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RESEARCH ARTICLE

PERCEPTIONS OF TEACHERS TOWARDS THE INTEGRATION OF MITIGATION STRATEGY TOPICS ON CLIMATE CHANGE INTO SECONDARY SCHOOL AGRICULTURE SYLLABUS IN MACHAKOS COUNTY, KENYA

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Abstract

Secondary school agriculture syllabus was introduced in Kenya to equip learners with knowledge on the basic principles of farming. Farming provides; food for the people, employment, market for industrial goods and raw materials for industries among others. In order to meet the needs of the society, agriculture syllabus like any other requires frequent reviews. Curriculum review is an ongoing process that seeks to adjust education to address the current, and or anticipated societal needs. In the wake of the last quarter of the 20th Century, climate change became the single most challenge to the Worlds agriculture sector, the developing countries being the most vulnerable. To tackle the phenomena, each country ought to find appropriate solutions to secure its own agricultural production. In Kenya, lack of knowledge on climate change adaptations and mitigations strategies affects the agriculture syllabus in meeting its objectives, which in turn translates to a shortfall in response to the farmers needs. The problem that the study sought to investigate therefore is lack of empirical data on the perceptions of teachers towards integration of mitigation strategy topics on climate change into secondary school agriculture syllabus. The purpose of the study, therefore, was to investigate the perceptions of teachers towards the integration of mitigation strategy topics on climate change into the secondary school agriculture syllabus. The design of the study was descriptive survey research design. The target population was three hundred and fifty (350) agriculture teachers in public secondary schools in Machakos County. A sample of a hundred (100) agriculture teachers was selected through proportionate stratified random sampling technique. A structured questionnaire was used to collect data from the respondents. The objectives of the study were analyzed using frequencies and percentages. The major findings of the study indicated that, an overwhelming majority of the respondents supported the suggestion to integrate relevant climate change and variability topics into secondary school agriculture syllabus. The major conclusions of the study were that, most agriculture teachers endorsed the suggestion to integrate climate mitigations strategy topics into agriculture syllabus authenticating the validity and reliability of the usual agriculture instructional resources and methodologies to facilitate them. The study therefore, recommends that, the Ministry of Education and teacher training institutions ought to improve the agriculture teachers' capacity to plan and implement the teaching of agriculture to respond to the changing climate. This may be done through provision of in-service training and workshops for the serving teachers' by inculcating climate change mitigation strategies into the agriculture syllabus as projected.

Introduction

Agriculture education is a fundamental tool in the development of agriculture sector, a key pillar of the Kenya's economy (Wanyama & Chang'ach, 2013). The sector contributes directly about 24 per cent of Gross Domestic Products (GDP) and about 19 per cent of the formal wage employment (Lewa and Ndungu, 2012). An estimated 60 per cent of all households in the country are engaged in farming activities and 84 per cent of rural households keep livestock. The sector also indirectly contributes a further 27 per cent to the country's Gross Domestic Product (GDP) through linkages with agro-based industries. The secondary school agriculture syllabus content broadly covers principles of; crops production, livestock husbandry and soil science. Other areas covered are; agricultural economics and agricultural engineering. Agricultural skills and knowledge are recommended to be taught both theoretically in a formal classroom setting and practically in a school farm/laboratory by professionally qualified teachers (KIE, 2008). Strong scientific evidence indicates that, the drifting climate change and variability pose a serious environmental concern for agriculture production today, than ever before (IPCC, 2010). A problem that, the secondary school agriculture education is presumed to curtail and sustain in Kenya. It is expected that, if a significant breakthrough in agriculture education at secondary school will be made, it will first have to review the syllabus in an attempt to adjusting it to respond to the climate change and mitigation strategies. Despite agricultural production being highly sensitive to climatic conditions, climate change related topics are not quite adequately covered in the entire secondary school agriculture syllabus.

Studies on secondary agriculture curriculum, particularly by Onyango (1982); Kathuri (1990 and 1993) and Konyango (2010) have revealed inconsistencies in secondary school agriculture teaching approaches, where at one time the emphasis is on practicals, and at another time theory. However, the main objective remains striking a balance between helping the students not only to pass examinations but also to acquire a motivation to transfer the skills and knowledge learned to productive labour. Therefore, despite the scientific explanation of climate change and variability being too wide in scope and too complex to explain in simple language, secondary school agricultural education was presumed to be the vehicle to transmit skills and knowledge useful in circumventing the susceptibility of agriculture from emerging issues including climate change and variability (GOK, 2013). The study on "the perceptions of teachers towards the integration of selected climate change topics in secondary school agriculture syllabus in Machakos County" therefore sought to address the teachers' opinions on the integration of these anticipated climate change mitigation strategy topics in the secondary school agriculture syllabus.

