Integrating Climate Change and Smart Agriculture Contents into Nigerian School Curriculum

Abdullahi Hussein Ahmed[1]✉   Oba Abdulkadir Ibrahim,[1] Mahmud Wasilah Agunbiade[2]

[1] Department of Vocational and Technical Education, Ahmadu Bello University, Zaria, Nigeria
[2] Department of Agricultural Technology, Hussaini Adamu Federal Polytechnic Kazaure, Jigawa State, Nigeria

Abstrak

Sektor pertanian sangat penting bagi perekonomian Nigeria, meskipun sangat responsif dan rentan terhadap perubahan iklim. Perubahan iklim telah menyebabkan penurunan dan ketidakstabilan dalam produksi pertanian, sehingga memperburuk kerawanan pangan dan kelaparan di negara-negara seperti Nigeria. Sebagian besar petani Nigeria menggarap pertanian tadah hujan dan konservatif terhadap perubahan teknologi. Kondisi tersebut meniscayakan perlunya mengembangkan konten kurikulum pertanian cerdas (*smart agriculture content*) untuk pemuda yang akan mengarahkan kegiatan pertanian dalam waktu terdekat. Studi ini mengadopsi model Stufflebeam (*Content-Input-Process-Product*) dalam proses pembuatan konten kurikulum untuk mengembangkan materi tentang perubahan iklim dan pertanian cerdas untuk dimasukkan dalam kurikulum ilmu pertanian sekolah menengah di Nigeria. Konten dikembangkan mengacu pada Organisasi Pangan dan Pertanian Perserikatan Bangsa-Bangsa yang menguraikan praktik pertanian cerdas iklim sebagai tema 1 dan 2 yang disarankan dari kurikulum.

Abstract

The importance of the agricultural sector to the Nigerian economy is highly invaluable, although, it is highly responsive and vulnerable to climate change. Climate change has caused decline and volatility in agricultural production, thereby exacerbating food insecurity and hunger in countries such as Nigeria. Most of the Nigerian farmers are rainfed and conservative towards technological change, this calls for the need to develop curriculum contents on smart agriculture for youth who will steer agricultural activities in the nearest future. This study adopts Stufflebeam's (Content-Input-Process-Product) curriculum content creation process to develop content on climate change and smart agriculture for incorporation into the senior school agricultural science curriculum in Nigeria. The contents were developed using the Food and Agricultural Organization of the United Nations outlined climate-smart agricultural practices as suggested in themes 1 and 2 of the curriculum.

✉ Corresponding author :
Address: Abdullahi Hussein Ahmed: Department of Vocational
and Technical Education, Faculty of Education, Ahmadu Bello
University, Zaria, Nigeria
E-mail: charanchihussy@gmail.com

INTRODUCTION

Education is regarded as a valuable tool for preparing an individual to achieve self-actualization and live in a safe environment free of threats to life and property. One of the most significant investments a country can make in its people, is education. Education is the single most powerful way to reduce poverty and promote rapid economic growth (Global Partnership for Education, 2015). The focus of any educational system all over the world is the development of the human capital required to meet present and future challenges of globalization and knowledge economy (Dike, 2014). Education is therefore regarded as the most effective method for transforming a people's social, psychological, physical, political, intellectual, and developmental characteristics, and curriculum remains the goal for accomplishing this goal.

Curriculum is a well-organized course schedule that outlines the objectives and learning experiences to accomplish target educational goals. Curriculum is a method of training individuals to become active citizens and useful members of the community, thus, is a tool of education to educate and humanize the whole man (Akin *et al.*, 2017). Modern interpretation sees the curriculum as all the knowledge and experience got by a child in and out of the school walls, either on the timetable or outside it, regardless of when or how they occur (Claiborne *et al.*, 2020). Agricultural Education curriculum in this regard is designed to lay a solid foundation for vocational agriculture primarily proposed to train individuals to acquire relevant occupational skills that will make them productive farmers. The curriculum in agriculture was jointly developed by the Nigerian Educational Research Development Council (NERDC) and West Africa Examination Council (WAEC). The main objectives of introducing the teaching of agricultural science in secondary school include: encouragement of students in the use of their hands; the appreciation for the dignity of labour; familiarity with biological processes and thereby instilling rationality in the students; and increasing self-sufficiency and self-reliance in food production by encouraging students to produce part of their food needs and improve their diet and thus, minimize the cost of feeding in their secondary schools (Ukonze, 2020).

