Proceedings of the Annual Conference of the Agricultural Extension Society of Nigeria
Number: Twenty-Ninth Annual Conference
Theme: Leveraging the Dynamics of Agricultural Extension Policies and Practices for Sustainable Development
Date: 21-24 April 2024
Venue: Federal University of Technology Akure, Nigeria
ISSN: 1595 – 1421.
Website: https://info@ajol.org.
Email: agricultural.extension.nigeria@gmail.com ; editorinchief@aesonnigeria.org

Use of climate-smart agricultural practices among smallholder farmers in Ogun State, Nigeria

https://dx.doi.org/10.4314/jae.v29i1.24S

Ojo Ibukun Elizabeth[1*], Kolawole Ayorinde Ebenezer.[2], Owolabi Ayotunde Olayinka[3], Obaniyi Kayode Samuel[4], Ayeni Matthew Durojaiye[5], Adeniyi Victoria Abosede[6], and Ogundipe Kanyinsola Racheal[7]

Landmark University, Omu-aran, Kwara State, Nigeria[1,2,3,4,5,6,7]

Department of Agricultural Economics and Extension,[1,2,3,4,5,6,7]

Landmark University SDG 13 (Climate Action Research group) [1,2,3,5]

Landmark University SDG 15 (Life on Land Research group)[1,4,6,7]

*Correspondence and presenting author:
[1]ojo.ibukun@lmu.edu.ng; +2347030290309
[2]kolawole.ayorinde@lmu.edu.ng, +2348068463024;
[3]owolabi.ayotunde@lmu.edu.ng, +2348032298663;
[4]obaniyi.kayode@lmu.edu.ng, +2347031267163;
[5]ayeni.matthew@lmu.edu.ng, +2348033771313;
[5]adeniyi.vitoria@lmu.edu.ng, +2347030263950;
[5]ogundipe.kanyinsola@lmu.edu.ng, +2348183119345

Abstract

The study assessed the use of climate-smart agricultural practices among smallholder farmers in Ogun state, Nigeria. A multistage sampling procedure was used to select 180 respondents. Data collected were analysed using frequency, percentage, mean, and Pearson product-moment correlation. The majority (70.6%) of the respondents indicated that the source of information on climate-smart agricultural practices was extension agents. All (100.0%) indicated they use minimum tillage, crop rotation, and mulching respectively, cover crop (81.1%), mixed cropping (82.2%), and integrated pest management (80%). Constraints limiting the use of climate-smart practices were: lack of supportive government policy ($\bar{x}$ = 2.69), insufficient access to credit ($\bar{x}$ = 2.60), lack of finance to adopt technology ($\bar{x}$ = 2.27), and lack of information ($\bar{x}$ = 2.28). Annual income (p= 0.028), education (p= 0.000, and contact with extension services (p= 0.000) had significant and positive correlation with the use of climate-smart agricultural practices by the farmers. The study recommends that the government should implement policies that support CSA practices and improve extension service delivery to increase farmers' use of climate-smart practices.

Keywords: Climate-smart agriculture, smallholder farmer, use

Introduction

Agriculture plays a vital role in the fight against extreme poverty and hunger, as it is the primary source of income for approximately 1.6 billion rural smallholder farmers (Ahmadzai et al., 2021). Nonetheless, this sector remains extremely vulnerable to climate change, disproportionately affecting small-scale farmers due to their poverty, reliance on natural resources, and inability to adopt new livelihood strategies (Tofu *et al*., 2022). In Nigeria, smallholder farmers are primarily situated in rural regions and rely heavily on agriculture, which serves as the backbone of Nigeria's economy, and contributes about 23.35% of the country's total Gross Domestic Products (FAO, 2021). The United Nation Conference on Trade and Development (UNCTAD) defined smallholder farmers as those who cultivate 2 ha or less of land and are characterized by the type of crops grown and the labour utilization, as well as restricted market access and financial resources. Despite these limitations, these vital farmers bear the burden of producing a significant portion of sustenance in impoverished and emerging nations while serving as the backbone for national food security. Hence, UNTCAD highly recommends that achieving food security relies on the continued active participation of smallholder farmers in reducing hunger and poverty through their role in food production. (Chiaka et al., 2022).