The Global Overview of Climate Change Phenomenon and Agriculture

The world cannot safeguard its food supplies if it is unable to get a grip on climate change, and it will not get a grip on climate change unless agriculture is allowed to play a central role (Food Agricultural Organization FAO, 2008). By 2050 the world's population is projected to grow by 3 billion to more than 9 billion. To feed so many people, it will be necessary to increase world food production by 70 percent (Rural 21, 2010). It's therefore the task of the world governments to prepare agriculture to meet climatic limitations, using new financing instruments and appropriate strategies that will enable production to be increased (FAO, 2008). To speed up climate protection, incentives must be created-for example through payments for ecosystem services. The history of the scientific discovery of climate change began in the early 19th century, when ice age and other natural changes in paleoclimate were first suspected and the natural greenhouse effect first identified. In the late 19th century, scientists first argued that human emissions of greenhouse gases could change the climate, but these speculations were disputed. Many other theories of climate change were advanced, involving forces from volcanism to solar variation. In the 1960s, the warming effect of carbon dioxide gas became increasingly convincing, although some scientists also pointed out that human activities, in the form of atmospheric aerosols such as pollution could have cooling effects as well.

During the 1970s, scientific opinion increasingly favoured the warming view point. By the 1990s, as a result of improving fidelity of computer models and observational work confirming the Milankovitch theory of the ice ages, a consensus position was formed that, greenhouse gases were deeply involved in most climate changes, and human emissions were bringing serious global warming. Since then most work has been oriented towards producing reports on the Intergovernmental Panel on Climate Change (IPCC) (Spencer, 2011). The concepts of climate change are

simple if explained well, even though the science is complex (Prasad, et al., 2009). United Nations Population Fund (UNFPA, 2009) explains climate change as the alteration of earth's climate caused by atmospheric accumulation of green house gases (GHGs) such as carbon dioxide because of human activity. The European Commission Directorate-General for Agriculture and Rural Development (ECDGARD, 2008) further concurs that, climate change is caused by high concentrations of greenhouse gases in the atmosphere, due to human activities that adds to the natural "greenhouse effects" thus increasing the Earth's temperature.

According to Prasad et al (2009), climate change is triggered by human-induced GHGs emissions which cause a build up of greenhouse gas in the atmosphere (carbon dioxide-CO_2 and methane-CH_4) which absorbs and re-emits infrared radiation. When pollution adds these gasses to the earth's atmosphere, they trap more solar energy in our planet (like in a greenhouse) warming the earth's surface and contributing to climate variability. Concentrations of GHGs mainly CO_2, have increased by 70 percent since 1970, leading to increased levels of heat trapped in the atmosphere thus setting off a process that is modifying weather patterns, which in turn affect temperatures, sea levels, and storm frequencies, thus upsetting the nature's control systems. Today, it is widely agreed by the scientific community that climate change is already a reality. The Intergovernmental Panel on Climate Change (IPCC, 2007) points out that, the rate and duration of warming observed during the twentieth century is unprecedented in the past thousand years. Increase in maximum temperatures, numbers of hot days, and heat index have been observed over nearly all lands during the second half of the twentieth century. Collective evidence suggests that, observed warming over the past fifty years can be mostly attributed to human activities. The warming trend in the global average surface temperature is expected to continue, with increases projected to be in the range of 1.4 to 5.8^0c by 2100 in comparison to 1990 (IPCC, 2010).

There is increasing observational evidence that, regional changes in climate have contributed to various changes in physical and biological systems in many parts of the world (IPCC, 2001a; 2001b). Science tells us that climate change will bring about gradual changes, such as sea level rise, and shifts of climatic zones due to increased temperatures and changes in precipitation patterns. Also, climate change is very likely to increase the frequency and magnitude of extreme weather events such as droughts, floods, and storms. While there is uncertainty in the projections with regard to the exact magnitude, rate and regional patterns of climate change, its consequences will change the fate of many generations to come and particularly impact on the poor if no appropriate measures are taken (IPCC, 2010). The IPCC report (2007) warns that, these climate changes would continue for decades, even if emissions stop today, due to the historical build-up of gases in the atmosphere. Climate change impacts will become progressively more severe throughout the World. The IPCC believes that, most of the temperature increase results from human activities, especially the burning of fossil fuels and deforestation both of which, cause co_2 and other gas emissions. Climate change presents a double challenge today: to cut the emissions of gases responsible for warming (known as mitigation); and to adapt to future climate change to lessen its adverse effects. These are major challenges for agriculture and agricultural policy-making the World Over (ECDGARD, 2008).

