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Perceptions of Teachers towards the Integration of Adaptation 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. 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 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 adaptation 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 adaptation strategy topics on climate change into 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 adaptation strategy topics on climate change into secondary school agriculture syllabus. The major conclusions of the study were that, most agriculture teachers endorsed the suggestion to integrate climate change adaptation strategy topics into secondary school 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 topics into the agriculture syllabus as projected.*

Key Words: *Perception, Integration, Climate change adaptation, Secondary school agriculture syllabus, Agriculture teachers, Climate change*

I. Introduction

The agriculture syllabus content in Kenya 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 variability phenomena. However, there can be no meaningful breakthrough in the agriculture syllabus appraisal if the agriculture teachers are not allowed to participate in it whether in part or exclusively as their views, opinions, perceptions feelings and attitudes form the basis upon which this study was based. 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. For instance, out of a total of thirty three units constituting the agriculture syllabus, only two, provide aspects tending to climate change adaptations in particular, water supply, irrigation and drainage, and risks and uncertainties in farming. These few topics therefore, provide a credible background upon which adaptation strategy topics on climate change should be included into secondary school agriculture syllabus. A well designed secondary school agricultural education syllabus can turn out to become integral part of the concerted

efforts to tackle climate change (UNDP, 2012). The World governments need not tell us what must be done at the individual level. But what they can do is to simplify the science of climate change so that every school leaver has an idea of how to rescue this earth for the future generations (Food Agricultural Organization (FAO, 2012). The concepts of climate change are simple if explained well, even though the science is multifaceted (Prasad, Ranghieri, Trohanis, Kessler & Sinha, 2009). Climate change by definition, refer to any change in climate overtime. Climate variability on the other hand refers to variations in the mean state and other statistics of climate on all sequential and spatial scales beyond that of individual weather events (Prasad, *et al.,* 2009). United Nations Population Fund (UNFPA, 2009) explains climate change as the variation of the earth's climate caused by atmospheric accumulation of greenhouse gases (GHGs) such as carbon dioxide and methane because of human activity. The European Commission Directorate-General for Agriculture & Rural Development (ECDGARD, 2008) further concur that, climate change is caused by high concentrations of greenhouse gases in the atmosphere, due to human activities that adds to the natural "greenhouse gases" thus increasing the earth's temperature. As asserted by Prasad *et al.* (2009), climate change is triggered by human-induced GHGs emissions which absorbs and re-emits infrared radiation. When pollution adds these gases to the earth's atmosphere, they trap more solar energy in our planet (like in a green house) warming the earth's surface and contributing to climate unpredictability. 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 adaptations to climate change can be achieved through integration of selected climate change topics in secondary school agriculture syllabus. The methodology through which this was envisaged to be achieved was by creating an independent unit on climate change and making the few aspects on climate change in the current syllabus fundamental parts of it. This was contemplated to be realized through reshuffling the identified aspects of climate change and variability into four key concepts/themes that is, introduction to climate change and variability, adaptations to climate change, mitigations of climate change and cost-reduction and sustainability strategies from climate change. The concepts/themes were addressed within the level and scope of understanding by the secondary school agriculture learners (Schneider, 2008). The study on "the perceptions of teachers towards the integration of adaptation strategy topics on climate change into secondary school agriculture syllabus in Machakos County" therefore sought to address the teachers' opinions on the integration of adaptation strategy topics on climate change into secondary school agriculture syllabus.

II. Statement of the Problem

There is lack of documented studies that have touched on the perceptions of teachers towards the integration of adaptation strategy topics on climate change in secondary school agriculture syllabus in Kenya. The intriguing question remains whether, the secondary school agriculture syllabus could be reviewed to adapt and use any benefits from climate change and variability which makes agriculture susceptible.

III. Objectives of the Study

The objective of the study was to investigate:

i) The perceptions of teachers towards integration of adaptation strategy topics on climate change into secondary school agriculture syllabus in Machakos County;

IV. Theoretical Framework of the Study

The study was guided by the functionalist theory of a French sociologist Emile Durkheim (Haralambos, 1980, cited by Konyango, 2010) which sees education as the transmission of the society's norms, values and skills to the schooling generation. The norms and values in this respect include competency of practical students in various academic and non-academic fields. Durkheim's theory was reinforced by John Dewey's pragmatist perspective of education. Dewey's pragmatist theory lends itself to vocational education, which implies curriculum change in a practical direction (King, 1988; Lauglo & Lillis, 1988). These theories are based on the premise that the school should serve the local community and its needs whether these needs are emerging or anticipated to emerge in the near future. The realization of the objectives of teaching agriculture in secondary schools is underpinned by the functionalist and pragmatist theories which emphasize on vocational and practical subjects, and improvement on the curriculum for self-reliance. In this study, the functionalist and pragmatism theories were adopted for their practical nature which is also shared by the secondary school agriculture syllabus

course objectives. For instance the promotion of: self-reliance, resourcefulness and problem solving abilities in agriculture; agricultural activities which enhance environmental conservation; and consciousness of healthy promoting activities in agricultural production. Agricultural education course should be seen in the skills and not just ideas which are applicable in solving societal problems, in this study it relates to the pragmatist theory.