These farmers however face formidable challenges in their pursuit of sustainable livelihoods, with a majority of them living on less than $2 a day (World Bank, 2023). Small-scale farmers are also vulnerable to the effects of climate change due to their inadequate agricultural management skills and limited access to superior irrigation infrastructure (Mthethwa, Ngidi, Ojo, & Hlatshwayo, 2022). Climate change has emerged as one of the greatest threats to global agriculture, impacting it in a variety of ways, including altered precipitation patterns, rising global average temperatures, insect and disease infestations, and alterations in the nutritional composition of certain crops (Shrestha, 2019). Since 1975, the mean global temperature has risen at a consistent pace of 0.15-0.20 °C per decade. (NASA, 2020)

The implications of climate change on agricultural production in Africa are profound, compelling farmers to implement measures of mitigation and adaptation. Igene, Onymekonwu, & Belonwu, (2023). Agricultural production in Nigeria is currently impacted by the effects of climate change resulting in catastrophic events such as storms, droughts, floods, and forest fires. These occurrences have ultimately led to decreased crop yield, widespread hunger and poverty, as well as a significant decline in farmer income. Hence smallholder farmers in Nigeria need to adopt climate-smart practices, because of the heavy reliance on rain-fed agriculture. More so, adopting climate-smart agriculture (CSA) is imperative for creating resilient agricultural systems and equipping smallholder farmers with the necessary tools to mitigate and adapt to the consequences of climate change (Mthethwa, et al., 2022).

According to the Food and Agriculture Organization (FAO), agricultural practices must be "climatic smart" in order to nourish the global population while promoting lasting development in rural regions. By implementing the Climate-Smart Agriculture (CSA) approach, we can cultivate ideal conditions for sustained growth in agriculture amidst a changing climate. CSA prioritizes three crucial objectives: augmenting agricultural output and profits, fortifying resilience against climate change impacts, and mitigating harmful greenhouse gas emissions - all with the overarching goal of advancing national food security and development efforts (FAO, 2022). Climate-smart goal is to ensure food security in the face of climate change and increasing dietary demands. Climate-smart agriculture include use of improved crop variety, mulching, use of organic manures, crop rotation, site specific nutrient management, mixed cropping, non-farm income amongst others. Therefore, CSA is an agricultural practice that contributes to the achievement of sustainable development goals (Mutengwa et al., 2023; Ojo et al., 2024).

Despite the numerous benefits associated with CSA practises their adoption has been reported to be low generally, especially in Africa including Nigeria (Makate, 2019; Wahab, Abubakar, Angara, Qasim, & Yakubu, 2020) and also been hampered by a number of obstacles, including limited access to finance and markets, a lack of knowledge and skills, and inadequate policy support (Ogunyiola *et al*., 2022; Adeagbo et al., 2023).

Efforts to enhance agricultural productivity necessitate the incorporation of climate-smart agricultural practices as shown by numerous studies (Adeagbo et al.,2023; Adeagbo, Ojo, & Adetoro, 2021; Ojo & Baiyegunhi 2021; Mogaka, & Muriithi, 2021; Abegunde, Sibanda, & Obi, 2019). All these are evidence of the utilization of these practices among the farmers. Nonetheless, there is still a need to assess the use of the climate-smart adaptation practices among the smallholder arable crop farmers owing to their contribution to food security in the community, hence the need for this study. Also owing to the fact that, research has shown that some agricultural zones in Ogun state are vulnerable to climate change (Fatoki, Adesope, Awe, & Arowolo, 2020; Akano, Modirwa, Oluwasemire, & Oladele, 2023). It is pertinent to know that without adoption sustainable development goal 2(zero hunger will not be achieved, thus leading to food insecurity in the country. The study assessed the use of CSA practices among smallholder farmers in Ogun state, Nigeria. Specifically, the study identified the source of information on CSA practice by the smallholder farmers, assessed the use of CSA practices among smallholder farmers, and identify the constraints faced by smallholder farmers in the use of CSA practices.