The developed countries have an obligation to help the developing world adapt to climate change by providing technical and financial support. Nevertheless, each country should try to find appropriate solutions itself and should take steps to secure its own agricultural production. Although Africa has not contributed to the problem in any way, it is prepared to contribute to the search for a solution. The use of traditional production methods that help to protect the soil could play a part in reducing GHGs. But there must be transfer of modern technologies and skills if the continent is to succeed in adapting to climate change (Rural 21, 2010).

Agriculture needs efficient and effective ways of managing resources and risks. An example is the system Agro, a multi-peril insurance scheme that takes account of the special circumstances of every region and every farm and therefore covers the risks that farmers are actually exposed to (FAO, 2008). The insurance should be available to all farmers and should preferably be organised in the form of a public-private partnership under central control of governments. In India for example, the online plat-form E-Choupal, is available for farmers to check market prices, order fertilizers and sell their products. A whole net-work of organisations has been involved in bringing this information together, and as a result millions of small farmers-including those in remote regions-now have access to comprehensive solutions (Rural 21, 2010).

The way in which the world governments deal with such vital resources as water and soil is a matter of global security, climate change and a growing world population mean that these resources are becoming in short supply, which could lead to conflict about their distribution. Investments in the more efficient use of water, in water recycling and storage are just as necessary efforts to maintain the fertility of the soil and use of underground facilities for disposing of unwanted carbon. A peaceful world will not be possible unless the currently under developed countries can undergo a process of development (FAO, 2008). In an effort to combat climate change through agriculture therefore, FAO calls for a networking by every country by analysing its own agriculture sector

and subjecting all the various climate-relevant processes to close scrutiny. Moreover, a global network should be created, to which each country can contribute its knowledge and experience in combating climate change.

Despite the international efforts to cushion the poor from the pangs of poverty, it has become widespread in many countries in the last decade making it the core challenge for development in the twenty first century (United Nations Development Programme (UNDP, 2000). Climate change poses a serious risk to poverty reduction and threatens to undo decades of development efforts (IPCC, 2010). As the Johannesburg Declaration on Sustainable Development (JDSD) states, "the adverse effects of climate change are already evident, natural disasters are more frequent and more devastating and developing countries more vulnerable."While climate change is a global phenomenon, its negative impacts are more severely felt by poor people and poor countries. They are more vulnerable because of their high dependence on natural resources, and their limited capacity to cope with climate variability and extremes (IPCC, 2010). Experience warns that the best way to address climate change impacts on the poor is by integrating adaptation responses into development planning. This is fundamental to achieve the Millennium Development Goals (MDGs) including over-arching goal of halving extreme poverty by 2015, and sustaining progress beyond 2015 (UNDP, 2000).

Agricultural activity is highly sensitive to climate change, largely because it depends on biodiversity and ecosystems (Clements, 2009). Climate change affects food production directly through change in agro-ecological conditions and indirectly by affecting growth and distribution of incomes and thus demand for alternative food sources (Schmidhuber and Tubiello, 2007). Clements (2009) notes that, sufficient freshwater supplies, fertile soil, the right balance of predators and pollinators, air temperature and average weather conditions all contribute to continuing agricultural productivity. IPCC (2007) also points out that climate change has affected rainfall reliability, increased frequency of droughts and raised average temperatures, threatening the availability of freshwater for home use and irrigation. Rural communities face reduced availability of fisheries and forest products (FAO, 2008). The changing temperatures and weather patterns occasioned by climate change also create conditions conducive for the emergence of new pests and diseases that affect animals, trees and crops, thus affecting agricultural production and food availability (IPCC, 2007). Rural farmers in developing countries are affected most by climate change partly because they make up the larger share of the agricultural workforce and partly because they tend to have access to fewer income-earning opportunities. They therefore are forced to work harder to produce food and walk further to access water, as the world becomes a hotter and drier place to live in (UNFPA, 2009).

Mitigations against Climate Change

Since it has been demonstrated that GHGs emissions resulting from man's activities are responsible for global warming and subsequent changes in the climate system, there is a need to identify measures for limiting greenhouse gas emissions into the atmosphere. There is a need to use cleaner technologies that do not emit a lot of GHGs and or provide sinks for the already emitted GHGs. Most of the mitigation measures will be in the energy sector through use of cleaner technologies, forestry sector through re-aforestation and the agriculture sector through improved fertilizer application, crop and livestock management. In the forestry sector strategies include planting of tree species in woodlots, forestry plantations, on-farm boundary planting and other agro-forestry systems. In the energy sector, strategies would include biomass-based technologies such as use of a) wood fuel in improved mud stoves and ceramics, b) biogas fuel from bio-wastes to produce biogas for cooking and heating, and c) briquettes for cooking instead of wood. The non-biomass based strategies would include i) rural electrification through grid extension, ii) mini-hydropower, iii) compact fluorescent lamps for lighting, d) renewable energy sources (solar cookers and heaters) and e) wind power for pumping water. For the agriculture sector, strategies to reduce the GHG emissions include: i) incorporation of crop residues into the soil instead of burning, ii) good management of livestock manure to reduce methane emissions and proper management of nitrogenous fertilizers in rice and upland agricultural soils to reduce nitrous oxide emissions.