IV. Location of the Study

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 generally experiences a flourishing agricultural economy. As a result, most public secondary schools located in the County offer agriculture subject, as an alternative to business studies, French, drawing and design, electricity and building and construction among other technical displines. Therefore a majority of secondary schools in the County have well established agriculture departments and trained agriculture teacher(s). Geographically, 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).

VI. Methodology

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 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.

VII. Data Presentation, Analysis and Discussion of Finding.

Question: What are the perceptions of teachers towards integration of adaptation strategy topics on 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 for or against each sub-topic on adaptation strategies. The scoring was in accordance to Likert's scale of rating that is (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 climate change adaptation sub-topics in relation to the three aspects (syllabus content, teaching resources and teaching methodologies) of the agriculture syllabus were presented in tables followed by interpretations and discussions.

Adaptation strategy sub-topics to climate change in relation to the agriculture syllabus content

Data on the perceptions of teachers towards integration of adaptation strategy sub-topics on climate change into secondary school agriculture syllabus with regard to agriculture content are presented in Table 7, followed by interpretations and brief discussions on each sub-topic. Table7:

Adaptation Strategy Sub-topics to Climate Change in Relation to the Agriculture Syllabus Content

Sub-topic	SD		D		U		A		SA	
	F	%	F	%	F	%	F	%	F	%
a) The meaning and importance of climate change adaptations	4	4	2	2	4	4	35	35	55	55
b) Adoption of adaptable crops and livestock	1	1	7	7	3	3	29	29	60	60
c) Adoption of modern technologies on farming	5	5	2	2	9	9	32	32	52	52
d)Adoption of bio-tech crops and livestock	6	6	10	10	20	20	37	37	27	27
e) Flexible approaches on farm production methods	2	2	8	8	8	8	35	35	47	47
f) Alternative sources of food	8	8	3	3	11	11	29	29	49	49
g) Diversification of farm enterprises	3	3	8	8	1	1	26	26	62	62
h)The concept of insurance schemes on crops and livestock	4	4	4	4	21	21	35	35	36	36
i) The concept of mixed farming, mixed cropping and intercropping	3	3	6	6	4	4	29	29	58	58
j) The concept of pre and post-harvest crop management	6	6	1	1	4	4	32	32	57	57

Key:
F – Frequency
% - Percent

a) The meaning and importance of climate change adaptations

The findings on the perceptions of teachers on the meaning and importance of climate change adaptations in reference to integrating it to the existing agriculture syllabus content are presented in Table 7a.
Table 7a:

Meaning and Importance of Climate Change Adaptations

Responses	Frequency	Percentage (%)
Strongly disagree	4	4.0
Disagree	2	2.0
Undecided	4	4.0
Agree	35	35.0
Strongly agree	55	55.0
Total	**100**	**100.0**

The findings revealed that, the majority (90 %) of the teachers either agreed or strongly agreed that, the sub-topic was pertinent to the secondary school agriculture syllabus content. However, (6 %) of them disagreed or strongly disagreed to the proposal, while (4%) of the teachers remained undecided.

The findings coincided with the expectations of the researcher that, most teachers supported the view that, the meaning and importance of climate change adaptations should be integrated into the agriculture syllabus content. This findings are in line with the principles of crops production (climatic factors influencing agriculture) where some bits of climatic aspects including rainfall, temperature, light, wind, relative humidity among others have been addressed (KIE, 2008). However, the coverage of these climatic aspects have little

bearing on the adaptation of climate change and variability. As also observed by Stern (2006), with the current accelerating levels of emissions due to fast-growing economies investing in high carbon infrastructure and as the demand for energy and transport, it is envisaged that there is between a 77-99 percent chances that by about 2035 the World would have warmed by greater than 2^0C. These changes are likely going to have negative impacts on food production.This significant shift in greenhouse gases (GHG) emissions therefore has important implications in Africa and the World agriculture in general. Warming may induce sudden shifts in regional weather patterns such as the El Nino phenomenon. These are changes that would have severe consequences for water availability and flooding in tropical regions and threaten the livelihoods of millions of people. Thus adapting strategies to climate change should involve integrating climate change aspects into school curricular particularly agriculture education syllabus.

b) Adoption of adaptable crops and livestock

The findings on the perceptions of teachers towards the adoption of adaptable crops and livestock to adapt to the climate changes with respect to integrating it to the existing agriculture syllabus content are presented in Table 7b.