Methodology

The study was carried out in Ogun state, Nigeria. The state is located between latitudes 6.2°N 7.8°N and Longitude 3.0°E and 5.0°E. It consists of 20 local government areas that are home to an estimated 3,728,098 people (Federal Republic of Nigeria, 2009) (Obayelu *et al*., 2015). The Ogun state Agricultural Development Project (OGADEP) has partitioned the state into four distinct agricultural zones in order to optimize the provision of agricultural extension services. These regions are: Abeokuta Zone, Ijebu Ode Zone, Ilaro Zone, and Ayetoro Zone. The designated zones within Ogun State encompass distinct local government areas and prioritize customized agricultural initiatives and extension services to assist farmers in their respective regions (Oyawole, Ojo, Aminu, & Oyawole, 2022)

A multistage sampling procedure was employed in selecting the respondents. Stage one involved random selection of Abeokuta zone from the four zones in Ogun state. The next phase involved the random selection of two blocks which include Ilewo and Ilugun out of the six blocks in the Abeokuta zone. In stage three, simple random sampling method was used to select three cells from each of the blocks, and the cells selected include Ibara Orile and Isaga Ilewo, and Oluwo for Ilewo Block and Kila, Olodo, and Osiele for Ilugun Block. In the final phase, thirty farmers from each of these cells were selected using a random sampling technique, making a sample size of one hundred and eighty (180) respondents.

Primary data were obtained through the administration of well-structured questionnaire after validated by expert in the department of agricultural economics and extension. The questionnaire was used to obtain information such as socio-economic characteristics, source of information, and constraints limiting the use of CSA practices. Source of information were measured using Yes and No, and constraints was measured using the three-point scale of not a constraint (0), minor constraints (1), and major constraints (2) to get a mean score of 1, and the mean score was used to rank the constraints. The dependent variable which is the level of use of CSA practices by the respondents was measured using awareness and use of the CSA practices. The socio-economic characteristics, source of information, and constraints limiting the use of CSA practices were analysed using descriptive statistics. The Pearson Product

Moment Correlation (PPMC) was used to test the relationship between selected socio-economic characteristics and uptake of CSA practices.

Result and Discussion

Source of information

Table 1 reveals that the majority (70.6%) of the farmers got information on climate-smart agricultural practices from extension agents. This indicates that extension services are effective and trusted channels for disseminating climate-smart agricultural practices to farmers. This finding is in line with Yusuf, Shuaib, & Nofiu, (2022) who reported that extension agents were one of the most common sources farmers use to obtain agricultural information. However, less than half of the respondents sourced information from neighbours and friends (44.3%)., suggesting an opportunity for advancement. Solidifying community-based information networks has the potential to enhance peer learning and aid in supporting one another. Meanwhile, the farmers reported television (44.4%), radio (36.1%), and mobile phones (31.7%) as alternative means of accessing information. The limited utilization of these sources could be attributed to deficient network coverage, and inadequate access to electricity impeding the operation of televisions, radios, and mobile phones. Furthermore, for certain farmers, the exorbitant expenses associated with possessing and maintaining such devices may act as a deterrent. This corroborates with the findings of Ifeanyi-Obi, & Corbon, (2023) that erratic power supply is one of the major challenges faced in using digital tools to disseminate information to farmers.

Table 1: Source of information

Source of information	Percentage (n=180)
Radio	36.1
Television	44.4
Mobile phone	31.7
Extension agent	70.6
Neighbours & friends	48.3

Source: Field survey, 2023

Use of climate-smart agricultural practices

Table 2 shows the utilization of climate-smart adaptation strategies among smallholder farmers. The result in the Table revealed that the climate-smart agricultural techniques mostly used by all respondents were minimum tillage (100%), crop rotation (100%), and mulching (100%). This could be attributed to the fact that all the farmers are aware and knowledgeable of the benefits of using those practices, hence promoting their continuous usage. This is in line with Emmanuel & Oba, (2019) that minimum tillage is the CSA practice mostly used by farmers in Ogun state. This finding also agrees with Akinnagbe & John, (2023) that mulching is one of the conservative practices used by farmers in Oyo state.

