Enhancing Food Security and Nutrition through Innovative Practical Agricultural Teaching Approaches: A Case of Secondary Schools in Embu County, Kenya

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Abstract

The study aimed at establishing ways in which food security and nutrition can be enhanced in secondary schools through innovative practical agricultural teaching approaches. Qualitative data was obtained from agriculture teachers, students and their parents. The study findings revealed that most of the secondary schools are either lacking or are inadequately equipped with agriculture teaching and learning facilities turning the teaching of agriculture into a lot of theory than practice. Very few practical innovations are embraced in the teaching process resulting into limited avenues for developing skills for food security and nutrition. The study concludes that with encouragement and further training teachers can employ practical innovative teaching approaches with what is at their disposal. This can lead to appropriate skills developed on the students and later transferred to their homes. All these have an implication on food security and nutrition to the school and the community around.

Key words: Food Security; Innovation; Practical teaching approaches; Nutrition; Skills development

Introduction

Food security is now a global concern. In its report on population dynamics and hunger, Food and Agricultural Organization (FAO, 2010) indicated that the world produces enough food to feed everyone, yet nearly one billion people remain hungry in all continents, in both developed and developing countries and in urban and rural areas.The global demand for food is expected to increase dramatically while the growing world population and climate change are already affecting farming practices and productivity (United States Agency for International Development (USAID, 2018)).

In their joint effort, the heads of the United Nations(UN), Food and Agricultural Organization (FAO), the International Fund for Agricultural Development (IFAD), the UN Children's Fund (UNICEF), the World Food Programme (WFP) and the World Health Organization (WHO) warned that alarming signs of increasing food insecurity and high levels of different forms of malnutrition are a clear warning that there is considerable work to be done to make sure no one is left behind on the road towards achieving the Sustainable Development Goal (SDG) on food security and improved nutrition (International Food Policy Research Institute (IFPRI, 2017)).

The recent interlinked food, fuel and financial crises have aggravated poverty and food insecurity, particularly in the developing world (Alarcón & Bodouroglou, 2011). International food prices have surged 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 these factors have threatened the sustainability of food production (Alarcón & Bodouroglou, 2011).

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). Kenya in particular is one of the countries endowed with vast agricultural land which is 587,000 km^2 of which 576,076 km^2 is arable land (Osongo, 2014). However, her agricultural production has not kept pace with population growth rate hence food security is becoming a concern. There is therefore the need to emulate the spirit of self-reliance by using what is at our disposal. Spending much of the Gross Domestic Income (GNI) on imports does not make a country sustainably food secure. A time will come when rich nations will donate food only as long as they themselves have surpluses. The world is moving to a situation where such food donations will be available only in specific crises, so it is prudent for nations to aim for self-reliance (Herdt, 1998).

In recent years, there is growing internationalconsensus over the centrality of small-scale farm holders in improving food security. The need to support small-scale farmingstems from the fact that they are the mainstay of food production in most developing countries (Alarcón & Bodouroglou, 2011). Between 75 and 90 per cent of staple foods in developing countries arelocally produced and consumed (United Nations on Trade and Development (UNCTAD, 2010)). In the context of the current study such efforts can also bear fruits if more investment is made on practical secondary school agriculture.These would represent small-scale farmers groups but at a 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).

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 places interventions to strengthen the quality of teaching highly qualified human resources to transfer the same skills to the students. 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).According to Aholi,*et. al.*, (2014) 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.

Practicals are an absolutely essential component of teaching most agriculture courses. However, the lack of appropriate facilities and 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 (Phipps, Osborne, Dyer, & Ball, 2008), poor management, maintenance, and upkeep of the facilities and insufficient budget to provide necessary supplies for each facility to allow students ample opportunities to learn and practice skill development (Engler & Kretzer, 2014).A common complaint among agriculture students is that practicals are lacking or inadequate (Konyango & Asienyo, 2015).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).

