry of agriculture Livestock and Fisheries (MoALF, 2017)). Food insecurity is still rampant despite the concerted efforts that have been made to fight it at both the global and national levels. About 23% of the total population in Sub-Saharan Africa still suffers from undernourishment (FAO, IFAD & WFP, 2015) while about 25% of Kenya's population is undernourished with about 15% of them requiring emergency food assistance annually (ROK, 2011).

Despite her vast land which is 587,000 km^2 of which 576,076 km^2 is arable land, Kenya still faces a major challenge of food insecurity (Osongo, 2014). There is too much cry by citizens about food shortage particularly maize flour in the stores. At the same time, there has been persistent meagre harvest in many parts of the country further escalating the problem of food shortage. Post- harvest losses among farmers have been following bumper harvests, adding more to food insecurity. In its report on post-harvest milk losses in Kenya, FAO (2011) noted that they are highest at the farm level. Losses at the farm level are as a result of spillage, lack of market and rejection at the market. Rejection at market is occasioned by poor handling and the time taken to reach markets due to long distances and bad roads. Losses at the farm level have been reported to account for 6 percent of total production, which means that at current production levels, national annual losses may reach 60 million kilogrammes (FAO, 2011). In regard to the statistics mentioned above, secondary school agriculture can instil food preservation skills such as processing and value addition among the students. If ignored or not sustainably resolved, this problem is likely to call for more resources to handle the escalating rollback problems and the government will continue missing out on critical development issues which have an implication on the economic trend.

The recurrent crises such as drought in Kenya's arid and semi-arid areas have exacerbated the vulnerability of basic livelihoods. This has posed critical challenges to food security as over two million people receive food aid annually (USAID, 2019). The 2012 IFPRI food security report indicates that the major causes of food insecurity are the frequent droughts in most parts of the country, displacement of a large number of farmers in the high potential agricultural areas following the 2007/2008 post-election violence and the high costs of domestic food production due to high costs of inputs especially fertilizer. The grim picture of food insecurity in Kenya is further captured in the 2017 IFPRI report. According to the report, Kenya is food insecure and is ranked position 86 out of 113 countries (IFPRI, 2017). This survey was based on affordability, availability, quality and safety of food (IFPRI, 2017). There is need to emulate the spirit of self-reliance by using what is at our disposal. In this case therefore, self-reliance in the country can be initiated at the school level where the agricultural skills developed among the students are immediately and continuously transferred to the food industry.

The Kenyan government through the Ministry of Agriculture has however made various initiatives to address youth involvement in agriculture. They include: youth mobilization in all counties to form farming groups, technical support and provision of start-up farming equipment's, promotion of 4-K (*Kuungana, Kufanya, Kusaidia, Kenya*) and Young Farmers Clubs (YFC) (MoALF, 2017)). The Kenya Youth Agribusiness Strategy aimed at providing new opportunities for the youth in agriculture and its value chains (MoALF, 2017) is another initiative. The benefits of such a strategy can also be reaped through tapping the skills the youths develop in the course of learning agriculture at the secondary school level. The investment on the small holder farmer by enhancing cheap access to farm inputs such as seeds and fertilizers (MoALF, 2017) is also a shot on the hand for the farmers to be food secure.

In its five-year plan to meet 100% food and nutrition security, the Kenyan government has spelt out its targeted commitments. These entail food availability, increasing land size under irrigation, small holder production and value addition, increased Small and Medium Enterprises (SMEs), more job creation as well as

affordability (MoALF, 2018) (Appendix 4.0.). A close analysis of the targets show that the production level of the targeted crops will go high by 2022 as the demand rises. This could be attributed to the population increase as well as the changing feeding lifestyle. However, the projections indicate that the net import on maize will decline from 12,000,000- 90 kg bags in 2017 to 193, 400- 90 kg bags in 2020 and rise again to 9,578, 000-90 kg bags in 2022 (Appendix 5.0.). In this context, the researcher was interested in finding out the contribution of secondary school agriculture in developing skills that could reduce the problem of food insecurity associated with rise in imports on staple food like maize, increase agricultural output and improve food security in terms of its availability and affordability.

The Kenyan government has further established guiding policies in response to the recent food crises. For instance, the subsidy on farm inputs especially fertilizers, improvement of research and extension services and improving their linkages (MoALF, 2018). In addition, there is the provision of subsidy to maize meal millers to bring down the consumer retail prices of maize meal and the enhanced efforts to contribute to the costs of social amenities such as the free basic education programme and reduced costs of health at public health facilities. All these policies ensure that even the poor have a little more disposable income to spend on food (IFPRI, 2012).

Further, the Kenyan government has made deliberate efforts to create business opportunities and decent employment for young men and women along priority agricultural value chains in Kenya through the provision of entrepreneurship skills, funding and business linkages. This is evidenced by the proposed Empowering Novel Agri-Business Led Employment (ENABLE) Youth Kenya, which is aimed at contributing to the objectives of Kenya's Vision 2030 (African Development Fund (ADF, 2017)). Additionally, there is the Agricultural Sector Development Strategy and the Kenya Youth Agribusiness Strategy objectives (ADF, 2017). The Government of Kenya was among the countries in the continent that expressed keen interest in participating in the Bank's ENABLE Youth Programme and requested the Bank's support to finance and identify innovative potential-oriented entrepreneurs who are willing to pursue agribusiness-oriented opportunities (ADF, 2017). Since the Bank's ENABLE Youth initiative is a comprehensive programme that builds

entrepreneurship in agribusiness through acquisition of skills and creation of an enabling environment in which young men and women can become owners of profitable agribusinesses, skills training for agriculture teachers at secondary school level may also motivate students to put effort in such areas as agricultural economics. This would be in preparation for establishing small scale businesses after form four which would be a major avenue for food production and security in the country.

1.2.5: Food Security Situation in Embu County

The assessment of the impact of the 2016 short rains on food and nutrition security in Embu County indicates that the current meal frequency is two to three meals per day compared with the normal three to four meals per day (ROK, 2017). This can be attributed to diminishing food stocks and limited sources of income. According to the report, the meals had low dietary diversity of 3-5 food groups consisting of cereals, pulses, vegetables, dairy products and fruits. This is an indication of seasonal food insecurity which can be reduced if the practical skills developed in schools can be applied in areas such as off-season farming and innovations such as multi- storey gardening which are not capital intensive.

The report further indicated that good hygiene practices such as hand-washing at the critical times remained a challenge; less than 20 percent of households in Embu County practised this, resulting to an increased prevalence of water-borne diseases (ROK, 2017). Water treatment methods also remained low at 60 percent, while latrine coverage was between 80 and 90 percent. In the context of the current study, the safety of food was compromised which is an aspect of food security. The cost of water and longer distances to water sources compromise good hygiene practices (ROK, 2017). Agricultural skills related to water harvesting and treatment for domestic use can greatly enhance the accessibility and safety of food in the county. For instance, simple decantation of surface runoff water using soils of various textures and its treatment can make water available for households. The water can be collected in ponds lined with polythene sheets.

A report by the Republic of Kenya (2016) shows that the government is promoting modern agricultural technologies. These include: greenhouse farming, drip irrigation and water harvesting for agricultural production. There is also promotion of

improved storage bags for postharvest management of pests and diseases that do not require the use of chemicals, provision of moisture meters for management of aflatoxin in stored grains and mechanized land preparation. In the context of the current study, such initiatives can be sustained in farming if school- community linkages are established from where students can learn during practical activities, through clubs or even field attachment over the school holidays.

Based on the current information and the contribution of other researchers about the teaching of agriculture and food security, various gaps have been identified which this study addressed. For instance, Konyango and Asienyo (2015) have indicated that the lack of practical sessions on school timetables has led to teacher-chalk-talks. However, the authors do not indicate possible alternatives for enhancing skills development besides the double lessons. For instance, Young Farmers' Clubs can be made compulsory so that practical agriculture is learnt through them. At the same time, all idle land in schools can be used for farming to instil the spirit of self-reliance. This cannot be done easily without employing farm managers and grounds men/women. Also, urban farming such as multi-storey gardening would be an avenue for production of more food crops in schools that have limited farming fields. Besides, school - community linkages can be encouraged through agriculture projects.

Other studies (Ndem, 2013; Saina, Kathuri, Rono, Kipsat & Sulo, 2012) have indicated that secondary school agricultural knowledge not only broadens the students' capacity, but also makes them more effective, self-reliant, resourceful and capable of solving farming problems even at their youthful stage. The authors have indicated that the challenge of the teaching profession is finding out the best teaching methods both in and out of school. The current study attempted to establish the contribution of the various teaching approaches employed in secondary schools in developing skills that would be appropriate for food security; hence, bridging this gap.

In his research, Gill (2013) indicates that what is common among the various approaches employed in teaching secondary school agriculture is that they impart knowledge, develop the learner's skills and all can be applied through the mixed method approach. According to the author, the hybrid approach blends the best of

everything that the teacher has to offer. However, the current research emphasizes that despite their intent in imparting knowledge and developing the learners' agricultural skills, developing skills geared towards food security remains a challenge. In this case therefore, not all the teaching approaches would blend well to develop the learners' skills. The current study investigated the mean contribution of each teaching approach to skills development and advocates for blending of only the approaches with significant contribution to skills development. As cautioned by various scholars, developing the relevant skills for food security in a country should put an emphasis on practical approaches to teaching agriculture (Amuriyaga, Zakaria & Abujaja, 2018; Donna, 2015). If done without well outlined guidelines, transfer of knowledge may remain theoretical, examination oriented and with class projects restricted to the main examinations only.

In view of this study, secondary agriculture in Kenya is being taught yet the country is still experiencing consistent food shortage to the level of importing staple food. This research therefore aimed at establishing the contribution of the agricultural teaching approaches in secondary schools in solving the problem of food insecurity in Kenya. It was specifically concerned with establishing the agricultural teaching approaches employed in secondary schools, finding out the effects of the agricultural teaching approaches on skills development for food security, determining the relationship between the agricultural teaching approaches and food security as well as finding out the constraints faced in teaching secondary school agriculture for food security.

1.3: Statement of the Problem

Applied education subjects such as Agriculture, Home science, Business studies, Computer studies, Art and Craft as well as Music are the centrepiece of the practical aspects of the secondary school curriculum (Mwiria, 2002). Among other elective subjects, Agriculture can foster the development of skills among students that can promote avenues for food security. A school that has a farm can give students a chance to develop the skills geared towards food security both within the school and the surrounding community (Njura, Kaberia & Taaliu, 2020a).

The fundamental objective in learning agriculture is for learners to develop basic principles of agricultural production relevant to a nation and the surrounding environment (Kenya National Examinations Council (KNEC, 2017). This can help to meet the United Nations initiative which outlines the first Millennium Development Goal (MDG) of eradicating extreme poverty and hunger (UN, 2010). The skills can however be developed if the approaches to teaching agriculture are relevant to alleviating the problem at hand. Practical teaching approaches result to development of the required skills for food security. The skills developed encompass the aspects of food production, accessibility, food safety and nutrition as well as constancy in its supply leading to the achievement of the four pillars of food security namely: availability, accessibility, utilization and stability (FAO, 2008).

The current situation however shows that despite the teaching of agriculture, the youth in and out of school are faced with the challenge of employing the skills developed to secure food for themselves and the future generation. At the same time, various governments' efforts all over the world to address youth issues such as unemployment have remained a challenge. For instance, in Kenya, these government efforts are through policies such as, the third National Development Plan (1974-1978), Sessional Paper number two of 1992 on small scale and cottage industry, the 1997-2001 Development Plan and the National Poverty Eradication Plan of 1999-2015 (MoALF, 2017). The principle challenge is ensuring optimal utilization of the youth potential in contributing to the sector goals of achieving food and nutrition security, income generation, decent employment as well as wealth creation (MoALF, 2017).

A snap review of Kenya's food balance sheet shows that Kenyan imports comprises of most of the basic food commodities including wheat, maize, rice, beans, potatoes, sugar and milk (Parliamentary Budget Office, 2018). The persistent scanty harvest in many parts of the country has further intensified the problem of food shortage. In the context of the current study, agricultural education at the secondary school level can develop skills geared towards household food security such as kitchen gardening and multi-storey farming. These ventures are cost-effective and can ultimately promote food security at the national level. Further, in Kenya, food consumption exceeds food production (Welborn, 2018). If ignored or not sustainably resolved, this problem is likely to call for more resources to handle the escalating rollback problems such as

drug and substance abuse, unemployment, insecurity and other violent activities among the youth. The government will also continue to miss out on critical development issues which have an implication on the economic trend.

Kenya's strategies to address food insecurity are broad-based and their implementation would benefit from reliable and research-based information on the role of agricultural teaching approaches in skills development for food security. Much of the research done on food security has not focused on the contribution of agricultural teaching approaches in secondary schools in averting the problem of food insecurity. This is the knowledge gap that this study attempted to fill. The inherent potential of the secondary school agriculture student can be energized through hands-on-training so that the skills developed can be applied at their own capacity for food security. The application of the psychomotor domain is such an avenue for skills development to meet the four pillars of food security, reduce poverty and reach the ultimate goal of economic development (Simpson,1972; Bloom, Engelhart, Furst, Hill & Krathwohl, 1956).

The integrated nature of the Big Four Agenda calls for inclusive and integrated approaches to its implementation and reporting. Therefore, identifying the agricultural teaching approaches employed in secondary schools, establishing their effect on skills development for food security, determining the relationship between the agricultural teaching approaches and food security as well as establishing the constraints faced in teaching secondary school agriculture for food security may guide in finding better ways of harnessing the agricultural skills developed at secondary school level in fighting food insecurity in Kenya.

1.4: General Objective

To establish the contribution of secondary school agricultural teaching approaches in solving the problem of food insecurity in Kenya.

1.5: Specific Objectives

1) To find out the agricultural teaching approaches employed in secondary schools in Kenya.

2) To determine the effect of the agricultural teaching approaches on skills development for food security.
3) To investigate the relationship between the agricultural teaching approaches and food security.
4) To establish the relationship between the constraints in teaching and learning agriculture and skills development for food security.

1.6: Research Question

One research question structured from the first objective was devised as follows:

Which agricultural teaching approaches are employed in Kenyan secondary schools?

1.7: Research Hypotheses

Three research hypotheses were structured from the second, third and fourth objectives as follows:

H_0: Agriculture teaching approaches do not have a statistically significant effect on skills development for food security.

H_1: Agriculture teaching approaches have a statistically significant effect on skills development for food security.

H_0: There is no statistically significant relationship between the agricultural teaching approaches and food security.

H_1: There is a statistically significant relationship between agricultural teaching approaches and food security.

H_0: There is no statistically significant relationship between the constraints in teaching and learning agriculture and skills development for food security.

H_1: There is a statistically significant relationship between the constraints in teaching and learning agriculture and skills development for food security.

1.8: Justification of the Study

Agriculture is the backbone of the Kenyan economy and has more opportunities than any other subject both at the farm and urban areas. Secondary agriculture in Kenya is being taught yet the country constantly experiences food insecurity to the levels of importing staple food like maize. There is also little research evidence to ascertain whether the approaches employed in teaching secondary agriculture develop the relevant skills for food security and the extent to which these skills are transferred to

the real world. Establishing the contribution of the agricultural teaching approaches in secondary schools in solving the problem of food insecurity in Kenya was therefore necessary.

One of the policy issues in the basic education curriculum framework of 2019 is to nurture the inherent potential of the learner to necessitate achievement of one of the core competences of "learning to learn". The proposed curriculum indicates that the junior secondary school (grade 7, 8 & 9) will be allocated three-forty minutes of agriculture lessons per week. This is intended to prepare learners for the immediate application of agricultural skills to solve contemporary food security challenges. Linked to this policy issue, lack of double lessons for practical sessions on the secondary school timetables will continue constraining the application of the relevant practical teaching approaches for skills development; hence, the need to inform policy.

Agricultural education is fundamental in promoting the capacity of the small-scale farmers to escape from poverty and hunger with their own power. The one with the agricultural skills developed at secondary school level can find a job and have the capacity to use more rationally the resources he or she owns. Such individuals have more probability to select valuable objectives in life, such as having stable access to food for their household. However, this is not the case in Kenya where the rural poor are the majority who farm only for subsistence and with poor methods being applied. At the same time, little has been done to ascertain whether the skills developed are employed for food security. Determination of the relationship between the agricultural teaching approaches and food security was necessary to help avert the problem. This also encompassed the level of innovation as taught at the school level.

The food security and nutrition policy clearly outlines the need for increasing the quantity and quality of food available, accessible and affordable to all Kenyans at all times. Linked to this policy issue, this study was necessary since its findings could be utilized to achieve the four pillars of food security. This can ultimately help to achieve the 2030 Agenda for Sustainable Development, the Africa's Agenda 2063 themed "The Africa We Want" which sets out Africa's aspirations for development by the year 2063 and the achievement of Kenya's food security agenda by the year

2022. At the national context, the food security agenda will be an avenue for achieving the food security pillar for the Kenya Vision 2030.

1.9: Significance of the Study

The study findings have both theoretical and practical implications. Theoretically, learning opportunities that can create more hands-on-skills driven towards food security in any country are highlighted. Practically, the study is informing policy by firstly, addressing the issue on the basic education curriculum framework. Its research findings are hoped to be used as inputs by the Kenyan education policy makers in the new Competence Based Curriculum (CBC). For example, incorporation of agriculture practical sessions on the school time tables, establishment of school-community based agriculture projects as well as introducing holiday-based field attachments for students. These can enhance better skills development as targeted by the Competence Based Curriculum (CBC).

Secondly, the study addresses the food security and nutrition policy which recognizes the need for multi-public-private sector involvement and that hunger reduction and nutrition improvements is a shared responsibility for all Kenyans. This policy is also framed in the context of basic human rights, child's rights and women's rights including the universal right to food. The study addresses the issue of increasing the quantity and quality of food available, accessible and affordable to all Kenyans at all times by emphasizing on the need to involve the secondary school agriculture students in implementing the food security agenda. This is through the adoption of the teaching approaches that contribute to hands-on-skills development that can be applied in real time to meet this agenda.

1.10: Assumptions of the Study

The researcher made the following assumptions for the study.

1) The respondents recognized the statements and understood the questions as presented in the research instruments.
2) Agriculture teachers and the students who participated in data collection were knowledgeable about the teaching approaches employed in agriculture classes and their contribution to food security.

3) Students would not have selected their subject options as they joined Form Three.

1.11: Scope of the Study

The study confined itself to secondary schools in Embu County. The respondents were agriculture teachers, students and their parents/guardians. There are other stakeholders involved in the teaching and learning process such as the school management who include the Board of Management (BOM), the sponsor such as the church, and the administrators such as the chiefs. This study however considered the agriculture teachers and the students who are directly involved in the learning process and the parents/guardians who are the direct beneficiaries of the skills developed. All the other stakeholders are not directly involved in the learning process. They were also likely to be represented by the targeted group which would have caused duplication of information by the same respondents. For example, parents form both the school community and members of the church. There are other practical subjects taught in secondary schools; however, this research was limited to agriculture for detailed and more informing work. Based on the content, the study focused on the contribution of the agricultural teaching approaches in solving the problem of food insecurity.

1.12: Limitations of the Study

The limitation of this study was that the relationship between digital learning as a pedagogy in agriculture classes and food security could not be established. Though highly discussed in the literature section as a great step towards innovative learning, its role in contributing to skills development for food security could not be explained in this particular study. The future plans are therefore to find out the relationship between digital learning in secondary school agriculture and food security.

1.13: Summary of Chapter One

The researcher has discussed the research gaps that were the drivers for the study in the background to the study. The researcher has also explained the expected, the current situation as well as the way forward in teaching and learning agriculture within the statement of the problem. The research objectives, one research question and three hypotheses that guided the study have been highlighted followed by the

justification section that explains the need for the study. The researcher has further spelt out the significance of the study followed by its assumptions, the scope of the study and winds up by explaining the draw backs encountered during the study as outlined in the limitations section.

CHAPTER TWO

LITERATURE REVIEW

2.1: Introduction

This chapter entails a presentation and a discussion of related research findings by other scholars. The existing research gaps have been addressed through this study as guided by the research objectives. The theoretical and conceptual framework that guided this research have also been explained.

2.2: Aspects of Food Security and Nutrition

Food security aspects entail its production, accessibility, food safety and nutrition as well as constancy in its supply. If achieved, these can lead to the achievement of the four pillars of food security namely: availability, accessibility, utilization and stability (FAO, 2008). The nutritional aspects of food security on the other hand are achieved when secure access to food is coupled with adequate health services, a sanitary environment and knowledgeable care to ensure a healthy and active life (free from malnutrition) for all household members (FAO, 2018; WHO, 2018). Secondary school agriculture should therefore not only impart knowledge on production but also integrate all other aspects of food security. Agricultural education and nutrition have a symbiotic relationship which can be explained through the teaching approaches. For instance, due to vulnerability of women and children, the kitchen garden model promotes dietary diversification using improved agricultural techniques that conserve limited resources (Global Communities, 2018).

In its report FAO (2017) indicates that the prevalence of hunger is on the rise in Africa after many years of decline. According to the report, a fifth of Africans are undernourished representing a staggering 257 million individuals. This is associated with difficult global economic and worsening environmental conditions as well as conflict and climate variability in many countries. Food insecurity has worsened in countries affected by conflict often exacerbated by drought and floods. For example, in Southern and Eastern Africa, many countries suffered from drought (FAO, 2017).

The threat to food security and nutrition is witnessed in both rural and urban centres. In its report on Urban Food Systems for Better Diets, Nutrition, and Health (IFPRI, 2019), the world is rapidly urbanizing and more than half the global population lives in cities. This figure according to IFPRI (2019) is expected to rise to two-thirds by 2050, with up to 90 percent of the growth occurring in Africa and Asia. In the context of the current study, the fact that urbanization creates opportunities for economic growth, it also comes with unique challenges which block food security and nutrition. This agrees with IFPRI (2019) report that as the cities expand, they struggle to ensure access to affordable and healthy diets, especially for the urban poor. Unhealthy diets are at the root of all forms of malnutrition and they drive such problems as the persistently high rates of maternal and child under-nutrition and currently booming rates of overweight, obesity and diet-related non-communicable diseases found in urban centres.

In its report WFP (2017) notes that most African countries have made progress over the past decade; however, the food-security situation remains severe. The percentage of children stunted in sub-Saharan Africa decreased from 49 percent in 1990 to 35 percent in 2016. Despite this overall shift, population growth has meant that the absolute number of stunted children has increased in sub-Saharan Africa from 45 million in 1990 to 57 million in 2016 (WFP, 2017).

Case studies from the Ending Rural Hunger (ERH) project show that environmental shocks and adverse macroeconomic conditions threaten food and nutrition security. For instance, in addition to fighting food insecurity, Ethiopia has faced recurrent drought. Nigeria has had to address oil price shocks and insurgencies while Ghana has faced difficult macroeconomic conditions such as inflation (WFP, 2017). Governments hoping to achieve food security have to plan for these shocks, for instance, although Senegal has made progress toward rice self-sufficiency, the country still imports almost half of its cereal requirement, exposing the country to global food price shocks. The macroeconomic shocks can be reduced if their level is reduced at the household level particularly through agricultural teaching approaches that can bring about school-community linkages.

In its report on Feed the Future Initiative, USAID (2019) indicated that by 2015, Kenya had increased access to diverse and quality foods that enhanced the nutritional status of women and children. Community health and agricultural extension workers helped 98,218 households to gain the knowledge and skills to choose, grow and prepare nutritious foods. In the context of the current study, inviting technical experts in schools can play a major role in disseminating knowledge through demonstration so that the same students can take back the knowledge to the community. This would also be a way of completing the chain of the same food, as the same students are taught how to produce the food.

2.3: Aspects of Innovative Practical Agriculture

The term practical agriculture is an activity whereby students use their own hands to manipulate real objects during the teaching and learning process or observe their teacher to manipulate a real object for them to see and practise later (Diise, Mohammed & Zakaria, 2018b). Lack of a conducive environment in the school such as teaching and learning facilities negatively affects students' interest in mastering agricultural practices (Diise, Zakaria & Mohammed, 2018). This is due to the inability of the school to offer hands-on experiences to students by allowing them to practise what they have learnt in the classroom. Developing skills in agriculture may help curb the output issue which would ultimately lead to food security (Maiga, 2016). Since there are many opportunities to get involved in the parts of the value chain provided people have the right skills; secondary schools can therefore be part of the value chain in production; hence, food security.

Innovations are ideas, practices or objects that are perceived as new by an individual or other unit of adoption (Rogers, 2003). Innovation in practical agriculture should therefore entail new and creative practices especially in the way teaching is done. One approach to achieving this goal is to identify and replicate sustainable innovative practices through basic but result-oriented strategies (Rogers, 2003). Innovativeness of a program should be from a local, regional, or national standpoint. For example, aquaculture may not be perceived as innovative in one place but it could be in another (Rayfield, et. al., 2012). To heighten innovation in the instructional delivery, variety is key. Therefore, the agriculture teacher must diversify the instructional methods s/he uses in teaching (Adom, 2017). S/he must

also be competent in the area to employ innovation in teaching. Competency, according to Olaitan and Ali (1997) is the knowledge, skill, attitude and judgment generally required for successful performance of a task example, for effective utilization of school farm.

Simulation is one of the innovative teaching strategies that can be used for teaching practical oriented topics such as the use and management of agricultural tools and technologies for crop farming, soil preparation and so forth (Adom. 2017. Models or mock-ups of moving and operating machinery are given to learners to operate, fix and even maintain as they would eventually do in the real world (Adom. 2017). The discovery method of instructional delivery is also innovative. The teacher can expose learners to a situation existing in a farmland or an agricultural site for them to discover the underlying principles that explain the situation and how the challenges identified there could be remedied. The students learn the effective agricultural methods, chemicals, technologies through discovery (Adom, 2017). In the context of the current study, innovativeness is needed in all the teaching approaches to ensure that thoroughness in skills development. Subsequently, students will become more innovative as they apply the skills in the real world.

2.4: Role of Innovative Practical Agriculture on Skills Development

Through innovative practical agriculture, students will develop skills on more food production with fewer inputs. They can make it more economical and also better nutritionally. By transferring the same skills to their homes, they can help parents who are farmers turn to data science, for instance, to make informed decisions using precision technologies about everything from soil quality to water use. Skills on sustainable food production and preservation are another focus area of innovative practical agriculture which can feed a growing population with limited resources. According to Boss (2018), food packaging using biodegradable materials is ripe for innovation. The purpose of innovative agricultural education is therefore to educate students and the community by matching industry trends and finding new ways to improve agriculture. Innovative agricultural education programs should therefore be focused on the students' future and strive to develop life-long learners who will be leaders in the agricultural industry as well as the community (Rayfield, et. al., 2012).

