



USE OF CLIMATE SMART AGRICULTURAL (CSA) PRACTICES AMONGST SMALLHOLDER FARMERS: IMPLICATIONS FOR AGRICULTURAL EXTENSION EDUCATION IN NIGERIA.

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ARTICLE INFO

Article History

Accepted on July, 2025

Keywords: greenhouse gases; climate change; climate-smart technology; extension education; climate education.

ABSTRACT

The study investigated farmers' perception about CSA practices, and examined their level and determinants of use, drawing implications for extension education in Nigeria. Three-stage sampling procedure was used to select 160 smallholder farmers in Nasarawa state, Nigeria. A structured interview schedule was used to elicit data, which were summarised with mean scores, while multiple linear regression was used for inferential deductions. Results showed that 29% received information about CSA practices from extension, 58% had formal education, and 65.8% were members of a farmers' association. Farmers opine that 'climate change is taking place' with 'drastic changes occurring in the past 5 – 15 years' and that 'climate change resulted in high temperature, and moisture reduction in soil'. Irrigation (0.65), crop rotation (0.60), mixed cropping (0.58), planting early maturing varieties (0.55) were most used CSA practices while the least used were green-house technology (0.06), construction of water retention structures (0.11), planting crop varieties requiring little water (0.21) and planting drought resistance varieties (0.18) with respective index scores in parenthesis. The significant determinants of use of CSA practices were knowledge (B=.202), education level (B=1.107) perception (B=0.120) at $p < 0.05$. The study concludes with implications of the findings for agricultural extension education and some recommendations.

Introduction

Climate change has continued to pose a serious threat to food security, and mostly in developing nations where agriculture serves as the main source of people's livelihood (Ani et al.,

2022; Abdulrahman et. al.,2021). As a result, the availability and accessibility of natural resources, such as land, water, and biodiversity that are essential for agricultural production, have been adversely affected, thus causing reduced crop yields and livestock productivity, thereby threatening farmers' livelihoods and well-being. (Okonkwo, 2018).

Agriculture is a major contributor to and victim of climate change. On one hand, it contributes to about 24% of the global greenhouse gas emissions that cause climate change, mostly from land use change, livestock production, fertiliser use, and rice cultivation. However, agriculture is highly sensitive and vulnerable to the adverse effects of climate change because of its dependence on the availability and quality of natural resources, such as land, water, and biodiversity. Climate change has an impact on the productivity and profitability of agricultural systems, as well as farmers' and consumers' food security and well-being (Wagner et al., 2020).

However, smallholder farmers must make use of climate-smart agricultural (CSA) practices to adapt to the changing climate and guarantee food security. According to Adika (2019), CSA practices are "agricultural practices that sustainability increase productivity, enhance resilience (adaptation), reduce/remove greenhouse gases (mitigation), while enhancing the achievement of national food security and development goals." CSA has the potential to lower greenhouse gas emissions and the environmental damage brought on by climate change while simultaneously increasing farmers' income, resilience, and productivity. It is worth noting that the use of climate-smart agricultural practices among smallholder farmers could be influenced by socioeconomic, institutional, and biophysical factors in the steps to improve the adaptive capacity of farmers and improve food security (Olooto et al., 2022).

Nigerian smallholder farmers have yet to embrace CSA practices (Musafiri et al., 2021). This might be due to farmers' lack of knowledge, skills, and awareness of climate change. It has been reported that agricultural extension education is essential for increasing farmers' ability to implement CSA practices and enhance their livelihood (Mashi et al., 2022). It also helps to equip farmers with the information and abilities they need to implement climate change-resilient, sustainable farming methods. Agricultural extension education is regarded as the process of providing information, training, and advisory services to farmers through various media and channels to improve their agricultural practices and livelihoods (Raidimi and Katibi, 2019). Agricultural extension education for CSA practices is that, which can help to increase the awareness, knowledge, and skills of smallholder farmers on CSA practices, as well as facilitate their access to inputs, markets, and policies that support CSA practices and their adoption. Better food security, adaptation, mitigation, and results for smallholder farmers and the environment can

result from this. Thus, this contributes to farmers' development of positive attitudes and behaviours regarding agricultural practices (Danso-Abbeam et al., 2018).

However, the availability of agricultural extension education to smallholder farmers is viewed as a threat to the adoption of agricultural practices, particularly those associated with climate-smart smart (Agwu Agwu Ejem, 2023). This study thus examined the use of climate-smart practices among smallholder farmers with the implications for extension education in Northern Nigeria.

Specific objectives of the study are to:

1. examine smallholder farmers' perception about climate change.
2. identify CSA used by the farmers
3. examine the determinants of use of CSA practices.