Table 7b:
Adoption of Adaptable Crops and Livestock

Responses	Frequency	Percent (%)
Strongly disagree	1	1.0
Disagree	7	7.0
Undecided	3	3.0
Agree	29	29.0
Strongly agree	60	60.0
Total	**100**	**100.0**

The results indicated that, majority that is (89%) of the teachers either agreed or strongly agreed that, the sub-topic was admissible to the agriculture content. Although (8%) of them disagreed or strongly disagreed to the suggestion, while (3%) of the teachers remained undecided. It was anticipated that most teachers would support this view since it is also in line with the existing secondary school agriculture syllabus content (KIE, 2008). It is particularly addressed under the principles of agricultural economics (overcoming natural catastrophies) such as weather variability, but fails to articulate its significance tin relation to adapting to climate change and variability, which today pose the greatest vulnerability to agricultural production. FAO's (2008) report on the other hand pointed out that, adaptation strategies need to be taken in tandem with government policies and strategies of poverty alleviation and food security. A number of organizations World-wide, for example FAO are promoting the use of indigenous and locally adapted plants and animals as well as the selection and multiplication of crop varieties adapted or resistant to adverse conditions. The selection of crops and cultivars with tolerance to abiotic stresses (such as high temperatures, drought, flooding, high salt content in the soil, pest and disease) allows harnessing genetic variability in new crop varieties. Therefore this sub-topic needs to be included in the schools agriculture syllabus content.

c) Adoption of modern technologies on farming

The findings on the perceptions of teachers towards the adoption of modern technologies on farming as a strategy against climate change and variability in reference to integrating it to the existing agriculture syllabus content are presented in Table 7c.

Table 7c:
Adoption of Modern Technologies on Farming

Responses	Frequency	Percent (%)
Strongly disagree	5	5.0
Disagree	2	2.0
Undecided	9	9.0
Agree	32	32.0
Strongly agree	52	52.0
Total	**100**	**100.0**

The findings reflected that, majority of the teachers (84%) either agreed or strongly agreed that, the sub-topic was viable for integration into the agriculture syllabus content. On the other hand however, (7%) of them either disagreed or strongly disagreed to the proposition, while (9%) of the teachers remained undecided. As the results confirmed, most teachers supported the sub-topic on adoption of modern technologies on farming as was also predicted by the researcher. The concept is within the secondary school agriculture syllabus content, particularly, principles of agricultural economics (ways of adjusting to risks and uncertainties in farming) and principles of crops production (crop rotation, early planting, planting early maturing crops among others).

Although these aspects are scarcely covered in the light to combat climate change and variability, they also contribute to increased farm production efficiency, minimal cost of production, and increased farm productivity (KIE, 2008). The findings also concurred with the research findings of Rural 21 (2010) that, the use of traditional production methods that help to protect the soil could play a part in reducing GHGs, although there must be transfer of modern technologies and skills if farmers are to succeed in adapting to climate change. There is therefore a necessity to integrate the sub-topic in the secondary school agriculture content as an adaptation measure to climate change and variability.

d) Adoption of bio-tech crops and livestock

The results on the perceptions of teachers towards the adoption of bio-tech crops and livestock as an approach to adapt to climate change and viability via integrating it to the existing agriculture syllabus content are presented in Table 7d.

Table 7d:
Adoption of Bio-tech Crops and Livestock

Responses	Frequency	Percent (%)
Strongly disagree	6	6.0
Disagree	10	10.0
Undecided	20	20.0
Agree	37	37.0
Strongly agree	27	27.0
Total	**100**	**100.0**

The outcome indicated that, most of the teachers (64%) either agreed or strongly agreed that, the sub-topic was suitable in view to integrating it to the agriculture syllabus content. Of a contrally opinion though, (16%) of the teachers either strongly disagreed or strongly disagreed to the scheme, while (20%) of them remained undecided. From the results analysis, majority of the teachers held the view that, adoption of bio-tech crops and livestock is relevant to the agriculture syllabus content. This concurred with the researches expectations. Although the concept has not directly been articulated in the secondary school agriculture syllabus content as an adaptation strategy to climate change and variability, it is in tandem with Saka's (2008) recommendations that, as adoption of bio-tech crops and livestock today is a significant goal to overcoming many difficulties faced by farmers. These include; growing crop species or varieties with higher thermal requirements or those that are tolerant to drought and floods, changes in crop location, control of insect pests and diseases associated with floods and droughts, diversifying species and intercropping crops with trees to benefit from improved micro-climate and tree products and services, and mass agricultural production to meet the market demand. The sub-topic on adoption of bio-tech crops and livestock therefore needs to be integrated into secondary school agriculture content as an adaptation strategy to climate change and variability.

e) Flexible approaches on farm production methods

The outcome on the perceptions of teachers regarding the sub-topic on flexible approaches to farm production methods to adjust to climate change phenomena through integrating it to the existing agriculture syllabus content are presented in Table 7e.

Table 7e:
Flexible Approaches on Farm Production Methods

Responses	Frequency	Percent (%)
Strongly disagree	2	2.0
Disagree	8	8.0
Undecided	8	8.0
Agree	35	35.0
Strongly agree	47	47.0
Total	**100**	**100.0**

The findings revealed that, majority of the teachers (82%) either agreed or strongly agreed that, the sub-topic was appropriate in view to integrate it to the agriculture syllabus content. Of a different opinion however, (10%) of the teachers either disagreed or strongly disagreed to the scheme, as (8%) of them remained undecided. From the results analysis, a large proportion of the teachers supported this proposal as was predicted by the researcher. This view is also shared in the current agriculture syllabus content particularly on principles of agricultural economics (adjusting to risks and uncertainties). It ascertains that, at farm level, farmers may design their enterprises such that, should there be a need to change from one enterprise to another in responses to changes in market demand or weather, they can easily do so with minimum expenses (KIE, 2008). However, this idea is not comprehensively articulated as a significant strategy to adapt to climate change and variability,

thus the need to integrate it in detail.

f) Alternative sources of food

The findings on the perceptions of teachers on alternative sources of food in response to climate changes through integrating it to the existing agriculture syllabus content are presented in Table 7f.