Today, many Nigerian secondary school leavers are unemployed and cannot engage themselves in agriculture. They are curiously idle because they lack the pre-requisites for job crea-

tion and knowledge of the environment despite the secondary education received (Alabi, 2014). Climate change, as one of the environmental challenges, is a variability in the weather over a span of 30-35 years on average. Given its political and agricultural challenge, climate change is the most significant socio-scientific problem that teachers could choose to discuss (Dawnson & Carson, 2013). Climate change is a threat to current and future generations because it influences vegetation patterns, animal and crop types and yields, and cropping season's length. As a result, any change in environment could influence the production and supply of food and raw materials, improving or restricting agriculture's ability to serve as a major source of food and industrial raw materials. Formal education should be a major tool for transferring the requisite awareness, skills, and improving people's attitudes toward climate change as a solution to the current situation. It is important to say that such formal education should embrace changes in environmental patterns that will continue to have a significant effect on human life and ecosystems (Amanchukwu *et al.*, 2015).

Climate Smart Agriculture (CSA) is a strategy for increasing agricultural investment in order to achieve long-term agricultural development and ensure food availability in the face of climate change (Amin *et al.*, 2015). The CSA aims to achieve long-term sustainability in green economy targets, food availability, and natural resource conservation. The Food and Agricultural Organization (FAO) develops CSA for crop yields by involving farmers in sustainable intensification steps such as agroforestry, conservation tillage, residue management, green manuring, and enhanced water management.

The Nigerian secondary school (SS) agricultural science curriculum covers three classes, 1-3, and was developed around 9 themes, namely: Basic Concept of agriculture; Agricultural Ecology; Agricultural Engineering/Mechanization, Crop Production; Forestry; Ornamental Plants; Crop Protection; Agricultural Economics and Extension. Afolabi *et al.* (2017) asserted that in selecting those contents, three major issues shaping the development of nations and influencing the world of knowledge were identified, these are globalization, information/communication technology and entrepreneurship. Provision is therefore not made in the curriculum for trending agricultural issues or discoveries to be discussed. The food security issues ravaging Nigeria called for the organization of contents around

the nine themes with neglect of issues posed by climate. Afolabi *et al.* (2017) opined that the SS curriculum is packaged with contents that may lead to self-actualization by students but with less practicality. The curriculum is divided into themes and classes, the themes show the topics and each theme is further divided into: performance objectives; content; teacher and students' activities; teaching and learning material; and, evaluation guide.

Climate Smart Agriculture (CSA) was first introduced in 2010 during the Hague conference on food security and climate change organized by FAO. According to FAO, CSA is an agricultural activity that increases productivity and incomes in a sustainable and efficient manner (adaptation), reduces or eliminates greenhouse gas emissions (mitigation), and contributes to the achievement of national food security and development goals (FAO, 2010). The idea behind the idea of CSA was to strike a balance between food production and environmental stability.

The CSA is a technique aimed to improve investment in agricultural sector, to attain sustainable agricultural progress and ensure food availability under climate change (Amin *et al.*, 2015). The CSA was developed by FAO for crop yields by adopting some form of sustainable land management practices that engage farmers in sustainable intensification measures such as agroforestry, conservation tillage, residue management, green manuring, and improved water management to improve agricultural performance. The CSA packages enable farmers use their knowledge and skills more effectively, share information, opt for more efficient pro-environmental technologies, and build stronger associations to facilitate effective negotiation of better market prices (Anuga *et al.*, 2019).

The following CSA practices according to FAO, (2013); Saguye, (2017) and Wekesa *et al.* (2018) were outlined as expected practices to be adopted by climate smart farmers to mitigate the adverse effect of climate: agronomic practices (improved seed varieties, crop rotation, intercropping, cover crop); water management (irrigation, bunds, terracing, contouring, water harvesting); tillage and residue management (conservation tillage, incorporation of crop residues); integrated soil fertility management (organic fertilizer, efficient use of inorganic fertilizer); integrated pest management (blend of cultural, biological and chemical control); and agro-forestry (intercropping crops and trees, live fencing).