Methodology

The study was carried out in Nassarawa State, which is in the middle belt, or central region of Nigeria. The state is located between the Latitude: 8° 34' 13.854" longitude: 8° 18' 31.8384" E. The state is bordered to the north by Kaduna, to the east by Plateau State, and to the west by the Federal Capital Territory. It has a total land mass of about 27,137.8 km with a total of 13 Local Government Areas. Through the use of an interview schedule, the research employs purposive and random sampling methods. Two Local Government Areas (LGAs), Karu and Keffi LGAs, were purposely selected from the thirteen (13) Local Government Areas of Nasarawa State. The LGA's high concentration of smallholder farmers and the obvious effects of climate change served as the basis for the selection. Four communities in each of the LGAs were then chosen at random for the study. Finally, the study selected twenty (20) farmers randomly in each of the selected communities, making a sample size of 160 farmers. The response variable of the regression model, use of CSA practices, was measured on a 2-point scale Yes = 1 and No = 0, for used and unused CSA practices, respectively. The summated scale was used to obtain total 'used score', which was used as the dependent variable in the regression model. Perception was scored on a 5-point Likert-type scale: Strongly agree = 5, Agree = 4, Undecided = 3, Disagree = 2, and Strongly Disagree = 1. Respondents' responses were obtained using a semi-structured interview schedule, and inferential deductions were made using multiple linear regression and frequency counts and mean scores to summarise the data.

Results and Discussion

Results in Table 1 show that the smallholder farmers mostly had a favorable perception about changes in climate in the study area. More specifically, perceptual view of respondents and respective mean score obtained included: ‘climate change is taking place’ (4.48), with ‘drastic changes occurring in the past 5 – 15 years’(4.37), ‘climate changes has resulted into high temperature and moisture reduction on soil which lead to wilting of crop’ (4.52), ‘increase in rainfall due to climate change result into erosion and flooding causing crop destruction’ (4.39), ‘emergence of new strains of pest and diseases’ (4.29). The least weighted mean score (4.25) recorded was on ‘desert encroachment and destruction of the ecological system being caused by climate’. The findings of this study align with the findings of Moutouama et al. (2022) and Nyang’au et al. (2021), which revealed a similar perception of farmers on climate change. These suggest that farmers strongly perceive climate change impacts on agriculture, highlighting the need for targeted extension education on climate-resilient practices, adaptation strategies, and climate-smart agriculture to enhance farmer resilience and sustainability.

Table 1: Smallholder farmers’ perception about climate change

Perception statements	Mean	Std. D
I believe that climate change is currently occurring	4.48	.571
Climate change has been occurring very drastically over the last 5-15 years	4.37	.695
Climate change has led to increased temperatures and soil moisture reduction, resulting in crop wilting	4.52	.571
Increased rainfall due to climate change leads to erosion, flooding, and the destruction of crops	4.39	.681
The emergence of new strains of pests and diseases is linked to increasing temperature variations	4.29	.863
Desert encroachment is primarily caused by climate change and the destruction of ecological systems	4.25	.955
The increasing frequency and severity of droughts in our region are clear indicators of climate change	4.35	.529
Climate change impacts, such as droughts and unpredictable weather patterns, have negatively affected my farming activities	4.52	.624
The increased intensity of flooding has led to a decline and instability in agricultural production	4.55	.758
Climate change has contributed significantly to food insecurity and poverty in our community	4.56	.600

Source: Computed, 2023

Results in Table 2 show that the use of early maturing variety planting (0.55), crop rotation (0.60), irrigation (0.65), and mixed cropping (0.58) were the most frequently employed CSA practices by farmers in the study area. However, in descending order, the least popular methods were building water retention structures, planting drought-tolerant varieties, and planting flood-tolerant varieties (0.19). This is consistent with the findings of Moutouama et al. (2022), who found that early maturing varieties and crop rotation were the most common climate-smart practices employed by small-scale farmers. The findings imply that while farmers are adopting some climate-smart agriculture (CSA) practices like early maturing varieties, crop rotation, irrigation, and mixed cropping, there's a notable gap in the adoption of other crucial practices such as building water retention structures and planting drought/flood-tolerant varieties, suggesting a need for targeted extension services and training to promote more comprehensive CSA adoption.