Skills development for instance through well-established class projects on school gardens are a wonderful and exciting way to make almost any classroom curriculum come alive and show "real-life" meaning to students as they learn (Parella, 1995). Through school gardens, students have an opportunity to participate in hands-on learning that teaches not only the intended subject but also responsibility, teamwork and respect for nature as well as promote healthier eating habits and appreciate locally grown food sources (Bucklin-Sporer & Pringle, 2010; Ozer, 2010). School gardens are therefore a practical opportunity for students to re-connect with nature and the ecology that surrounds them (Ozer, 2010).

Incorporation of school- community based projects is also an opportunity for hands - on-skills development that can enhance food security around the schools. Important roles played by learning outside formal institutions such as informal learning from parents and peers provide opportunities for the rural youth to acquire both traditional and new knowledge and skills. Therefore, there is need to strengthen linkages between informal, non-formal and formal learning as part of lifelong learning (FAO, 2014).

2.5: Agricultural Teaching Approaches Employed in Secondary Schools

Teachers in secondary schools have been found to use the various pedagogical methods at their disposal in the various subjects. The common methods are lecture, discussions, class experiment/projects, demonstration, problem solving/guided discovery and field trips and tours. Digital learning has currently found its way in education as technology advances especially with the novel Corona Virus (Covid-19) (Troussas, Krouska & Sgouropouou, 2020). However, different teachers use different methods depending on the availability of facilities and resources as per the status of the institution (Munyao, 2014). The teaching methods employed need to be designed in a way that the responsible teacher has the possibility to analyse all aspects of the knowledge acquired by the students (Daluba, 2013). To arrest students' attention, interest, curiosity and promote their performance, the use of activity stimulating and student-centred approach like demonstration method instead of depending on the conventional lecture approach need to be embraced (Daluba, 2013).

Digital learning has not been well exploited in secondary education although it is the most result-oriented approach due to its appeal to adolescents (Kurt, 2020). The use of computers, tablets, digital cameras, video conferencing technology and Global Positioning Systems (GPS) devices is a modern approach that can enhance a student's learning experience (Resilient Educator, 2020). The intuitive nature of the mobile technology, their affordability compared to other ICT devices, mobility, usability and accessibility among the youth are factors that can ease their integration in agriculture. The first objective for this research was concerned with establishing the agricultural teaching approaches employed in secondary schools for food security.

2.5.1: Lecture Method

Lectures usually take place in a classroom-format. It is also referred to as talk and chalk or textbook method (Gbamaja, 1991). In the course of employing the method, the teacher dominates the teaching with very little participation on the part of the learners (Umar, 2012). The teacher is seen as the repository of all knowledge while the students are passive recipients of knowledge transmitted by the teachers in the learning process (Umar, 2012).

The method has the advantage of covering a wider area within a short time but it is not student centred and students do not gain mastery of the concepts (Umar, 2012). The major advantage of lecture method is the ability to relay huge amount of information to a lot of people within a short period of time (Charlton, 2006). In the context of the current study, this method is the least effective in developing agricultural skills for food security. In many cases, lectures contain no form of interaction between the teacher and the student and can be quite boring (Seevers & Graham, 2012). Studies show that people only retain 20 percent of what they are taught in a lecture (Charlton, 2006). According to Seevers and Graham (2012), lectures are only useful when used in a conscious way. Properly structured-lectures may be the best teaching method especially when suited to the transmission of conceptual and systematic knowledge (Charlton, 2006).

In a study, Umar (2012) notes that the use of this method excludes the use of any equipment, laboratory or learning material. The students' listening skills are

developed and the approach is very helpful when learning languages. Contrary to this, Umar (2012) outlines the disadvantages of lecture method of teaching. They include: teachers delivering the same lecture to students without recognizing the individual differences, the language use in the lecture is above the standard of the students; hence, they are not able to get full advantage of the lecture because lectures are often forgotten by the students soon after while learning is retained if activities are experienced and the attention level is not the same for students listening to the lecturer. Lectures are therefore usually the best medium for teaching up to the point where the student begins to specialize and train as practising scientists, at which point a more individualized and skill-orientated apprenticeship becomes necessary (Charlton, 2006).

Related literature (Charlton, 2006; Gbamaja, 1991; Seevers & Graham, 2012; Umar, 2012; Mwiria, 2002) indicate that the lecture method is appropriate for institutions of higher learning such as colleges and the universities where specialization to a given pathway starts. The authors have further indicated that its use has found its way into secondary schools. However, the extent of its use has not been clearly explained; hence, the need for this investigation in the current research filling this gap.

2.5.2: Discussion Method

The use of discussions as a primary teaching method in agriculture allows the teacher to stimulate critical thinking on the learners (Umar, 2012). This approach also helps the teacher establish a rapport with the students, demonstrate an appreciation of their contributions and challenging them to think more deeply and to articulate their ideas more clearly. The frequent questions asked by both the teacher and the students provide a means of measuring learning and exploring in-depth, the key concepts of the course (Seevers & Graham, 2012).

Through discussion method, a set of acquired skills that is necessary for establishing and developing interpersonal relationships such as communication skills, cooperation, emotional intelligence as well as critical thinking are developed (Falode, Adewale, Ilobeneke & Robinson, 2015; Daluba, 2013). The current research advocates the incorporation of this approach to develop these skills. When linked to food security, students can have a clear picture of the likely causes, effects and

mitigation measures of food insecurity in their homes, community and the nation at large. Discussion can be improved through incorporation of digital technology. For instance, if a student does not feel comfortable speaking in a classroom of more than 40-50 students, they may post a "Tweet" to contribute to class discussion (Jessy & Charu, 2015).

2.5.3: Tours and Field Trips

Tours are a series of field and demonstration meetings arranged in a logical sequence (Seevers & Graham, 2012). A tour may be devoted to a specific topic or the cumulative effect of several result demonstrations (Seevers & Graham, 2012). The usual purpose of outdoor training through tours and fieldtrips is to develop teamwork skills (Umar, 2012). In the context of the current study, agriculture students can benefit from such experiences by employing the team spirit in school-based and community projects. Such projects may include nursery practices and poultry farming where they can sell the produce to both the school and the community making them food secure. A key benefit in fieldtrip learning is the transfer of knowledge between students (Goh, 2011). Students with prior experiences share their knowledge with other students and the experiences serve to connect the group (Goh, 2011). Studies (Goh, 2011; Wong, & Wong, 2008) have reported fieldtrips to have enhanced students' learning and increased their practical knowledge.

Field trips to agricultural centres, industries, farmlands etc., where students get first-hand experience and practice of the theoretical methods of agriculture can prove very helpful (Adom, 2017). However, assignments, write-ups, and projects must be given to students to aid them to participate effectively in the field trips (Adom, 2017). Instruction in agriculture classes should therefore emphasize inquiry, field trips, project-based learning and technology integration all of which are part of a national movement to prepare the next generation to feed a hungry planet (Boss, 2018).

On the flip side, tours and field trips in secondary schools may disorient the school time table; hence, they need proper timing such as during the school mid-breaks and holidays. Moreover, the field trip is one of the most complex and expensive activities in the educational system; thus, should be planned as an integral part of the curriculum rather than as an isolated activity (Orion & Hofstein, 1994). Based upon

the model of experiential learning (Figure 2.1), field trips can be an effective experiential learning activity (Roberts, 2006).

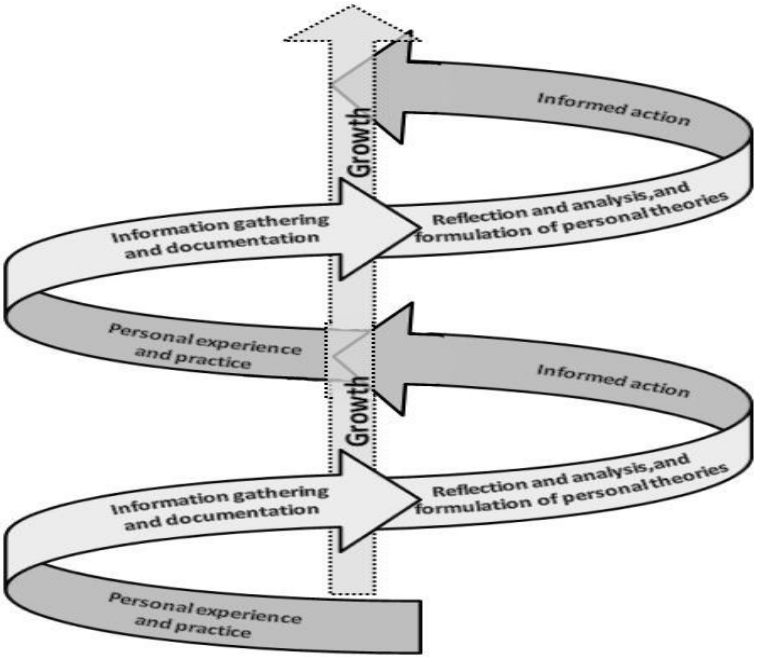


Figure 2.1: Cyclical and Spiral Experiential Learning Framework (Kolb's, 1984)

Experiential learning emphasizes the role that experience plays in the learning process, an emphasis that differentiates it from other learning theories. It defines learning as the process whereby knowledge is created through the transformation of experience (Kolb, 1984). In the context of the current study, constructivist theory by Dewey (1998) fits in this approach because of the endless experiences learnt from the farm. Students are reconnected to local agriculture so that farms are no longer an abstract notion. They develop hands-on experience so that they can truly understand with all their senses just what it means to be on a farm (Goh, 2011). The researcher therefore advocates the incorporation of this approach through creation of adequate time and ensuring it becomes part of the project work done at form four in the final examination to gain more seriousness as it is being carried out.

2.5.4: Demonstration Method

It refers to a type of teaching method whereby the teacher is the principal actor while the learners watch with the intention to act later. Here, the teacher does whatever the learners are expected to do at the end of the lesson by showing them how to do it and explaining the step-by-step process to them (Ameh, Daniel & Akus,

2007). The demonstration may include diagrams, charts, and other illustrative material accompanied by an oral explanation (Seevers & Graham, 2012). The audience observes the process, listens to the explanation and poses questions during or at the conclusion of the demonstration (Seevers & Graham, 2012). Demonstration method increases students' interest and understanding and consequently promotes high achievement rate (Daluba, 2013). Such procedures may include machine milking, how to preserve fish, how to graft a mango tree or how to install drip irrigation in a home garden. In the context of the current study, incorporation of demonstration improves both recall and psychomotor skills when the students are allowed to repeat the same procedures either individually or as groups.

In a study, Daluba (2013) recommends the need for teachers to make efforts to thoroughly integrate demonstration method in the teaching of agricultural science in secondary schools in all classes. The current study was specific as it sought opinions from agriculture teachers and the students on the extent to which the method was integrated to food security. The current study further suggests the need for integration of demonstration method by agriculture teachers and the extension experts to students and the members of the community during school-community linked projects as an innovative way of learning.

2.5.5: Class Projects

Several methods of classifying projects have been put in place; one approach has been to classify projects based on the purpose or outcomes while another approach has been to classify projects based on the actions of the learners rather than project outcomes (Roberts, 2007). It can also be done individually or as a group of not more than five members (Diise, et, al., 2018b). Regardless of the classification used, class projects are important approaches that develop hands-on-experiences that are transferable to homes (Meece, Anderman & Anderman, 2006). Agricultural projects seek to improve food security by diversifying a household's resource base and facilitating the social and economic empowerment of women (Walingo, 2018).

The project method is a teacher-facilitated collaborative approach in which students acquire and apply knowledge and skills to define and solve realistic problems using a process of extended inquiry (Howell, 2003). Class projects are therefore student-

centred, following standards, parameters and milestones clearly identified by the teacher. Project teaching method is based on the conviction that learning by doing, discussing in groups, and revisiting ideas and experiences are superior ways of gaining a better understanding of one's environment (Diise, et, al., 2018). According to existing literature, practical work though class projects makes learning more enjoyable (Toplis, 2012; Jenkins & Nelson, 2005; Osborne & Collins, 2001). However, the purposes of projects in agricultural education have expanded beyond skill acquisition and proficiency to include personal development for diverse career preparation beyond agriculture (Roberts, 2007).

The current study advocates for class projects as an important part of an agricultural education that provides application of concepts taught in class. Students can hence transfer the acquired skills to their homes. For instance, skills on breaking seed dormancy can be done in school and the students do the same when establishing a mango tree nursery which is an indication of sustainable food availability even for future generations. Based on the theories that informed this study, the hand-on-experiences as in the case of breaking seed dormancy are what Kolb (1984) advocates for, while the impact of the skills as in the case of ability to establish a fruit tree nursery and the subsequent income generation as well as fruit harvesting is what Hattie (2011) recommends.

Findings from the reviewed literature on project-based method of learning (Meece, Anderman & Anderman, 2006; Darling, Hyler, & Gardner, 2017; Diise, et al., 2018; Konyango & Asienyo, 2015) indicate that this is the most appropriate method of gaining a better understanding of one's environment. Besides, the recommendation of provision on adequate teaching and learning facilities (Konyango & Asienyo, 2015) and the need for in-service teacher instruction (Darling, et. al., 2017), the studies have not indicated whether continuous assessment for a given project would improve on skills development and their application in the real world. This study has highlighted the need for the agriculture projects done at the end of Form Four in Kenya under the Kenya National Examinations Council (KNEC) be assessed all along from the lower classes such as Form Two and cumulative marks be recorded up the grades. This can be done with variation of projects every year within the school or through joint learning with the neighbouring community.

2.5.6: Problem Solving Approach/ Discovery Method/ Problem -Based Learning

The problem -solving approach is a student-centred approach to teaching where students participate in the learning process by contributing problems, analysing the factors associated with the problems, developing possible solutions to the problems, placing the solution(s) into action, and evaluating the results of the solution (Olowa, 2009).

Problem-Based Learning (PBL) is a constructivist approach to instruction that revolves around a real-world ill-structured problem (Burris & Garton, 2006). The method promotes both the acquisition of content knowledge and the development of thinking skills and strategies. Teachers typically take on the role of the facilitator and students become responsible for information learned. This method typically ends with a presentation of solutions and an evaluation of the process used in solving the problem.

When incorporated into secondary school agriculture, students develop an extensive and flexible knowledge base; develop effective problem-solving strategies; develop self-directed, lifelong learning skills; become effective collaborators; and become intrinsically motivated to learn (Vernon & Blake, 1993). There is agreement on the contribution of PBL to factors such as knowledge retention, student satisfaction, motivation, and critical thinking. However, there is much less agreement on the role of PBL in knowledge acquisition (Vernon & Blake, 1993).

Various studies (Ball & Knobloch, 2004; Hmelo, 1998: Garton, 2006) have evidenced that PBL can help promote critical thinking skills among students and consistently display growth in problem-solving skills (Ball & Knobloch, 2004; Hmelo, 1998: Garton, 2006). The method has been found to be effective in promoting higher-order thinking (Cockrell, Caplow & Donaldson, 2000; Dods, 1997; Vernon & Blake, 1993).

When incorporated into agriculture, the discovery method has been found to improve student motivation and interest (Herman & Knobloch, 2004; Gordon, Rogers, Comfort, Gavula & McGee, 2001; Norman & Schmidt, 1992). Students also indicate more satisfaction with PBL than with traditional methods of instruction (Ball &

Knobloch, 2004; Gordon, et. al., 2001; Cockrell, et. al., 2000; Albanese & Mitchell, 1993; Vernon & Blake, 1993). Nonetheless, controversy on the use of this approach is the existence of little empirical evidence as to what students are learning and how (Olowa, 2009; Hmelo-Silver, 2004; Dyer & Osborne, 1999). In the context of the current study, problem solving instruction may not fit the learning style of some students since abstract learners may not recognize problems as such when presented to them. Future studies may therefore require investigating the use of constructivist problem-based approaches to determine effects on learning outcomes in agriculture classrooms.

2.5.7: Digital Learning

Technology provides the possibility of including multimedia and interactive resources that can make the young adults' learning more attractive, realistic, encouraging and even inspiring them to develop their skills (Krouska, Troussas & Virvou, 2019). In reference to the youth who are the targeted future farmers, this technology can enhance their skills development and its application to the food industry.

Videos, radio, mobile phones and television are among the Information Communication Technology (ICT) tools that are gaining popularity in enhancing farmers' access to agricultural related knowledge (Van Mele, 2008). Due to their social learning nature, videos in particular have a high potential to stimulate social learning because they combine visual and audio elements that facilitate internalization and contextualization of knowledge or information, which enable farmers to share and learn from experiences (Bentley, Van Mele & Musimami, 2013; MacGregor, 2007). When incorporated into the classroom setting, the social learning nature of the ICT devices can fast track skills development in agriculture and be the bait that makes the youths be more interested in agriculture.

The utilization of mobile technologies in game-based learning improves the effectiveness of the educational process and augments students' knowledge hence, an effective educational game design must achieve a balance between fun and educational value (Troussas, et. al., 2020). The current study emphasizes that the use of the digital tools such as the computers, tablets, digital cameras, video conferencing

technology and Global Positioning Systems (GPS) devices can enhance a student's learning experience (Resilient Educator, 2020). Digital learning especially in secondary school agriculture should therefore not be underestimated if skills that will enhance food security have to be developed.

The review of literature indicated that digital learning through the use of devices like computers, mobile technology and videos is a technological teaching approach. Its role in in agriculture classes was not mentioned leaving a research gap on the role of the media technology in secondary school agriculture for enhancing food security. The integration of digital learning mainly focused on higher education (Akrivi, et al., 2019; Van Mele, Wanvoeke & Zossou, 2010a; Kurt, 2020; MacGregor, 2007; Troussas, et al., 2020). This leaves another gap recommending for further research on the extent to which digital learning as a pedagogy has been integrated into teaching of secondary school agriculture. The integration of the social media- based learning tools in the curriculum such as mobile learning can help the teachers to design the instructional system according to the changing needs of learners or society at large such as the food security agenda.

2.6: Effect of Agricultural Teaching Approaches on Skills Development for Food Security

Kenya is naturally an agrarian economy blessed with vast areas of rich agricultural land, human and material resources needed for agricultural development. This is comparable to other developing countries such as Nigeria as reported by United Nations Food and Agriculture Organization (UNFAO, 2008) that by virtue of the skills acquired through agricultural education, an individual becomes employable and will be able to create jobs thereby reducing unemployment; hence, increased food production which implies food security for the nation.

Agricultural education is geared towards the acquisition of saleable skills to enhance employability, increase food production which will lead to food security, wealth creation, security in the nation and supply of raw materials required for the development of industries so as to create employment opportunities for the general population. The interest and zeal manifested by the youth towards agricultural

education are significantly related to the achievement of self-sufficiency in food production which is the aspiration of the nation now and in the future. Proper involvement of the head (thinking), heart (feeling) and hands (skills) in agriculture, can promote a new era in agricultural education to develop requisite skills and abilities in the individual so that they can immediately be employable (Engbule, 2002).

The central aim of the agricultural education at the basic level is to train students in the basic principles of agriculture, provide avenues for the development of their skills and change the attitudes of the young children towards agriculture. In a study on the Ghanaian context, basic education in agriculture is vital because the future generation of farmers and agriculturists will need basic technical, managerial and entrepreneurial skills to compete in the expanding agricultural economy (Annor-Frempong, Zinnah & Adam, 2003). This is not different from the Kenyan context in that when knowledge, skills and attitudes are rationally utilized, they contribute greatly to social and economic development (Kathuri, 1990).

Skills development is key to the agricultural sector development. A skill is a well-established habit of doing things by people which entails the ability to demonstrate, act, think and behave in specific activity in such a way that the process becomes natural to the individual through repetition or practice (UNFAO, 2008). This is therefore equivalent to capacity building for food security. On the other hand, capacity building involves enhancing the ability of individuals, groups, organizations and communities to sustainably meet their food and nutrition security challenges (IFPRI, 2006). The ever-increasing technological advancement and the surge of unemployed graduates even after secondary school in the country have necessitated the inclusion of more technology and vocational-oriented subjects into the school curriculum (Tardi, 2010). In the context of the current study, skills acquisition by students make them competent to the extent that they become self-reliant to work for food production.

Relevant teaching approaches lead to a higher involvement and commitment of pupils and their parents and a kind of ownership of the educational process (Engler & Kretzer, 2014). In the context of the current study, open and learner-centred pedagogy especially the teaching of agricultural aspects has a huge potential to

overcome all obstacles so that a focus on teaching agriculture connects school with the everyday life of the pupils in both rural and urban areas. In their study Saina, et. al. (2012) explain how secondary school agriculture knowledge broadens farmers' capacity, makes them more effective, self- reliant, resourceful and capable of solving farming problems and as a result, significantly improves their crop productivity and hence, guarantees food security for the family. In another study, Ofoegbu (2015) indicates that in most cases, agricultural science teachers are fond of using conventional methods, particularly the lecture method in teaching agriculture in secondary schools which does not contribute to skills development for food security.

In the context of the current study, innovations in teaching agriculture can build the students' pre-requisite skills for food security and nutrition despite the facility challenge. This would consequently transform schools and the neighbouring communities by using the cheaply available resources at their disposal rather than dismissing practical agriculture as a whole due to the perceived expense. This is possible if the appropriate teaching approaches are used to teach agriculture with the aim of developing the relevant skills for food security.

Based on the reviewed literature, little has been done to ascertain the effect of each of the teaching approaches on skills development for food security. Finding out the effect of the agricultural teaching approaches both in and out of class for skills development for food security was therefore necessary. For instance, in the research findings (Charlton, 2006; Gbamaja, 1991; Seevers & Graham, 2012; Umar, 2012; Mwiria, 2002) the implications of the lecture method on skills development was not articulated; hence, need for further investigation. This particularly concerns the skills development for food security.

In other studies (Ameh & Dantani, 2012; Daluba, 2013; Ogologo & Wagbara, 2013; Udo, 2010) the focus is on the effect of demonstration approach on students' achievement in various disciplines of study. For instance, Ameh and Dantani (2012) in a study examine the effect of demonstration and lecture methods on student's achievement in chemistry. They found demonstration approach as being effective in enhancing chemistry achievement of secondary school students as the approach allows active participation of students in the lesson. Similarly, Ogologo and Wagbara (2013) as well as Udo (2010) argue that due to the adequate participation of students

in the learning process, the achievement of demonstration approach for students was significantly better than that of their counterparts in the conventional approach. The study by Daluba (2013) highlighted improved effect of demonstration method on teaching on students' achievement scores in agricultural science. However, the studies were not specific to what domains of learning were targeted; for example, cognitive, affective or psychomotor skills. The current research recommends that the teaching of agriculture should be oriented towards developing psychomotor skills to meet the aspects that are actually needed for food security and nutrition as presented on Table 2.1. This can eventually contribute to achieving the four pillars of food security, eradication of extreme poverty and hunger as well as the ultimate economic achievement in any country.

Table 2.1: Food Security and Nutrition Pillars, Aspects of Food Security and Nutrition and the Required Skills Development

Food Security Pillar	Aspects of Food Security and Nutrition	Required Skills Development on Students
Availability - It is the physical existence of food.	Production:- a) Domestic or commercial imports and exports, food aid and domestic food stocks. b) Own production or bought food.	- Crop and livestock production practices - Timely planting to take advantage of unexpectedly early favourable soil and air conditions - Timely field management practices such as weed, pest and disease control - Soil and water management including prevention of water logging and salinization - Seed selection and its quality - Infrastructure development for water harvesting - Planning and management of local water user groups to minimize risks of scarce resources and reduce conflicts - Appropriate livestock production practices such

		selection and breeding, nutrition and health management.
Accessibility- for sufficient quantity, quality and diversity for nutritional diet	a) Physical access b) Social access c) Economic access- income and expenditure d) Policy environment- marketing strategies and its timing	- Infrastructure construction such as weirs and rock catchment - Improved drainage - Preservation and rehabilitation of ecosystems - Early warning systems and emergency plans
Utilization	a) Food safety aspects such as sanitary facilities, healthy physical environment, as well as understanding and awareness of proper health care. b) Nutritional aspects such as biological utilization, diversity of the diet, good feeding practices as well as proper food preparation.	- Safe drinking water - Safe food preparation - Management of agriculture waste water - Diversity of crop variety production - Food combination at consumption level - Post-harvest management practices
Stability	a) Constancy in supply b) External risk factors such as natural disaster and climatic change c) Price volatility d) Conflicts and epidemics	- Insurance against drought and crop failure - Environmental protection - Sustainable use of natural resources like land, soil and water.

Source: Njura, Kaberia & Taaliu (2020a); Modified from FAO, 2008

2.7: Relationship between the Agricultural Teaching Approaches and Food Security

Teachers in secondary schools have been found to use the various pedagogical methods at their disposal in teaching agriculture. Different teachers use varied methods depending on the availability of facilities and resources as per the status of

the institution to develop the youth's skills in all the areas outlined in the secondary school agriculture syllabus that is targeted to contribute to food security. For effective teaching and learning of agriculture for food security, the pedagogical approaches should be learner centred (Modebelu & Mwakpadolu, 2013). This is likely to prompt the learners to be active and increase their interest in the learning activity.

Based on the conceptual framework (Figure 2.2), the relationship between the agricultural teaching approaches and food security could be explained by their contribution to skills development and the contribution of these skills to achieving food security.

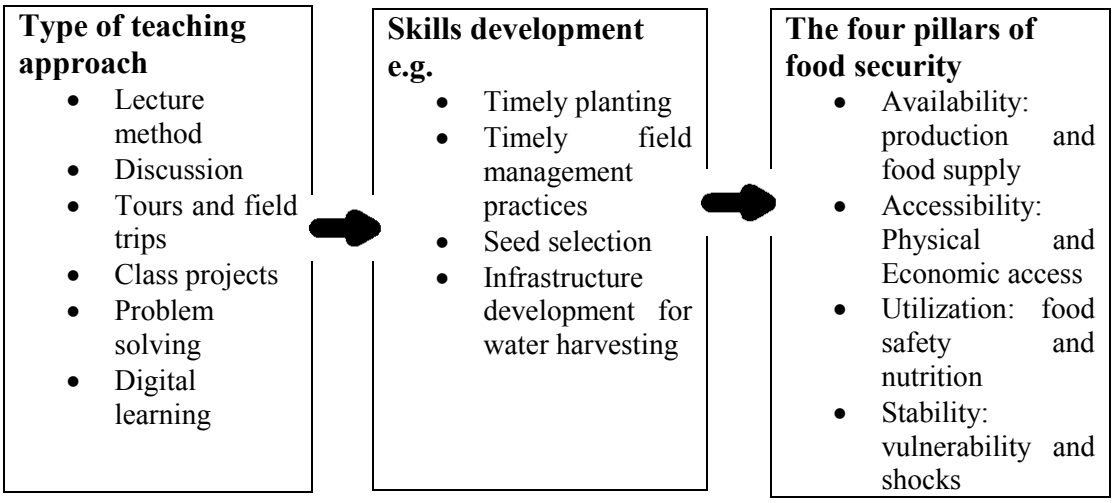


Figure 2.2: Relationship between Agricultural Teaching Approaches and Food Security

Source: Njura, Kaberia, Taaliu & Kakai (2020b)

2.7.1: Relationship between the Agricultural Teaching Approaches and Skills Development

Basing on Dewey's constructivist's theory (Dewey, 1998), demonstration of standard type of experiments are supposed to be carried out by the learners themselves and the main purpose is to illustrate a concept. In addition, the discovery method is where

the teacher directs the approach to the experiment but learners develop the procedure. The learner is placed as far as possible, in the attitude of the discovery and the teacher's role profile is more diminished. To mobilize greater innovation in the agriculture sector, insight from the youth is needed and it must be instrumental in creating their future (Osongo, 2014).