The effects of climate change and the public outcry for a solution call for the development of curriculum contents for a formal education in Nigeria. The climate change and related environmental issues are seen as important aspects of education for the Nigerian students by many scholars. However, most education curricula in developing countries and indeed Nigeria have little or no content on climate change and CSA. It is for this reason, that this study was set to establish the need for curriculum inclusion of climate change and CSA in secondary schools in Nigeria, with a view to mitigate and ensure resilience to threats of adverse weather conditions. This study further was hinged on developing a curriculum content in SS agriculture expected to create awareness among senior secondary school students on climate change to develop attitudinal change, make sound decisions about the immediate environmental factors on agriculture and adapt to challenges of CSA practices.

METHOD

This study used an action research design. Action research entails participants taking a self-reflective, systematic, and critical approach to inquiry while still being members of the research community. The goal is to recognize challenging circumstances or problems that participants believe should be investigated in order to bring about critical informed practice improvements (Cornwell, 1999, citing Burns). Action research is a term used to describe initiatives in which professionals seek to effect changes in their own practices (Tripp, 2005).

It is on this premise; a purposive sampling and content analysis of the Nigerian senior school agricultural science curriculum documents were used to determine the degree to which climate change and CSA practices were included as topics. The Nigerian senior school agricultural science curriculum, agricultural syllabus, agricultural textbooks, agricultural teacher's guides, several academia websites using different search engines such as google.com, google scholar, ask.com, mamma.com, yahoo.com, universities' subscribed data bases, open data bases, online catalogue and special collections were searched as guide for any possible inclusion of climate change and CSA practices.

The content analysis of these documents showed no inclusion of climate change and CSA.

Curriculum contents on climate change and climate smart agricultural practices were therefore developed using the first two components of Stufflebeam's CIPP (Content-Input-Process-Product) curriculum content creation process for use in the senior school agricultural science in Nigeria following (Tokmak *et al.*, 2017).

The first two component of Stufflebeam's process entails development of contents and integrating the contents developed as input in the curriculum. Contents on CSA were developed using FAO, (2013), Saguye, (2017), and Wekesa *et al.* (2018) outlined CSA practices. The contents developed were created to align with the Bloom's taxonomy of educational objectives. The contents were scrutinized and perused by one expert each from the Department of Educational Foundation and Curriculum and the Department of Vocational and Technical Education, Ahmadu Bello University, Zaria in order to determine the content and face validity of the developed contents to creating awareness and solving the problems posed by climate change to agriculture in Nigeria.

The contents developed were broken into performance objective, content, teachers' activities, students' activities, teaching and learning materials and evaluation guides following the experts' recommendations.

RESULT AND DISCUSSION

This section reports the contents developed in form of performance objective, contents, expected teachers' activities, students' activities, teaching and learning materials that are to be used as instructional aid and the evaluation guide using the first two components of Stufflebeam's CIPP (Content-Input-Process-Product) curriculum content creation process putting into consideration the three domains of learning. The section also encompasses the justification and discussion on the developed contents.

A. Justification for Developing Content on Climate Change

Many Nigerians are aware that some changes occur in the environment almost every time of the year but lack knowledge of the reasons for such change. They are also aware of persistent food shortages and extreme flooding at various localities during certain periods of the year. Yet there have been no efforts to reduce the occur-

rences or avert them completely. Nairametrics, (2019) noted that the impact of climate change alone could reduce crop yields by half over the next 35 years, compounded by the fact that in Nigeria, the agricultural sector continues to be impacted by weather hazards, restricting access to food and increasing food insecurity. There is a need to educate the public on the signs of climate change, management, and prevention strategies (Amanchukwu *et al.*, 2015).