Table 2: Distribution of respondents by climate-smart practices used

Practices	Percentage using the practices	Mean	Std. Deviation
Appropriate climate-tolerant varieties	51.6	.52	.501
Flood-tolerant varieties	18.6	.19	.391
Drought-tolerant varieties	18.0	.18	.385
Disease & Pest-tolerant Varieties	31.1	.31	.464
Early maturing varieties	54.7	.55	.499
Mixed Cropping	57.8	.58	.495
Integrated cropping system	13.0	.13	.338
Improved fallowing	9.9	.10	.300
Greenhouse technology	6.2	.06	.242
Crop Rotation	59.6	.60	.492
Rainwater harvesting	45.3	.45	.499
Irrigation	64.6	.65	.480
Soil and water conservation	15.5	.16	.363
Construction of water retention structures	11.2	.11	.316
Crops using little water	21.1	.21	.409
Planting Cover crops	24.2	.24	.430
Mulch cover	21.1	.21	.409

Source: Computed, 2023

Determinants of the use of CSA practices amongst the farmers

The results of the multiple linear regression analysis show that knowledge ($B = 0.202$), education ($B = 1.170$) and perception ($B = 0.120$) had significant and positive relationships with the use of CSA practices amongst smallholder farmers at $p < 0.05$. Conversely, farming experience ($B = -0.071$) had a significant but inverse relationship with the use of CSA practices. The overall model shows that 16.1 % variation in the dependent variable and is significant ($F = 3.657$) at $p < 0.01$. These results indicate that increasing farmers' knowledge, reshaping their perception through continuous climate education, would significantly enhance the use of CSA practices. The finding of this study corroborates those of Nyang'au et al. (2021) and Amir et al. (2020), which show that a high level of education and knowledge significantly influences the use of CSA practices among small-scale farmers. Asrat and Simane (2018) also noted that the perception of farmers has a significant influence on the use of climate change practices.

Table 3: Results of regression analysis on determinants of use of climate-smart practices amongst farmers

Regression Model	Unstandardized Coefficients		Standardized Coefficients	T	Sig.
	B	Std. Error	Beta		
(Constant)	-2.271	2.944		-.771	.442
Knowledge	.202	.068	.232	2.992	.003
Sex	.651	.718	.078	.906	.366
Education	1.170	.486	.190	2.408	.017
Perception	.120	.055	.178	2.181	.031
Undergone any training on climate-smart practices for more than 2 weeks in an institution	-.329	.317	-.084	-1.037	.301
Size of farm	.092	.109	.079	.846	.399
Farming experience	-.071	.037	-.186	-1.929	.056
Member of the farmers' association	-.433	.508	-.068	-.852	.396

Source: Computed, 2023

Implications for agricultural extension education in Nigeria

Given the study's findings, the following are some implications for extension service education in Nigeria:

1. **Improved Climate Change Education:** According to the study, Nigerian agricultural extension education programs must give climate change education top priority. Extension services should concentrate on increasing awareness and offering training on climate-smart agricultural practices, given farmers' perceptions of drastic climate changes and their effects on agricultural productivity.
2. **Targeted Knowledge Dissemination:** The results highlight the significance of using extension services to spread knowledge about climate-smart agricultural practices. Extension agents can help farmers adopt and implement CSA practices like crop rotation, irrigation, and mixed cropping by enhancing their knowledge of these techniques.
3. **Customised Educational Programs:** Efforts to educate Nigerian smallholder farmers should be adapted to their unique circumstances and needs. Creating specialised training materials, seminars, and exhibits that highlight regional climate issues and workable solutions may be one way to achieve this.
4. **Partnerships with Farmers' Associations:** To spread knowledge and encourage the adoption of CSA practices, agricultural extension organisations should work closely with farmers' associations, as a significant percentage of farmers are members of these organisations. Partnerships can help farmers learn from one another, share knowledge, and work together.
5. **Promotion of Innovative Technologies:** Extension services ought to aggressively support cutting-edge technologies that smallholder farmers have not fully utilised, like greenhouse technology and water retention structures. This could entail offering access, financial incentives, and technical support and access to resources to facilitate the adoption of these practices.
6. **Continuous Capacity Building** Agricultural extension education programs should place a high priority on ongoing capacity building among extension agents, given the important role that knowledge, education level, and perception play in determining the adoption of CSA practices. This entails giving them the most recent data, effective communication techniques, and resources necessary to interact with farmers on climate change issues.
7. **Policy Support and Advocacy:** At both the national and local levels, agricultural extension organisations ought to promote climate-smart agriculture-friendly policies and funding. This entails promoting financial resources, the construction of infrastructure, and institutional assistance to enable the broad implementation of CSA methods among Nigerian smallholder farmers.

Conclusion

This study underscores the importance of strengthening agricultural extension services to enhance smallholder farmers' resilience to climate change. In conclusion, investing in targeted climate change education, tailored extension programs, partnerships, and innovative climate-resilient practices is crucial for promoting sustainable agricultural productivity and adapting to climate change impacts.