The level at which practical agriculture was started was beyond sustainability in a 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 (Konyango & Asienyo, 2015). 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, *et. al*., 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.

In the context of the current study, innovations in teaching agriculture can build in the students the pre-requisite skills for food security and nutrition despite the facility challenge. This would consequently transform schools and the communities around by using the cheaply available resources at their disposal rather than dismissing practical agriculture as a whole due to the perceived expense. This paper argues that meeting the food security and nutrition challenge will require explicit policies to build sustainable agricultural innovation systems with a strong secondary school agriculture perspective to make knowledge and technology available to agriculture students who can further transfer the skills to the food industry at local levels. The paper sets out by providing an overview the findingsof the school conditions in Embu County before

identifying multiple innovative practical interventions suggested by the respondents aimed at enhancing food security and nutrition.This study aimed at establishing the ways in which food security and nutrition can be enhanced in secondary schools through innovative practical agricultural teaching approaches. In order to achieve this, agriculture teachers' views, those of the students and the parents in secondary schools within Embu County were sought through interviews, Focus Group discussions and questionnaires respectively. The study was guided by one question: In what ways can secondary school agriculture enhance food security and nutrition in Kenya? The specific objective for the study was to establish ways in which innovative practicalagricultural teaching approaches in secondary schools could enhancefood security and nutrition in the country.

2.0: Literature Review

2.1: Aspects of Food Security and Nutrition

Food security exists when all people at all times have physical, social and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life (WHO, 2018). The four pillars of food security are: food availability, access to food, utilization and stability. The nutritional aspect of food and nutrition security is achieved when secure access to food is coupled with a sanitary environment, adequate health services, 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.

2.2: Aspects of Innovative Practical agriculture

The term practical agriculture can be defined as an activity whereby students use their own hands to manipulate real objects during teaching and learning process or observe their teacher to manipulate a real object for them to see and practice later (Diise, *et. al.,* 2018). Lack ofconducive environment in the school such as teaching and learning facilities negatively affects students' interest in mastering agricultural practices (Diise, *et. al.,* 2018). This is due to the inability of the school to offer hands-on experience to students by way of allowing them to practice and try out what they have learnt in the classroom.

Rogers (2003) defined innovations as ideas, practices, or objects that are perceived as new by an individual or other unit of adoption. 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. 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 agricultural site and ask 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).

Project-based learning is an approach whereby individuals and teams are assigned projects in agriculture can prove very helpful. Projects such as establishment of a school-community linked tree nursery, income generation from the tree seedlings as well as communal tree planting are sustainable and remedies to food insecurity. In this approach, students do research and prepare marketing materials to explain their approach (Boss, 2018). It is an academically rich project that also appeals to students' desire for hands-on learning. There is the real life of caring for trees that we rely on. Urban students can also explore projects such as hydroponics, floriculture, entrepreneurship as well as multistory gardens.

Field trips to agricultural centers, industries, farmlands etc., where students get firsthand 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).

2.3: Role of Innovative Practical Agriculture on Skills Development

Through innovative practical agriculture students will develop skills in 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. This with a concern of concerned about feeding 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 and in the community (Rayfield,*et. al.,* 2012).

2.4: Implications of Innovative Agricultural skills Development on Food Security

The approaches employed in teaching secondary school agriculture should be in a position to develop skills among students that promote avenues for food security. This can help to meet the United Nations (UN, 20)) initiative which outlines the first Millennium Development Goal (MDG) of eradicating extreme poverty and hunger. Food security is also one of the big four agenda that the Kenyan government wishes to tackle in its 2018-2022 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. The Big Four Agenda also aligns well with Africa's Agenda 2063 themed "The Africa We Want" which sets out Africa's aspirations for development by 2063. In the national context, the Big Four are rightly pegged on the Kenya Vision 2030 and well-mainstreamed in the third-Medium Term Plan of the Vision (World Food Programme (WFP, 2018)). The Big Four Agenda is also a major step in the realization of the country's Constitutional obligations.