For effective teaching and learning of agriculture for food security, the pedagogical approaches should be learner centred (Modebelu & Mwakpadolu, 2013). This is likely to prompt the learners to be active and increase their interest in the learning activity. The approaches employed in teaching secondary school agriculture should develop in the youth, the skills in all the areas outlined in the secondary school agriculture syllabus that is targeted to contribute to food security.

2.7.2: Relationship between the Agricultural Skills and Food Security

The relationship between the agricultural skills developed and food security could further be explained by the frequency of use of the skills for food security as well as their contribution to the aspects of food security.

2.7.2.1: Frequency of the Use of the Skills Developed for Food Security

There are many ventures both in crop and livestock production where secondary school students can employ the skills developed in agriculture destined to food security. For instance, skills in budding, grafting and layering which can sustain an individual. Budded citrus is required in different compounds including homes, churches, playgrounds, schools and hospitals among others for planting. Empowerment of youth with skills in piggery production can sustain an individual in the management, control, feeding, fattening and finishing them for marketing, distributing and processing their products as well as by-product for the benefit of man- kind. This can generate a lot of money for the investors.

Skills training in agriculture also includes using farm tools to till the soil, manipulating farm machines and equipment to carry out different farming activities (Ndem, 2013). In schools, students learn how to grow crops using sustainable food production practices, combine theoretical and practical approaches and they are encouraged to see farming as an enterprise. In the context of the current study,

capacity building through investment in research, innovation systems, linking researchers, extension agents, farmers and Non-Governmental Organizations (NGOs) with schools is necessary so that the skills are absorbed and effectively employed in the various food production sectors. It is not only about learning skills and techniques, but also about becoming empowered and frequently applying the skills developed especially at local levels to boost production (IFPRI, 2006).

The benefits and opportunities of linking young agriculture students to farmers through practical internships can create a closer relationship between the two (IFAD-UNESCO, 2014). This is likely to be a way of taking the knowledge learnt in class to the field. Both the farmer and the student can use such knowledge in food production subsequently combating food insecurity. Food security and nutrition can be boosted if the produce grown by schools is utilized by the same learners, for example by incorporating it into the school feeding programme in an effort to tackle hypertension, diabetes and obesity (IFPRI, 2006). The study therefore intended to find out how frequently the agricultural skills developed at school were being employed for food security.

2.7.2.2: Contribution of the Agricultural Skills to Aspects Food Security

The aspects of food security are attributed to parameters such as having physical and economical access to sufficient, safe, and nutritious food that meets the dietary needs and food preferences for an active and healthy life (Kedir, 2017). Agricultural skills that the learners develop should enable them access food both at household and individual level. Food availability can be achieved through developing skills to enhance access to sufficient quantities of food all year round (Abu, 2017). These include: urban farming practices, off-season irrigation and post-harvest practices to curb food losses as well as food preservation measures.

In the context of the current study, food insecurity arises due to inadequate skills or failure to utilize the skills learnt. Transitory food insecurity can be reduced if skills associated with timely land preparation, planting and harvesting are developed and timely utilized. According to Abu (2017), field cultivation itself is a very seasonal activity, with differing labour requirements at different times of the year. Ground clearance, planting, weeding and harvesting all make different demands on the farm

household and leave varying amounts of family labour available for off-farm activity, which might or might not be food-related (Kedir, 2017). Youths at home can utilize the agricultural skills for off- season farming when the labour demand is low resulting into continuous food supply.

Marketing too can be seasonal as some food commodities are easily perishable and only available for short periods of time after harvest. Others are available all year round, because they can be stored fairly readily (Abu, 2017). Agricultural skills in food processing such as drying of fruits, vegetables and tuber crops can enhance their availability off-season. When done at the household level, food production and supply will eventually have positive effects in terms of stabilizing food supplies at the community and ultimately, at the national level. This is particularly true if measures aimed at improving rural infrastructure, research, storage and food marketing as well as irrigation which will reduce susceptibility to rainfall variations are adopted (Abu, 2017).

The teaching of secondary school agriculture should be in a position to develop appropriate skills to adequately address food security in the country. Incorporating food safety standards in the syllabus will expose agriculture students to a wider scheme of food security management. For instance, the kitchen garden model can be used to promote dietary diversification using improved agricultural techniques that conserve limited resources (Global Communities, 2018). Skills on food safety from production, preservation, preparation to its consumption can prevent contamination, parasitic infections and toxic substances that would be injurious to human life (Ndem, 2013). These skills can be developed among students as guided by the CODEX food safety standards (CODEX, 2019). Such skills can help in safeguarding against food safety hazards like consumption of pesticide residual on vegetables and foreign bodies such as heavy metals and detergents in waste water. The practical approaches can help students to develop skills as guided by the East African Food Safety Standards (EAC, 2015) to safeguard harvested grains like maize that form the hub of staple food in the country. For instance, skills on moisture control, vermin control in grain stores, proper aeration and regular inspection during storage can greatly improve on safety and reduce post-harvest losses. Additionally, skills in agricultural planning and budgeting exposes the students to proper farm management

practices which lead to better production techniques and subsequent improved livelihoods in the society (Saina, et. al., 2012).

Based on the reviewed literature, there is little research evidence to show the relationship between the agricultural teaching approaches and food security. The current research filled this gap by emphasizing that the relationship between the agriculture teaching approaches and food security can be established if skills are developed at the psychomotor domain. The researcher therefore developed a conceptual framework (Figure 2.3) as a guide for agriculture teachers so that teaching and learning can take place at the psychomotor domain for enhanced skills development, for food security. If appropriately applied, the impact of the skills can be realized through the achievement of the four pillars of food security, subsequent poverty eradication and the ultimate economic development in the country.

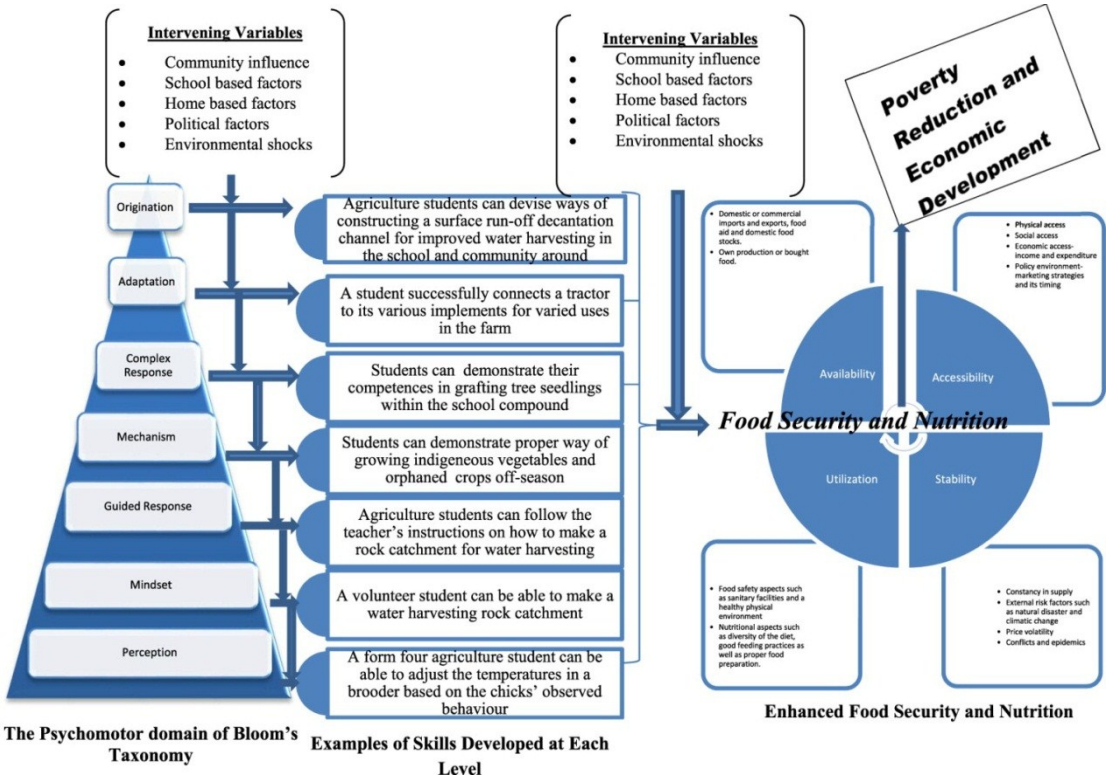


Figure 2.3: The proposed conceptual framework on teaching secondary school agriculture at the psychomotor domain for enhanced skills development for food security.

Source: Njura, Kaberia, & Taaliu (2020c).

The contribution of the agricultural skills to the aforementioned aspects of food security however cannot be successfully achieved if constraints such as overloaded school curriculum, inadequate teaching and learning support materials are not first, adequately dealt with.

2.8: Relationship between the Constraints in Teaching and Learning Agriculture and Skills Development for Food Security

Despite the many efforts of teaching agriculture for skills development, different scholars have associated various obstacles to poor skills acquisition and their application in securing food among learners. This research intended to find out the extent to which these obstacles may have hindered skills development in Kenyan secondary schools which ultimately threatens the government's effort to increase food security in the country.

Despite periodic efforts to market agriculture among students, the community demand for academic education leading to high status and pay of the modern sector has kept most schools within an academic line as a means of escaping from agriculture and manual labour (Njoroge & Orodho, 2014). Secondary schools have remained oriented for the fortunate minority who gain access to the modern rather than to the vast majority who remain in traditional agriculture (Njoroge & Orodho, 2014). In view of the current study, this could be a major hindrance to developing skills when learning agriculture. Many youths do not view agriculture as a business (Alliance for a Green Revolution in Africa (AGRA, 2015) so that they take advantage of the opportunities in it to make good money from the activities along the agricultural value chain as they produce food in their homes.

In their study Engler and Kretzer (2014) argue that agricultural education has been confronted with inadequacy of teachers, both in quantity and quality. Yet it is the teacher who implements the curriculum in terms of knowledge of subject matter and skills acquisition among the learners. Poor teaching strategies are a major challenge against practical secondary agricultural education. A number of authors (Seevers & Graham, 2012; Umar, 2012; Charlton, 2006; Mwiria, 2002) note that there has been too much theory and there is no longer much emphasis on the learners' practical skill acquisition. Teachers in most instances use lecture method only in a programme they

are supposed to apply lecture method and demonstration (Seevers & Graham, 2012; Umar, 2012; Charlton, 2006; Mwiria, 2002).

According to Aholi, Konyango and Kibett (2017), the aim of linking the resources and facilities to the curriculum and syllabus was in a way a move to implement the teaching of agriculture in a practical manner. Employing practical approaches to teaching of agriculture has the potential of developing skills geared towards sustainable food production; hence, food security. Time constraints, lack of or inadequate infrastructure, facilities and books has resulted in a situation where the teaching of theoretical knowledge has dominated over practical content (Odu, 2010). In addition, resources invested in agricultural education have been too thinly spread, providing theoretical knowledge without adequate practical skills (Ngugi, 2002).

Constraints to teaching-learning materials are related to shortage of tools, and other equipment to facilitate smooth teaching. Lack of finance to provide the required materials and facilities, insufficient textbook for students and absence of school farms are other constrains (Engler & Kretzer, 2014; Annor-Frempong, et. al., 2003). In this case, agricultural education is one of the vocational courses which cannot be adequately imparted without proper and adequate facilities and equipment for a well-balanced programme because their inadequacy hampers the student's exposure to practical skills.

At a secondary school level, inadequate facilities and lack of skilled workforce to demonstrate with the facilities have a negative impact on skills development. There is therefore need to put in place interventions to strengthen the quality of teaching highly qualified human resources to transfer the same skills to the students. In their study Konyango and Asienyo (2015) note that the level at which practical agriculture was started was beyond sustainability in secondary school in terms of costs and level of competence of teachers. Wide range of resources such as machinery and laboratory equipment went into disuse because the teachers could neither service nor repair them. A major technological upgrading in agriculture will have to take place to open the space for the adoption of sustainable technologies and land management practices to increase food production (Konyango & Asienyo, 2015).

Harnessing the innovation, energy and dynamism of youth must be a central element to overcoming challenges related to food security and nutrition (IFPRI, 2006). Such

challenges according to the author include the rising demand for food, climate change and environmental degradation. Lack of funds prevents schools from developing their farms (Aholi, et.al., 2017). Lack of textbooks, poor management, and poor funding are among the factors that impede the teaching and learning of practical agriculture (Owino, Yungungu, Ahmed & Ogolla, 2015; Ssekamwa, 2009). According to Cheplogoi (2011), the level of availability of agricultural science facilities in the school has significant influence on students' attitudes towards the subject.

Lack of interest on the part of students is another factor which could be associated with students viewing agriculture as a punishment and a career for people who could not do well in other areas such as medicine, pharmacy and engineering. Students perceive farming as dirty and non-lucrative and as such, it should be left on the hands of the illiterates and the poor. The students have low regard for agricultural studies since weeding was for long time used to punish students (Osongo, 2014). Students therefore, see activities carried out in the farms as forms of punishment. Traditional farming is associated with uncertain profitability and limited career opportunities in the rural areas (AGRA, 2015). In the context of the current study, the lack of interest in agricultural education is the reason for the low prestige value of farming lowering the numbers that are trained in agriculture to promote food production hence, security at secondary school level.

Lack of motivation and incentives to agriculture teachers is another constraint. In the context of the current study, the aspiration and commitment level among the teachers is greatly determined by the nature of motivation and incentive given to them. Teachers who are not motivated have low morale and will not be encouraged to put in their best in the job and also impart the required knowledge, skills, attitude, and ideas in their studies because there is no job satisfaction (UNFAO, 2008). There are no monetary rewards other than salary for achievements in school agriculture (Annor-Frempong, et. al., 2003).

Looking at the Kenyan context, sponsorship packages to improve competencies for teachers at conferences and training workshops are minimal. In-service needs can vary with time, years of teaching experience, and geographic location (Roberts & Dyer , 2003). On the other hand, four years of undergraduate education is not

adequate for someone to master the subjects one has to teach in this era of technological changes (Iqbal, Ali, Ahmad & Abbasi, 2007). The authors further indicate that traditional teaching methods are inadequate to effectively educate the changing student population highlighting the need for innovative teaching methods to teach millennial students. Industrial in - servicing of agriculture teachers would equip them with skills which would help expose students to scientific and technological trends and promotion of lifelong ideas. This would enable learners to better adjust to their work and domestic worlds through the inculcation of competencies that promote creativity, communication, cooperation, innovativeness and problem-solving abilities in food production and utilization. The parents' negative attitudes constitute a constraint which could be associated with the fact that they do not influence the choice of the subject (Annor-Frempong, et. al., 2003). At the same time, parents do not participate in the management of school agriculture.

The Agriculture syllabus coverage does not match the time allocated on the timetable yet sufficient exposure of learners to the learning tasks is an important issue that should be adequately addressed to ensure effective practical approach to the subject (Annor-Frempong, et. al., 2003; Mwiria, 2002). In a study Udoudo (2015) notes that habit-forming experiences must be repeated sufficiently, to enable the learners form permanent habits as the high degree of skill and the performance of the activities become automatic. In the context of the current study, enough practical sessions would result into a personally and socially effective individual in food production. Agriculture teaching deserves relatively more teaching time and effort yet there is a huge competition for time between subjects due to increased enrolment at secondary level (Mwiria, 2002).

This study was concerned with the time left for the students to conceptualize and practise what they had learnt so that they could engage in food production; hence, security. This is because students are likely to be left with a lot of work such as making notes rather than being with the teacher doing practical work. In their research, Diise, Zakaria and Abujaja (2018) observe that schools have not yet identified the best way to handle practical lessons to ensure that students are being equipped with requisite practical skills required to be competent future agricultural practitioners. The current study however suggests that allocation of adequate time on school timetables is one way of mitigating the ultimate impact of time constraints

faced in the teaching and learning of agriculture for food security. This study further highlights school-community based projects and field attachment in agriculture-based institutions as approaches that can be integrated into teaching of agriculture to take care of the inadequate facilities and the real time skills development and their application for food security.

Despite the fact that a lot of research has been done on the challenges of teaching and learning secondary school agriculture, much of the research findings have been generalized. Thus, the in-depth impact on skills development is not emphasized. The current study fills this gap by categorizing the constraints into three themes: teaching and learning facilities, activities and services available giving a greater meaning to the impact of the constraints to skills development for food security.

2.9: Theoretical Framework

The study was anchored on three theories namely: The Visible Learning theory (Hattie, 2011), the Experiential Learning theory (Kolb, 1984) and the Constructivists theory by John Dewey (1998). The Visible Learning theory emphasizes on the enhanced role of teachers as they become evaluators of their own teaching. The basic principle is that visible teaching and learning occurs when teachers perceive learning through the eyes of students and help them become their own teachers. This theory is evaluative in nature and is therefore a checklist for the impact achieved on the students' achievement. Based on the impact created, the teachers are able to make decisions about changing their teaching approaches. When linked to this study, teachers can vary the teaching approaches depending on the intended learning outcomes to enhance skills development for food security.

The Experiential Learning theory proposed by Kolb (1984) takes a more holistic approach and emphasizes on how experiences, including cognition, environmental factors, and emotions influence the learning process. Experiential learning can be good as it helps learners explore their own strengths when learning new things. Its basic principle is that abstract conceptualization and a concrete experience are needed to grasp experience while transformation of experience requires active experimentation and reflective observation. When linked to agricultural education, experiential learning can be good in helping students explore their own strengths

when learning new concepts as well as develop areas where they are weak. The theory however does little to look at learning that occurs in larger social groups.

The Constructivist theory by John Dewey (1998) on the other hand asserts that learning is the process whereby knowledge is based on a given schema. It further emphasizes that learning is more effective when a student is actively involved in the learning process rather than attempting to receive knowledge passively. According to Dewey (1998), learning relies on guided discovery where the teacher avoids direct instruction and instead attempts to lead the student through questions and activities to discover, appreciate and verbalize the new concepts. In this case, students are not a blank slate and knowledge cannot be imparted without the child making sense of it according to his/her current conceptions. The study acknowledges that the primary goal of this theory is to enable students to learn how to learn by giving them the initiative for their own learning experiences.

Constructivist views of learning indicate that it is the process of connecting new experiences and knowledge to the learner's pre-existing personal knowledge (Baker, Robinson & Kolb, 2012; Roberts, 2006). Based on Dewey (1998), the Learning Theory is grounded on four principles: first, learners are actively involved, second, the environment is democratic, third, activities are interactive and student centred and finally the teacher facilitates the process of learning whereby students are encouraged to be responsive and autonomous. The basic tenet of the theory is that students learn by getting involved rather than observing. Hence, students bring their prior knowledge which they must critique and re-evaluate in their understanding.

When the Constructivist Theory is applied to secondary agricultural education, it illustrates the total learning experience of the practical aspect of the subject. The students are given the opportunity to experiment as individuals and discuss the results together. When students have projects in the school, the teacher assists them to build the project around their area of interest. Once students' interest is achieved, they present their findings to the class. Students also experience meta-learning on how to solve problems on their own and how to implement their plans. This independence is what projects are about. Field trips also help students to apply the ideas discussed in class to the real world. This is also followed by classroom discussion. Lastly, films can be used to provide the visual context and thus, bring

another sense into the learning experience. Classroom discussion as well as digital learning can be applied in all the above discussed methods. In the context of the current study, the contribution of the agricultural teaching approaches to skills development is achieved if there is blending of the teaching approaches.

The three theories have their merits with respect to the variables of this study. For instance, based on the Visible Learning theory, teachers can vary the teaching approaches to suit the intended outcomes. Further, class projects can be established to develop the learners' food production skills while tours and field trips can be employed to explore the various ecological aspects that can influence food production. The effects of each teaching approach can be evaluated based on the students' achievement. Moreover, students can relate the teaching approaches employed on the extent to which they contribute to skills development and the achievement of the aspects of food security such as its adequacy, safety and nutritional status. The change in the teaching approaches can be a platform for both the teacher and the student to explain the constraints they face in their efforts to achieve food security.

2.10: The Conceptual Framework

The conceptual framework is a model of presentation showing the relationship between variables in the study. According to Oso and Onen (2005), a conceptual framework is a diagrammatic representation of variables that the researcher operationalizes in order to achieve the objectives of the study. The independent variables for this study were the types of teaching approaches, the effects of the teaching approaches on skills development for food security, the relationship between the teaching approaches and food security and the constraints in teaching and learning secondary school agriculture for food security. The dependent variable was food security. The conceptual framework for the study is presented as Figure 2.4.

The influence of the independent variables over the dependent variable may be affected by intervening variables namely; school-based factors, community influence, home-based factors, political factors/governance as well as the teacher's level of training. The framework was based on some of the researcher's ideas

regarding the contribution of the approaches to teaching agriculture to skills development as well as related literature. It is from these, that more ideas were generated on the contribution of these skills to food security. This was therefore an expansion of the already existing body of knowledge in that it puts an emphasis on the blended practical teaching approaches at the psychomotor domain of Blooms' taxonomy.

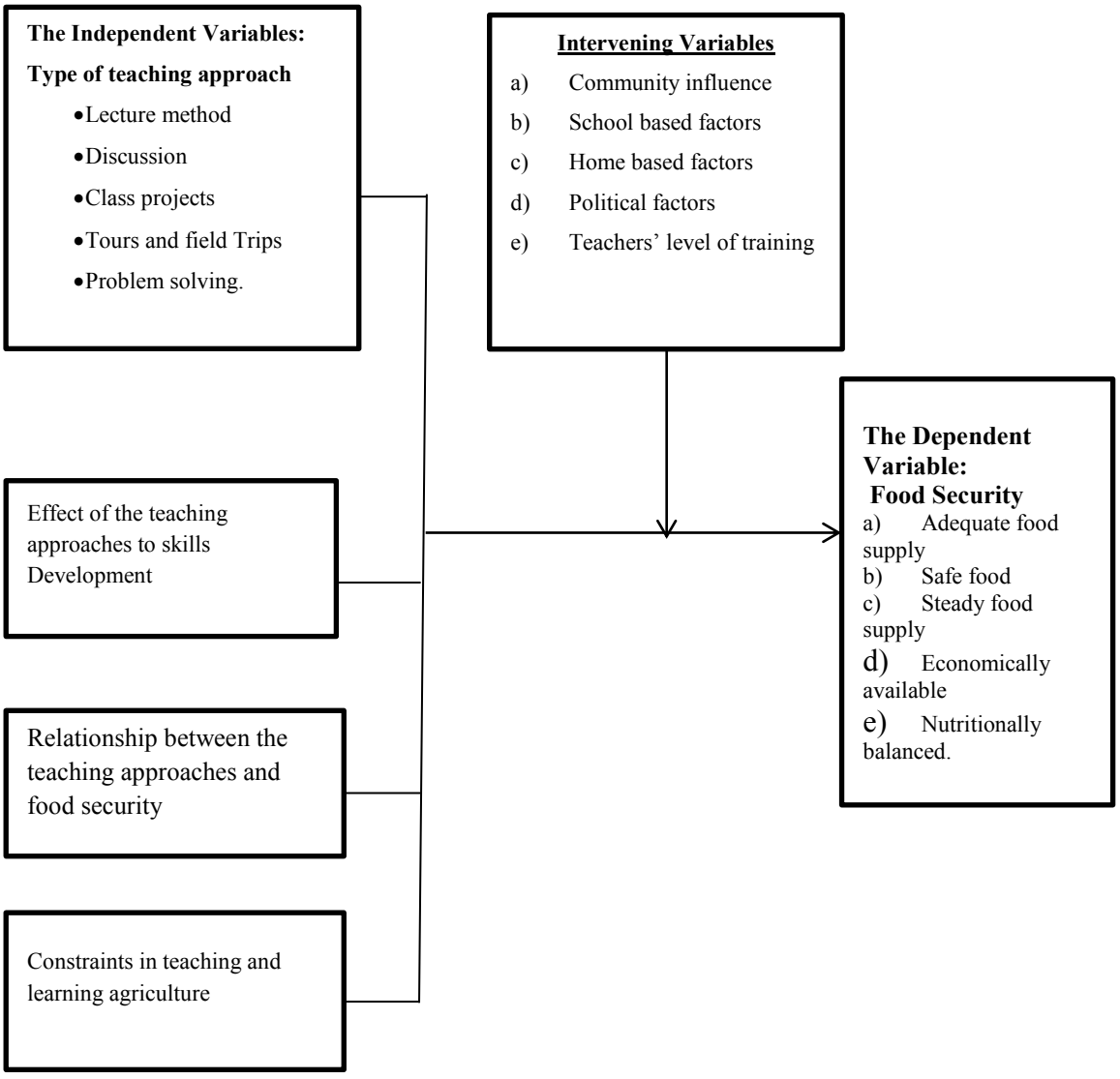


Figure 2.4: Relationship between the Independent and Dependent Variables

2.11: Summary of Literature Review

Chapter two has articulated the research gaps in alignment with each objective. The researcher introduced the chapter by explaining the aspects of food security and nutrition, aspects of innovative practical agriculture and the role of innovative practical agriculture on skills development. The first objective guided the study by spelling out the agricultural teaching approaches employed in secondary schools. The reviewed literature showed that lecture method is the most commonly used method of instruction in agriculture classes at the expense of the practical approaches. The identified research gap was on the need to establish which approaches were the most appropriate for developing skills for food security.

The second objective guided this study in establishing the effect of the agricultural teaching approaches on skills development for food security. Related literature indicates that lecture method only imparts cognitive skills to the learners while the practical approaches develop psychomotor skills. The latter are the most suitable for food and security. The research gap identified was that little research has been done to ascertain the effect of each of the teaching approaches on skills development for food security.

The third objective was concerned with the relationship between the agricultural teaching approaches and food security. Related literature revealed that food security can be explained by the contribution of the teaching approaches to skills development as well as the contribution of the skills developed to the aspects of food security. However, little research has been done to explain how frequently students use the skills by transferring them to the food industry warranting its investigation through this research.