Table 7f:
Alternative Sources of Food

Responses	Frequency	Percent (%)
Strongly disagree	8	8.0
Disagree	3	3.0
Undecided	11	11.0
Agree	29	29.0
Strongly agree	49	49.0
Total	**100**	**100.0**

The results indicated that, majority of the teachers (78%) either agreed or strongly agreed that, the sub-topic was permissible to the agriculture syllabus content. Of a contrally opinion though, (11%) of the teachers disagreed or strongly disagreed to the suggestion, while (11%) of them remained undecided. From these findings, most teachers supported the idea to integrate alternative sources of food topic into secondary school agriculture syllabus content as per the expectations of the researcher. Although this idea is not addressed in the secondary school agriculture syllabus content, the fact that, Kenya is among food crisis nations with 3.8 million people being food insecure, there is need to embrace alternative sources of food (Schmidhuber and Tubiello, 2007). A similar view is shared by (IPCC, 2010) report that, the negative impacts of climate change are more severely felt by poor people in the poor countries, as their vulnerability is worsened by their high dependence on natural resources, and their limited capacity to cope with climate variability and extremes. Therefore, alternative food sources sub-topic if integrated into secondary school agriculture syllabus content will not only be significant as an adaptation to climate change, but will also be 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). Therefore, there is a felt need to address the sub-topic in detail in the agriculture syllabus content.

g) Diversification of farm enterprises

The results on the perceptions of teachers towards diversification of farm enterprises to outmanoeuvre climate change phenomena through merging it to the secondary school agriculture syllabus content are presented in Table 7g.

Table 7g:
Diversification of Farm Enterprises

Responses	Frequency	Percent (%)
Strongly disagree	3	3.0
Disagree	8	8.0
Undecided	1	1.0
Agree	26	26.0
Strongly agree	62	62.0
Total	**100**	**100.0**

The findings indicated that, a large proportion of teachers (88%) either agreed or strongly agreed that, the sub-topic was relevant to the agriculture syllabus content. However, (11%) of them disagreed or strongly disagreed to the suggestion, while only (1%) of the teachers remained undecided. Based on these results analysis, majority of the teachers agreed to the proposal as was predicted by the researcher. A similar idea is also shared in the secondary school agriculture syllabus content in the principles of economics (ways of adjusting to risks and uncertainties). This involves setting up several and different enterprises on the farm so that should one fail, the farmer does not suffer a total loss (KIE, 2008). However, this idea is not comprehensively addressed, and does not highlight its significance as a climate change and variability adaptation strategy, therefore the need to make it more comprehensive in the agriculture syllabus content.

h) The concept of insurance schemes on crops and livestock

The findings on the perception of teachers regarding the concept of insurance schemes on crops and livestock in response to climate change and variability with respect to integrating it to the existing agriculture syllabus content are presented in Table 7h.

Table 7h:

The Concept of Insurance Schemes on Crops and Livestock

Responses	Frequency	Percent (%)
Strongly disagree	4	4.0
Disagree	4	4.0
Undecided	21	21.0
Agree	35	35.0
Strongly agree	36	36.0
Total	**100**	**100.0**

The findings showed that, a significant proportion of the teachers (71%) either agreed or strongly agreed that, the sub-topic was suitable in view to integrating it to the agriculture syllabus content. Although, (4%) of them disagreed or strongly disagreed to the idea, while a whopping (21%) of the teachers remained undecided. From the results analysis, most teachers supported the suggestion to integrate the concept of insurance schemes on crops and livestock as was predicted by the researcher. A related idea is shared in secondary school agriculture syllabus content in the principles of agricultural economics (adjusting to risks and uncertainties). Insurance companies are expected to take the risk of insuring farm machinery, crops and livestock against loss. Farmers should pay small amounts of money (premium) as insurance covers to the insurance companies. The cover guarantees them compensation in the event of loss (KIE, (2008). Such scheme covers losses due to crop failure, death of livestock, theft, fire and accidents involving farm machinery. However, the idea is not comprehensively addressed, and does not articulate its significance as an adaptation strategy to climate change. Similar sediments were also shared by FAO's (2008) report that, 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. 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. Other relevant sediments were observed in Rural 21, (2010) report, citing India as an example where the online plat-form E-Choupal insurance scheme, 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.

i) The concepts of; mixed farming, mixed cropping and intercropping

The findings on the perception of teachers regarding the sub-topic on the concepts of; mixed- farming, mixed cropping and intercropping in response to the varying climatic conditions with respect to integrating it to the existing agriculture syllabus content are presented in Table 7i.