In research conducted by Orusha *et al.* (2012), maintained that because agriculture is affected by so many factors, in which its participants must always be prepared to react, plan, and adapt. According to the authors, integrating climate change issues into agricultural education curricula is imperative given that African countries, especially Nigeria are at risk. Nigeria is seriously facing climate change related problems as other countries but have yet to recognize that education is the most effective counterstrategy (Amanchukwu *et al.*, 2015). Education should be embarked on to save people and the environment but currently there is a deficit in the fields of climate change and education that curriculum planners need to address (Amanchukwu *et al.*, 2015). The Nigerian school children are important target to achieve this goal, not yet properly educated on how to deal with the situations caused by climate change. The inclusion of climate change in the Nigerian educational curricula has become pertinent.

Yembuu and Getsel (2017) argues that students who do not take climate related courses, lack the basic understanding and skills relevant to climate change adaptation. Amanchukwu *et al.* (2015) argues that the identification and non-inclusion of environmental education in the school science curriculum is one of the challenges in tackling the issue of global warming and climate change in Nigeria. According to Ibrahim (2011), understanding the effects of climate change is an essential starting point for discussion on the governance and the environmental sustainability of climate change. Schools would be the ideal place to introduce climate change education where school children can be given skills to manage their own environment, and in turn, will practice in their various localities (Ololube, 2008).

Table 1 elucidates information on developed contents on climate change for incorporation in SS1 theme. Knowledge, skills, attitudes and assessment criteria of learners were described in

Table 1 Developed contents on climate change for inclusion in SS1 theme agriculture curriculum in Nigeria

Performance objective	Content	Teacher' Activities	Student' Activities	Teaching and Learning Materials	Evaluation Guide
Student should be able to 1. Define climate change 2. List the effect of climate change on agricultural activities 3. Discuss the causes of climate change 4. Outline the ways of mitigating climate change threats	1. Concept of climate changes 2. Effect of climate change on agricultural activities 3. Causes of climate change 4. Methods of mitigating climate change threats	1. Guide discussion on the topic of climate change 2. Display effect of climate change on agricultural crops and animals using ICT devices such as projector 3. Guide class discussion on causes of climate change 4. Motivate class to propose ideas of mitigating climate change threats	1. Participate actively in the class discussion on climate change concept 2. Observe the displayed images on the ICT output device 3. Participate in discussion on causes of climate change 4. Use ICT images to propose ways of mitigating climate change threats	Field trip to farmland affected by gully erosion or flood and other climate change related areas	1. What is climate change? 2. List and explain effects of climate change on agricultural activities 3. Explain the causes of climate change. 4. Enumerate ways of mitigating climate change threats

this theme. Contents were developed for inclusion in the SS curriculum to enable students identify causes of climate change in the world and identifying its consequences. Four performance objectives were developed which aimed at imparting the meaning of climate change, its effect, the causes and mitigation of climate change for inclusion in the curriculum by first developing the contents and then input the contents in the curriculum following Stufflebeam (2007).

The contents developed were made to align with the three learning domains of cognitive, affective and psychomotor. The developed content is expected to create awareness among senior secondary school students on climate change and make them appreciate climate change phenomenon with its pertinent consequences. Teachers expected activities during class were outlined from having to guide discussion on the concept of climate change to causes and mitigation of climate change. Students' activities were outlined, this ranges from students having to participate actively in the class discussion on concept of climate change to its causes and mitigation, this is done to ensure participatory learning.

This is in line with the recommendation of Bradley, 2012) and McPherson, (2018) who as-

serted that the process of participation fosters mutual learning. The teaching and learning materials were outline in the developed content, in line with Tuimur and Chemwei (2015) who opined that for knowledge to be internalized, more of the learner's senses have to be stimulated other than hearing alone. This is found to be in agreement with Shukla (2021) who stated that the resources a teacher uses while teaching play a role in how students learn. Four evaluative questions were developed in line with Mahajan and Singh (2017) who posited that learning activities and assessment scheme have to be properly designed to successfully conduct and complete a course.