The last objective was concerned with the relationship between the constraints faced by agriculture teachers and their students in the teaching and learning process to skills development for food security. Related literature indicates that the numerous constraints faced are associated with the teaching and learning facilities, activities and the available agriculture services. However, little research evidence showed the ultimate impact of the constraints faced on skills development for food security;

hence, this study attempted to fill this gap. This chapter also entails a clear explanation of the theoretical framework as well as the conceptual framework that formed the basis for the study.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1: Introduction

This chapter presents a description of the research procedures that were applied in carrying out the study. It has been organized under the following sections: research design, location of study, the target population, sampling procedures and sample size, research instruments, validity of research instruments, reliability of research instruments, data collection procedures and data analysis. Logical and ethical considerations have also been included at the end of the chapter.

3.2: Research Design

The study adopted two research designs: descriptive survey design for objective one where qualitative data were collected and correlational research design through survey method for objectives two, three and four. Descriptive survey designs are preliminary used in exploratory studies to allow researchers to gather information, summarize, present and interpret data for the purpose of clarification (Orodho, 2003). Additionally, descriptive survey is intended to produce statistical information about aspects of education that interest policy makers and educators (Borg & Gall, 1989). This study adopted the design for the first objective because only opinions of the respondents on the agricultural teaching approaches employed in Kenyan secondary schools were being investigated.

On the other hand, correlational research design involves observing two variables in order to establish a statistically corresponding relationship between them (Anderson, & Arsenault, 2001). The study adopted the design to establish whether the agricultural teaching approaches employed in Kenyan secondary schools had a statistical effect on skills development for food security (objective two). Additionally, the researcher was interested in investigating whether there is any statistical relationship between the agricultural teaching approaches and food security (objective three). Lastly, the researcher sought to establish whether there is a statistical relationship between the constraints experienced in teaching and learning agriculture and skills development for food security (objective four). In correlational

design, no manipulation of the variables is done or any attempt to control the extraneous variables (Anderson, & Arsenault, 2001). The researcher measures or observes the natural relationship between two variables using a scientific method of testing the hypothesis as was done with objective two, three and four without taking the future into consideration since correlation may change in future.

3.3: Location of Study

The study was conducted in Embu County, one of the forty-seven counties of Kenya (Appendix 6.0). It lies 120 kilometres north east of Nairobi, on the south-eastern side of Mount Kenya. The County's geographical coordinates are 0° 32' 0" South, 37° 27' 0" East and covers an area of 2,818 square kilometres which is characterized by highlands and lowlands. The County borders Tharaka Nithi to the North, Kitui to the east, Machakos to the south, Murang'a to the south west and Kirinyaga to the West (County Government of Embu, 2016). Embu County is divided into five sub-counties. They are: Embu West with its headquarters at Embu town and Embu North with headquarters at Manyatta. These two form Manyatta constituency, Embu East with headquarters at Runyenjes, Mbeere North with headquarters at Siakago, and Mbeere South with headquarters at the Kiritiri market. The map of Embu county is as presented as Figure 3.1.

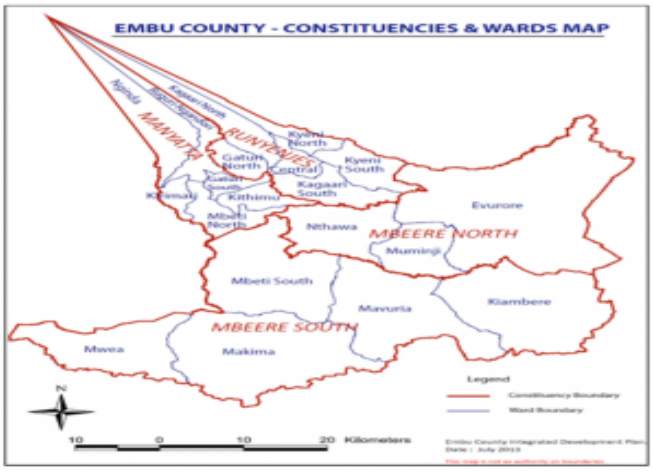


Figure 3.1: Map of Embu County, Source: Embu County Government (2016)

The county has diverse ecological conditions ranging from the highlands of the slopes of Mount Kenya to the arid areas of Mbeere sub-counties. Embu County is

well placed to allow for surgical measures to mitigate food insecurity due to its diverse agro-ecological zones that allow the growing of many crops that include: maize, beans, sorghum, root crops, horticulture and industrial crops mainly coffee, tea, macadamia and cotton as well as household dairy farming (County Government of Embu, 2016). Due to these diverse features, the researcher purposively selected the County as a representative of the forty-seven counties in Kenya.

Secondary schools in Embu County are broadly divided into public and private schools distributed in the five sub-counties occupying the varied features of the County in regards to rural versus urban areas, highlands versus lowlands as well as diversity in population distribution. Such differences have an influence on the number, type and distribution of schools as well as the students', teachers' and parents/guardians' opinions on the contribution of the secondary school agricultural teaching approaches to food security.

In the study region, the teaching and learning of Agriculture occurs in almost all the secondary schools as a compulsory subject in Form One and Form two and as an elective subject in Form Three and Four. The respondents could therefore be found in all the selected schools in the County. The problem of inadequate employment of agricultural skills by secondary school graduates and the issues of food insecurity within the County were problems of concern warranting the study in the area.

3.4: The Target Population

The target population for this study were all the students, parents/guardians and agriculture teachers from all the public and private schools in Embu County. According to the Embu County Headquarters' 2017 statistics, there were a total of 198 secondary schools and 46,340 students in the county. Since each student had at least a parent or a guardian, the number of the targeted parents/guardians was equivalent to that of the students. The agriculture teachers' population was 235 as obtained from the Teachers Service Commission, Embu County's human resource office. The target population is presented as Table 3.1.

Table 3.1: The Target Population

Subject category	Target population
Public schools	186
Private schools	12
Agriculture teachers	235
Students	46,340
Parents/guardians	46,340

Sources:

Ministry of Education Statistics Office - Embu County (2017)

Teachers Service Commission, Human Resource Office – Embu County (2017)

3.5: Sampling Procedures and Sample Size

The study applied mixed sampling methods where both random and non-random sampling designs were used. First, Embu County was purposively selected. In purposive sampling, the researcher deliberately chooses the particular units in the population (Kothari, 2011). The county was selected on the basis that the researcher is familiar with it and it is a typical representation of the other counties in Kenya in regard to geographical features, extremes of both arid and semi - arid areas as well as school distribution. Second, stratified random sampling was administered to obtain the number of schools required in the public and private school categories. Third, systematic random sampling was applied to get the specific schools as well as the agriculture teachers.

The researcher further carried out simple random sampling to obtain the required number of students. This was achieved by obtaining the number of students specializing in agriculture in Form Three and Four from their subject teachers. However, class registers from the class teachers in Form One and Two were used to determine the students present. The selection of form one and two was based on the assumption that they would not have selected their subject options by the end of Form Two. The researcher then assigned numbers to all the students and used Microsoft excels to generate random numbers to sample the students to take part in the study. Through proportionate sampling, twelve groups of students were obtained

from the public schools while eight groups were obtained from the private school category. Random sampling ensures the law of statistical regularity which states that if on average the sample chosen is a random one, the sample will have the same composition and characteristics as the universe (Kothari, 2011).

The researcher established the scheduled school academic clinics and parents' meetings from the school principals to be able to reach them for issuance and filling in of the questionnaires. The questionnaire administration to the parents was done in nine public schools and three private ones that had been selected for data collection for this group of respondents. The expected sample size was 132 public schools, 12 private schools, 148 agriculture teachers, 381 students and 381 parents/guardians as presented on Table 3.2. Sample size determination was based on Krejcie and Morgan (1970) sample size determination procedure presented as appendix 7.0.

Table 3.2: Sample Size

Subject category	Target population	Expected sample
Public schools	186	132
Private schools	12	12
Agriculture teachers	235	148
Agriculture students	46,340	381
Parents/Guardians	46,340	381

Using Krejcie and Morgan (1970) formula, the sample size was determined.

$$S = \frac{Z^2 NP(1-P)}{d^2(N-1) + Z^2 P(1-p)}$$

Where:

S = required sample size

Z = z value (1.96 for 95% confidence level)

N = population size

P = population proportion (expressed as decimal) (assumed to be 0.5 (50%)

d = degree of accuracy (5%), expressed as a proportion (0.1); it is margin of error

3.6: Research Instruments

Research instruments are used to gather information relating to the problem under study (Ochola & Ngige, 2007). The following instruments were developed and used for the study:

3.6.1: Parents' Questionnaires (PQ)

The PQ is presented as appendix 8.0. Questionnaires enable the person administering them to explain the purpose of study and to give meaning of the items that may not be clear (Siniscalco & Auriat, 2005). The PQ contained a total of ten questions distributed into six close ended and two-three point Likert scale to obtain quantitative data as well as two open ended questions to provide qualitative data. One closed ended question gathered data on the parents' area of residence in order to establish the likelihood of their interaction with agricultural activities. This is where their children could put into practice what they had learnt in school. Another closed ended question helped in establishing the proportion of the parents who grew up in the farm. This helped to establish the likelihood of individual parents judging how appropriately the skills were being applied by their children for food security. The open-ended questions helped the researcher establish the parent's opinions on the frequency of use of the skills developed on their children as well as the extent to which these skills improved food security at home.

3.6.2: The Agriculture Teachers' Interview Schedule (ATIS)

The ATIS is presented as appendix 8.0. In his argument, Kerlinger (1973) argues that more people are willing to communicate orally than in writing and will therefore provide data more readily in an interview. Interviews are strong methods for capturing spoken and non-spoken information. They are flexible tools for data collection, enabling multisensory channels to be used, including verbal and body language (Cohen, Manion, Marrison & Bell, 2011). On the other hand, interviews tend to yield more detailed data than questionnaires. Besides, certain types of confidential information may be obtained that an individual may be reluctant to put into writing (Siniscalco & Auriat, 2005). The interview schedule contained sixteen

questions distributed into closed ended, open ended and three point and four point Likert scales. The closed ended questions helped to collect bio data on teachers' duration of teaching in the same school. This had an implication on their experience with the school characteristics and the neighbouring community's influence in relation to how well they could link their schools to the community and in particular to the use of approaches that could enhance food security. The open-ended questions helped to collect data related to the commonly used methods of teaching agriculture, their frequency of use, and their contribution to skills development for food security as well as the constraints faced in teaching and learning agriculture. The questions on Likert scales aimed at finding out the relationship between the agricultural teaching approaches and food security. This was in regard to their contribution to skills development, frequency of the use of the skills for food security and contribution of the skills so developed to aspects of food security. The 3- point Likert scale questions further obtained data on the relationship between the constraints in teaching and learning agriculture and skills development for food security.

3.6.3: Students' Focus Group Discussion Guide (SFGDG)

This is presented as appendix 9.0. It was prepared with a set of open-ended questions which allowed students to speak freely and provide as much information as they knew. Two handouts labelled A and B were attached to the guide for the students to fill in during the discussion. Focus group discussions keep the interactions focused, while allowing individual perspectives and experiences to emerge (Gill, Stewart, Treasure & Chadwick, 2008). The questions helped the researcher to develop themes in relation to the students' opinions on the agricultural teaching approaches they thought would develop skills for food security. The questions further helped in establishing their opinions on the role of the skills developed for food security. Lastly, the researcher was in a position to find out the constraints the students faced in learning agriculture. This is in regard to development of skills needed for food security.

3.7: Pretesting the Research Instruments

The questionnaire, the interview schedule and the focus group discussion guide were subjected to pre-testing. A pre-test sample of 1% and 10% depends on the sample size, which is 1% for a large sample and 10% for a small sample (Mugenda &

Mugenda, 2003). The researcher used 10% of the research participants to give a total of 14 schools, two focus group discussions, 11 interview schedules and 32 parents to participate in the pilot study. The pilot study was done in three sub-counties namely: Mbeere-South, Embu-North and Embu-East. The schools that were selected for the pilot study had comparable features with those that were left out for the actual study. These included geographical locations, urban and rural settings as well as public and private school categories.

The researcher pre-tested the instruments to determine their accuracy, clarity of questions, validity and reliability. A pre-test is done to test whether the questions measure what they are supposed to measure, check ambiguity and to test for researcher's biasness (Kombo & Tromp, 2006). The randomly selected schools for piloting were not included in the actual study. Piloting improved the validity of the instruments by addressing any difficulties that the respondents would have encountered especially on the clarity of the questions as well as the time allocation for the interviews and the focus group discussions. The pilot data was used to compute the reliability coefficient of the instruments using the internal consistency approach.

3.8: Validity of the Research Instruments

Validity refers to how accurately a method measures what it is intended to measure. If a research has high validity it produces results that correspond to real properties, characteristics, and variations in the physical or social world (Lillis, 2006). Content validity was ascertained through consultation with the two supervisors at the University of Embu as well as other experts in the field of study and the review of the related literature. This was to ensure that the content of the research instruments covered all areas of the study that they aimed to measure without missing or having irrelevant aspects included; thus, threatening validity. The researcher further ensured construct validity by properly operationalizing the variables of the study.

3.9: Reliability of the Research Instruments

Reliability refers to how consistently a method measures something. If the same result can be consistently achieved by using the same methods under the same circumstances, the measurement is considered reliable (Trochim, 2020).

The researcher ensured reliability of the research instruments through the pilot study. The instruments showed similar results among the respondents in both the public and the private schools. After the pilot test, reliability analysis was undertaken by calculating Cronbach's alpha using SPSS version 23. Cronbach's alpha is the most common measure of internal consistency (reliability) and is mostly used when one has multiple Likert questions in a survey/questionnaire that form a scale and wish to determine if the scale is reliable. The researcher devised questions in a questionnaire and an interview schedule with the intention of describing and exploring the contribution of agricultural teaching approaches to food security in the country. The questions were on a 3- point Likert scale from disagree to agree.

The value of the alpha coefficient ranges from 0 to 1 and may be used to describe the reliability of factors extracted from dichotomous (that is, questions with two possible answers) and/or scales (e.g. rating scale: 1 = strongly disagree, to 5 = strongly agree and 1= all the time to 5=never. A higher value shows a more reliable generated scale. Since, the alpha coefficients were all greater than 0.6, the conclusion was that the instruments had an acceptable reliability coefficient; hence, appropriate for the study. The result in Table 3.3 indicates that the Cronbach's alpha is **0.698 for teachers and 0.676 for parents** which is a high level of internal consistency for our scale with this specific sample. All the values are higher than the acceptable lower limit of 0.6 according to Nunnally (1978).

Table 3.3: Reliability Statistics

	Cronbach's Alpha	N of Items
Teachers	.698	16
Parents	.676	14

The Cronbach's alpha is more than 0.6 ($\alpha > 0.6$) for all the questions, which indicates a high level of internal consistency (reliability) for our scale with this sample. The closer the alpha is to 1, the higher the level of consistency.

3.10: Data Collection Procedures

A letter of introduction was obtained from the University of Embu to help the researcher obtain a research permit (appendix 11.0) from the National Commission for Science, Technology and Innovation (NACOSTI). The researcher also obtained a consent letter from the County Director of Education (CDE) before contacting the school principals to prepare for data collection. The research instruments were administered over a span of three months where the interviews with the agriculture teachers were conducted. Within these months, the researcher met the students in their focus group discussions. Parents filled the questionnaires during school gatherings and returned them on the same day. This was also spread over a span of three months to complete the filling in of the questionnaires before they were collected. Two field research assistants were involved in the distribution and collection of the research instruments in the sampled schools. Both qualitative and quantitative data was obtained.

3.11: Data Analysis

Thorough examination of the instruments was done in order to detect anomalies and incomplete responses. Edited data were coded and fed into the computer for analysis using the Statistical Package for Social Sciences (SPSS) version twenty-three for windows.

In reference to the first objective, the researcher transcribed the audio data obtained from the agriculture teachers' face-to-face interviews and the students' focus group discussions. The students' and the agriculture teachers' responses were read and re-read for proper interpretation and the responses coded. The codes were used to generate themes for answering the research question. Qualitative data were obtained from this objective and analysed using descriptive statistics which comprised of mean, percentages, frequencies and standard deviation. The results from this objective were presented in tables and also in a narrative form.

Both qualitative and quantitative data were obtained as guided by the second objective. Qualitative data was first categorized into themes and analysed through descriptive statistics and presented into tables and also in a narrative form.

Quantitative data from this objective was analysed through inferential statistics using the one sample- t-test.

In reference to the third objective, both qualitative and quantitative data was obtained. Qualitative data were categorized into themes and analysed using descriptive statistics. The results were presented in tables, bar graphs and pie charts. Multiple correlation analysis tests on the relationship between agricultural teaching approaches, extent of skills development and extent of use of the skills developed for food security was run based of the multiple regression equation of $\hat{Y}$ on X which is $\hat{Y}=a+b_1X_1+b_2X_2+b_3X_3$, where $\hat{Y}$ is food security, 'a' is constant while b1, b2 and b3 are all other factors remaining constant. The values of X_1, X_2 and X_3 obtained represent a unit increase on the teaching approaches, the extent of skills development as well as the extent of use of the skills developed.

Based on the fourth objective, qualitative data was categorized into themes and analysed using descriptive statistics. The results were presented in tables and bar graphs as well as narrative form. Quantitative data were analysed through multiple correlation analysis on the relationship between the constraints in teaching and learning agriculture and extent of skills development for food security based on the multiple regression equation of $\hat{Y}$ on X which is $\hat{Y}=a+b_1X_1+b_2X_2+b_3X_3$, where $\hat{Y}$ is food security, 'a' is constant while b1, b2 and b3 are all other factors remaining constant. The values of X_1, X_2 and X_3 obtained represent a unit increase in facility constraints, activity constraints and service constraints respectively.

3.12: Logistical and Ethical Considerations

3.12.1: Logistical Considerations

After obtaining a research permit from the National Commission for Science, Technology and Innovation, the researchers obtained a consent letter from the office of the County Director of Education-Embu which was presented to the school principals to allow for data collection from the agriculture teachers and their students as well as the parents/ guardians during school academic forums.

3.12.2: Ethical Considerations

The students assented to participate in the study while the school principals consented on behalf of the parents and guardians because the study involved students who were under 18 years of age. A copy of the consent letter was also attached to the parent's questionnaire. Respondents participated in the study on a voluntary basis and they were informed that they could withdraw at will.

3.13: Summary of Chapter Three

The discussion in this chapter includes a detailed description of the design of the study and the methodology that was followed. Both descriptive and correlational designs were adopted as they were appropriate to the research problems and the question identified, as well as the hypothesis stipulated in chapter one. Further presented is the target population, study location, sample size and sampling procedures. Data collection and analysis procedures are equally discussed. The chapter ends with the logical and ethical considerations of the study.

CHAPTER FOUR

RESULTS, INTERPRETATION AND DISCUSSION

4.1: Introduction

This chapter presents the findings of the study, their interpretation and a discussion of their implications. It is organized into the survey response rate and the presentation of the results as per the study objectives. The results are presented both quantitatively and qualitatively.

4.2: The Survey Response Rate

The researcher sought to find out the survey response rate from the expected sample size. This is the number of the agriculture teachers, students and the parents who actually participated in interviews, discussions as well as filling in of the questionnaires respectively expressed as a percentage of the expected sample size. The response rate is presented in Table 4.1.

Table 4.1: The Survey Response Rate

Subject category	Expected Sample	Actual sample	% Response Rate
Public schools	132	60	46
Private schools	12	8	67
Agriculture teachers	148	111	75
Agriculture students	381	376	98
Parents/Guardians	381	323	85

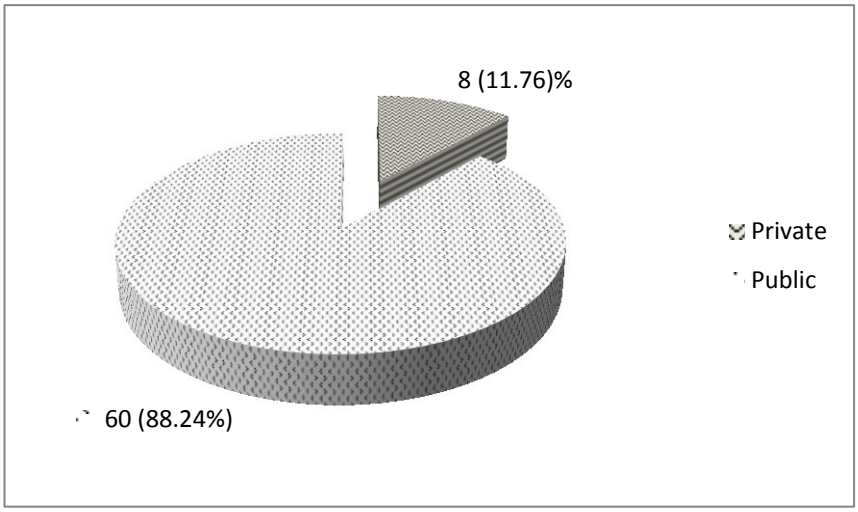
A survey's response rate is viewed as an important indicator of survey quality (Draugalis, 2009). A higher response rate is preferable because the missing data is not random. A high response rate (>80%) from a small, random sample is preferable to a low response rate from a large sample (Draugalis, 2009). Based on the response rate, the variation between the expected sample and the actual sample was due to the non-response groups. For instance, some schools which had been selected for data collection did not finally participate in the process mainly because of changes in the

school programme. To ensure that the required number was reached, the researcher adjusted to the change by proportionately increasing the number of agriculture teachers, agriculture students and the parents in the schools that participated in the process. The adjustment was done in the schools that were in the same locality with the non-response ones similar since they had similar regional characteristics. This resulted into an actual sample that was at least 60% of the expected sample. This is the minimum recommended sample (Fincham, 2008) to be able to gather data that is representative of the characteristics of the population. According to Draugalis (2009), the response rate is number of the usable responses expressed as a percentage of the eligible sample chosen. A high response rate/return rate is important to ensure that the results are representative of the target sample and that the research instruments are performing as intended (Fincham, 2008).

In reference to Table 4.1, public schools had a higher percentage of respondents since their total population was high. A total of 111 agriculture teachers participated in the study based on their small number in relation to other subjects in Embu County. The researcher categorized the students into groups of between fifteen to twenty members forming a total of twenty focus discussion groups, eight of which were from private schools while 12 were from the public schools. The researcher analysed the parents' responses individually. All the groups of respondents reached the minimum required number based on the recommendation by Krejcie and Morgan (1970) on determination of sample size of a known population.

4.2.1: School Participation

A total of 132 public and 12 private schools were sampled for data collection. The actual total sample constituted 68 schools out of which 60(88.24%) were public schools and 8(11.76%) was private schools. This indicates that a total of 68(34.3%) of the total schools in the County participated in the study. Figure 4.1 indicates the percentage proportion of the public and private secondary schools that participated in data collection.



n=68 Schools

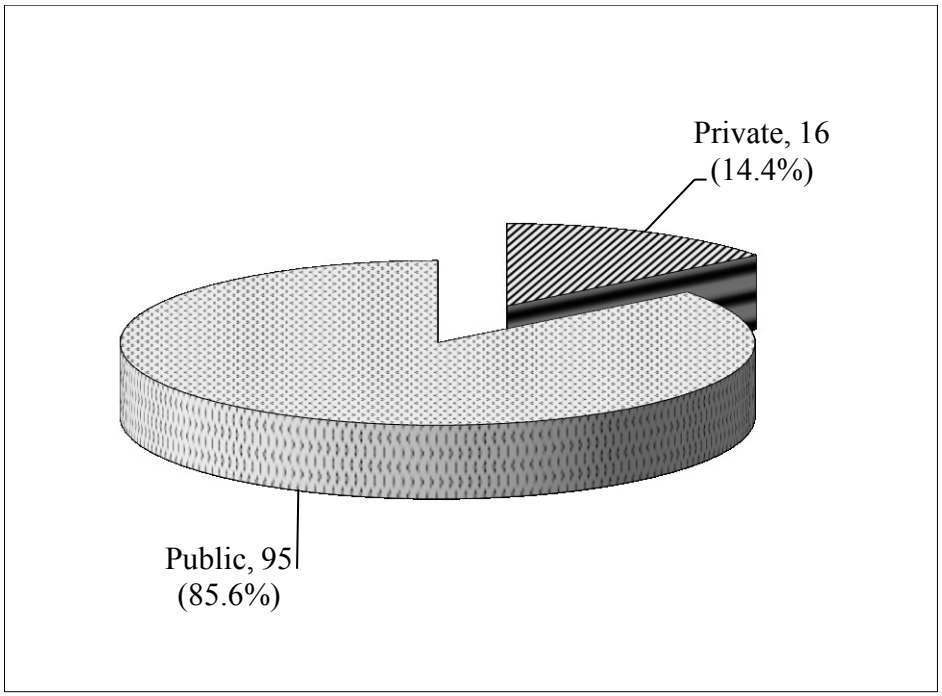
Figure 4.1: Percentage Proportion of Schools that Participated in data Collection

4.3: Respondents' Bio Data

Bio data refers to the information that relates to one's life, work experiences as well as items involving opinions, values, beliefs and attitudes that reflect a historical perspective. It has elements of both biography and auto biography. The study sought to establish the bio data of the agriculture teachers, the students and the parents who were the respondents in this study.

4.3.1: Agriculture Teachers' Bio data

The researcher first sought to establish the percentage proportion of the teachers who participated in the study. Figure 4.2 shows the proportion of teachers in the private and public schools who participated in the face to face interviews.



n=111

Figure 4.2: Percentage Proportion of Agriculture Teachers who Participated in the Study

A total of 95(85.6%) teachers sampled were from public secondary schools with only 16(14.4%) from private secondary schools. This could be attributed to the higher number of public schools than the private ones within the county; consequently, giving a similar ratio of the teachers.

The study further sought to find out the duration, the teachers had taught agriculture in their current stations. The mean duration, mode and standard deviation, minimum and maximum number of years the agriculture teachers had taught in the same school was further established as presented on Table 4.2.

Table 4.2: Duration Agriculture Teachers had Taught in their Current School

Descriptive statistics	
N	109
Mean	4.9
Mode	1.0
Std. Deviation	3.9
Minimum	1.0
Maximum	20.0

The statistics on Table 4.2 show that on average, majority of the teachers had taught for less than five years with a standard deviation of 3.9 for a total N of 109 teachers who responded to this particular question. The difference in the value of N is attributed to the two teachers who did not mention the duration of teaching and gave ranges instead and mentioned that they had some personal reasons. These responses are further presented as a graph of the number of teachers against the duration of time spent in the school in years. This is as shown on Figure 4.3.