The energy sector which plays a critical role in socio-economic development of a country has not been spared by the effects of climate change and variability. For instance, the wood fuel and biomass accounting for 68 percent of total energy consumption have direct correlation to vegetation which depends heavily on climatic factors (rainfall, temperatures, light intensity, relative humidity, altitude, atmospheric pressure and soils among others) for growth. The power current generated from sources like hydro have been affected by climate change due to their reliance on rainfall water sources in rivers. Thus the need to use the available energy as efficiently as possible and measures put in place to mitigate and adapt to global climate change and variability.

Climate change is a time bomb and a threat to national development, community livelihood support mechanisms, and environmental management. Energy sector strategies to reduce GHGs include: Energy Efficiency and Conservation Measures (EECMs) such as; i) turning off of lights in any room where they are no longer needed, ii) use of energy efficiency equipments like motors, iii) local shifting / peak load leveling and iv) using newer and

energy efficient technologies. Some scientists think mitigation of climate change needs a more radical approach. The Royal Society Academy in England has written a series of papers in "Philosophical Transactions" proposing "geo-engineering" as a way of buying time for the transition to a low-carbon economy to take place in an orderly manner (Schneider, 2008). Broadly the ideas fall into two categories: one is to remove excess CO_2 from the atmosphere while the other is to compensate for climate-warming greenhouse effects the CO_2 and other gases cause, by reducing the amount of sunlight reaching the ground. The strategies include increasing photosynthesis to wipe out excess CO_2 through planting more trees and also through encouraging increased phytoplankton growth which eventually will sink to the bottom of the ocean and not release the carbon.The CO_2 can also be recycled into fuel through a reaction with H_2 or it can be ejected from the atmosphere using the planet's magnetic field. The stratosphere can also be deliberately polluted with sulphate in order to reflect solar heat into space. These ideas are all being tested and if they could offer mankind the space and opportunity to think through more sustainable mitigation strategies to the challenges posed by climate change. It will be important that students in tertiary agricultural institutions have a good understanding of the issues surrounding climate change mitigation and the new concept of geo-engineering (Schneider, 2008).

The overall education policy in Kenya aims to predispose youth in acquisition of skills and knowledge that equips them with appropriate skills to enable them exploit their immediate environment for livelihoods after schooling. The National goals of education particularly goal number (8) advocates for "Promotion of positive attitudes towards good health and environmental protection". This further concurs with two broad objectives of secondary school agriculture curriculum that is, Promotion of agricultural activities which enhance environmental conservation, and Promotion of consciousness of health promoting activities in suitable agricultural production (KIE, 2008). Some agricultural practices emphasized in secondary school agriculture curriculum that can mitigate the adverse effects of climate change include; conversion of animal wastes into biogas though it is disadvantageous in emission of methane gas to the atmosphere, conversion of significant amounts of co_2 from the atmosphere in to the soil through organic farming, minimum tillage, mixed cropping and intercropping. And provision of renewable resources for bio-energies and bio-products through growing oil producing crops, taping solar and wind energies to provide electricity in rural homes. Other agricultural practices recommended in the secondary school agriculture curriculum that farmers can utilize as adaptation strategies to climate change include: crop rotation programmes, dry planting/early planting, planting early maturing crop varieties / species, practicing agro-forestry and growing biotech crops. Yet others are use of modern technologies and helping farmers to adjust to risks and uncertainties among others (KIE, 2008).

Material and Methods

The study employed a descriptive survey research design. The design was chosen because it generated the views, opinions, feelings and or perceptions of the target population on the subject matter under investigation. The study was carried out among agriculture teachers working in public secondary schools within Machakos County. The County is characterised by varying agro-climate zones ranging from zone I to VI, which represent high, medium and low agriculture potential areas prevalent in the entire country. Machakos County is located in the former Eastern Province of Kenya. It borders Embu County to the North, Kitui to the East, Makueni to the South, Kajiado to the South-West, Nairobi and Kiambu to the West and Murang'a and Kirinyang'a to the North-West. Machakos County comprises of eight Sub-Counties formerly Districts, including; Machakos, Athi-River, Kathiani, Kangundo, Matungulu, Mwala, Yatta and Masinga. The number of public secondary schools in Machakos County was three hundred and ten (310). The population under study comprised of all the trained secondary school agriculture teachers in public secondary schools. The total population of the study was three hundred and fifty (350) agriculture teachers employed by the Teachers Service Commission (TSC). The researcher identified this group of respondents because they were 'information rich' with respect to the purposes of the study (Gall, Borg, & Gall, 1996). Stratified random sampling technique was used to obtain a sample size of one hundred and five (105) agriculture teachers selected from the eight (8) sub-counties of Machakos County. Thirty percent (30%) of agriculture teachers were sampled from each sub-county to obtain a hundred and five (105) respondents for this study. According to Kathuri and Pals (1993), a sample size of a hundred (100) respondents is said to be ideal number for a survey research in social sciences. However, for the purpose of taking care of the attrition, the researcher sampled out 105 respondents for the study.