Since the integrated nature of the Big Four Agenda calls for inclusive and integrated approaches to its implementation and reporting. Establishing the ways in which food security and nutrition can be enhanced in secondary schools through innovative practical agricultural teaching approaches may help the government meet the food security agenda even from a secondary school level. In the context of the current study, skills acquisition by students makes them competent to the extent of becoming self-reliant to work for food security.

3.0: Methodology

3.1: Location of study

The study was carried out in Embu County representing the forty seven counties in Kenya in regard to resource endowment, climatic conditions, rural versus urban areas, private versus public schools as well as diversity in population distribution. Such differences have an influence on the varied teaching approaches and their effect on skills development for food security.

3.2: Research design

The study adopted descriptive survey design where qualitative was obtained. The study adopted the design because only opinions of the respondents on the ways of enhancing food security and nutritionthrough the various teaching approaches for food security were being investigated.

3.3: Sampling procedures and sample size

The study applied mixed sampling methods where both random and non-random sampling designs were used. Embu County was purposively selected. Stratified random sampling was administered to obtain the number of schools required in the public and private school categories. Systematic random sampling was further applied to get the specific schools, as well as the agriculture teachers. Simple random sampling was carried out on the students in the selected schools. The researcher achieved this by obtaining the number of students specializing in agriculture in Form Three and Four from their subject teachers. However, the class registers from the class teachers in Form One and Two were used to determine the students present. This was with the assumption that they would not have selected their subject options by the end of Form Two. The researcher then assigned random numbers to all the students to sample those who would take part in the study. The students who were randomly selected were also issued with questionnaires for their parents to fill. The sample population is presented as table 1.0.

Table 1.0:

Population Sample

Subject category	Target population	Expected sample	Actual sample	Percentage sample
Public schools	186	132	60	41.67
Private schools	12	12	8	0.06
Agriculture teachers	235	148	111	75.00
Students	46,340	381	350	91.8
Parents/Guardians	46,340	381	300	78.7

Sources: Target Population -Embu County Headquarters Statistics Office

Actual Sample:- Field Data

3.4: Research instruments

An Agriculture Teachers' Interview Schedule (ATIS) containing 18 questions was developed. These were distributed into seven open ended questions, six closed ended questions and five in likert scales. A Students' Focus Group Discussion Guide (SFGDG) was also prepared with a set of fourteen open-ended questions which allowed students to speak freely and provide as much information as they knew. A parents' questionnaire containing seven close- ended questions and three open-ended questions was developed. It is from these items that the question on the ways in which innovative practicalagricultural teaching approaches in secondary schools could enhancefood security and nutrition was answered.

3.5: Pretesting the research instruments

The interview schedule and the focus group discussion guide were subjected to pre-testing. A pretest 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 fourteen schools, two focus group discussion,thirty eight parents and fourteen interview schedules in the selected schools to participate in the pilot study. The randomly selected schools for piloting were not included in the actual study. The pilot data was used to compute the reliability coefficient of the instruments using the internal consistency approach.

3.6: Data collection procedures

A letter of introduction from the affiliating University helped the researcher obtain a research permit from the National Commission for Science, Technology and Innovation (NACOSTI). The researcher also obtained a consent letter from the county director of Education 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 also met the students in their focus group discussions and also issued them with the parents' questionnaires. Two field assistants were involved recording the interviews and the discussions.

3.7: Data analysis

The edited data was coded and fed into the computer for analysis using the Statistical Package for Social Sciences (SPSS) version twenty four for windows. The researcher transcribed the audio data from face-to-face interviews and the focus group discussions. The responses were read and re-read for proper interpretation. Content analysis was used to explain the qualitative data.