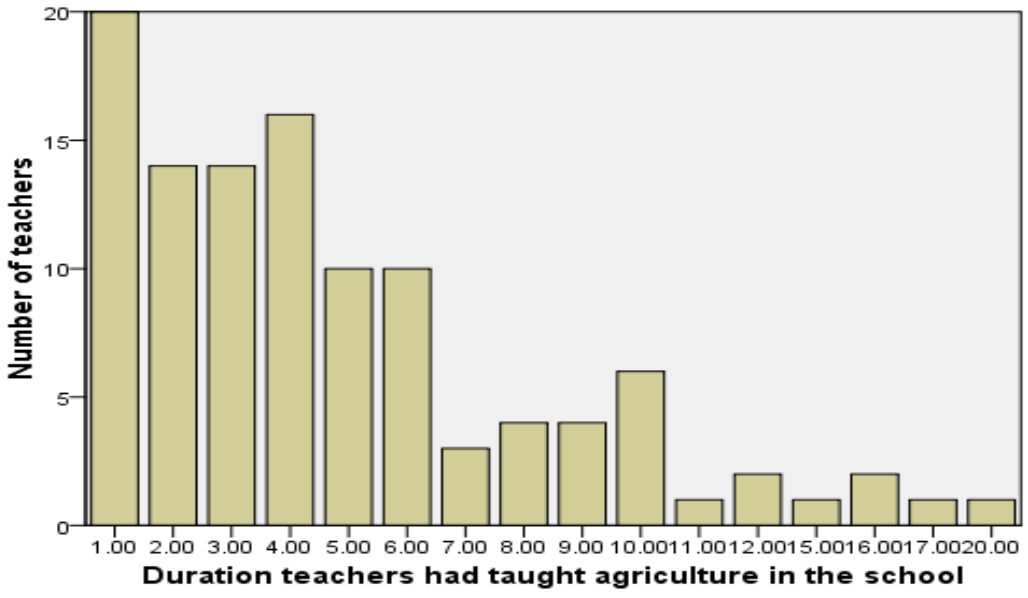


Figure 4.3: Graph of the Number of Teachers against the Time Spent in the School in Years

The descriptive statistics on Figure 4.3 reflects that teachers who had spent more time in the same school were the least in number (7-20 years), while those that had less than seven years were the majority. The length of time spent teaching agriculture in the same station has the implication on experience with the school characteristics and community influence. This may have influenced the pedagogical methods employed in teaching agriculture with an impact on food security. For instance, all communities have educational assets and resources that teachers can use to enhance learning experiences for students. At the same time, students not only learn from and in their community, but they also use what they are learning to influence change or give back to the community in some meaningful way. This observation agrees with that of Schaps (2003) that community-based learning is a way of promoting stronger relationships between the school and its community while increasing the community's investment in, understanding of, and support for the school and the learning experiences it provides.

4.3.2: Agriculture Students' Bio Data

The researcher sought to know from the agriculture teachers the average number of agriculture students taught per class. The statistics on Table 4.3 shows the mean, standard deviation, the lowest and the highest number of agriculture students in the schools.

Table 4.3: Agriculture Students' Population per Class

Descriptive Statistics					
	N	**Lowest**	**Highest**	**Mean**	**Std. Deviation**
Form one	106	5	290	57	42.31
Form two	107	8	119	42	22.40
Form three	105	4	95	32	17.58
Form four	106	1	100	29	19.37

It was observed that on average, form one classes in the county had 57 students with a standard deviation of 42.31, form two had an average of 42 students with a standard deviation of 22.40, form three had an average of 32 students with a standard deviation of 17.58, whereas form four had an average of 29 students with standard

deviation of 19.37 students. There was a form one class with a high number of 290 students while another had as low as 5 students. The form two with the highest number had 119 students and the lowest had 8 students while the form three with the highest estimated number of agriculture students had 95 and the lowest had 4 students. The average number of students was necessary to deduce how possible each teaching approach would have been applied for effective skills development. This is in regard to resource allocation and the proportion of students that would transfer the developed skills to the food industry at each level of learning.

4.3.2.1: Preparedness for Learning Agriculture

The researcher further sought to establish from the agriculture students the level of preparedness for learning agriculture as a subject in secondary school. A good number of students mentioned that they had heard that agriculture is a practical subject. Others mentioned that it is easy to understand while some mentioned that to them, agriculture was a booster subject. However, a few students had no knowledge about agriculture as a subject at secondary school. (From a Form Two student) "I had no idea of agriculture in secondary school because it is not done in primary school. (From a Form One student) "I heard about agriculture from my cousin, she told me it is the easiest subject…I intend to be an agricultural officer." Information on the level of preparedness of students to do agriculture was necessary because the researcher could infer the level of motivation to enrol for agriculture. Knowledge about agriculture as a subject would give the agriculture teacher an idea of the best approach to orient the learners into the subject especially on areas related to improved food security.

4.3.2.2: Expectation from Learning Agriculture

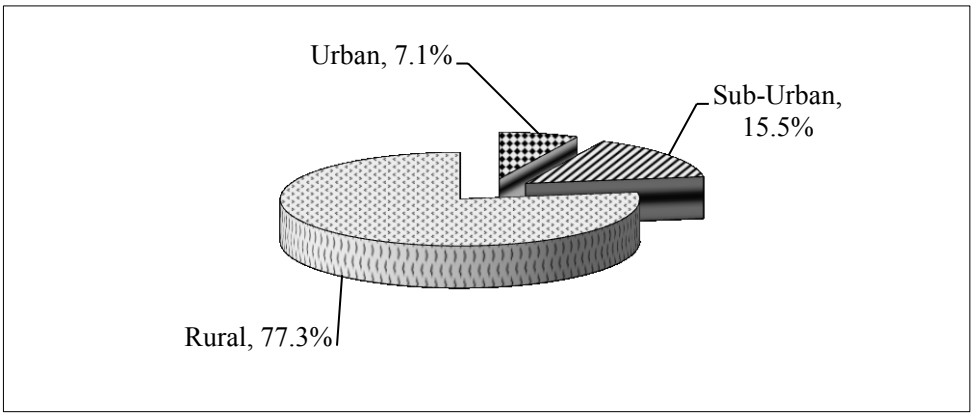
When asked about their expectation after learning agriculture, 320(85%) of the 376 students who participated in the study mentioned the career paths they would venture into. (From a form four student) "I am likely to do agricultural engineering." (From another form four student) "I intend to become my own farm manager." The researcher deduced that many students who had selected agriculture as one of their subjects were ambitious enough to venture into agricultural related careers. Such careers would enable them to be more productive in the society and in particular, to improve food security.

4.3.2.3: Guidance on Selection of Agriculture as an Elective Subject

The form threes and form fours were asked to mention the resources or people they relied upon for guidance when they chose agriculture among other elective subjects. (From a form three student) "I made my personal decision…the school has no career guidance." (From a form four student) "I made my personal decision on which optional subjects to do at form three, I could perform well in agriculture hence I knew I would do it at form three." The knowledge on subject selection was mainly the students' decision. The researcher advocates for a joint guidance from the parent, the teacher and the student so that the latter could make an informed decision when choosing the area of specialization. Such guidance has an implication on the pathway to engage in future careers. Those related to agriculture would ultimately lead to improved food security.

4.3.3: Parents' Bio Data

The study sought to find out the categories of parents who participated in the research. This was based on their area of residence as presented in Figure 4.4.

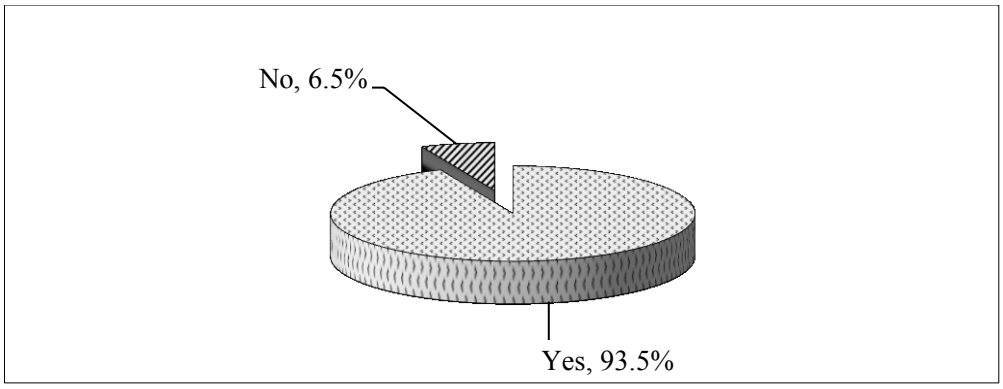


n =322

Figure 4.4: Parents' Area of Residence

A total of 249(77.3%) parents that responded to this question lived in rural areas, 50(15.5%) in sub-urban areas whereas 23(7.1%) of them reported that they lived in urban areas. It is clear that most of the parents of the students taking agriculture lived in rural areas where there could be reasonable pieces of land where they practised

what was learnt in class. This finding is in agreement with that of Osongo (2014) who highlighted that Kenya's vast land which is 587,000 km^2 of which 576,076 km^2 is arable land with majority of the people living here. Further Njoroge and Orodho (2014) indicate that the rural poor are the majority and have mainly remained in traditional agriculture. The researcher further investigated the proportion of parents that had grown up in the farm. This is presented as Figure 4.5.

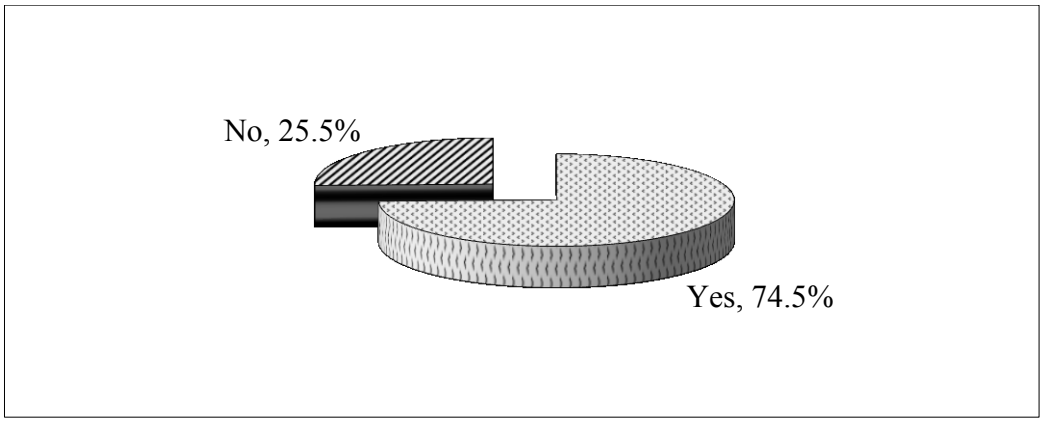


n= 323

Figure 4.5: Proportion of Parents who Grew up in the Farm

A total of 302(93.5%) parents reported that indeed they were brought up in the farm whereas only 6.5% grew up in urban areas. This indicates that quite a large number of parents were interacting with their children in the farms as they practised what they had learnt in school. Such parents therefore stood a better ground to judge how well the skills were being applied for food security.

The study further sought to find out whether the same parents had attended a secondary school that offered agriculture as a subject. Their responses are as shown in Figure 4.6.



n=318

Figure 4.6: Parents' Attendance of Secondary School that Offered Agriculture Classes

The study observed that a total of 237(74.5%) parents had attended secondary schools that offered agriculture classes with only a very small proportion of 81(25.5%) parents reporting that the secondary schools they attended did not offer agriculture classes. This implies that majority of the parents had an idea on what agriculture entailed. Such parents could further tell how the skills developed on their children could be applied for food security. This therefore would have translated to what they would have expected from their own children.

4.4: Agricultural Teaching Approaches Employed in Secondary Schools for Food Security

The first objective sought to establish the agricultural teaching approaches employed in secondary schools for food security. The study was guided by the following research question: What agricultural teaching approaches are employed in secondary schools for food security? The researcher first sought the teachers' opinions on the teaching approaches employed in secondary school.

4.4.1: Agriculture Teachers' Opinions on the Teaching Approaches Employed in Secondary Schools for Food Security

4.4.1.1: Percentage Weekly Use of each Teaching Approach Identified

The researcher first sought to investigate from the agriculture teachers the frequency of weekly use of each teaching method identified. Table 4.4 shows the agriculture teachers' responses to this objective.

Table 4.4: Agriculture Teachers' Opinions on Percentage Weekly Use of each Teaching Method Identified

Teaching method	N	%
Discussion	98	31.9%
Demonstration	79	25.7%
Lecture	65	21.2%
Problem solving	35	11.4%
Class projects	30	9.8%
Total Responses	**307**	**100.0%**

Table 4.4 indicates the number of respondents for each teaching method as represented by 'n'. Cumulatively, 307 responses were attained out of which the percentage weekly use of each teaching method was calculated. In a multiple response question i.e. a question with more than one answer, the number of responses is the one used to calculate the percentage response (Eugene, 2020) as in the case of Table 4.4.

A total of 98(31.9%) of teachers termed discussion as the most common teaching method used followed by demonstration 79(25.7%) whereas lecturing 65(21.2%) came in third. Other methods used were problem solving 35(11.4%) and class projects 30(9.8%). Discussion, demonstration and lecture methods were commonly used in teaching agriculture classes. This implies that the teacher had a higher control of the class. However, learners were not frequently exposed to problem solving and class projects. These two are better in developing agricultural skills which would be necessary for food security. Relating the responses on Table 4.4, approaches that

have the ability to develop skills for food security are ranked last in their usage in schools. This implies that practical agriculture is theoretically taught.

4.4.1.2: Percentage Length of Time Spent with the Students under each of the Method Identified

The researcher further sought to find out the percentage length of time spent with the students under each of the methods identified. The descriptive statistics in Table 4.5 shows the average percentage of time each approach took in teaching agriculture in a week.

Table 4.5: Percentage Weekly Length of Time Spent on each of the Methods Employed

Teaching Method	N	Lowest %	Highest%	Mean%	Std. Deviation
Lecturing agriculture	84	0.50	80.00	36.0%	21.1
Discussion	101	10.00	90.00	33.7%	16.4
Demonstration	93	3.00	69.00	25.3%	14.3
Problem solving	54	2.00	50.00	20.9%	11.0
Class projects	56	0 .50	50.00	14.8%	9.9
Total Responses	**388**				

The results from Table 4.5 were from a multiple response question resulting into a cumulative number of answers totalling to 388. The statistics on Table 4.5 reveals that lecturing agriculture (36.0% equivalent to 43.2 minutes in form one and two and 57.6 minutes in form three and four classes) took the largest percentage of the allocated time for teaching agriculture followed by discussion at 33.7% (40.44 minutes in form one and two and 53.92 in form three and four). Demonstration came in third at 25.3% (30.36 minutes in form one and two and 40.48 minutes in form three and four) whereas problem solving was fourth at 20.9% (25.08 minutes in form one and two and 33.44 minutes in form three and four classes. It is worth noting that class projects were given the least time (14.8%, equivalent to 17.76 in form one and two classes and 23.68 minutes in form three and four classes) yet students ought to carry out more projects and practical so as to put into practice what they have learnt

in class. In this case therefore, problem solving and projects were both less frequently employed and also given least time among all other methods. This could be associated the minimal time available for teaching agriculture in the general school time table. One of the agriculture teachers made a comment on the same:

> "Mwalimu (teacher), you also know that agriculture does not have double lessons like other sciences…when do, I plan for a practical unless I create my own time or inconvenience other subject teachers? We even do not have an agriculture laboratory. I mainly demonstrate, use photographs or at least organize for a field trip."

It was observed that some schools allocated lecturing of agriculture as high as 80% of allocated teaching time, others allocated discussion as high as 90% of the allocated time, the highest time that was allocated for demonstration was 69% while class projects and problem solving had each an allocation of 50% of the teaching time. This implies that practical agriculture was least done and much time was spent on the theory work. Developing agricultural skills for food security requires hands-on-training as outlined by the Competence Based Curriculum which would be possible through class projects and problem solving approaches.

4.4.1.3: Relative Amount of Time Spent on various Class Activities in an Ideal Forty Minutes Agriculture Lesson

The study further sought to find out the amount of time spent on each of the teaching activity applied in a 40 minutes class. Table 4.6 shows the relative amount of time spent in various class activities in an ideal forty minutes lesson.

Table 4.6: Relative Amount of Time Spent on various Class Activities in an Ideal Forty Minutes Agriculture Lesson

Activity	N	Lowest	Highest	% Mean	Std. Deviation
Teacher explaining to the whole class	108	10.00	80.00	35.2	16.9
Teachers giving notes	104	4.00	80.00	21.5	13.9
Whole class discussion	105	5.00	50.00	17.4	10.3
Students making their own notes	101	1.00	40.00	14.8	7.5
Students doing practical activities in small groups	100	1.00	40.00	15.2	8.8

The study revealed that teachers explaining to the whole class took the highest percentage (35.2%) which is equivalent to 14.08 minutes on average of the ideal 40 minutes set for teaching agriculture followed by teachers giving notes that took 21.5% equivalent to 8.6 minutes. Whole class discussion took 17.4% of the ideal 40 minutes which is equivalent to 6.96 whereas students doing practical activities in small groups took 15.2% which is equivalent to 6.08 minutes. Finally, students making their own notes took the least percentage of the assigned 40 minutes for teaching agriculture (14.8%) equivalent to 5.92 minutes.

The statistics on Table 4.6 implies that teaching agriculture is mainly teacher-centred than student centred. Teachers did a lot in giving notes and explaining than students discovering and participating in practical activities. This could be attributed to the wide agriculture syllabus that needs to be covered within the stipulated time of three (40 – minutes) lessons a week in form one and two and four (40 minutes) lessons in form three and four classes.

4.4.2: Students' Opinions on the Agricultural Teaching Approaches Employed for Food Security

The researcher was further interested in finding out the students' opinions on the approaches they felt that their teachers were employing with the aim of developing skills in them for food security. The information was audio recorded and then transcribed into themes for analysis.

4.4.2.1: School Projects

Some schools were reported to have been rearing fish, cattle, pigs and poultry. However, as reported by the students, much of the work was left to the school grounds men to manage the enterprises. This could be attributed to inadequate time allocated to cover the entire agriculture syllabus. Hence, students could not effectively participate in the management practices. Others reported that students had Young Farmers' Clubs from where they could practise agriculture. One form three student had this to say. "Our school has tree nurseries which are visited at form two to learn nursery practices and are managed by the grounds man." Another form three student had this to say. "We rarely have class projects because the shamba is very small; as a result, only the form fours carry their KCSE projects on them."

4.4.2.2: Tours and Field Trips

Further, some students reported that their schools had sometimes allowed them to attend shows and incorporated field trips in teaching agriculture. A good number of students reported that their schools sometimes gave time for exploration and outside learning. This was reported by a form four student: "sometimes we are taken out on field trip around the school and to the neighbouring counties. We have learnt machine milking, silage preparation… I believe these skills are good enough for application after school." Another form two student reported this "Agriculture students in our school go for tours at form three and form four. Our teacher told us by then, we shall have covered a good number of topics."

4.4.2.3: Demonstration Method

Some students reported that their teachers used demonstration method. However, the research findings for this study revealed that such demonstrations were mainly carried out by facilitators during field trip and tours. In this regard, students who were not taken out on field trips had no demonstration going on. Those that had demonstrations in school had a few livestock, farm tools and equipment as well as an operational school farm as mentioned by a form three student. "Our school has a fenced demonstration garden from where we practise nursery practices. Also, it has a traditional model granary from where we learn post-harvest practices at form two." Another form four student had this to report: "my school has a greenhouse where we

grow vegetables through irrigation and we are also shown how to pinch them. I would like to do such a farming system after school if I'll have capital."

4.4.2.4: Discussion Method

A number of students in their groups mentioned that their agriculture teachers gave them discussion questions which developed their theoretical approach to answering questions related to food security. In addition, participation in agriculture symposiums gave them opportunities to interact and blend ideas learnt with students from other schools not only for the examination but also for observation progress in their school farms.

4.4.3: Students' Opinions on Specific Approaches that may help them Develop more Skills for Food Security

The researcher further sought to find out from the students the approaches that needed to be incorporated in learning agriculture for them to develop more skills for sustainable food production at home. Students were individually asked to highlight the most preferred approach from a handout labelled B. This was based on three themes that the researcher used to guide students to make selection on the choices that were related to internship programmes, invitation of technical experts and increased practical sessions. Their suggestions were recorded and they are shown on Table 4.7.

Table 4.7: Students' Views on Specific Approaches that may help them Develop more Skills for Food Security

Approach	N	%
Students should be attending internships for at least two weeks in agriculture based institutions	158	42.0%
Greater commitment involving technical experts from agricultural institutions	129	34.2%
Increased instructional practical sessions through creation of adequate time aimed at food security	89	23.8%
N	**376**	**100.0%**

4.4.3.1: Attendance of Internship Programmes

A total of 158(42.0%) students recorded attendance of internship as the most critical approach. They felt that students should be attending internships for at least two weeks in an agriculture-based institution to give them the required exposure and experience of the real world. This would not only prepare them for jobs in future but also help them continually develop skills for food security while in school; this would be equivalent to on-job-training.

4.4.3.2: Invitation of Technical Experts

A total of 129 (34.2%) students felt that greater commitment in involving technical experts from agricultural institutions was necessary in schools as this would in turn add more and new skills to the students.

4.4.3.3: Increased Practical Sessions

Finally, 89(23.8%) the students listed increased instructional sessions through creation of adequate time for practical agriculture as the third critical approach for success in agriculture aimed at food security. In agreement with the teachers' views was the opinion that more time was needed for practical sessions and in-depth learning. Majority of the work covered theoretically through lectures and giving notes would translate into problem solving and class projects paving way for more skills development for food security in secondary schools.

In regard to the research findings of the first objective, different teachers use different methods depending on the availability of facilities and resources as per the status of the institution. The commonly used methods are the lecture method and class discussions which have little contribution to skills development for food security. These findings are in agreement with those of other researchers (Seevers & Graham, 2012; Umar, 2012; Charlton, 2006; Mwiria, 2002) who indicate that teachers in most cases use lecture method in a programme they are supposed to use practices and that the method is most applicable to students in higher institutions. The only advantage of lecture is the ability to get a huge amount of information to a lot of people within a short amount of time (Umar, 2012). Lecture method has been noted to be the least effective of all teaching methods. In many cases, lectures contain no form of interaction from the trainer to the trainee and can be quite boring.

Discussion method is highly effective in improving students' achievement and retention than the conventional lecture method; hence, needs to be integrated with other teaching approaches. This is in tandem with findings by Falode, Adewale, Ilobeneke and Robinson (2015) who stated that using discussions as a primary teaching method allows for stimulation of critical thinking. Frequent questions, whether asked by the teacher or by the students, provide a means of measuring learning and exploring in-depth the key concepts of the subject.

Class projects, field trips and tours as well as demonstration methods were not commonly used in agriculture classes yet they are highly ranked in skills development for food security. The inadequate inclusion of these approaches to teaching and learning of agriculture was linked to inadequate time to cover the whole syllabus and lack of double lessons on the school timetables for practical work. In agreement with these findings are those of Daluba (2013) in that demonstration method increases the students' interest and understanding and consequently promotes high achievement rate.

The project method aligns with constructivism and its central precept that learners construct knowledge based on their experiences (Von Glasersfeld, 1995). The project method concurs with experiential learning theory, which asserts that learning occurs as a result of experiences held by the learner (Roberts, 2006; Kolb, 1984). This approach of teaching significantly helps in improving agricultural students' skills acquisition and technical competency which can be incorporated into food security aspects. This finding agrees well with the view of Meece, Anderman and Anderman (2006) that project method of teaching creates the learning environment which provides hands - on experiences for students and it enables them to better understand and acquire the requisite knowledge and skills. Since financial constraints could hinder the establishment of projects in schools, Maiga (2016) suggests the need to establish common demonstration farms to expose the young people to the agricultural activities.

Problem solving method was rarely employed despite is potential to solve problems around the school and the neighbouring community. Students were not very conversant with this method. It is also worth noting that the review of literature

indicated that digital learning through the use of devices like computers, mobile technology and videos is a technological teaching approach. However, it was not mentioned as a teaching method that was being incorporated in the learning of agriculture. This leaves a research gap on the role of the media technology in secondary school agriculture for enhanced food security. The integration of digital learning mainly focuses on higher education. Therefore, another research gap this study recommended for further research is the extent to which digital learning as pedagogy has been integrated into teaching secondary school agriculture. This is because the related literature indicates that the mobile technology is a friendly support tool for teachers to develop their classes, generate an environment of interaction, cooperation and collaboration between them and the learners (Kurt, 2020). The integration of the social media based learning tools in the curriculum such as mobile learning can help the teachers to design the instructional system according to the changing needs of learners or society at large such as the food security agenda (Kurt, 2020; Troussas et al., 2020; Krouska, et al., 2019).

4.5: Effect of the Agricultural Teaching Approaches on Skills Development for Food Security

The second objective sought to establish the effect of the agricultural teaching approaches employed in secondary schools on skills development for food security. Both the agriculture teachers' views and those of the students were obtained for this objective. The analysis was done to test the hypothesis that agriculture teaching approaches have an effect on skills development for food security.

H_0: Agriculture teaching approaches do not have any statistically significant effect on skills development for food security.

H_1: Agriculture teaching approaches have a statistically significant effect on skills development for food security.

4.5.1: Teachers' Opinions on the Effect of the Agricultural Teaching Approaches on Skills Development for Food Security

The researcher asked the agriculture teachers to rank the teaching approaches they employed based on their importance in developing skills for food security. The results are presented on Table 4.8.

Table 4.8: Teachers' Views on the Importance of each of the Teaching Approaches Employed in Developing Skills for Food Security

		Most important		Important		Least important	
	N	n	%	n	%	n	%
Lecture	108	16	14.8%	31	28.7%	61	56.5%
Problem solving/discovery	106	54	50.9%	36	34.0%	16	15.1%
Class project	107	56	52.3%	31	29.0%	20	18.7%
Demonstration	108	50	46.3%	49	45.4%	9	8.3%
Discussion	107	40	37.4%	58	54.2%	9	8.4%

It was observed that 56(52.3%) of the agriculture teachers felt that incorporation of class projects was the most important agricultural teaching approach that developed skills for food security followed closely by problem solving as reported by 54(50.9%) of the teachers. A total of 50(46.3%) teachers felt that demonstration ranked third in developing skills for food security. A total of 58(54.2%) agriculture teachers said that discussion method was important in developing skills for food security. It is worth noting that 61(56.5%) teachers felt that lecturing was the least important teaching approach that developed skills for food security. This implies that more emphasis should be put on class projects and problem solving as they were seen to contribute greatly to skills development for food security.

Relating the responses on Table 4.8 to those on Table 4.4, teaching approaches that have the ability to develop skills for food security are ranked last in their usage in schools. This implies that practical agriculture is theoretically taught in lectures contributing very little to skills development for food security. This argument is in agreement with a study by Ransford, Yuan, Kwesi, Abbey, Liu and Kumi (2016) that Agricultural Science teachers in the senior high school feel more comfortable using the lecture method of teaching than the other methods of teaching.

4.5.2: Students' Opinions on the Effect of Agricultural Teaching Approaches on Skills Development for Food Security

The study further established the students' opinions on the approaches they felt their teachers were employing with the aim of developing skills in them for food security. The information was audio recorded and then transcribed into two themes for analysis. These were the effect of the teaching approaches employed for skills development and the role of the skills developed for food security.