The researcher relied on a structured questionnaire as the main tool for collecting data from the respondents. Questionnaires were deemed ideal for the study since it was concerned mainly with variables that could not have been directly observed such as views, opinions, perceptions and feelings of the respondents. Such information could best have been collected through use of questionnaires than the other alternative instruments (Gall et al, 1996). Quantitative data was collected from 100 respondents sampled from 310 public secondary schools in Machakos

County. All the secondary schools offering agriculture subject and with TSC posted agriculture teachers were identified from each Sub-county. Eight (8) enumerators were used to conduct the interviews. Permissions to meet the agriculture teacher(s) were sought. The agriculture teachers who were present at the time of the visits were briefed about the exercise and their consent to participate was sought. Those who agreed to participate had their identification and mobile telephone contacts recorded in a writing pad and assured of the confidentiality of the information they were to supply in the questionnaire. They were then allowed to react to the briefing through asking questions where they needed further clarifications. Those who conceded to participate in the study were supplied with questionnaires to study, critically think about, and fill in the information they deemed appropriate in their own free time. Finally, they were later contacted via their cell phones on the appropriate day and time the filled questionnaires could be collected. The optimum time the respondents were allowed to fill the questionnaires was one week, however, those who requested additional time due to varied reasons were added an extra week. The return rate to the filled questionnaires was 97 percent. Since the sampled respondents were 105, the 97 percent return rate was enough to obtain the minimum required number that is 100 for quantitative survey research in social sciences as per Kathuri and Pals, (1993). The quantitative data obtained after data collection was synthesised through selecting and organizing it into topical themes and central ideas or concepts. Data analysis involved coding and classifying data (also called categorizing or indexing) into numerical values depending on the appropriate scales of measurements before keying it into a computer master data sheet for reorganization using Statistical Package for Social Sciences (SPSS) programme version 17.

Result and Discussion

What are the perceptions of agriculture teachers towards integration of mitigation strategy topics against climate change into secondary school agriculture syllabus in Machakos County?

The respondents were required to score by ticking (√) in the blank spaces provided, their degree of rating against, or for each sub-topic. The scoring was in accordance Likert's scale of rating (1 to 5), where 5 represented-strongly agree, 4-agree, 3-undecided, while 2 and 1 represented; disagree and strongly disagree respectively. This information was presented in the questionnaire by the following key: 1=S.D (Strongly Disagree); 2=D (Disagree); 3=U (Undecided); 4=A (Agree); while 5=S.A (Strongly Agree). After scoring was done, results for each mitigation sub-topic were presented in tables followed by brief discussions.

Mitigation strategy sub-topics against climate change in relation to agriculture syllabus content

Data on the perceptions of teachers towards integration of mitigation strategy sub-topics against climate change into secondary school agriculture syllabus with regard to agriculture syllabus content are presented in Table 10, followed by interpretations and brief discussions on each sub-topic.

Table 10:

Mitigation Strategy Sub-topics against Climate Change in Relation to Agriculture Syllabus Content

Sub-topic	SD		D		U		A		SA	
	F	%	F	%	F	%	F	%	F	%
a) Meaning and importance of climate change mitigations	4	4	4	4	14	14	30	30	48	48
b) Carbon sink/disposal through farming	1	1	15	15	16	16	40	40	28	28
c) Environmental conservation and sustainability	3	3	3	3	7	7	37	37	50	50
d) Land reclamation and remediation	4	4	4	4	7	7	34	34	51	51
e) Allocation of farm land to other alternative uses e.g. estate development	13	13	17	17	21	21	24	24	25	25
f) Soil and water conservation	5	5	5	5	5	5	33	33	52	52
g) Water supply, irrigation and drainage	2	2	7	7	2	2	34	34	55	55
h) The concept of agro-forestry	5	5	4	4	3	3	38	38	50	50
i) The concept of organic farming	5	5	2	2	6	6	33	33	54	54
j) The concept of green economy	8	8	5	5	14	14	33	33	40	40

Key:
F – Frequency
% - Percent

a) Meaning and importance of climate change mitigations

The findings on the perceptions of teachers towards integration of the sub-topic on the meaning and importance of climate change mitigations in reference to incorporating it to the existing agriculture syllabus content are presented in Table 10a.