4.0: Results /Findings

4.1: School Characteristics

A total of 132 public and 12 private schools respectively were sampled for data collection. The actual sample size was 60(41.67%) for public schools and 8(0.06%) for private schools. This indicates that a total of 72 (60.08%) schools were actually sampled meeting the 30% threshold for data collection hence the general population of schools in the county was well represented.Figure 1.0.indicates the percentage of the sampled public and private secondary schools in Embu County.

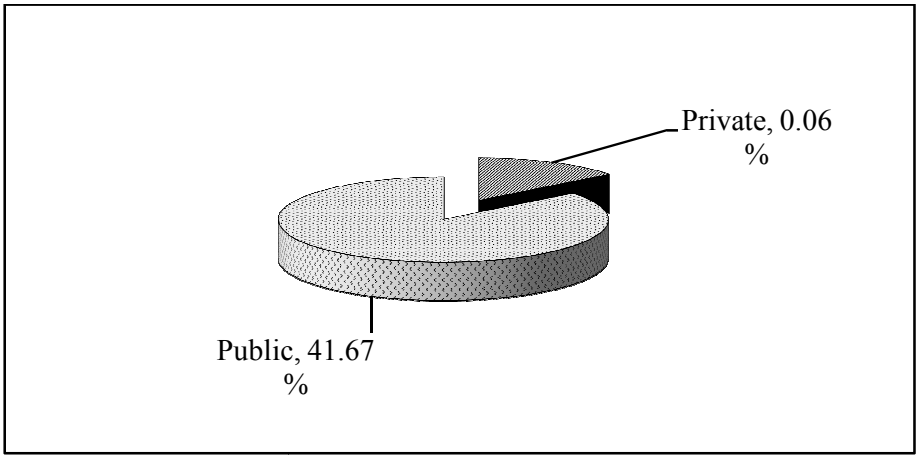

Figure 1.0: Percentage sample of the public and private secondary schools in Embu County

The study further sought to find out the school conditions as teachers employed the various agricultural teaching approaches. Table 2.0 rates the aspects of the school conditions as mentioned by the agriculture teachers.

Table 2.0:

Aspects of School Conditions

Conditions in the school	Disagree		Neutral		Agree	
	n	%	n	%	n	%
There is an agriculture laboratory	93	86.1%	8	7.4%	7	6.5%
There is an agriculture laboratory assistant	95	87.2%	7	6.4%	7	6.4%
There is a school workshop	82	74.5%	11	10.0%	17	15.5%
The workshop is well equipped	75	72.1%	23	22.1%	6	5.8%
Students were involved in the weekly practical in the laboratory or workshop	76	70.4%	22	20.4%	10	9.3%
There is adequate time for the practical sessions	44	41.1%	45	42.1%	18	16.8%
The school had a demonstration farm	28	25.5%	22	20.0%	60	54.5%
Students frequently carryout agriculture projects in those farms	19	17.3%	42	38.2%	49	44.5%

A total of 93(86.1%) agriculture teachers mentioned that there were no agriculture laboratory in the schools, no agriculture laboratory assistant 95(87.2%), no school workshop 82(74.5%), that students were not involved in the weekly practical in the laboratory or workshop 76(70.4%) and that the few workshops available were not well equipped 75(72.1%). This implies that most schools concentrated on theory and did very little on practical activities. Secondly a total of 45(42.1%) of the teachers had neutral perception towards the fact that there was adequate time for the practical sessions. However, 60(54.5%) of teachers positively felt that schools had demonstration farm and that students frequently carried out agriculture projects in the farm 49(44.5%).

In agreement with the teachers' opinions, students in their discussion groups mentioned that their schools had demonstration farms; however, there were neither both agriculture laboratories, workshops nor storage facilities in the schools. Contrary to the teachers opinions, demonstrations and projects were rarely done in the farms. This could be attributed to the minimal time usually allocated for agriculture in a week.