B. Justification for Developing Contents on Climate Smart Agriculture

Climate-smart agriculture as a concept developed by FAO and used as a guide to integrates the three dimensions of sustainable development (economic, social and environmental) by jointly addressing the food security, ecosystems management and climate change challenges. The CSA approach is an alternative designed to identify and operationalize sustainable agricultural development within the explicit parameters of climate change (Florian & Mercado,

Table 2 Developed contents on climate change for inclusion in SS1 theme agriculture curriculum in Nigeria

Performance objective	Content	Teacher' Activities	Student' Activities	Teaching and Learning Materials	Evaluation Guide
Student should be able to 1. State the meaning of climate smart agriculture 2. Mention various types of climate smart agriculture practices 3. List the importance of smart agricultural practices 4. Carry out climate smart practices on the school farm	1. Meaning of climate smart agriculture 2. Types of climate smart agriculture 3. Advantages of climate smart agricultural practices 4. Climate smart agricultural practices	1. Guide discussion on meaning of climate smart agriculture 2. Display materials for carrying out various types of climate smart agricultural practices e.g., mulching material to conserve soil water and use of selective herbicide on weed 3. Guide students' discussion on various climate smart practices 4. Guide student practical on carrying out CSA practices on school farm	1. Listen and contribute to teacher's discussion on CSA practices. 2. Participate in mentioning the various types of CSA practices. 3. Participate in listing the advantages of CSA practices. 4. Demonstrate various type of climate smart agricultural practices	Mulch material, less harmful pesticide to man and crops. Improve seeds that are resistant to drought	1. Define climate smart agriculture 2. Mention various types of climate smart agricultural practices 3. List the importance of climate smart agricultural practices 4. Demonstrate some climate smart practices on the school farm

2010). Actions are required from a broad range of stakeholders from the government and public sector, private sector, academia and research among others as implied in SDG 17, and a practical platform for their engagement and delivery of solutions (FAO, 2013). The World Bank Group backs research programmes such that develops climate-smart technologies and management methods, early warning systems, risk insurance, and other innovations that promote resilience and combat climate change (World Bank, 2021). Instruction around adaptation teaches students how to adapt to changes in economic, social and ecological levels with a focus on increased resiliency and reduced vulnerability ("The Essential Parts," 2022).

Table 2 illustrates developed contents on CSA for incorporation in SS2 theme. The CSA contents were developed to enable students inculcate how to adapt to challenges pose by climate change using CSA practices and to provide learners with preventive measures to man-made forces that are responsible for climate change. Performance objectives on CSA were formulated to enable students internalize the meaning of CSA; mention various types of CSA; list the importance of CSA and; carryout CSA practices on

school farm. This is in line with the recommendation of Umi, (2017) who stated that student-centered learning and teaching emphasizes the way in which learning involves the students creating concepts or constructs to achieve short-term mastery but long-term retention, in-depth understanding of course material, achievement of critical thinking, creative problem-solving skills, development of a positive approach, and a level of confidence in their knowledge and skills.

Contents were developed on the meaning of CSA, types, advantages and practices. Teachers' activities were highlighted in the developed content which ranges from displaying material for carrying out CSA operations to guiding students to carryout CSA practices, this is found to be in line with Umi (2017) who recommends demonstration of learning objectives for students to internalize experience.

Students' activities were listed as developed content which ranges from students having to list out CSA practices after initial demonstration by the teacher. This is in line with recommendation of London School of Educational Management (2019) which states that there are different categories of learners who have varying needs and as such different methods must be

adopted in the planning and delivery of lessons to ensure that such needs are addressed through the use of various domains of learning. Sample of instructional aid to be used were listed, this is in line with Tuimur and Chemwei (2015) who recommends adequate and appropriate use of teaching aid to ensure effective learning and teaching. Evaluation guide was formulated in the study to show how students can be evaluated based on what had been taught. This is in line with the recommendation of Disha (2016) who stated that in education how much a child has internalized can only be determined through evaluation.

CONCLUSION

The study conclude that contents can be developed putting into consideration the three learning domains and the diction of construction following Bloom's recommendation. The developed contents on climate change when incorporated by curriculum planners into the senior school agricultural science curriculum will create awareness among the students on climate change and to appreciate climate change phenomenon with its pertinent consequences on agriculture.