4.5.2.1: Effect of the Teaching Approaches Employed for Skills Development

Class projects were reported to be the most important in developing skills for food security. Such projects included aquaculture, cattle, pigs and poultry farming. However, much work was left to the school grounds men to manage the enterprises leaving very little opportunity for the students' practice. Some students reported that their schools carried out projects through the Young Farmers' Clubs which gave students opportunities to practice agriculture. "When I was in form one, each student was allocated five trees to manage for two dry seasons. Today we enjoy the cool breeze from these trees whereas some branches are fed to the school goats after pruning." (From a form four student. A form three student had this to say, "Our teacher guided us on breaking seed dormancy on mangoes. She allowed us to carry a third of the grafted seedlings. Today my six mango plants have started flowering."

Demonstration was ranked second as a method that developed skills for food security. This was carried out in the school farms, agricultural shows and field trips. Class discussion and lecturing were ranked last respectively in contributing to skills development for food security. However, all students in their groups mentioned that these were the most common methods of teaching that were applied by their teachers. One student supported this in a statement:

> "In our school, two students in preparation for the Kenya Science and Engineering Fair (KSEF) demonstrated how to make syrup to trap flies that destroy mangoes at the flowering stage. I believe I can do the same if I become a mango farmer."

The students' opinions imply that though their teachers had the passion for teaching practical agriculture for skills development, other factors hindered them from

meeting this objective. These included inadequate time for teaching and learning as well as the facilities in their schools. The students' opinions were in tandem with those of their teachers in ranking the teaching approaches in accordance with their ability to develop skills for food security. However, none of the students recognized problem solving as a method that was being applied in their schools. This finding agrees with that of Olowa (2009) that cognitive or abstract learners may not recognize problems as such when presented to them.

4.5.2.2: Role of the Skills Developed for Food Security

The researcher further sought to know the role of the skills the students gained from the teaching methods they had mentioned as appropriate for food security. Most of the students mentioned that the agricultural skills developed from class projects could be used to earn income which could further be used to produce or buy food. An example of such a statement was from a form three student. "We were taught how to fence our farms to prevent large animals from invading our crops."

A number of students also mentioned that they had a chance to meet experts who taught them some technical skills in agriculture like machine milking and seed inoculation as well as dressing. One student said that he had learnt of the many challenges facing agriculture and how to solve them. For instance, poor post-harvest practices such as storage problems which have always made farmers incur losses on their harvest leaving them food insecure.

> "My grandmothers' granary has always been a habitat for rats…after being taught the qualities of a good food store, I made rat guards and sealed all the holes. For a year we have not seen rats in the granary."

A number of students further mentioned that the skills had made them more creative and innovative. For instance, some could grow vegetables in guinea bags, banana pseudo stems and roof gutters where land was minimal making them food secure. Quite a number of students in their groups affirmed that doing agriculture practically improved their memory and critical thinking. In addition, as mentioned by some students, practical sessions were locally organized by teachers especially during the weekends.

4.5.3: Teachers' Opinions on the Effect of each of the Teaching Approaches to Skills Development for Food Security

The researcher further rated the teachers' opinions on the effect of each of the teaching approaches to skills development for food security. This is presented on Table 4.9.

Table 4.9: Teachers' views on Effect of each of the Teaching Approaches to Skills Development for Food Security

Teaching Approach	N	Mean	Std. Deviation	Std. Error Mean
Lecture	108	2.4167	.73783	.07100
Problem solving/discovery	106	1.6415	.73275	.07117
Class project	107	1.6636	.77635	.07505
Demonstration	108	2.3796	.63713	.06131
Discussion	107	2.2897	.61444	.05940

In reference to the descriptive statistics on Table 4.9, with the entire mean between 1.5 and 2.4, it can be deduced that the agricultural teaching approaches employed moderately contributed to development of skills for food security.

4.5.4: One Sample t- test

Since the mean were different, a one sample t- test was carried out to investigate whether this difference in mean was statistically significant or not. This was based on the t-distribution and presented as Table 4.10.

Table 4.10: One-Sample t-test

	Test Value = 0					
	T	**Df**	**Sig. (2-tailed)**	**Mean Difference**	**95% Confidence Interval of the Difference**	
					Lower	**Upper**
Lecture method	34.039	107	.000	2.41667	2.2759	2.5574
Problem solving/discovery	23.064	105	.000	1.64151	1.5004	1.7826
Class projects	22.165	106	.000	1.66355	1.5148	1.8123
Demonstration	38.814	107	.000	2.37963	2.2581	2.5012
Discussion method	38.547	106	.000	2.28972	2.1720	2.4075

Since the one sample t-test gave a p-value of 0.000 which is less than the statistical p of 0.05, the decision rule is therefore to reject the null hypothesis and state that agriculture teaching approaches have a statistically significant effect on skills development for food security.

The descriptive statistics from the second objective indicate that lecturing hardly contributed to skills development for food security. Emphasis on the theoretical aspect of the subject deprived the students of the practical aspects that are needed for skill acquisition in agriculture. In order to enhance relevant skills development for food security in the country, practical based approaches need to be incorporated and beefed up with discussions to enhance acquisition of knowledge and its transfer to the food industry.

The research findings from this objective agree with those of Ofoegbu (2015) and Konyango and Asienyo (2015) who found out that in most cases, agricultural science teachers are fond of using conventional methods, particularly the lecture method in teaching agriculture in secondary schools. The authors emphasized that class projects, demonstration as well as problem solving are learner centred and critical in developing skills for food security. The lecture method is criticized as ineffective as it turns the learners into passive participants in the teaching and learning process

though it is useful in covering large content (Costello, 2001). The lecture method is teacher-centred with very little participation on the part of the learners.

4.6: The Relationship between the Agricultural Teaching Approaches and Food Security

The third objective sought to establish the relationship between the agricultural teaching approaches employed in secondary schools and food security. Both the agriculture teachers' views and those of the parents were obtained from this objective. The researcher stipulated the following hypothesis for this objective.

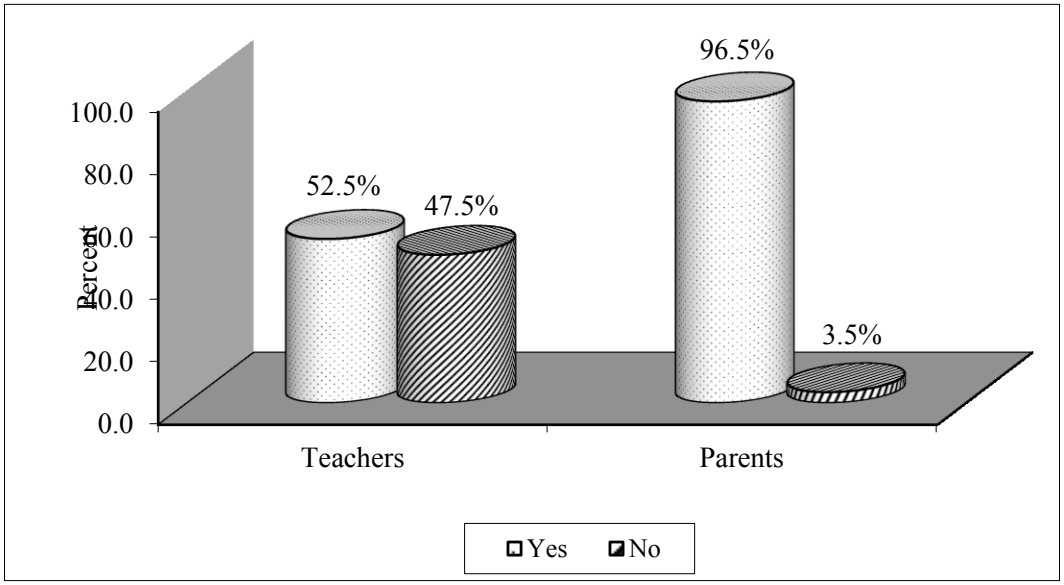
H_0: There is no statistically significant relationship between the agricultural teaching approaches and food security.

H_1: There is a statistically significant relationship between agricultural teaching approaches and food security.

The researcher established that the relationship between the agricultural teaching approaches and food security could be explained by their contribution to skills development and the contribution of the skills developed to the aspects of food security (Figure 2.2). Since the contribution of the agricultural teaching approaches to skills development was dealt with in objective two, the researcher narrowed down to establish the contribution of the skills developed to food security for this particular objective.

4.6.1: Opinions on the Contribution of the Skills Developed to Food Security

The agriculture teachers' opinions and those of the parents were sought in order to explain the contribution of the agriculture skills developed in secondary schools to food security. Their opinions are as presented on Figure 4.7.



teachers and 260 parents

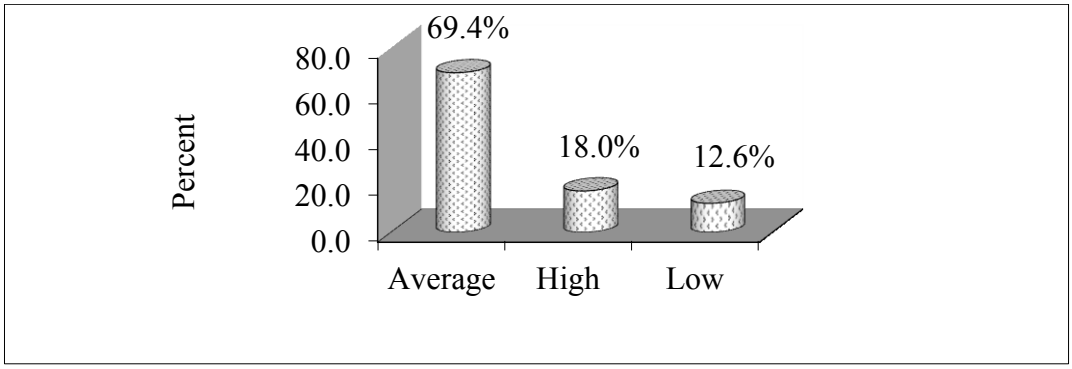
Figure 4.7: Opinions on the Contribution of the Agricultural Skills to Food Security

A total of 251(96.5%) of the parents that participated reported that agricultural skills developed had resulted into increased food security within the school community with only 9 (3.5%) of them feeling otherwise. The parents' opinions are an indication that they were directly benefiting from the agricultural skills that had been developed on their children. For instance, it is likely that food was made economically available through kitchen gardens and constantly supplied through irrigation especially the small-scale vegetable production during the dry season. The availability of food and constancy in its supply are important parameters of food security. On the other hand, only 52(52.5%) of the agriculture teachers reported that agricultural skills developed had resulted into increased food security within the school community with a 47(47.5%) of them having the opinion that the skills developed had not led to increased food security. The low opinion by the agriculture teachers that the skills developed had not translated into increased food security could be associated with constraints such as inadequate financial support for learning practical agriculture in schools, some students disliking manual work and inadequate time for agriculture practicals and projects ultimately decreasing food production hence food insecurity within the school community. Though the perceived contribution of the agricultural skills to food security was found to have a wide

disparity between the agriculture teachers and the parents, on average it can be deduced that agricultural skills developed and food security had a positive relationship. Thus, the teaching of agriculture for skills development should be encouraged at secondary school level with the aim of increasing food security. The researcher further sought to find out the aspects of food security that were being increased from the skills developed. Both the agriculture teachers and the parents had their opinions.

4.6.2: Teachers' Opinions on the Contribution of the Agricultural Skills to Aspects of Food Security

To attain the rate of contribution, the sum of all the agriculture teachers' responses was calculated with the highest being 24 and the lowest being 6. This was then categorized into three, 1-8 as low contribution, 9 -16 as average and 17-24 as high. These results are shown in Figure 4.8.



n=111

Figure 4.8: Contribution of Agricultural Skills Developed to Aspects of Food Security

The responses obtained entailed aspects of food security which included availability of enough food for an active healthy life, food was readily available when needed, and food available was nutritionally balanced in many households, available food was safe to consumers, availability of steady supply of food for households and economical acquisition of food by the household. A total of 69.4% of the teachers reported that agriculture skills developed on students had an average contribution towards increased food security, 18.0% said that the contribution was high whereas

12.6% of teachers said that agriculture skills developed on students had a low contribution towards food security.

4.6.3: Parents' Opinions on the Contribution of Agricultural Skills to Aspects of Food Security

The researcher established that the contribution of the agricultural skills to the aspects of food security could best be explained by the parents' experiences from the contribution of agricultural skills developed in their children in secondary schools. The parents were first asked to rate their experiences from the agricultural skills developed in their children in secondary schools and their responses are presented as Table 4.11.

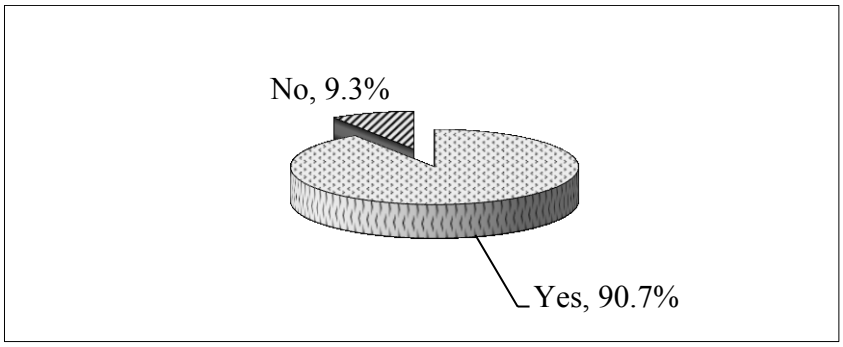
Table 4.11: Parents' Opinions on the Experience from the Agricultural Skills Developed in their Children

Type of Experience	N	Most important		Important		Least important	
		n	%	N	%	N	%
Improved food production at home	300	236	78.7%	46	15.3%	18	6.0%
Personal growth	301	230	76.4%	55	18.3%	16	5.3%
Career preparation	303	181	59.7%	91	30.0%	31	10.2%
Home based income generating projects	296	181	61.1%	80	27.0%	35	11.8%
Hands on training	293	133	45.4%	91	31.1%	69	23.2%
Community service learning	299	132	44.1%	99	33.1%	68	22.7%
Room for travel	297	88	29.6%	104	35.0 %	105	35.4%

Source: Field Data

A total of 236 (78.7%) parents rated improved food production at home as the most important experience they had witnessed from their children who had done agriculture in secondary schools. This implies that students were applying the agriculture skills developed in school at home. This was followed closely by personal growth as reported by 230(76.4%) parents. This could be associated with the livelihood earned from the home-based projects or even the passion for farming after learning agriculture. A total of 181(59.7%) parents rated career preparation as the most important success for their children in agriculture. The deduction from this experience is that agriculture helped students to gain skills that would in future offer

career opportunities for them either in employment e.g. in a farm or self-employment. A total of 181(61.1%) parents also felt that through success in agriculture, their children could undertake home based income generating projects thus adding to food security in their families. Further, a total of 132(44.1%) parents felt that hands on training and community service learning were also very important aspects developed from learning agriculture. However, a total of 105(35.4%) of the parents felt that room for travel was least important in relation to their children's success in agriculture. Based on the parents' opinions on the experience from the agricultural skills developed in their children; the study further sought to find out whether parents would choose their children to do agriculture as an elective subject as they joined form three. The proportion of their responses is as shown in Figure 4.9.



n=321

Figure 4.9: Percentage Proportion of the Parents' Opinions for their Children to Do Agriculture as an Elective Subject

A total of 291(90.7%) of the parents who responded to this question reported that they would choose their children to do agriculture as an elective subject with only 30 (9.3%) saying that they would not. This implies that most parents had embraced agriculture as an important subject. When asked in an open ended question to give reasons why they would choose their children to do agriculture as an elective subject, majority mentioned to earn income from it, to gain soil conservation skills, leads to career and national development, to help learners to acquire knowledge and skills for food production and food security. They also mentioned, for the students come up with new ideas of farming skills, for personal growth, and that agriculture is the backbone of the Kenyan economy. However, one parent reported that he would not choose his children to do agriculture as an elective subject because it was time consuming with a lot of manual work. This has the implication that some parents had an influence on their children's' subject selection or their children selected the

subject without informed decision on the expectations on the skills they would acquire for food security.

The researcher further established that the frequency of the use of the skills developed was a key factor for achievement of the aspects of food security. It was therefore necessary to find out the agriculture teachers' opinions and those of the parents on how often they applied the skills developed in agriculture classes.

4.6.4: Frequency of the Use of the Skills Developed for Food Security

The agriculture teachers' opinions on the frequency of the use of the skills for food security are presented as Table 4.12.

Table 4.12: Agriculture Teachers' Opinions on the Students' Frequency of the Use of the Skills Developed for Food Security

Agricultural Practice	N	Most often		Often		Least often	
		N	%	N	%	N	%
Nursery practices	106	22	20.8%	60	56.6%	24	22.6%
Ploughing	104	8	7.7%	43	41.3%	53	51.0%
Irrigation	103	15	14.6%	47	45.6%	41	39.8%
Soil and water conservation	105	22	21.0%	55	52.4%	28	26.7%
Livestock production e.g. Poultry and rabbitry	106	19	17.9%	38	35.8%	49	46.2%
Pest and disease control	106	16	15.1%	54	50.9%	36	34.0%
Crop propagation such as budding and grafting	106	13	12.3%	34	32.1%	59	55.7%

As reported by agriculture teachers, students often applied agricultural skills developed especially in nursery practices 60(56.6%), irrigation 47(45.6%), soil and water conservation 55(52.5%) and pest and disease control 54(50.9%). However, most teachers felt that students least applied agricultural skills developed in livestock production 49(46.2%) e.g. poultry and rabbitry, ploughing 53(51.0%) as well as crop

propagation such as budding and grafting. This is probably because the pieces of land they were living on were not large enough for use of ploughs, capital intensive or their conditions did not necessitate the use of the implements. When asked to rate how often their children applied the skills developed in school for food security, the parents had their opinions against the listed farming practices as presented as Table 4.13.

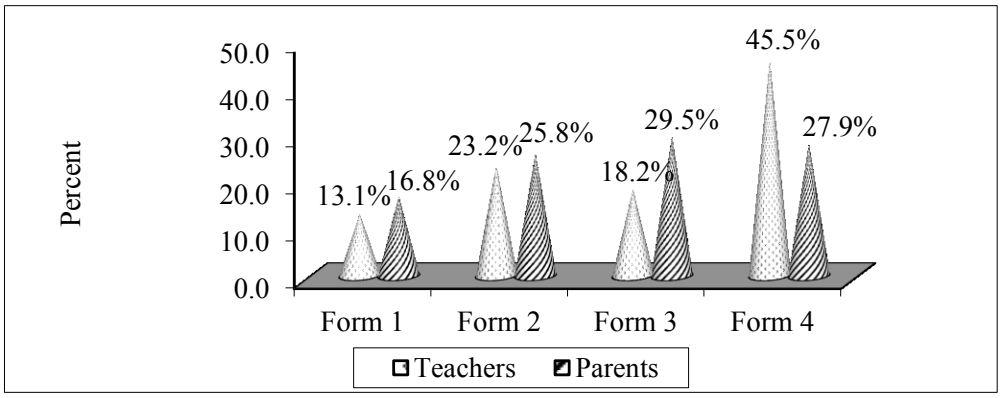
Table 4.13: Parents' Opinions on the Frequency of the Use of the Skills Developed for Food Security

Agriculture Practice	N	Most often		Often		Least often	
		n	%	n	%	N	%
Nursery practices	295	121	41.0%	107	36.3%	67	22.7%
Ploughing	293	145	49.5%	79	27.0%	69	23.5%
Irrigation	289	117	40.5%	85	29.4%	87	30.1%
Soil and water conservation	299	152	51.5%	94	31.9%	49	16.6%
Livestock production e.g. poultry and rabbitry	295	168	56.2%	85	28.4%	46	15.4%
Pest and disease control	297	145	48.8%	86	29.0%	66	22.0%
Crop propagation such as budding and grafting	297	121	41.0%	107	36.3%	67	22.7%

Source: Field Data

A total of 168 (56.2%) parents reported that their children most often applied skills developed in livestock production such as poultry and rabbitry while 152 (51.5%) applied them in soil and water conservation. These two practices require basic skills that can be practised by a form two students hence, likely to be frequently carried out. It was also observed that children often applied the skills developed in nursery practices 121 (41.0%), ploughing 145 (49.5%), irrigation 117 (40. 5%) and in pest and disease control 145(48.8%). The three practices may be capital intensive for the parents, however, when established, students could participate. This indicates that most students were applying the agriculture skills developed in their homes which in turn resulted into improved food security. Finally, it is worth noting that crop

propagation such as budding and grafting were least applied by students in their homes. These practices require experts who may not have been available during the teaching of such a topic. This implies that technical experts were either sometimes or never invited to the schools to demonstrate the practical agricultural aspects. When asked the level at which the students were very active in the use of the skills developed for food security, both the agriculture teachers and the parents had almost similar opinions as shown in Figure 4.8.



n=111 teachers and 323 parents

Figure 4.10: Level at which the Students were very Active in Use of the Agricultural Skills Developed

The study revealed that most students were very active in the use of the skills developed in school at form three and four as reported by 29.5% of the parents and 45.5% of the agriculture teachers respectively. This could be associated with the fact that students at these levels had covered a wide syllabus content with a variety of skills to make choices from which could be employed both at school and home for food security. Students however were not very active in the use of the skills at form one probably because they were new to the school with very few agriculture topics having been covered at this level.

4.6.5: Multiple Regression Analysis Tests on the Relationship between Agricultural Teaching Approaches, Extent of skills Development and Extent use of the Skills Developed and Food Security

The researcher was interested in establishing whether there was a relationship between the agriculture teaching approaches on food security. The independent variables were the teaching approaches, extent of skills development and the extent

of use of the skills developed while the dependent variable was the aspects of food security. Before carrying out multiple regression analysis to test the relationship between agricultural teaching approaches and food security, the researcher first checked the assumption of this data.

4.6.5.1: Test for Independence/Auto-correlation

One of the assumptions of regression is that the observations are independent. If observations are made over time, it is likely that successive observations are related. If there is no autocorrelation (where subsequent observations are related), the Durbin-Watson statistic should be between 1.5 and 2.5. Since the Durbin-Watson statistic (1.42) was slightly below 1.5, it indicates that there was an insignificant autocorrelation.

4.6.5.2: Test for Multicollinearity

Multicollinearity is an unacceptably high level of inter-correlation among the independents, such that the effects of the independents cannot be separated. Under multicollinearity estimates were unbiased but assessments of the relative strength of the explanatory variables and their joint effect were unreliable. Since the Variance Inflation Factor is VIF=1.0<5.0, then we conclude that multicollinearity was not a problem.

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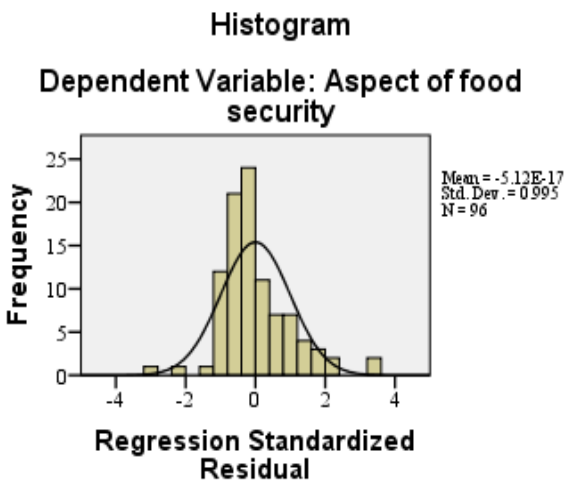
<td> 
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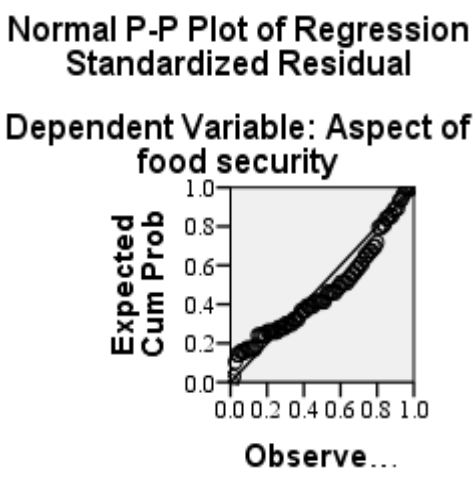
<td> 
</td>
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<tr>
<td>Normality; The residuals are approximately normally distributed; hence, the assumption was met.</td>
<td>Linearity; The scatterplot showed that there was a strong positive linear relationship between the two</td>
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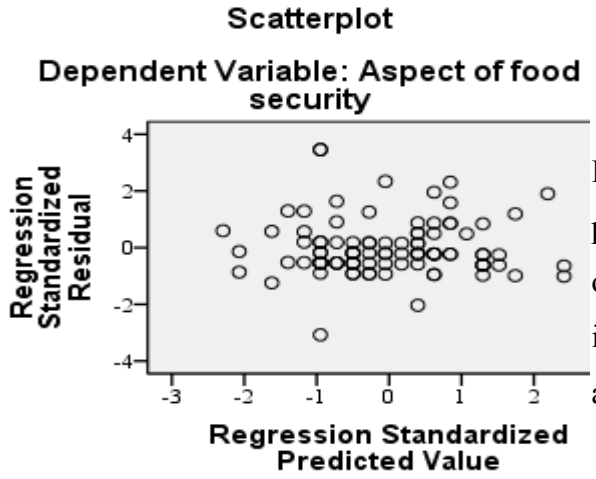
<td> 
</td>
<td>Homoscedasticity; There is no pattern in the scatterplot. The width of the scatter as predicted values increase is roughly the same. So, the assumption has been met.</td>
</tr>
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Figure 4.11: Test for Normality, Linearity and Homoscedasticity

Table 4.14: Mean and Standard Deviation

	Descriptive Statistics		
	N	Mean	Std. Dev
Aspect of food security	95	14.62	2.745
Teaching approaches	95	8.99	1.705
Extent of skills development	95	24.41	4.821
Extent of use of the skills developed	95	16.65	3.540

The statistics in Table 4.14 indicate the mean and standard deviation of the dependent and independent variables. The mean for aspect of food security was 14.62 with a standard deviation of 2.745 for a total N of 95. That of the teaching approaches 8.99 with standard deviation of 1.705 for a total N of 95. The mean for extent of skill development was 24.41 and a standard deviation of 4.821 while that of extent of use of the skills developed was 16.65 and a standard deviation of 3.540. A model summary on the relationship between the agricultural teaching approaches and food security was further run as shown on Table 4.15.