Table 7i:
The Concept of Mixed Farming, Mixed Cropping and Intercropping

Responses	Frequency	Percent (%)
Strongly disagree	3	3.0
Disagree	6	6.0
Undecided	4	4.0
Agree	29	29.0
Strongly agree	58	58.0
Total	**100**	**100.0**

The findings revealed that, a greater percentage of teachers (87%) either agreed or strongly agreed that, the sub-topic was applicable to the agriculture syllabus content. Of a different view however, (9%) of them disagreed or strongly disagreed to the proposition, while (4%) of the teachers remained undecided. From the findings, majority of the teachers agreed to the submission as was expected by the researcher. The concepts of mixed-farming, mixed-cropping and intercropping are highlighted in the secondary school syllabus content. Though as strategies for diversifying farm enterprises to guard against loss should one enterprise fail. Mixed-farming in the principles of agricultural economics (product-product relationship), articulates that, farm products can be used to complement each other such that, an increase in the production of one product leads to a simultaneous increase in the production of the other. Mixed-cropping and inter-cropping on the other hand are useful conservation measures against soil erosion (KIE, 2008). However, the concepts are not inclusively addressed in the syllabus content in the light to adapt agriculture to climate change and variability, thus the need to expound on them further.

j) The concepts of; pre and post-harvest crop management

The findings on the perceptions of teachers concerning the sub-topic on the concepts of; pre and post harvest crop management in response to climate change and variability with a view to integrating it to the existing agriculture syllabus content are presented in Table 7j.

Table 7j:
The Concept of Pre and Post-harvest Crop Management

Responses	Frequency	Percent (%)
Strongly disagree	6	6.0
Disagree	1	1.0
Undecided	4	4.0
Agree	32	32.0
Strongly agree	57	57.0
Total	**100**	**100.0**

The findings revealed that, majority of the teachers (89%) either agreed or strongly agreed that, the sub-topic was permissible to the agriculture syllabus content. Alternatively, (7%) of the teachers disagreed or strongly disagreed to the suggestion, while (4%) of them remained undecided. From the results analysis, most teachers supported the view that, the concept of pre and post-harvest crop management should be integrated into secondary school agriculture syllabus content. This finding was also expected by the researcher, and concurs with the principles of agricultural economics (physical yield uncertainty). In this type of risk and uncertainty, farmers lack precise knowledge on how much to expect from the crop already in the field due to inevitable pre and post harvest losses from weather changes, pests and diseases among other losses (KIE, 2008). Similar sediments were observed in Saka's (2008) report that, there is need for establishment and creation of food grain reserves at farm and community levels for safe-keeping and storage of harvested produce, thus, the necessity to make the sub-topic on the concepts of; mixed-farming, mixed-cropping and intercropping more inclusive the agriculture syllabus content.

Adaptation strategy sub-topics to climate change in relation to agriculture teaching methodologies

Data on the perceptions of teachers towards integration of adaptation strategy sub-topics on climate change into secondary school agriculture syllabus with regard to imparting it using the agriculture teaching methodologies are presented in Table 8, followed by interpretations and brief discussions on each sub-topic.

Table 8:
Adaptation Strategy Sub-topics to Climate Change in Relation to Agriculture Teaching Methodologies

Sub-topic	SD		D		U		A		SA	
	F	%	F	%	F	%	F	%	F	%
a) The meaning and importance of climate change adaptations	5	5	2	2	11	11	34	34	48	48
b) Adoption of adaptable crops and livestock	2	2	2	2	7	7	40	40	49	49
c) Adoption of modern technologies on farming	1	1	2	2	14	14	35	35	48	48
d) Adoption of bio-tech crops and livestock	4	4	8	8	23	23	33	33	32	32
e) Flexible approaches on farm production methods	2	2	5	5	17	17	33	33	43	43
f) Alternative sources of food	2	2	7	7	14	14	34	34	43	43
g) Diversification of farm enterprises	2	2	2	2	9	9	28	28	59	59
h) The concept of insurance schemes on crops and livestock	6	6	5	5	22	22	36	36	31	31
i) The concept of mixed farming, mixed cropping and intercropping	1	1	3	3	8	8	38	38	50	50
j) The concept of pre and post-harvest crop management	2	2	1	1	11	11	33	33	53	53

Key:
F – Frequency
% - Percent

a) The Meaning and importance of climate change adaptations

The findings on the perceptions of teachers towards the integration of the sub-topic on the meaning and importance of climate change adaptations in relation to teaching it by use of the convectional agriculture teaching methodologies are presented in Table 8a.