The developed contents on CSA when included into the curriculum will develop attitudinal change in learners to make sound decisions about their immediate environment that assist them face the challenges of climate and improve their abilities to practice agricultural skills with proficiency. This will increase agricultural production through CSA practices not only in Nigeria but other areas with similar conditions. It is recommended that the Federal ministry of education through the Nigeria Educational Research Development Council consider the inclusion of climate change and CSA practices as topics in the secondary school agriculture curriculum. Funds should also be appropriated for research and innovation in other areas that have not been included in the current curriculum.

ACKNOWLEDGEMENT

REFERENCES

Afolabi, K. O., Oba, A. I. & Shuaib, S.B. (2017). Developing Activity-Based Young Farmers' Club Projects for Incorporation into the Senior School Curriculum in Nigeria. *Journal of Curriculum and Instruction, 10*(1), pp. 12-22.

Akin, S., Calik, B., & Engin-Demir, C. (2017). Students as change agents in the community: Developing active citizenship at schools. *Educational Sciences: Theory & Practice, 17*, pp. 809–834. http://dx.doi.org/10.12738/estp.2017.3.0176

Alabi, F. O. (2014). Implementing the New Senior Secondary School Curriculum for The Realization of The Objective of Entreprenuership Education in Ondo State, Nigeria. *European Scientific Journal, 1*, pp. 1857–7881.

Amanchukwu, R. N., Amadi-Ali, T. G. & Ololube, N. P. (2015). Climate Change Education in Nigeria: The Role of Curriculum Review. *Education, 5*(3), pp. 71-79. DOI: 10.5923/j.edu.20150503.01

Amin, A., Mubeen, M., Hammad, H. M., & Nasim W. (2015). Climate Smart Agriculture: an approach for sustainable food security. *Agricultural Resource Community, 2*(3), pp. 13-21. www.aspublisher.com

Anuga, S.W., Gordon, C. Boon E. & Surugu J. M. (2019). Determinants of Climate Smart Agriculture (CSA) Adoption among Smallholder Food Crop Farmers in the Techiman Municipality, Ghana. *Ghana Journal of Geography, 11*(1), pp. 124-139. DOI: https://dx.doi.org/10.4314/gjg.v11i1.8

Burns, A. (1999). *Collaborative Action Research for Language Teachers.* Cambridge University Press, Cambridge.

Claiborne, L., Morrell, J., Bandy, J., Bruff, D., Smith, G. & Fedesco, H. (2020). Teaching Outside the Classroom. *Vanderbilt University Center for Teaching.* Retrieved [04/04/2021] from https://cft.vanderbilt.edu/guides-sub-pages/teaching-outside-the-classroom/.

Dawnson, V., & Carson, K., (2013). Australian secondary school students' understanding of climate change. *Teaching Science, 59*(3), pp. 9-14.

Dike, S., (2014). *Opening Remarks Presented at the Train-the–Trainers Workshop on the Use of the Revised 9-Year Basic Education Curriculum* held at Rockview Hotel, Abuja Nigeria, 5-9th August, 2014.

Disha, M. (2016). *Evaluation in Teaching and Learning Process | Education.* Retrieved from https://www.yourarticlelibrary.com/statistics-2/evaluation-in-teaching-and-learning-process-education/92476

FAO, (2010). *Climate-Smart Agriculture Policies, Practices and Financing for Food Security, Adaptation and Mitigation.*

FAO. (2013). *Climate-Smart Agriculture Sourcebook. Food and Agriculture Organization of the United Nations, Rome.* Retrieved from http://www.fao.org/docrep/018/i3325e/i3325e04.pdf

Retrieved 02-03-2021

Florian, E.M. & Mercado. (2010). *Curriculum for Farmer Field Schools on Climate Smart Agriculture in Belize.* Retrieved from https://www.adaptation-undp.org/sites/default/files/resources/undp_curriculum_climate_smart_agriculture_belize.pdf

Global Partnership for Education. (2015). *Education.* Retrieved from http://www.globalpartnership.org/education.

Ibrahim D. S. (2011). Impact of climate change: The Need for Environmental Education. *Vunoklang Multi-Disciplinary Journal of Science and Technology Education (VMJSTE) (2011), 1*(1), pp. 68-72.