Table 4.15 Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.175[a]	.031	-.001	2.752

a. Predictors: (Constant): Teaching approaches, Extent of skills development, Extent of use of the skills developed

The results of the model summary revealed that only 3.1% of food security could be explained by the collective effect of the type of agricultural teaching approaches, extent of skills development and the extent of the use of the skills developed. Hence, the model has a poor fit. This implies that food security could be affected by other factors other than the approaches used in teaching agriculture, extent of skills development as well as the extent of the use of the skills. In order to determine the significance of the model, an analysis on variance was further carried out as shown on Table 4.16.

Table 4.16: Analysis of Variance

Model	Sum of Squares	df	Mean Square	F	Sig.	
1	Regression	21.867	3	7.289	.962	.414[b]
	Residual	689.291	91	7.575		
	Total	711.158	94			

a. Dependent Variable: Aspect of food security
b. Predictors: (Constant), Extent of skills development employment, Teaching approaches, Extent of skills development

From the results obtained, F (1, 94) =0.962 and p-value = 0. 414 >0.05, it was concluded that the relationship between the teaching approaches, extent of skills development and extent of use of the skills developed and food security was not statistically significant. The decision rule is therefore not to reject the null hypothesis and state that there is no statistically significant relationship between the agricultural teaching approaches and food security. The regression coefficient was further run to determine the degree of dependence of food security on the teaching approaches, extent of skills development as well as the extent of use of the skills developed.

Table 4.17: Regression Coefficient

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	18.004	2.376		7.577	.000
	Teaching approaches	-.215	.164	-.136	-1.315	.192
	Extent of skills development	.012	.075	.020	.164	.870
	Extent of use of the skills developed	-.105	.098	-.131	-1.077	.284

a. Dependent Variable: Aspect of food security

Results of the regression coefficient revealed that agricultural teaching approaches did not significantly influence food security since the beta value is a negative (-0.215). This implies that, teaching approaches employed for skill development did not significantly affect food security. The extent of skills development was however

slightly significant at 0.012, while that of the extent of the use of the skills for food security was not significant since the beta value was a negative (-0.105). In reference to the multiple regression equation of $\hat{Y}$ on X which is $\hat{Y}=a+b_1X_1+b_2X_2+b_3X_3$, where $\hat{Y}$ is food security, 'a' is constant while b_1, b_2 and b_3 are all other factors remaining constant. The values of X_1, X_2 and X_3 obtained represent a unit increase, the teaching approaches, the extent of skills development as well as the extent of use of the skills developed. Therefore, the equation for this objective will be $\hat{Y}=18.004 + (-0.215b_1) + (-0.012\ b_2) + (-0.105b_3)$, where '$b_1$, b_2 and b_3' are all other factors held constant. However, as shown by significance of the intercept or constant, it implies that there are other factors that influence food security not within the scope of this study as also found from results of the model summary.

Based on the research findings for the third objective, the relationship between the agriculture teaching approaches and food security can be explained by their contribution to skills development and the contribution of the skills developed to aspects of food security. Food security can be affected by many factors apart from the teaching approaches and skills acquired in schools. In agreement with this, FAO (2011) reported that farmers and herders are the best observers of how changing climate, drought, flooding and other extreme weather events affect their harvesting of crops or animals. The United Nations Food and Agriculture Organization (UNFAO, 2008) emphasized that climate change will affect all the four dimensions of food security: food availability, food accessibility, food utilization and food system stability. Even though other factors that influence food security cannot be matched with the approaches to teaching agriculture as was done with the regression analysis test, they are useful in providing relevant information. For instance, they can affect other important variables that impact availability, access, utilization and stability of food for individuals, households and communities at national and international levels. Directions for further research could entail investigations on appropriate skills that target when teaching agriculture with food security in mind.

4.7: Constraints Faced in Teaching Secondary School Agriculture for Food Security

The fourth objective sought to establish the constraints faced in teaching secondary school agriculture for food security. The responses were categorized into constraints

faced by the agriculture teachers and those faced by the students. The researcher devised a hypothesis for this objective.

H_0: There is no statistically significant relationship between the constraints in teaching and learning agriculture and skills development for food Security

H_1: There is a statistically significant relationship between the constraints in teaching and learning agriculture and skills development for food Security

4.7.1: Constraints Teachers Faced in Teaching Agriculture for Food Security

The study sought to find out the constraints agriculture teachers faced in the process of teaching the subject. The researcher distributed the responses based on three themes: agriculture teaching and learning facilities, agriculture teaching and learning activities and the services available.

4.7.1.1: Constraints Based on the Agriculture Teaching and Learning Facilities

The agriculture teachers' responses on the constraints based on the school facilities were presented on a 3-point Likert scale from disagree to agree as presented on Table 4.18.

Table 4.18: Teachers' Views on the Constraints Based on the Agriculture Teaching and Learning Facilities

Facility Characteristic	N	Disagree		Neutral		Agree	
		N	%	N	%	N	%
There is an agriculture laboratory	108	93	86.1%	8	7.4%	7	6.5%
There is an agriculture laboratory assistant	109	95	87.2%	7	6.4%	7	6.4%
There is a school workshop	110	82	74.5%	11	10.0%	17	15.5%
The workshop is well equipped	104	75	72.1%	23	22.1%	6	5.8%
The school has a demonstration farm	110	28	25.5%	22	20.0%	60	54.5%

Source: Field Data

A total of 93(86.1%) agriculture teachers mentioned that there were no agriculture laboratories in the school, 95(87.2%) said there were no agriculture laboratory assistants, 82(74.5%) mentioned that there were no school workshops, another 75(72.1%) disagreed that the few workshops that were there were well equipped. This implies that most schools concentrated on theory and did very little on practical

activities. Government funding for school- based projects such as construction of agriculture laboratories in schools lacking them, Information Communication Technology (ICT) integration in teaching agriculture as well as building storage facilities and agricultural workshops could further improve the practical aspect and development of skills among the learners for food security.

A total of 60(54.5%) agriculture teachers positively felt that their schools had demonstration farms. However, in reference to Table 4.19, 68(64.2 %) of the teachers were neutral about practical work being applied weekly to illustrate the concepts that had been taught. This could be associated with the limited time on the school timetable to carry out agriculture projects leading to most of the work being taught theoretically than being practical in nature.

4.7.1.2: Constraints Based on the Agriculture Teaching and Learning Activities

The agriculture teachers' responses on the constraints based on the teaching and learning activities were presented on a 3-point Likert scale from disagree to agree as shown on Table 4.19.

Table 4.19: Teachers' Views on Constraints Based on the Teaching and Learning Activities

Teaching and learning Activity	Disagree		Neutral		Agree	
	N	%	N	%	N	%
Practical work was applied to illustrate the concepts that had been taught	0	0.0	68	64.2	38	35.9
Students did hands-on practical work every week	16	14.9	61	57.0	30	28.0
Students were taken for field work or a technical institute after every agriculture topic	37	34.9	56	52.8	13	12.3
Agriculture teachers were recognized and worked hand in hand with the surrounding community	44	41.1	34	31.8	29	27.1

Source: Field Data

It was observed that a total of 68(64.2%) agriculture teachers were neutral about the fact that practical work was applied to illustrate the concepts that had been taught. At

the same time 61(57.0%) were also neutral about the fact that students did hands-on practical work every week. Another 56(52.8%) of the agriculture teachers were also neutral about the fact that students were being taken for field work or a technical institute after every agriculture topic. This has the implication that practical activities, hands-on-training and field work that could have probably been carried out during class demonstration and class projects were hardly present. These two teaching approaches were not allocated adequate time which could be detrimental to developing skills for food security.

A total of 44(41.1%) agriculture teachers had the opinion that they were neither recognized nor worked hand in hand with the neighbouring community as they taught the subject. Lack of recognition by the community could be associated with the lack of school-community based projects around the schools. For instance, a school could have a project which is supported by the community whose members are also invited to learn some skills such as grafting, budding and breaking seed dormancy which are all attributed to food security. Neighbouring farms could also be set aside for demonstration and field visit where the school does not have adequate space. This would end up linking the school to the community through such projects and imparting them with the relevant knowledge and skills for food security.

4.7.1.3: Constraints Based on the Agriculture Services Available

The agriculture teachers' responses on the constraints based on the agriculture services available were presented on a 3-point Likert scale from disagree to agree as presented on Table 4.20.

Table 4.20: Teachers' Views on Constraints Based on the Agriculture Services Available

Agriculture Service	Disagree		Neutral		Agree	
	n	%	n	%	n	%
Technical experts were invited to the school to teach some agriculture lessons	55	51.9	48	45.3	3	2.8
Teachers had sufficient opportunity to attend seminars and workshops to improve on the teaching	22	20.8	52	49.1	32	30.2
The agriculture syllabus was focused on preparing students for food security	20	18.6	29	27.1	58	54.2
Agriculture teachers had sound content knowledge	3	2.8	9	8.4	90	88.8
Agriculture teachers were supported by the school administration	5	4.7	43	40.2	59	55.1
There was sufficient time to explain each topic in depth	28	26.4	40	37.7	38	35.9

Source: Field Data

A total of 48(45.3%) agriculture teachers were neutral while another 55(51.9%) disagreed that technical experts were invited to the school to teach agriculture lessons. Inviting technical experts lies in the hands of the agriculture teachers themselves through the school administration. The limited times experts were invited could be attributed to time factor to organize for longer teaching spells outside the normal school timetable or even lack of knowledge by some teachers with the conviction that they were experts in their own fields. Inviting technical experts can help blend ideas on better ways of teaching agriculture for food security.

A total of 52(49.1%) of the agriculture teachers were neutral about the fact that they had sufficient opportunity to attend seminars and workshops to improve on the teaching of the subject. This could be linked to the time needed for practical training such as soil sampling and testing. This may require two continuous days to achieve the results. Facilitation and travelling to soil laboratories may have been the hindering block as many schools lacked agriculture laboratories as mentioned by most teachers.

The study found out that a total of 58(54.2%) agriculture teachers agreed that the agriculture syllabus was most of the time focused on preparing students for food

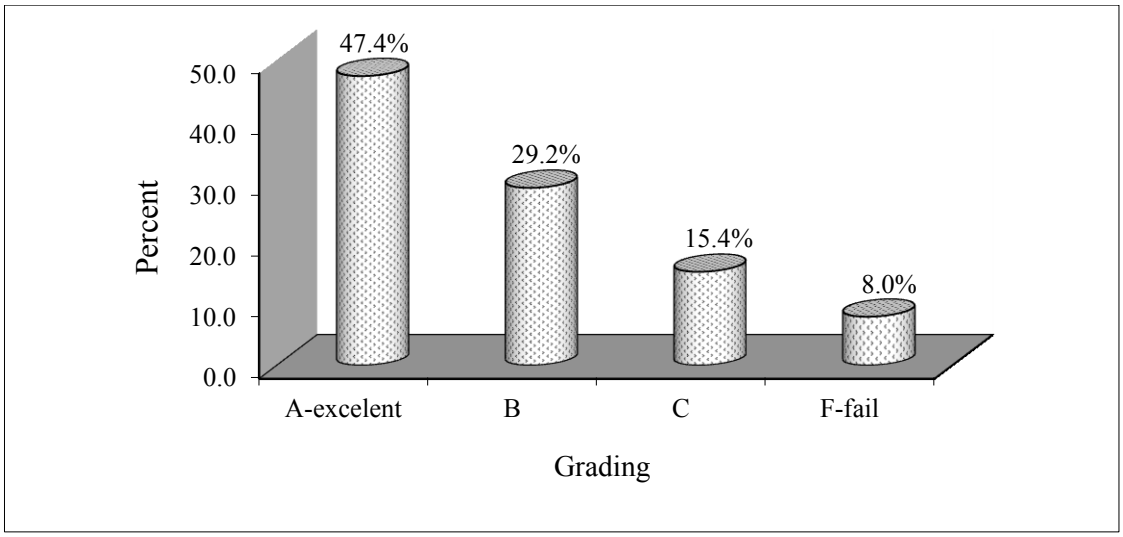
security. This implies that the government through the Kenya Institute of Curriculum Development (KICD) had set guidelines for teaching agriculture for food security. The implementation lied on the hands of the schools to see to it that the same areas were objectively taught for food security. However, the practical aspects in such areas might have been overtime taught theoretically through lectures due to the constraints based on the teaching and learning facilities which an individual school cannot handle failing to meet the food security agenda.

The statistics further indicated that 90(88.8%) of the agriculture teachers agreed that they had sound content knowledge of the subject hence, could deliver it at ease but much work was covered theoretically to cover the syllabus. Nonetheless, a number of the agriculture teachers 40 (37.7%) were neutral about the fact that there was sufficient time to explain each topic in depth. This could be linked to time needed to explain the practical aspects leaving majority of the work to be covered theoretically in lectures and students making notes.

A total of 43(40.2%) agriculture teachers were neutral about the fact that they were supported by the school administration. The support given could be attributed to the few agriculture seminars, workshops and field trips carried out by teachers in the course of teaching the subject. More support could probably be made if class projects were continuously done in schools such as nursery practices, livestock farming and crop production all of which not only develops skills but also make schools food secure. The same skills could be transferred by the students to their homes which represent the school community.

4.7.2: Constraints Experienced by Students in Learning Agriculture for Food Security

The study further sought to establish the constraints experienced by students in learning agriculture for food security. The information was audio recorded and then transcribed into three themes for analysis namely agriculture teaching and learning facilities, teaching and learning activities and agriculture services. Some more information was recorded by the students in handouts A and B issued by the researcher. The researcher introduced by first defining the term food security and asked the students to rate their schools on what they had done in preparing them for food security.



N= 376

Figure 12: Students Grading their Schools on the Job they had Done in Preparing them for Food Security.

A total of 47.4% of students assigned a grade A-excellent to their schools on what it had done in preparing them for food security. A total of 29.2% gave their schools grade B whereas 15.4% gave their school grade C. This implies that a good number of schools were trying to impart students with the correct knowledge they needed to ensure that there was food security in their homes and in the country at large. However, eight percent of the students assigned their schools grade F-indicating that their schools had failed in preparing students for food security. Those who assigned their schools low grades reported that it was due to the constraints they experienced in the learning process.

4.7.2.1: Constraints Based on the Agriculture Teaching and Learning Facilities

A number of students in their groups reported that their schools had inadequate resources to carry out practical agriculture. These included land, tools and equipment and insufficient water to carry out irrigation on their demonstration plots. Others mentioned that their school farm was large enough for food production but not maximally utilized. “We do not have an agriculture laboratory from where we can do agriculture practicals” (from a form two student). Another form two student had this to say: “Our school is not doing enough to teach agriculture practically; the school

farm is large but idle. I think there is need for better utilization of the farm through irrigation."

4.7.2.2: Constraints Based on the Agriculture Teaching and Learning Activities

Some students reported that their schools had established projects such as rearing fish, cattle, pigs and poultry. However, they had limited time to practise animal husbandry on the same projects because the school grounds men managed the enterprises. This left little opportunity for developing the relevant skills needed for food security.

Students also listed in a hand out that the instructional sessions were not adequate enough to carry out practical activities. In agreement with the teachers' views is also the opinion that more time was needed for practical sessions and in-depth learning. Majority of the work covered theoretically in lectures and giving notes would hence translate into problem solving and class projects paving way for more skills development for food security in secondary schools.

Some students also mentioned that they were poorly linked to the community around the schools. In this case, starting school-community based projects would expose them to actual field and its agricultural activities. At the same time, involving extension officers in the projects would help them develop the relevant skills as early as at the secondary school level.

A large proportion of the students further mentioned that attendance of shows and field trips was not common in their schools. If common, they would give learners the required exposure and experience of the real world. This would not only prepare them for jobs in future but also help them continually develop skills for food security while at school. "I have never been to an agricultural show; I think the school should be organizing for them so that we can get more ideas about farming," (from a form three student).

4.7.2.3: Constraints Based on the Agriculture Teaching and Learning Services

A number of the students reported that technical experts were rarely or never invited to their schools. The students' responses agree with the agriculture teachers' views that technical experts were either sometimes or never invited to the schools to teach

agriculture lessons. They further felt that greater commitment in involving technical experts from agricultural institutions was necessary as this would enhance additional and new skills to the students.

Students further said that the agriculture syllabus content was too wide encouraging the use of lecture method of teaching by their teachers and students spending a lot of time making notes. In addition, a number of students had the feeling that lack of agriculture in the primary school curriculum was a major factor contributing to the lack of motivation on the side of the students to develop the basic concepts and apply them even at home.

Some students reported that there was minimal or even none career guidance during subject selection. This might have resulted to lack of role models in the agricultural sector hence, many students did not select the subject or they selected it without any informed decision on the right path to follow later in life. Quite a large number of students stated that they had little access to agricultural reference materials. This resulted to the agriculture teachers giving handouts to students to make notes. There was therefore a lot of sacrifice from the students which left them with little time for personal revision.

Lastly, students complained that the distribution of marks in the examination was not at all motivating. There are two agriculture papers; paper 1 covering 21 topics entailing areas on crop production, soil science and agricultural economics. Paper 2 covers 12 topics entailing areas on livestock production and agricultural engineering. Each of the papers has three sections: A, B and C. Section A has 30 marks distributed in half marks covering a very wide content. Such an area could be reorganized in terms of marks allocation. More importantly, a number of students pointed out that much of the topics in book four were on agricultural economics. This required a lot of mathematical skills which challenged quite a number of students. Reorganizing the topics so that they are covered earlier in form two or three would give students sufficient time to revise the same areas. This would also open students to more career paths related to agricultural economics which can be applied in food production hence, security. “We have very many notes to read through during examination. But the half marks are very demotivating” (from a form four student). Another form four student mentioned this, “We need to have more trained agriculture

teachers in our schools. These together with the agricultural officers can help us learn technical areas in agriculture."

4.7.3: Ways of Improving the Teaching of Practical Agriculture for Food Security

The researcher sought to find out the various ways in which the teaching of agriculture could be improved for food security both in schools and around the school community.

4.7.3.1: Agriculture Teachers' Opinions

The agriculture teachers suggested that in- service training of agriculture teachers, compulsory field trips for students and school-community partnership programmes in farming could expose teachers and students to modern skills and innovations which could lead to increased food security in the country. At the same time, summarized syllabus content, prohibiting the use of lecture method of teaching, allocating more time for practical and increased number of lessons per week could give room for problem solving and class projects. The hands- on-training could develop more skills for food security among the students.

Agriculture teachers further recommended more funding for school-based projects, construction of agriculture laboratories in schools lacking them, Information Communication Technology (ICT) integration in teaching agriculture as well as building storage facilities and agricultural workshops could further improve the practical aspect and development of skill among the leaners. Lastly, the teachers pointed out that involving student in form one to form four in carrying out class projects in the school on small plots, invitation of role models, encouraging learners to carry out nursery practices in school farms, making demonstration plots and project work mandatory for agriculture students would motivate learners to apply the problem solving approach of learning and further skills for food security.

4.7.3.2: Parents' Opinions

The researcher further sought the parents' opinions on the ways that could improve the level of food security at home through their children. A number of the parents in an open-ended question suggested introduction of modern farming methods through their children, encourage innovations such as training them on how to use sacks to

grow vegetables and taking children to agricultural shows to have more exposure to new technologies. At the same time, some parents suggested that their children could be trained on proper record keeping so that parents may venture into less risky enterprises.

Parents further made their recommendations on what could be done to promote food security around the community. These included provision of certified planting materials to farmers, provision of tax-free farm inputs and encouraging communism in farming. In addition, they suggested promotion of agroforestry among farmers which can curb the ever-changing climatic conditions. Lastly, enhancing access to maternal child health services especially in rural areas can mitigate the roll back problems of selling the meagre harvest to cater for the health problems. Good transport and communication systems can on the other hand increase efficiency in farming like the purchase of the farm inputs. The parents further highlighted the need for inclusion of nutritional aspects in the teaching agriculture. This would lead to production of important crops for the body depending on their ecological zones. Free extension services were also mentioned by the farmers as they will impact on the farming practices. Lastly, the parents averred that professionals could be used to sensitize their children on importance of agriculture as a source of food security for the country.

4.7.3.3: Students' Opinions

Students felt that the greater commitment in involving technical experts from agricultural institutions was necessary as this would lead to gaining more and new skills among the students. Some students mentioned that they were poorly linked to the community around the schools. In this case, starting school-community based projects would expose them to the actual field and its agricultural activities. At the same time, involving extension officers in class projects would help them develop the relevant skills early while they are at secondary school level. Students further said that the agriculture syllabus content was too wide encouraging use of lecture method of teaching by their teachers and students spending a lot of time making notes. In addition, a number of students felt that lack of agriculture in the primary school curriculum was a major factor contributing to the lack of motivation among

the students to develop the basic concepts and applying them to enhance food security at home.

4.7.4: Multiple Correlation Analysis on the Relationship between the Constraints in Teaching and Learning Agriculture and Extent of Skills Development for Food Security

The researcher conducted a correlation analysis in order to ascertain the direction and the strength of the correlation between the constraints in teaching and learning agriculture and skills development for food security. The findings are presented as Table 4.21.

Table 4.21: Correlation Analysis on the Relationship between the Constraints in Teaching and Learning Agriculture and Extent of Skills Development for Food Security

		Extent of skills development	Facility constraint	Activity constraints	Service constraints
Extent of skills development	Pearson Correlation	1	-.360**	-.815**	-.871**
	Sig. (2-tailed)		.000	.000	.000
	N	107	107	107	107
Facility constraint	Pearson Correlation	-.360**	1	.281**	.304**
	Sig. (2-tailed)	.000		.003	.001
	N	107	111	107	107
Activity constraints	Pearson Correlation	-.815**	.281**	1	.540**
	Sig. (2-tailed)	.000	.003		.000
	N	107	107	107	107
Service constraints	Pearson Correlation	-.871**	.304**	.540**	1
	Sig. (2-tailed)	.000	.001	.000	
	N	107	107	107	107

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

The results in Table 4.21 shows that the linear relationship between the activity and service constraints of teaching agriculture and skills development for food security was fairly strong, negative and statistically significant ($r = -0.815$ $p<0.05$) and ($r = -0.871$ $p<0.05$) respectively. This implies that an increase in the constraints of teaching agriculture leads to a decline in food security. For facility constraints, the correlation was negative and fairly weak although it was statistically significant ($r = -$

0.360 p<0.05). This implies also to a low extent that an increase in facility constraints of teaching agriculture leads to a decline in food security. The mean and standard deviations of the extent of skills development and the constraints were further established as presented on Table 4.22.

Table 4.22: Mean and Standard Deviation

Descriptive Statistics			
	N	Mean	Std. Deviation
Extent of skills development	107	24.41	4.821
Facility constraints	107	7.2613	1.98041
Activity constraints	107	12.2991	2.45032
Service constraints	107	20.2710	3.72794

In order to establish the relationship between the constraints in teaching and learning agriculture and skills development for food security, a regression model summary was established and presented as Table 4.23.

Table 4.23: Regression Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.964[a]	.928	.926	1.308

a. Predictors: (Constant), service constraints, facility constraint, activity constraints

Table 4.23 presents a correlation coefficient of 0.964 and adjusted coefficients of determination of 0.926. This depicts a very strong relationship between constraints in teaching and learning agriculture and skills development for food security. Thus, constraints in teaching and learning agriculture in secondary schools contribute to about 92.6% of the variations in skills development for food security. Hence, the model has a good fit. Analysis of variance was used to test the significance of relationship that exists between the variables; thus, model's significance. The results are presented in Table 4.24.

Table 4.24: Analysis of Variance

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2287.697	3	762.566	445.743	.000[b]
	Residual	176.210	103	1.711		
	Total	2463.907	106			

a. Dependent Variable: Extent of skills development
b. Predictors: (Constant), service constraints, facility constraints, activity constraints

The results in Table 4.24 revealed that the model is statistically significant ($p<0.05$). The researcher further established the extent to which the constraints in teaching and learning agriculture affected skills development for food security. The regression coefficient is as presented on Table 4.25.

Table 4.25: Regression Coefficient

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	52.506	.806		65.128	.000
	Facility constraints	-.109	.071	-.043	-1.541	.126
	Activity constraints	-.944	.062	-.480	-15.153	.000
	Service constraints	-.775	.041	-.599	18.781	.000

a. Dependent Variable: Extent of skills development

The study established that holding all other possible factors that influence skills development for food security constant, a unit increase in facility constraints would negatively affect skills development by -0.109 although the influence is insignificant. Activity constraints would negatively and significantly affect skills development by -0.944 while the service constraints would negatively and significantly affect skills development by -0.775.

In reference to the multiple regression equation of $\hat{Y}$ on X which is $\hat{Y}=a+b_1X_1+b_2X_2+b_3X_3$, where $\hat{Y}$ is skills development for food security, 'a' is constant at 52.506 and X_1, X_2 and X_3 are unit increase in facility, activity and service constraints

which are -.109, -.944 and -.775 respectively. Therefore, the equation for this study will be $\hat{Y}=52.506 + (-.109b_1) + (-.944b_2) + (-.775b_3)$, where '$b_1$, b_2 and b_3' are all other factors held constant.

The research findings from the fourth objective revealed that as the country moves towards achievement of the big four agenda and in particular food security, there are some constraints faced by the students and agriculture teachers in secondary schools that derail skills development and need to be addressed. These constraints are based on the teaching and learning facilities, teaching and learning activities as well as the agricultural services available. The low integration of practical agriculture in the teaching and learning process due to the aforementioned constraints derail adequate skills acquisition and their application for food security.

The results of the multiple regression analysis show that constraints in teaching and learning agriculture in secondary schools had a negative impact on skills development for food security. This finding agrees with Ransford, et. al. (2016) that inadequate teaching and learning resources, poorly organized teaching and learning activities as well as limited services constrain the teaching and learning process. These ultimately negatively impact on skills development especially those geared towards food security. Similar studies (Awuku, Baiden, Brese, & Ofosu, 1991; Sskamwa, 2009; UNESCO, 1999 & Wootoyitidde, 2010) emphasize that it is the financial constraints that have reduced the expansion of facilities leading to specific problems in practical agriculture.

The study findings from the fourth objective further revealed that most secondary schools in Embu County are lacking or inadequately equipped with agriculture teaching and learning facilities. These findings are in tandem with those of Muchena (2013) who established that land was not enough in most schools as the available land was used for form four KCSE projects. This was a clear indication that other agriculture students apart from form fours seldom or never do practical agriculture in the field. Tools and equipment are not enough in the schools. The researcher observed that only a few schools had simple tools and equipment like jembes, pangas and spades or even totally lacked them. The study further established that schools lacked agriculture laboratory except the agriculture stores where the equipment is kept. These findings agree with those of Ngesa (2006) that most secondary schools

lack primary basic crop production tools and equipment, livestock tools and farm machinery. Schools therefore need to find ways of providing students with basic tools to make the subject more interesting (Aholi, et. al., 2017).

The findings in this objective are also in agreement with those of Konyango and Asienyo (2015) that practicals are essential for teaching most of the agriculture topics. However, the lack of appropriate facilities and the high cost of setting up practical training has affected the quality and frequency of practical classes offered. The lack of appropriate facilities such as agriculture laboratories and livestock units, poor management, maintenance and upkeep of the facilities and insufficient budget (Phipps, Osborne, Dyer & Ball, 2008; Engler & Kretzer, 2014) denies students ample opportunities to learn and practice skill development.