Table 8a: The Meaning and Importance of Climate Change Adaptations

Responses	Frequency	Percent (%)
Strongly disagree	5	5.0
Disagree	2	2.0
Undecided	11	11.0
Agree	34	34.0
Strongly agree	48	48.0
Total	**100**	**100.0**

The results indicated that, a majority of the teachers (82%) either agreed or strongly agreed that, the sub-topic was relevant in terms of being taught using the agriculture teaching methodologies. However, (7%) of them disagreed or strongly disagreed to this suggestion, while (11%) of the teachers remained undecided. In this regard, most teachers supported the idea to integrate the sub-topic on the meaning and importance of climate change adaptations into secondary school agriculture syllabus. This finding was also predicted by the researcher as some climatic aspects influencing agricultural production are already covered in the principles of crops production but to a limited scope. The fact that, these climatic aspects are taught through the convectional agriculture teaching methodologies is a proof that, the meaning and importance of climate change if integrated into the agriculture syllabus will conveniently be taught using the available agriculture teaching methodologies.

b) Adoption of adaptable crops and livestock

The findings on the perceptions of teachers towards the integration of the sub-topic on the adoption of adaptable crops and livestock in the context of teaching it by use of the convectional agriculture teaching methodologies are presented in Table 8b.

Table 8b:
Adoption of Adaptable Crops and Livestock

Responses	Frequency	Percent (%)
Strongly disagree	2	2.0
Disagree	2	2.0
Undecided	7	7.0
Agree	40	40.0
Strongly agree	49	49.0
Total	**100**	**100.0**

The findings revealed that, most teachers (89%) either agreed or strongly agreed that, the sub-topic was relevant to be taught by use of the familiar agriculture teaching methods. On the other hand however, (2%) of them disagreed or strongly disagreed to the submission, while (7%) of the teachers remained undecided. From the results analysis, majority of the teachers supported the idea to integrate the sub-topic on adoption of adaptable crops and livestock into secondary school agriculture syllabus. This finding was also predicted by the researcher as the concept is addressed in the agriculture syllabus though to an insignificant scope and breadth. Since this idea is taught through the convectional agriculture teaching methodologies, it goes without say that, this sub-topic if integrated into the agriculture syllabus will comfortably be taught using the available agriculture teaching methodologies.

c) Adoption of modern technologies on farming

The findings on the perceptions of teachers towards the integration of the sub-topic on the adoption of modern technologies on farming, in view to teaching it by use of the regular agriculture teaching methodologies are presented in Table 8c.

Table 8c:
Adoption of Modern Technologies on Farming

Responses	Frequency	Percent (%)
Strongly disagree	1	1.0
Disagree	2	2.0
Undecided	14	14.0
Agree	35	35.0
Strongly agree	48	48.0
Total	**100**	**100.0**

The outcome indicated that, majority of the teachers (83%) either agreed or strongly agreed to the idea that, the sub-topic was viable in relation conveying it using the conventional agriculture teaching methods. Nevertheless, (3%) of them either disagreed or strongly disagreed to the proposition, while (14%) of the teachers remained undecided. Majority of the teachers supported the idea to integrate the sub-topic on adoption of modern technologies on farming into secondary school agriculture syllabus. This finding was expected by the researcher as the idea is also covered in the agriculture syllabus to a limited extend. In view of the fact that this concept is taught by the use of the locally available agriculture teaching methodologies, it is on the same strength that, this sub-topic if integrated into the agriculture syllabus will conveniently be handled using the same agriculture teaching methodologies.

d) Adoption of bio-tech crops and livestock

The findings on the perceptions of teachers towards the integration of the sub-topic on the adoption of bio-tech crops and livestock into agriculture syllabus for facilitation using the existing agriculture instructional methodologies are presented in Table 8d.

Table 8d:
Adoption of Bio-tech Crops and Livestock

Responses	Frequency	Percent (%)
Strongly disagree	4	4.0
Disagree	8	8.0
Undecided	23	23.0
Agree	33	33.0
Strongly agree	32	32.0
Total	**100**	**100.0**

The outcome indicated that, most teachers (65%) either agreed or strongly agreed that; the sub-topic was suitable in view training it using the agriculture teaching methodologies. Of a different view though, (12%) of them either disagreed or strongly disagreed to the scheme, while a whooping (23%) of the teachers remained undecided. Majority of the teachers supported the idea to integrate the sub-topic on adoption of bio-tech crops and livestock into secondary school agriculture syllabus. This finding was anticipated by the researcher as the idea is relevant to the agriculture knowledge. Therefore with regard to this relevancy, the concept on adoption of bio-tech crops and livestock on farming is deemed fit to be taught by the use of the available agriculture teaching methodologies if integrated into the agriculture syllabus.

e) Flexible approaches on farm production methods

The findings on the perceptions of teachers towards the integration of the sub-topic on flexible approaches on farm production methods in view to facilitating it using the agriculture teaching methodologies are presented in Table 8e.

Table 8e:
Flexible Approaches on Farm Production Methods

Responses	Frequency	Percent (%)
Strongly disagree	2	2.0
Disagree	5	5.0
Undecided	17	17.0
Agree	33	33.0
Strongly agree	43	43.0
Total	**100**	**100.0**

The findings indicated that, majority of the teachers (76%) either agreed or strongly agreed to the proposal. On the other hand though, (7%) of them either disagreed or strongly disagreed to the proposal, while (17%) of the teachers remained undecided. From the results analysis, majority of the teachers supported the idea to integrate the sub-topic on flexible approaches on farm production methods into secondary school agriculture syllabus. This finding was expected by the researcher as the concept is covered in the agriculture syllabus though to a limited extend. In view of the fact that this concept is taught by the use of the available agriculture teaching methodologies, it is on the same strength that, this sub-topic if integrated into the agriculture syllabus will handled using the agriculture teaching methodologies.

f) Alternative sources of food

The findings on the perceptions of teachers towards the integration of the sub-topic on alternative sources of food in an attempt to teach it using the usual agriculture teaching methodologies are presented in Table 8f.