Table 10a:

Meaning and Importance of Climate Change Mitigations

Responses	Frequency	Percent (%)
Strongly disagree	4	4.0
Disagree	4	4.0
Undecided	14	14.0
Agree	30	30.0
Strongly agree	48	48.0
Total	**100**	**100.0**

The findings pointed out that, a majority of the teachers (78%) either agreed or strongly agreed that, the sub-topic was relevant to the agriculture syllabus content. Of a contrary opinion though, (4%) of them disagreed or strongly disagreed with the suggestion, while (14%) of the teachers remained undecided. The findings that most of the teachers supported the view on integrating the sub-topic on the meaning and importance of climate change mitigations into secondary school agriculture syllabus were consistent with the researcher's expectations. This is also in line with the principles of crops production (climatic factors influencing agriculture) where insignificant climatic aspects including rainfall, temperature, light, wind, relative humidity among others have been highlighted (KIE, 2008). However, the coverage of these climatic aspects is brief in scope and breadth, and has fallen short in highlighting pertinent information on the importance of mitigating climate change impacts on the agricultural production. Therefore, the syllabus needs to be reviewed in order to conform it to address mitigation measure against climate change and variability.

b) Carbon sink/disposal through farming

The findings on the perceptions of teachers towards integration of the sub-topic on the carbon sink/disposal through farming in reference to incorporating it to the existing agriculture syllabus content are presented in Table 10b.

Table 10b:

Carbon Sink/Disposal through Farming

Responses	Frequency	Percent (%)
Strongly disagree	1	1.0
Disagree	15	15.0
Undecided	16	16.0
Agree	40	40.0
Strongly agree	28	28.0
Total	**100**	**100.0**

The results indicated that, a large proportion of the teachers (68%) either agreed or strongly agreed that, the sub-topic was relevant. On the contrally though, (16%) of them disagreed or strongly disagreed to the suggestion, while (16%) of the teachers remained undecided. From the results analysis, most teachers supported the idea to integrate the sub-topic on the knowledge of carbon sink/disposal into secondary school agriculture syllabus content. Similar expectation was also held by the researcher. Although no idea on this sub-topic has been highlighted in the agriculture syllabus, FAO's (2010) report observed that, the agriculture sector has the potential to reduce GHGs through: i) incorporation of crop residues into the soil instead of burning, ii) good management of livestock manure to reduce methane emissions and proper management of nitrogenous fertilizers in rice and upland agricultural soils to reduce nitrous oxide emissions. Therefore the sub-topic if integrated in the agriculture syllabus can significantly contribute enormous gains in mitigating climate change impacts on the agricultural production.

c) Environmental conservation and sustainability

The findings on the perceptions of teachers towards integration of the sub-topic on the environmental conservation and sustainability in reference to incorporating it to the existing agriculture syllabus content are presented in Table

10c.

Table 10c:

Environmental Conservation and Sustainability

Responses	Frequency	Percent (%)
Strongly disagree	3	3.0
Disagree	3	3.0
Undecided	7	7.0
Agree	37	37.0
Strongly agree	50	50.0
Total	**100**	**100.0**

The findings indicated that, a large proportion of the teachers (87%) either agreed or strongly agreed that, the sub-topic was viable in relation integrating it to the agriculture syllabus content. Nevertheless, (3%) of them either disagreed or strongly disagreed to the proposition, while (7%) of the teachers remained undecided. Based on the findings, teachers overwhelmingly supported the idea to integrate the sub-topic on the environmental conservation and sustainability into secondary school agriculture syllabus content. This is in line with one of the fundamental objectives of education that advocates for promotion of positive attitudes towards good health and environmental protection. It further concurs with one broad objective of secondary school agriculture syllabus on promotion of agricultural activities which enhance environmental conservation (KIE, 2008). Although the idea on environmental conservation is already highlighted in the agriculture syllabus, it is not exhaustively addressed to articulate its importance in the light to mitigate climate change impacts.

d) Land reclamation and remediation

The findings on the perceptions of teachers towards integration of the sub-topic on land reclamation and remediation in reference to merging it to the existing agriculture syllabus content are presented in Table 10d.