A common complaint among agriculture students is that practical agriculture is either lacking or inadequate (Konyango & Asienyo, 2015). In agreement with the findings of the current study, Konyango and Asienyo point out that the underlying cause of students' poor skills in agriculture is the lack of adequate teaching and learning materials, tools, equipment and facilities such as laboratory and school garden which are critical in the teaching of agricultural practical skills. Practical instruction, using hands-on approaches, is a great way to reach higher levels of Bloom's Taxonomy, giving students more relevant skills to enter the workforce in the food industry (Adom 2016). Related literature cited with regards to this objective does not have adequate research evidence linking the categories of constraints to teaching of agriculture and skills development for food security. This study hence adds to the existing body of knowledge by establishing the relationship between the facility constraints, activity constraints as well as service constraints to extent of skills development for food security.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1: Introduction

This chapter presents a brief summary and conclusion based on the research findings of each objective and in reference to the reviewed literature. The study findings and conclusions also inform the recommendations for the study. The researcher finalizes by suggesting areas that call for further research.

5.2: Summary

The major research findings for the study are that it is the practical based agricultural teaching approaches that have major contributions to skills development for food security. If incorporated into theory, practical sessions, field attachment and school-community linked projects are major avenues for hands-on-training, skills development and their application in the real food security industry. To enhance skills development for food security, agricultural teaching approaches should mainly be practical based with an emphasis on the psychomotor domain of Bloom's taxonomy. The skills developed are avenues for reducing poverty and the ultimate economic development in any country.

5.3: Conclusion

In regard to the findings of the first objective, the study established that the agricultural teaching approaches employed in Kenyan secondary schools are the lecture method and class discussion and rarely demonstration, class experiment/projects and field trips and tours. Notably, problem solving and digital learning were not recognized as teaching approaches in agriculture classes. Though commonly used, the lecture method and class discussions have little contribution to skills development for food security while the least applied methods have major contribution to skills development for food security.

Based on the findings from the second objective, the various agricultural teaching approaches employed in secondary schools except lectures were perceived to positively contribute to skills development. However, the low integration of practical agriculture in the teaching and learning process derailed adequate skills development and their application for food security.

The third objective for this study established the relationship between agricultural teaching approaches and food security. This was based on the contribution of the teaching approaches to skills development and further, the contribution of these skills to aspects of food security. These entail the aspects of food production which are, its accessibility, food safety and nutrition as well as production economics which ultimately help to meet the four pillars of food security namely: its availability, accessibility, utilization and stability hence, reduce poverty and finally achieve economic development in any country. In reference to the findings from the third objective, the results of the regression coefficient revealed that agricultural teaching approaches do not significantly influence food security. However as shown by significance of the intercept or constant, it implies that there are other factors that influence food security not within the scope of this study as also found from results in the model. The limitation of this objective was that the relationship between digital learning as a pedagogy in agriculture classes and food security could not be established.

Based on the findings from the fourth objective, the study concluded that there are some constraints faced by the students and agriculture teachers in secondary schools that need to be tackled. These are based on the teaching and learning facilities, teaching and learning activities as well as the agricultural services available. The low integration of practical agriculture in the teaching and learning process due to the constraints experienced derailed adequate skills acquisition and their application for food security.

5.4: Recommendations

Based on each objective, the researcher recommends integration of the following aspects into teaching of secondary school agriculture for food security in the country.

1) Secondary school agriculture teachers to be discouraged from the use of the conventional lecture method in teaching agriculture as the method does not develop agricultural skills that can be applied for food security.
2) There is need to incorporate field attachments/internships to students at form three and four over the school holidays in agricultural-based institutions or farms for better skills development especially those geared towards food security.
3) Review of the agriculture syllabus by the Kenya Institute of Curriculum Development (KICD) in order to reorganize chapters, summarize and allocate double lessons for practical sessions which lack in the current school time tables.
4) The government should put a greater effort in establishing well equipped agriculture laboratories and workshops in schools that are lacking them. This will promote more practical learning than theory for better skills development.
5) Education policy makers to establish programmed school-community based projects as avenues for linking students to the real world and to enhance skills acquisition geared towards food security.

5.5: Directions for Future Research

1) There is need to establish the role of the media technology in secondary school agriculture for enhancing food security.
2) The extent to which digital learning as pedagogy has been integrated into teaching secondary school agriculture.
3) There is need to develop an agriculture skills transfer manual to guide the agriculture teachers on the most appropriate skills to target in the teaching and learning process and their transfer to the food industry.

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APPENDICES

Appendix I: Abstract for Research Article: 'Effect of Agricultural Teaching Approaches on Skills Development for Food Security: A Case of Secondary Schools in Embu County, Kenya'

Authors: Hellen J. Njura, [1] Isaac K. Kubai, [2] and Simon T. Taaliu, [3]

Purpose: To investigate the effect of the agricultural teaching approaches employed in secondary schools on skills development for food security in Kenya.

Design/Methodology/Approach: Descriptive survey design was employed targeting 46,340 students and 235 agriculture teachers. The actual sample size constituted 490 students in 20 focus discussion groups and 111 agriculture teachers. Data was collected using an Agriculture Teachers' Interview Schedule and a Students' Focus Group Discussion Guide. Quantitative and qualitative data were analysed using inferential statistics and content analysis respectively.

Findings: The agricultural teaching approaches employed in secondary schools positively contributed to skills development leading to increased food security. However, the low integration of practical agriculture with hands on experiences derailed adequate skills development and their application for food security.

Practical implication: The findings of the study may be used as inputs for the Kenyan education policymakers to develop a guideline on incorporation of agriculture practical sessions on school timetables, school-community based agriculture projects and holiday-based field attachments for students for better skills development as targeted by the Competence Based Curriculum (CBC).

Theoretical Implications: The paper makes a contribution to the growing body of knowledge by highlighting learning opportunities that can create more hands-on-skills driven towards food security in any country.

Originality/value: In current studies on secondary school agriculture in developing countries, a framework which incorporates school-community based projects and field attachments is hardly found. When incorporated into the theory, the approaches can be avenues for enhancing food security from the secondary school level.

Key words: Agricultural Teaching Approaches; Effect; Food security; Practical; Relevance; Skills development.

Appendix II: Abstract for Research Article: ''The Relationship between Agricultural Teaching Approaches and Food Security in Kenya'

Authors: ***Hellen J. Njura,*** [1] ***Isaac K. Kubai,*** [2] ***Simon T. Taaliu,*** [3] ***and Shem K. Khakame***[4]

All correspondence should be addressed to Hellen J. Njura; hellenanjurah@yahoo.com

The continued food insecurity, despite the teaching of agriculture and amidst the novel Corona Virus (Covid -19) is a major global concern especially in Africa. There is food shortage in Africa and Kenya in particular despite the teaching of Agriculture as a major subject in secondary schools. Many youth who have graduated from Kenyan secondary schools cannot adequately employ the agricultural skills developed during and after school for food security. The teaching approaches employed in secondary school agriculture should be in a position to develop skills on aspects of food production, its accessibility, food safety and nutrition as well as production economics. Towards this direction this paper investigates the relationship between the agricultural teaching approaches employed in secondary schools and food security in Kenya. The study adopted descriptive survey design where data was collected using an Agriculture Teachers' Interview Schedule, a Students' Focus Group Discussion Guide and a Parent's Questionnaire and was then analysed using descriptive and inferential statistics. The research findings established that the lecture method, class discussions, class projects, problem solving and tours and field trips were the common methods in agriculture classes. Though recommended in the literature review section, the digital learning was hardly mentioned as a teaching approach for this study. A major conclusion for this study is that there is statistically insignificant relationship between the teaching approaches and food security. There are other factors not in the scope of this study that could be affecting food security and can be tackled at secondary school level. This paper makes a contribution to the growing body of knowledge by highlighting research gaps worth investigation on the relationship between the agricultural teaching approaches and food security that were beyond the scope of the study.

Key Words: Agricultural teaching approaches; aspects of food security; food security; home-based factors; school - community linkage; skills development.

Appendix III: Abstract for Research Article: ' Teaching secondary school agriculture at the psychomotor domain: a conceptual framework for enhanced skills development for food security.'

Authors: Hellen J. Njura, [1] Isaac K. Kubai, [2] and Simon T. Taaliu, [3]

Purpose: To develop a conceptual framework that can be employed in secondary school agriculture classes on skills development for food security.

Design/Methodology/Approach: The conceptual framework was developed from findings of an earlier study by the authors on the effect of agricultural teaching approaches on skills development for food security. Qualitative data was collected and analysed through descriptive statistics.

Findings: Skills development can be enhanced at the psychomotor domain of Bloom's taxonomy through integration of practical agricultural activities as guided by the conceptual framework. The skills developed at secondary school level can be timely applied for food security and nutrition which can ultimately reduce poverty and boost economic development in any country.

Practical implication: The conceptual framework can be used as a guide to developing agricultural skills which can be drivers of economic development in any country. Such a transition can be an avenue for ultimate achievement in eradicating extreme poverty and hunger by the year 2030.

Theoretical Implications: The paper makes a contribution to the growing body of knowledge by highlighting practical learning opportunities that can be incorporated within the psychomotor domain. The hands-on-skills developed are applicable at meeting the four pillars of food security.

Originality/value: In current studies on secondary school agriculture a conceptual framework which incorporates learning at the psychomotor domain of Bloom's taxonomy is hardly found. When incorporated into the theory, the framework can be a guide to skills development for enhanced food security and nutrition.

Key words: Food security; Nutrition; Psychomotor domain; Skills development; Teaching agriculture.

Appendix IV: Kenyan Government's Target on 100% Food and Nutrition Security Commitment

Target	2017	2018	2019	2020	2021	2022
Food Availability						
Maize ((90kg bags)	40million	46million	-	-	-	67million
Rice (metric tonnes)	112,800	124,080	-	-	-	406,486
Potatoes (metric tonnes)	1.3	1.55	-	-	-	2.52
Land under irrigation(in acres)	500	540	720	880	1040	1200
Small holder production and value addition(% of agricultural production and export)	16	21	28	35	42	50
Small and Medium Enterprises (SMEs) 1000 production SMEs (No of businesses)	0	200	400	600	800	1000
Jobs created						
Direct	-	200	750	1,000	1,100	1.150
Indirect	-	500	-	-	-	
Affordability (cost of food as a percentage of income)	47	43	39	35	30	25

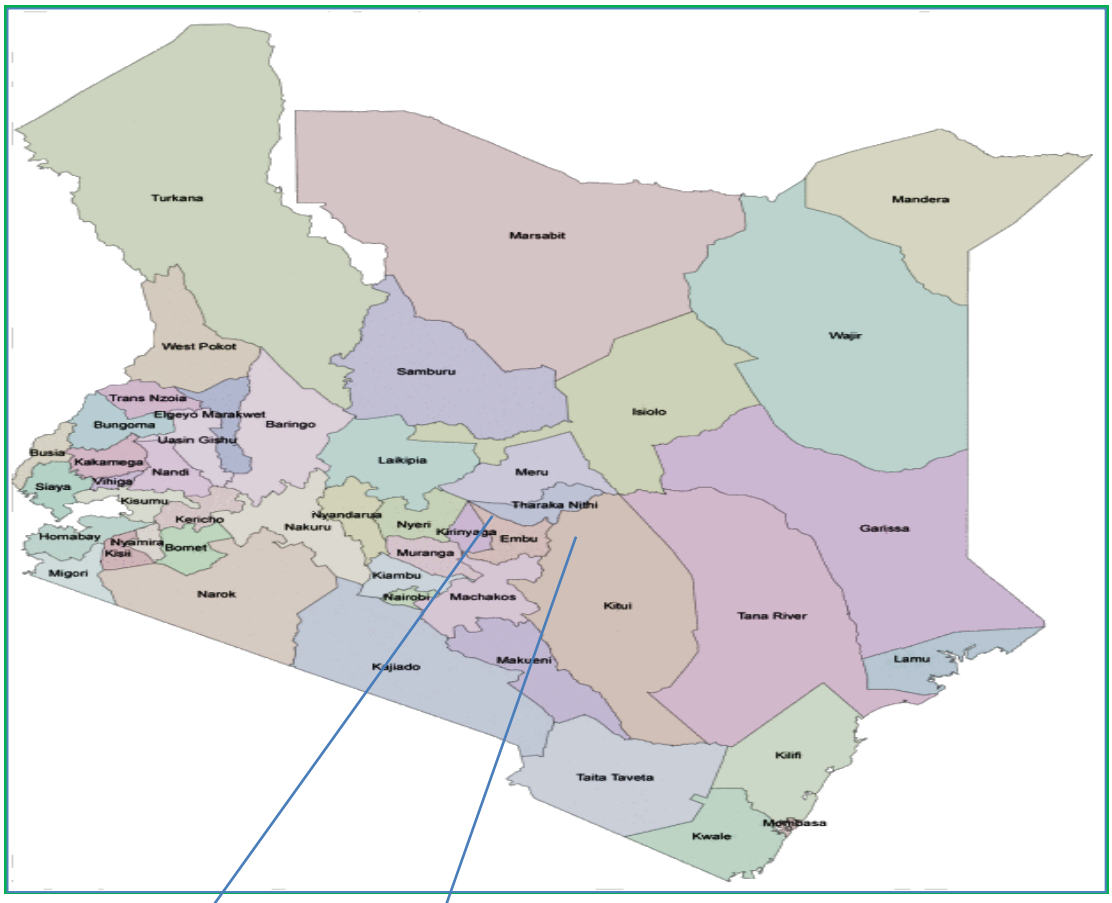
Source: Ministry of Agriculture- Draft Agricultural Sector Transformation and Growth Strategy, 2018-2022.

Appendix V: Kenyan Government's Target on 100% Food and Nutrition Security Commitment on Maize

Target crop- Maize	2017	2018	2019	2020	2021	2022
Production level in 90 kg bags	40m	46m	-	-	-	67m
Demand/consumption in 90 kg bags	52.0m	53.156m	54.311m	55.466m	56.622m	57.77m
Gap/Imports in 90 kg bags	12.0m	7.156m	3.711m	193,400	4.604m	9.578m
Retail price in ksh/2kg maize grain	79.12	71.28	67.7	64.3	61.1	58
Retail price/ 2kg flour pack.	135	108	102	98	95	90

Source: Ministry of Agriculture - Agricultural Sector Transformation and Growth Strategy, 2018-2022

Appendix VI: Map of Kenyan Counties



Appendix VII: Krejcie and Morgan Sample Size Determination

Table 3.1

Table for Determining Sample Size of a Known Population

N	S	N	S	N	S	N	S	N	S
10	10	100	80	280	162	800	260	2800	338
15	14	110	86	290	165	850	265	3000	341
20	19	120	92	300	169	900	269	3500	346
25	24	130	97	320	175	950	274	4000	351
30	28	140	103	340	181	1000	278	4500	354
35	32	150	108	360	186	1100	285	5000	357
40	36	160	113	380	191	1200	291	6000	361
45	40	170	118	400	196	1300	297	7000	364
50	44	180	123	420	201	1400	302	8000	367
55	48	190	127	440	205	1500	306	9000	368
60	52	200	132	460	210	1600	310	10000	370
65	56	210	136	480	214	1700	313	15000	375
70	59	220	140	500	217	1800	317	20000	377
75	63	230	144	550	226	1900	320	30000	379
80	66	240	148	600	234	2000	322	40000	380
85	70	250	152	650	242	2200	327	50000	381
90	73	260	155	700	248	2400	331	75000	382
95	76	270	159	750	254	2600	335	1000000	384

Note: N is Population Size; S is Sample Size *Source: Krejcie & Morgan, 1970*

Appendix VIII: Parent's Questionnaire

This questionnaire seeks your opinions and concerns about the contribution of the agricultural teaching approaches employed in secondary schools for food security. There is no right or wrong answer to each question. The information you give will be used to improve the teaching of agriculture in Kenyan secondary schools with the aim of improving food security. The information will be aggregated and summarized for inclusion in the research report. The information you will provide will be treated with absolute confidentiality.

Part A: Bio Data

1. How would you classify where you currently live (Tick as appropriate)

   Urban ☐

   Sub-Urban ☐

   Rural ☐

2. Did you grow up in a farm?

   Yes ☐

   No. ☐

3. Did you attend a secondary school that offered agriculture classes?

   Yes ☐ No ☐

Part B: Importance of Agricultural Skills Developed in Secondary Schools.

Please rate the following experiences about your child's overall success in agriculture. Use the following scale: 1= most important, 2=somewhat important and 3= least important.

Experience	3	2	1
Personal growth			
Career preparation			
Community service learning			
Hands -on- training			
Room for travel			
Home based income generating projects			
Improved food production at home			

Part C: Opinions on the Use of the Skills Developed for Food Security.

1. Given a chance to decide, would you choose your child to do agriculture as an elective subject?

Yes ☐

No ☐

b. If yes, state three reasons

……

……

……

……

……

……

2. If your child already does agriculture, rate how often the skills developed are applied in the following practices. Use the scale of 1=most often, 2= often and 3=least often.

Practice	**3**	**2**	**1**
Nursery practices			
Ploughing			
Irrigation			
Soil and water conservation			
Livestock production e.g poultry and rabbitry			
Pest and disease control			
Crop propagation such as budding and grafting.			
Any other			

3. If the child has reached form four, at what level was he/she very active in the use of the skills?

   Form 1……..

   Form 2…….....

   Form 3……..

   Form 4……..

4. In your own opinion, have the agricultural skills resulted into increased food security?
5. Suggest five ways that can be done to improve the level of food security in your home through your child.

   ……

   ……

   ……

   ……

   ……

Appendix IX: Agriculture Teachers' Interview Schedule (ATIS)

The following information seeks your opinions concerning the relevance of the approaches to teaching agriculture in your school for food security. Please answer to the best of your knowledge. Your opinions will be treated with maximum confidentiality.

Part A: Bio data

1. Is your school private or public (tick?)

   Private …… Public …….

2. For how long have you taught agriculture in this school…….

3. What is your estimated agriculture students' population per class?

   Form one…… Form two…… Form three……. Form four……..

Part B: Opinions on Agricultural Teaching Approaches Employed in Secondary Schools for Food Security

1. What are the various teaching/instructional methods that you employ in your agriculture class? Indicate the percentage weekly use of each teaching approach identified.

Teaching approach	**Percentage weekly use**
1)	
2)	
3)	
4)	
5)	
6)	

2. Estimate the percentage length of the teaching time spent on each of the teaching method you have mentioned. (Distribute the percentage so as to add up to 100%).

Instructional method	Percentage (%)	Reason
1)		
2)		
3)		
4)		
5)		
6)		

3. Consider an ideal agriculture lesson (40 minutes) and determine the relative amount of time spent on the following activities in percentage (%).

Activity	Percentage (%)
Teacher explaining to the whole class	
Whole class discussion	
Students making own notes	
Teacher giving notes	
Students doing practical activities in small groups	

Part C: Opinions on Effect of the Agricultural Teaching Approaches on Skills Development for Food Security.

1. Rate the following teaching approaches at a scale of 1-3 on their contribution to developing skills for food security. Where 1= most important, 2=important and 3= least important.

Teaching Method	3	2	1
Lecture			
Problem solving/discovery			
Class projects			
Demonstration			
Discussion			

2. What are your opinions on percentage contribution of each of the teaching approaches you employ to skills development for food security?

Teaching Approach	Percentage Contribution to skills Development
Lecture	
Problem solving/discovery	
Class project	
Demonstration	
Discussion	

Part D: Opinions on the Students' Use of the Skills Developed in Agriculture for Food Security

1. Rate how often your students apply the skills developed in the following practices within the school. Use the scale of 1=most often, 2= often and 3=least often.

Practice	3	2	1
Nursery practices			
Ploughing			
Irrigation			
Soil and water conservation			
Livestock production e.g poultry and rabbitry			
Pest and disease control			
Crop propagation such as budding and grafting.			
Any other			

2. At what level are the students very active in use of the skills?

Form One…….. Form Two…… Form Three…… Form Four…….

3. In your own opinion, has the agricultural skills resulted to increased food security within the school community?

4. Suggest five ways of improving the teaching of agriculture in schools for food security around the school community.

……

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…….

5. How would you rate the relationship between the contributions of the agricultural skills developed on students to the aspects of food security listed below?

Aspects of food security	Strongly agree (1)	Agree (2)	Disagree (3)	Strongly disagree (4)
There is enough food for an active, healthy life				
The food is readily available when needed				
The food available is nutritionally balanced in many households				
The food available is safe to consumers				
There is steady supply of food for households				
The food is economically acquired by households.				

Part E: Opinions on the Relationship between Constraints in Teaching and Learning Agriculture and Skills Development for Food Security

1. Agriculture is both a theoretical and a practical subject

a) Strongly Agree…… b) Agree…… c) Disagree……

2. The following information relates to the agriculture teaching and learning facilities, activities and services available. Give your opinions relating to your school conditions to the best of your knowledge.

a). Agriculture Teaching and Learning Facilities.

Facility Characteristic	Disagree	Neutral	Agree
There is an agriculture laboratory			
There is an agriculture laboratory assistant			
There is a school workshop			
The workshop is well equipped			
The school has a demonstration farm			

b). Agriculture Teaching and Learning Activities

Teaching and learning Activity	Disagree	Neutral	Agree
Practical work was applied to illustrate the concepts that had been taught			
Students did hands-on practical work every week			
Students were taken for field work or a technical institute after every agriculture topic			
Agriculture teachers were recognized and worked hand in hand with the surrounding community			

c). Agriculture Teaching and Learning Services

Agriculture Service	Disagree	Neutral	Agree
Technical experts were invited to the school to teach some agriculture lessons			
Teachers had sufficient opportunity to attend seminars and workshops to improve on the teaching			
The agriculture syllabus was focused on preparing students for food security			
Agriculture teachers had sound content knowledge			
Agriculture teachers were supported by the school administration			
There was sufficient time to explain each topic in depth			

3. In your own opinion, how do you think the challenges mentioned in part 2 above can be addressed?

……

……

……

……

……

……

Appendix X: Students' Focus Group Discussion Guide (SFGDG)

A. Introduction

This guide is designed for a discussion lasting approximately 100-120 minutes.

1. First, I would like you to sit in a circle and introduce yourselves (FIRST NAME ONLY) and your class

B. General Opinions about Agriculture as a Subject

First, give me three words that describe your feelings about agriculture.

PROBE: What are the most positive things about learning agriculture?

PROBE: What are the most negative things about learning agriculture?

C. Preparing to Learn Agriculture

I would like you to think back to when you first joined secondary school, think about what you were told or what you heard about agriculture as a vocational subject.

1. First of all, how knowledgeable were you when joining secondary school about what to expect from the experience and the academic opportunities that would be available after studying agriculture?

2. Do you think that you had a pretty good idea of agriculture as a subject in secondary school?

3. And thinking about the advice you received when you attended the first agriculture lesson, what were you told?

4. What were the resources or people that you relied on for guidance on how best to decide on choosing agriculture among other elective subjects, opportunities and challenges? Who gave you the best advice? (DIRECTED TO FORM THREE AND FORM FOUR STUDENTS).

(PROBE IF NOT MENTIONED :) What about… Friends

Parents/family Teachers

5. How well do you think your high school agricultural education prepares you to produce food at home?

6. How good has your school prepared you to meet your expectations in skills development for food security?

D. Agricultural Teaching Approaches Employed for Food Security

a). What approaches does your agriculture teachers use that you think develop relevant skills for food security?

PROBE: In what areas do they excel? PROBE: In what areas are they falling short?

b). Role of the skills developed for food security

Since you joined Form One, you were taught many skills that can be applied in food production through the approaches employed; mention such areas.

c). What more can be done during the teaching so that you may sustainably produce food in your homes?

HANDOUT A

In this handout, you will find a list of reasons people may have for learning agriculture. Please circle the three that you think are the MOST important for food production, and then I'd like you to go around the room and talk about what you picked. Please only pick three. Second, please put an X next to the two that you think are the LEAST important.

1. Agricultural education will bring more career choices and a greater number of job opportunities in food industries.

2. Agricultural education will provide me with the knowledge, skills, capabilities, ethics, and values that are essential for food production.

3. Agricultural education will help me to be a more critical thinker and problem-solver, better able to adapt in today's ever-changing society and economy in times of food insecurity.

4. Agricultural education will provide me with the specific skills and knowledge required in the field in which I hope to work.

5. Agricultural education will help me to gain more knowledge that will be helpful throughout life-both on and off the job to bring food on the table.

What did you pick and why?

b. When it comes to agriculture as a practical subject, are there some skills that are more critical for the long term and others that matter more for the short term to necessitate food production?

On a Scale from A to F, What Grade would you Assign your School on the Job it has done in Preparing you for Food Production? A is Excellent, F is Fail.

a. What are the intellectual skills that are most important to attain?

b. What are the practical skills that are most important to attain?

HANDOUT B

1. This handout lists a variety of specific approaches that may help you to develop skills for food security. Please circle the two YOU think are the most critical for success in agriculture. Second, please put an X next to the one that you think is the LEAST important for skills development.

a. Students should be attending internships for at least two weeks in an agriculture-based institution to improve on: their ability to solve problems and think analytically, time-management skills, independent and critical thinking/reasoning skills and strong work habits.

b. Greater commitment to involving technical experts from agricultural institutions to teach and train the practical aspect of agriculture in secondary schools.

c. Increased instruction sessions through creation of adequate time for practicals aimed at improving food security.

2. Thinking about the approaches that you consider most important, how well has your school done in preparing you to be successful and ensuring that you have the knowledge, skills, and experience needed for food production and security?

PROBE: In which areas does it fall short? Where does it need to improve?

2. I would like to go around the room and have each of you tell me what benefits you would get from the approaches you have preferred.

C. WRAP-UP

1. To wrap things up, I'd like to go around the room and have each person tell me at least one or two things you will take away from this discussion today. It can be anything relating to any of the areas we have discussed over the last one hour.

2. Thank you very much for your time.

Appendix XI: Research Permit

THIS IS TO CERTIFY THAT:
MS. HELLEN NJURA JOSEPH
of UNIVERSITY OF EMBU, 0-60105
KARABA, has been permitted to conduct
research in *Embu County*

on the topic: *APPROACHES TO TEACHING AGRICULTURE FOR FOOD SECURITY IN KENYA A CASE OF SECONDARY SCHOOLS IN EMBU COUNTY KENYA*

for the period ending:
23rd April,2019

Permit No : NACOSTI/P/18/79441/22274
Date Of Issue : 25th April,2018
Fee Recieved :Ksh 2000

.....
Applicant's Signature

.....
Director General
National Commission for Science, Technology & Innovation

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RESEARCH CLEARANCE PERMIT

Serial No.A 18414

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