Table 8f:
Alternative Sources of Food

Responses	Frequency	Percent (%)
Strongly disagree	2	2.0
Disagree	7	7.0
Undecided	14	14.0
Agree	34	34.0
Strongly agree	43	43.0
Total	**100**	**100.0**

The findings indicated that, most teachers (77%) either agreed or strongly agreed that, the sub-topic was relevant to teach using the agriculture teaching methodologies. However, (9%) of them disagreed or strongly disagreed to the suggestion, while (14%) of the teachers remained undecided. Depending on the results analysis, most of the teachers supported the idea to integrate the sub-topic on alternative food sources into secondary school agriculture syllabus. This finding was anticipated by the researcher as the idea is applicable to the agriculture syllabus content. Therefore with regard to this applicability, the concept on alternative food sources is deemed ideal to be taught by the use of the available agriculture teaching methodologies if integrated into the agriculture syllabus.

g) Diversification of farm enterprises

The findings on the perceptions of teachers towards the integration of the sub-topic on diversification of farm enterprises on the strength to tackle it in classroom using the agriculture teaching methodologies are presented in Table 8g.

Table 8g:
Diversification of Farm Enterprises

Responses	Frequency	Percent (%)
Strongly disagree	2	2.0
Disagree	2	2.0
Undecided	9	9.0
Agree	28	28.0
Strongly agree	59	59.0
Total	**100**	**100.0**

The findings indicated that, majority of the teachers (87%) either agreed or strongly agreed that, the sub-topic was relevant for handling using the agriculture teaching methodologies. Though, (2%) of them disagreed or strongly disagreed to the suggestion, while (9%) of the teachers remained undecided. In this regard, majority of the teachers supported the idea to integrate the sub-topic on diversification of farm enterprises into secondary school agriculture syllabus. This finding was expected by the researcher as the concept is also covered in the agriculture syllabus though to a limited extend. In view of the fact that this concept is taught by the use of the locally available agriculture teaching methodologies, it is on the same strength that, this sub-topic if integrated into the agriculture syllabus will handled using the same agriculture teaching methodologies.

h) The concept of insurance schemes on crops and livestock

The findings on the perceptions of teachers towards the integration of the sub-topic on the concept of insurance schemes on crops and livestock in view to teaching it using the conventional agriculture instructional methods are presented in Table 8h.

Table 8h:
The Concept of Insurance Schemes on Crops and Livestock

Responses	Frequency	Percent (%)
Strongly disagree	6	6.0
Disagree	5	5.0
Undecided	22	22.0
Agree	36	36.0
Strongly agree	31	31.0
Total	**100**	**100.0**

The findings indicated that, most teachers (67%) either agreed or strongly agreed that, the sub-topic was appropriate to handle in an ordinary agriculture learning lesson using the agriculture teaching methods. Nevertheless, (11%) of them disagreed or strongly disagreed to the scheme, while whooping (22%) of the teachers remained undecided. As per the results, majority of the teachers supported the idea to integrate the sub-topic on the concept of insurance schemes on crops and livestock into secondary school agriculture syllabus. This finding was expected by the researcher as the concept is also covered in the agriculture syllabus though to a limited extend. In view of the fact that this concept is taught by the use of the available agriculture teaching methodologies, it is on the same strength that, this sub-topic if integrated into the agriculture syllabus will handled using the same agriculture teaching methodologies.

i) The concepts of; mixed farming, mixed cropping and intercropping

The findings on the perceptions of teachers towards the integration of the sub-topic on the concepts of; mixed- farming, mixed cropping and intercropping in view to be taught by use of the usual agriculture teaching methodologies are presented in Table 8i.

Table 8i:
The Concepts of; Mixed Farming, Mixed Cropping and Intercropping

Responses	Frequency	Percent (%)
Strongly disagree	1	1.0
Disagree	3	3.0
Undecided	8	8.0
Agree	38	38.0
Strongly agree	50	50.0
Total	**100**	**100.0**

The findings indicated that, a whooping (88%) of the teachers either agreed or strongly agreed that, the sub-topic was suitable to be facilitated via agriculture instructional methodologies. Nevertheless, (4%) of them disagreed or strongly disagreed to the proposition, while (8%) of the teachers remained undecided.On the basis of the results analysis, majority of the teachers supported the idea to integrate the sub-topic on concept of mixed- farming, mixed cropping and intercropping into secondary school agriculture syllabus. This finding was expected by the researcher as the idea is also covered in the agriculture syllabus though to a limited extend. In view of the fact that this concept is taught by the use of the locally available agriculture teaching methodologies, it is on the same strength that, this sub-topic if integrated into the agriculture syllabus will handled using the same agriculture teaching methodologies.

j) The concepts of; pre and post-harvest crop management

The findings on the perceptions of teachers towards the integration of the sub-topic on the concept of pre and post harvest crop management with regard to facilitate it by use of the existing agriculture teaching methodologies are presented in Table 8j.