Table 10d:

Land Reclamation and Remediation

Responses	Frequency	Percent (%)
Strongly disagree	4	4.0
Disagree	4	4.0
Undecided	7	7.0
Agree	34	34.0
Strongly agree	51	51.0
Total	**100**	**100.0**

The outcome revealed that, most teachers (85%) either agreed or strongly agreed to the idea that, the sub-topic was suitable in view integrating it to the agriculture syllabus content. Of contrary opinion though, (4%) of them either disagreed or strongly disagreed to the scheme, while (7%) of the teachers remained undecided. Based on the results analysis, majority of the teachers have supported the idea to integrate land reclamation and remediation sub-topic in the secondary school agriculture syllabus content. This was also expected by the researcher since climate change has impacted negatively on agricultural land, making it unfavourable for farming activities. Such lands need to be reconverted back to agricultural use through soil conservation measures, irrigation, desalinisation, drainage, fertilizer application, afforestation and reforestation among others. Therefore, the topic if integrated into secondary school agriculture syllabus content will be paramount in mitigating the impacts of climate change and variability.

e) Allocation of farm land to other alternative uses like estate development among others

The findings on the perceptions of teachers towards integration of the sub-topic on allocation of farm land to other alternative uses like estate development among others, with respect to incorporating it to the existing agriculture syllabus content are presented in Table 10e.

Table 10e:

Allocation of Farm Land to Other Alternative Uses

Responses	Frequency	Percent (%)
Strongly disagree	13	13.0
Disagree	17	17.0
Undecided	21	21.0
Agree	24	24.0
Strongly agree	25	25.0
Total	**100**	**100.0**

The findings revealed that, (49%) of the teachers either agreed or strongly agreed that, the sub-topic was appropriate in view to permeate it to the agriculture syllabus content. Of a contrary view however, (30%) of them either disagreed or strongly disagreed to the scheme, while a whooping (21%) of the teachers remained undecided. From the results analysis, slightly less than 50% of the teachers supported the idea to integrate the sub-topic on the allocation of land to other uses such as estate development, into secondary school agriculture syllabus content. This was contrally to the expectations of the researcher. However, the fact that, as many as (21%) teachers returned undecided verdict to the proposal is a possible reason that, the idea was misconstrued by the teachers. Thus were it elaborated or expounded further, could be teachers would have perceived it in a better sense.

f) Soil and water conservation

The findings on the perceptions of teachers towards the integration of the sub-topic on soil and water conservation, in view to incorporating it to the existing agriculture syllabus content are presented in Table 10f.

Table 10f:

Soil and Water Conservation

Responses	Frequency	Percent (%)
Strongly disagree	5	5.0
Disagree	5	5.0
Undecided	5	5.0
Agree	33	33.0
Strongly agree	52	52.0
Total	**100**	**100.0**

The findings indicated that, majority of the teachers (85%) either agreed or strongly agreed that, the sub-topic was relevant to the agriculture syllabus content. However, (5%) of them disagreed or strongly disagreed to the suggestion, while (5%) of the teachers remained undecided. As was the expectation of the researcher, a big proportion (85%) of the teachers supported the idea to integrate soil and water conservation into agriculture syllabus content. Although this topic already appears in the secondary school agriculture syllabus content, it does not comprehensively articulate significant details on mitigations against climate change and variability. It is hoped if it were reorganised and expounded further in the light of addressing mitigation strategies against climate change and variability, it would be more appropriate and significant than it is in the present context.

g) Water supply, irrigation and drainage

The findings on the perceptions of teachers towards integration of the sub-topic on water supply, irrigation and drainage, in view to integrating it to the existing agriculture syllabus content are presented in Table 10g.

Table 10g:

Water supply, Irrigation and Drainage

Responses	Frequency	Percent (%)
Strongly disagree	2	2.0
Disagree	7	7.0
Undecided	2	2.0
Agree	34	34.0
Strongly agree	55	55.0
Total	**100**	**100.0**

The findings revealed that, a whooping (89%) of the teachers either agreed or strongly agreed that, the sub-topic was

relevant to the agriculture syllabus content. Nevertheless, (9%) of them disagreed or strongly disagreed to the suggestion, while only (2%) of the teachers remained undecided. An overwhelming number of teachers (89%) favoured the idea to integrate water supply, irrigation and drainage into agriculture syllabus content. This was also predicted by the researcher since rain fed agriculture today faces greatest vulnerability from climate change and variability. Although this topic is already discussed in the secondary school agriculture syllabus content, it does not articulate its significance as mitigation strategy against climate change and variability. Similar views have also been shared by Saka (2008) who advocates for, i) intensive and extensive use of irrigation water and improved fertilizer use efficiency to counter the effects of droughts, periodic water stress and low soil fertility conditions, ii) improvements in soil management practices to reduce surface runoff and soil erosion and diversifying species and iii) intercropping crops with trees to benefit from improved micro-climate and tree products and services.

h) The concept of agro-forestry

The findings on the perceptions of teachers towards integration of the sub-topic "the concept of agro-forestry" with the intention to include it to the existing agriculture syllabus content are presented in Table 10h.