Recommendations

The following suggestions are made for the study in light of the aforementioned:

1. More funding is required for agricultural extension services to improve outreach and education initiatives aimed at smallholder farmers regarding climate change.
2. Customised training materials and extension programs centred on climate-smart agricultural practices must be created, taking into consideration the unique requirements and environments of various farming communities.
3. To encourage information exchange and cooperative action on climate change adaptation, partnerships between government agencies, farmers' associations, research institutes, and agricultural extension organisations must be fostered.
4. The advancement of cutting-edge methods and technologies that boost agricultural productivity and climate resilience must be given top priority, taking into account the socioeconomic limitations smallholder farmers face.

References

- Abdulrahman, O.L., Adebayo, A.R. and Olatunde, P.F. (2021): Climate change and Insecurity in Nigeria. Proceedings of the 30th Annual National Congress of the Rural Sociological Association of Nigeria. <https://rusan.org.ng/proceedings/30th.pdf>. Pp 122-125
- Amir, S., Saqib, Z., Khan, M.I., Ali, A., Khan, M.A., Bokhari, S.A., Zaman ul Haq, M (2020): Determinants of adaptation to climate change in rain-fed agriculture of Pakistan. Arabian Journal of Geosciences. September 2020. 13(19). DOI: [10.1007/s12517-020-06019-w](https://doi.org/10.1007/s12517-020-06019-w)
- Ani, K.J., Anyika, V.O. and Mutambara, E. (2022), "The impact of climate change on food and human security in Nigeria", *International Journal of Climate Change Strategies and Management*, Vol. 14 No. 2, pp. 148-167. <https://doi.org/10.1108/IJCCSM-11-2020-0119>
- Asrat, P. and Simane, B. (2018): Farmers' perception of climate change and adaptation strategies in the Dabus watershed, North-West Ethiopia. Ecological Processes (2018) 7:7 <https://doi.org/10.1186/s13717-018-0118->

- Danso-Abbeam, G., Ehiakpor, D.S. & Aidoo, R. Agricultural extension and its effects on farm productivity and income: insight from Northern Ghana. *Agric & Food Secur* 7, 74 (2018). <https://doi.org/10.1186/s40066-018-0225-x>
- Ejem, A. A., Aremu, C., Olanrewaju O.P., Ajakaiye, A., Ben-Enukora, C., A., Akerele-Popoola, O., Ibiwoye, T. I., A., Olaniran, A.F. (2023). Perspectives on communicating 21st-Century agricultural innovations to Nigerian rural farmers. *Journal of Agriculture and Food Research* 11, pages 100511. www.sciencedirect.com/journal/journal-of-agriculture-and-food-research
- Mashi, S.A., Inkani, A.I and Obaro, D.O. (2022): Determinants of awareness levels of climate Smart Agricultural Technologies and Practices of Urban Farmers in Kuje, Abuja, Nigeria. *Technology in Society*. 70(2020).
- Moutouama, F.T.; Tepa-Yotto, G.T.; Agboton, C.; Gbaguidi, B.; Sekabira, H.; Tamò, M. Farmers' Perception of Climate Change and Climate-Smart Agriculture in Northern Benin, West Africa. *Agronomy* 2022, 12, 1348. <https://doi.org/10.3390/agronomy12061348>
- Musafiri, C. M., Kiboi, M., Macharia, J., Ng'etich, O. K., Kosgei, D. K., Mulianga, B., Okoti, M., & Ngetich, F. K. (2021). Adoption of climate-smart agricultural practices among smallholder farmers in Western Kenya. 7(12), e08432.
- Nyang'au JO, Mohamed JH, Mango N, Makate C, Wangeci AN. Smallholder farmers' perception of climate change and adoption of climate-smart agriculture practices in Masaba South Sub-county, Kisii, Kenya. *Heliyon*. 2021 Apr 21;7(4):e06789. doi: 10.1016/j.heliyon.2021.e06789. PMID: 33981877; PMCID: PMC8085708.
- Olooto, F. M., Abdulrahman, O.L. and Bello, O. G. (2022): Constraints to the Use of Climate-Smart Agriculture Practices among Small-Holder Farmers in Kwara State, Nigeria. 27th Proceedings of the Annual Conference of the Agricultural Extension Society of Nigeria held at Nnamdi Azikiwe University Awka, ISSN: 1595 – 1421. Pp 90-97
- Raidimi and Katibi 2019): Raidimi, E.N. and Katibi, H.M. (2019):. A Review of the role of Agricultural Extension and Training in achieving sustainable food security: A case of South Africa. Vol. 47 No. 3, 2019: 120 – 130. <http://dx.doi.org/10.17159/2413-3221/2019/v47n3a520>
- Wagner, B., Baker, P. J., Stewart, S. B., Lumsden, L. F., Nelson, J. L., Cripps, J. K., Durkin, L. K., Scroggie, M. P., & Nitschke, C. R. (2020). Climate change drives habitat contraction of a nocturnal arboreal marsupial at its physiological limits. *Ecosphere*, 11(10), e03262.