Table 8j:
The Concepts of; Pre and Post-harvest Crop Management

Responses	Frequency	Percent (%)
Strongly disagree	2	2.0
Disagree	1	1.0
Undecided	11	11.0
Agree	33	33.0
Strongly agree	53	53.0
Total	**100**	**100.0**

The findings showed that, majority of the teachers (86%) either agreed or strongly agreed that, the sub-topic was relevant to handle using the available agriculture teaching methodologies. However, only (3%) of them disagreed or strongly disagreed to the suggestion, while (11%) of the teachers remained undecided. From the results analysis, majority of the teachers supported the idea to integrate the sub-topic on the concept of pre and post harvest crop management into secondary school agriculture syllabus. This finding was anticipated by the researcher as the idea is applicable to the agriculture syllabus content. Therefore with regard to this applicability, the concept on alternative food sources is deemed ideal to be taught by the use of the available agriculture teaching methodologies if integrated into the agriculture syllabus.

VIII. Summary of the Study

The study specifically focused on the perceptions of teachers towards the integration of adaptation strategy topics on climate change into secondary school agriculture syllabus. Climate change and variability is an environmental pandemic responsible for increasing global warming and environmental degradation today. The consequences from this pandemic include; the declining agricultural, forestry, wildlife, and fisheries productivity. To create resilience to the rural based farmers whose livelihoods depends on these natural gifts, climate change and variability comes to critical focus. Society view education as the vehicle through which skills and knowledge on manipulating their immediate environment for a survival are acquired. Secondary school agricultural education was indented to develop the agriculture sector which is one among Kenya's economic pillars. It is therefore hoped that, the agriculture syllabus if well reviewed can transmit useful skills and knowledge that can help in creation of resilience against climate change and variability among farmers. A number of climate change and variability topics pertinent to agriculture education knowledge were proposed for integration into secondary school agriculture syllabus including adaptation strategy sub-topics. The study used a descriptive survey research design. The target population considered for the study included the secondary school agriculture teachers, employed by teachers service commission (TSC) who have undertaken specialized training in agricultural education. The preference was those who have been practicing and are conversant with the secondary school agriculture syllabus and were working in schools within Machakos County. A sample size of

105 respondents was obtained through a proportionate stratified random sampling technique. Structured questionnaires were used to obtain the data regarding respondents on adaptations, mitigations and cost-reduction and sustainability strategy topics from climate change. The dependent variable was perceptions by teachers towards the integration of climate change topics into agriculture syllabus based on three aspects of the syllabus including syllabus content, teaching resources and teaching methods. Data were analysed quantitatively using a computer based statistical package for social sciences (SPSS) version 17, at 0.05 alpha level of significance, and presented using descriptive statistics including frequencies and percentages. One major finding of the study was that, the secondary school agriculture teachers endorsed the proposal to integrate the adaptation strategy topics on climate change into secondary school agriculture syllabus.The major sources on which the study was founded included, (Temu, Mwanje and Mogotsi, 2003), (Yamin, Rahman and Huq, 2005), (Temu and Chakeredza, 2008) and (Van zyl, Gorgens, Bloom, Knoetze and Von Blottmitz, (2008). Temu, who is a team leader with African Network for Agriculture, Forestry and Natural Resources Education (ANAFE) has spearheaded critical studies and symposiums on mainstreaming climate change into agricultural and natural resources management education in Kenya, Malawi and other African countries for the past one decade. The findings provided the basis for identifying the independent and dependent variables for this study. Van zyl, Gorgens, Bloom, Knoetze and Von Blottmitz, have on the other hand provided significant information on the potential of bio-energy (bio-fuels) production in Southern Africa, while Yamin, Rahman, and Huq, have contributed additional information on the vulnerabilities and adaptations to climate change disasters. Finally, the secondary school agriculture syllabus provided significant gaps, links and guidelines upon which the identified climate change topics befitted integration to synchronize climate change knowledge with the agriculture education. This was presumed to create resilience against climate change impacts to farming communities. These documentations provided basic information regarding adaptations strategies from climate change and variability, with the view to assimilate them into secondary school agriculture syllabus.

IX. Conclusion

The major finding of the study was that:

i) The verdict on perceptions of teachers towards integration of adaptation strategy sub-topics on climate change into agriculture syllabus with respect to their relevancy to its three aspects (content, teaching resources and teaching methodologies), illustrated that, over (67%) of the teachers agreed or strongly agreed on the suggestion.

X. Recommendation

The findings from this study elicited a number of recommendations that are in line with policy issues on the secondary school agriculture curriculum. The key recommendations drawn from the study were that;

i) Secondary school agriculture syllabus needs to be reviewed to integrate the adaptation strategy topics on climate change into agriculture syllabus.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.

ii) Schools should be equipped with appropriate teaching and learning resources that would enhance the teaching of a robust knowledge on relevant emerging issues including climate change and variability alongside the general principles on farming.

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