Table 10h:

The Concept of Agro-forestry

Responses	Frequency	Percent (%)
Strongly disagree	5	5.0
Disagree	4	4.0
Undecided	3	3.0
Agree	38	38.0
Strongly agree	50	50.0
Total	**100**	**100.0**

The findings pointed out that, majority of the teachers (88%) either agreed or strongly agreed that, the sub-topic was suitable in view to infuse it to the agriculture syllabus content. Though, (9%) of them disagreed or strongly disagreed to the scheme, while (3%) of the teachers remained undecided. As per the expectations of the researcher, a big proportion (88%) of the teachers supported the idea to integrate the concept of agro-forestry into agriculture syllabus content. Although this topic already appears in the secondary school agriculture syllabus content, it does not comprehensively articulate significant details on mitigations against climate change and variability. Similar sediments were shared by Schneider (2008) who advocated planting of tree species in woodlots, forestry plantations, on-farm boundary planting and other agro-forestry systems. The key climate change mitigation strategies here include biomass-based technologies such as use of a) wood fuel in improved mud stoves and ceramics, b) biogas fuel from bio-wastes to produce biogas for cooking and heating, and c) briquettes for cooking instead of wood. The non-biomass based strategies would include i) rural electrification through grid extension, ii) mini-hydropower, iii) compact fluorescent lamps for lighting, d) renewable energy sources (solar cookers and heaters) and e) wind power for pumping water. It is hoped if agro-forestry sub-topic could be reorganised and expounded further in the light of addressing mitigation strategies against climate change and variability, it would be more appropriate and significant than it is at the present context.

i) The concept of organic farming

The findings on the perceptions of teachers towards integration of the sub-topic on the concept of organic farming in view to integrating it to the existing agriculture syllabus content are presented in Table 10i.

Table 10i:

The Concept of Organic Farming

Responses	Frequency	Percent (%)
Strongly disagree	5	5.0
Disagree	2	2.0
Undecided	6	6.0
Agree	33	33.0
Strongly agree	54	54.0
Total	**100**	**100.0**

The findings indicated that, most of the teachers (87%) either agreed or strongly agreed that, the sub-topic was

applicable to the agriculture syllabus content. Even though, (7%) of them disagreed or strongly disagreed to the proposition, while (6%) of the teachers remained undecided. In view of the expectations of the researcher, majority (87%) of the teachers supported the idea to integrate the concept of organic farming into agriculture syllabus content. Although this idea already appears in the secondary school agriculture syllabus content, it is brief in scope and breadth and does not articulate significant details on mitigations against climate change and variability. It is hoped if it were expounded and given prominence in the light of addressing mitigation strategies against climate change and variability, it would confer much significance than at the present context.

j) The concept of green economy

The findings on the perceptions of teachers towards integration of the sub-topic on the concept of green economy in the light of integrating it to the existing agriculture syllabus content are presented in Table 10j.

Table 10j:

The Concept of Green Economy

Responses	Frequency	Percent (%)
Strongly disagree	8	8.0
Disagree	5	5.0
Undecided	14	14.0
Agree	33	33.0
Strongly agree	40	40.0
Total	**100**	**100.0**

The findings indicated that, majority of the teachers (73%) either agreed or strongly agreed that, the sub-topic was relevant to the agriculture content. Nonetheless, (13%) of them disagreed or strongly disagreed to the suggestion, while (14%) of the teachers remained uncertain. From the results analysis, most teachers supported the proposal to integrate the concept of green economy into secondary school agriculture syllabus content as was also expected by the researcher. This idea is not highlighted in the syllabus content, though it is perceived pertinent in the light of the climate change and variability issues. FAO (2010) defines the concept of green economy as the interaction between the environment and economy which attracts payments for environmental services (PES) including both financial rewards and non-financial incentives such as capacity building and knowledge sharing. Increased access to information on capacity building and knowledge development and or funding mechanisms such as Global Environmental Facility (GEF) make it possible for efforts that contribute to sustainable environmental development. The sub-topic on the concept of green economy therefore if integrated into secondary school agriculture content as a mitigation strategy against climate change and variability, it would provide significant knowledge to circumvent the phenomena.

Conclusion and Recommendations

From the study, it was concluded that the perceptions of teachers towards integration of mitigation strategy sub-topics against climate change into agriculture syllabus with regard to their relevancy, indicated that, (58%) of the teachers agreed or strongly agreed on the submission. It was recommended that Secondary school agriculture syllabus needs to be reviewed to integrate the relevant climate change topics including mitigations strategies. The Ministry of Education through the Teacher Training Colleges should improve agriculture teachers' capacity to plan and implement the teaching of secondary school agriculture to respond to climate change and variability in order to create resilience to farmers. This may be done through provision of in-service training and workshops for the serving teachers, while for those in training colleges and universities climate change and variability knowledge should be integrated in their learning curricular.

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