Based on the teachers and students opinions, it is clear that a large number of schools are not adequately equipped with facilities for teaching agriculture. This could be translating to teaching a lot of theory with very less hands-on-skills development. Students are not likely to be carrying out any laboratory activities such as soil testing as studied in form two. In addition, though most schools had demonstration farms, there was inadequate time to carry out agriculture projects in the farm. This could be attributed to the single forty minutes lesson in the school time table. Teachers and students are hence compelled to plan outside the set school programme to be in the farm.

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 leaners for food security. However, in the context of the current study, schools can integrate innovative practical approaches within the school farms such as continuously assessed projects, demonstrations as well as discovery methods. This is with the reasoning that it would be very expensive to construct and equip the agriculture laboratories. The government can also establish education policies to equip common agriculture laboratories for neighbouring schools to share.

4.2: 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.

4.2.1: 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 open up teachers and students to modern skills and innovations which could lead into 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 in applying the problem solving approach of learning and further skills for food security.

The researcher further sought the parents' opinions on the ways that could improve the level offood 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, taking children to agricultural shows to have more exposure to new technologies. At the same time, some parents recorded their children could be trained on proper record keeping so that parents may venture into the less risky enterprises.

4.2.2: Parents' Opinions

Parents further made their recommendations on what more 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. At the same time promotion of agroforestry among farmers can carb the ever changing climatic conditions. Lastly, enhancing access to maternal child health services especially in rural areas can mitigate the roll back problems selling the meager harvest to cater for the health problems. Good transport and communication systems can on the other hand increase efficiency in farming like in purchase of the farm inputs. The parents further highlighted the need for inclusion of nutritional aspects in teaching agriculture. This would lead to production of the most important crops for the body depending on their ecological zones. Free extension services were also encouraged by the farmers on the best farming as well as using professionals to sensitize the pupils on importance of agriculture as a source of food security on the country.

4.2.3: Students' Opinions

Students felt that that greater commitment in involving technical experts from agricultural institutions was necessary as this would in turn add more and new skills to 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 as early as at the 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 in making notes. In addition a number of students had

the feeling that lack of agriculture in the primary school curriculum was a major factor in the lack of motivation on the side of the students to develop the basic concepts and apply them even at home.

5.0: Discussion

The study findings reveal that most of the secondary schools in Kenya 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 Kenya Certificate of Secondary Education (KCSE) examination projects. This was a clear indication that other agriculture students apart from form fours do not do practical in the field. Tools and equipment are not enough in the schools as the researcher observed that the schools had simple tools and equipment like jembes, pangas, spade wheelbarrow and forkjembes 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) who stated that most secondary schools lack primary basic crop production tools and equipment, livestock tools and farm machinery tools. Schools should find ways of providing students with basic tools to make the subject more interesting (Aholi, *et. al.,* 2017). The study further established that most of the agriculture teachers laid more emphasis on the theoretical aspect of the subject depriving the students of the practical knowledge that is needed for skill acquisition in agriculture had low competence in some practical aspects such as tractor systems which may call for involvement of technical experts in such fields.

6.0: Conclusion and Recommendations

The study aimed at establishing ways in which innovative practical agricultural teaching approaches in secondary schools could enhance food security and nutrition in the country. Innovative practical approaches encourage students to think outside the box and challenge themselves to become life-long learners through placing emphasis on developing problem solving and critical thinking skills. There are few innovations in school resulting into emphasis on theory than practice in agriculture classes. The school conditions reveal inadequate teaching facilities limiting teaching into theory. However, most schools have demonstration farms and with encouragement and further training teachers can employ innovative teaching approaches with what is at their disposal. This can lead to appropriate skills developed on the students and later transferred to their homes. All these have an implication on food security and nutrition to the school and the community around. The study further recommends the following to create room for more innovation in teaching secondary school agriculture.

1. Government funding for school - based projects such as construction and equipping of agriculture laboratories in schools lacking them.
2. Establishment of school-community based projects to expose students to the actual field and its agricultural activities.
3. Inclusion of agriculture as a subject in the primary school curriculum to motivate students and develop in them the basic agricultural concepts and apply them at home.

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