London School of Educational Management (2019). *The Three (3) Domains of Learning–Cognitive; Affective; And Psychomotor (Caps)–It's Application in Teaching and Learning.* Retrieved from https://lsme.ac.uk/

Mahajan, M. & Singh, M. S., (2017). Importance and Benefits of Learning Outcomes. *Journal of Humanities and Social Science, 22*(3), pp. 65-67 DOI: 10.9790/0837-2203056567

McPherson, S. (2018). Inclusive Participatory Learning with Social Media in the Curriculum. In E. Langran & J. Borup (Eds.), *Proceedings of Society for Information Technology & Teacher Education International Conference* (pp. 2301-2306). Washington, D.C., United States: Association for the Advancement of Computing in Education (AACE). Retrieved from https://www.learntechlib.org/p/182841.

Ololube N. P. (2008). Evaluation Competencies of Professional and Non-professional Teachers in Nigeria. *Studies in Educational Evaluation, 34*(1), pp. 44-51.

Orusha, J. O., Alukogu, C. T., Onogu, B., Nwaigwe, M. O., Ohuaka, P., & Tim-Ashama, A. (2012). Integrating climate change issues into agricultural education teaching and learning in Nigeria. *Advanced Research Journal of Educational Research and Review, 1*(5), pp. 57-67. http://beta.garj.org/garjerr/abstract/2012/June/Orusha.htm

Saguye, T. S. (2017). Assessment of Farmers' Perception of Climate Change and Variability and its Implication for Implementation of Climate-Smart Agricultural Practices; the case of Geze-Gofa District. *Southern Ethiopia Journal of Geography & Natural Disasters, 7*(191). pp. 1-9.

Shukla, A. (2021). *Teaching aids and Instructional materials-tools for teachers and students-Cognition Today.* Retrieved from https://cognitiontoday.com/teaching-aids-and-instructional-materials-tools-for-teachers-and-students/

Stufflebeam, D. L. (2007). *CIPP evaluation model checklist* (2nd ed.). Retrieved from http://www.wmich.edu/evalctr/archive_checklists/cippchecklist_mar07.pdf

The Essential Parts of a Strong Climate Change Curriculum. (2022). Chalk. Retrieved from https://www.chalk.com/resources/the-essential-parts-of-a-strong-climate-change-curriculum/

Tokmak, H. S., Baturay, H. M. & Fadde, P. (2013). *Applying the Context, Input, Process, Product Evaluation Model for Evaluation, Research, and Redesign of an Online Master's Program.* Retrieved from http://www.irrodl.org/index.php/irrodl/article/view/1485/2536

Tripp, D. (2005). Action research: a methodological introduction. *Education Pesqui, 31* (3), pp. 443-466.

Tuimur, H. N. & Chemwei, B. (2015). Availability and Use of Instructional Materials in The Teaching of Conflict and Conflict Resolution in Primary Schools in Nandi North District, Kenya. *International Journal of Education and Practice, 3*(6), pp. 224-234. DOI: 10.18488/journal.61/2015.3.6./61.6.224.234

Ukonze, J. (2020). Innovative Strategy for Measuring Skill Performance of Students of Agricultural Education for Sustainable Development in Nigeria. *International Journal of Innovative Research and Advanced Studies, 6*(7), pp. 1-12.

Umi, J. (2017). Student-Centred Learning and Teaching: Theoretical Versus Practical Approach. *European Journal of Education Studies, 3*(6)1-14. Doi: 10.5281/zenodo.581682

Wekesa, B. M., Ayuya, O. I. & Lagat, J. K. (2018). Effect of climate-smart agricultural practices on household food security in smallholder production systems: micro-level evidence from Kenya. *Agriculture & Food Security, 7*, pp. 80-92. https://doi.org/10.1186/s40066-018-0230-0

World Bank. (2021). *Climate-Smart Agriculture.* Retrieved from https://www.worldbank.org/en/topic/climate-smart-agriculture

Yembuu, B. & Getsel, U. (2017). *Curriculum Development on Climate Change Adaptation for Pre-Service Teacher Training in Mongolia.* Retrieved from https://www.researchgate.net/publication/317633915