A larger percentage of the respondents use compost or farm yard manure (89.4%), planting cover crops (81.1%), mixed cropping (82.2%), and fertilizer application (69.4%). This could be because most of these practices help to increase soil fertility and reduce the risk of crop failure. This suggests that most of these practices such as mixed cropping, fertilizer application among others have been proven to be effective in adapting to climate change in the past. This is in consonance with Aliyu et al., (2021) that concurrent cultivation of two or more crops on a single piece of land has been identified as a practice that fosters both conservation agriculture and sustainable agricultural intensification. The finding is also in tandem with Ayeni, Owolabi, Ayeni & Alhassan, (2023) that utilization of both organic manure and inorganic fertilizers were the commonly adopted climate-smart practices among arable crop farmers in Nigeria. Furthermore, more than half of the respondents employed integrated pest management (IPM) (61.1%), construction of water channels (62.2%), irrigation (56.7%), and pest and disease free varieties (53.3%).

Although, a low proportion of the farmers employed water harvesting (31.1%), agro-forestry (38.9%), micro-dosing (42.2%), use of early maturing variety (11.1%), and drought-tolerant crop varieties (11.1%), none of the respondents used site-specific nutrient application (0.00%). The limited usage could be attributed to the inadequate dissemination of knowledge by the extension agents. This highlights the need for increased efforts to educate farmers on the benefits of these practices. This aligns with (Ojo, Akangbe, & Owolabi, 2023) which highlight the low competence of extension agents in disseminating information on site-specific nutrient applications to farmers.

Table 2: Climate-smart adaptation practices used by smallholder farmers

Climate-smart adaptation practices	(%)
Minimum tillage	100
Planting of cover crops	81.1
Use of pest and disease free varieties	53.3
Mixed cropping	82.2
Early maturing variety	11.1
Integrated pest management:	61.1
Crop rotation.	100
Use of drought-tolerant crop varieties.	11.1
Soil enrichment practices	
Mulching	100
Compost or farm yard manure	89.4
Fertilizer application	69.4
Micro-Dozing	42.2
Site- Specific Nutrient Application	0.0
Agro-forestry	38.9
Water management	
Irrigation	56.7
Water harvesting	31.1
Construction of water channel	62.2

Source: Field survey, 2023

Constraints to the use of climate-smart agricultural practices

Table 3 shows that lack of supportive government policy ($\bar{x}$ = 2.69), insufficient access to credits ($\bar{x}$ = 2.60), lack of finance to adopt technology ($\bar{x}$ = 2.27), lack of information ($\bar{x}$ = 2.28), limited access to extension service ($\bar{x}$ = 1.99), lack of technical know-how ($\bar{x}$ = 1.79) and land tenure system issues ($\bar{x}$ = 1.79) were the major constraints to the use of CSA practices. This implication of this finding is that unfavourable government policy may limit farmers from using certain CSA practices. Likewise some of the CSA practices such as irrigation, construction of water channel may be quite costly. Thus the finding suggests the need to provide smallholder farmers with adequate information, financial incentives, and adequate extension services. In addition practicing good land tenure system and formulating favourable government policy will facilitate the use of CSA practices. This agrees with Awe et al., (2023), that access to credit is one of the major factors influencing the adoption of multiple climate-smart agricultural practices. The result is also in tandem with Kehinde, et al., (2022) that farmers will concurrently invest less and try to extract maximum value from land resources if they are unsure about the security of their tenure.

Table 3: Constraints to the use of climate-smart agricultural practices

Constraint Statement	Mean	Standard Dev.
Lack of supportive government policies.	2.69	.462
Insufficient access to credits	2.60	.657
Lack of information	2.28	.610
Lack of finance to adopt the technology	2.27	.648
Limited access to extension service	1.99	.467
Lack of technical know-how	1.79	.701
Land tenure system issues.	1.19	.393

Source: Field survey, 2023

Correlation between Socio-economic characteristics and use of climate-smart agricultural practices

The results in Table 4 indicate that education (p= 0.000), shows a strong positive and significant correlation with the use of CSA practice. This suggests that increase in level of education will result in increase in the use of CSA practices by farmers. This is because education has a way of influencing an individual thinking capacity. This finding is similar to Tadesse & Ahmed (2023) that higher levels of education positively influence the adoption of sustainable agricultural practices among smallholder farmers.

Additionally, annual income (p= 0.028) had a positive and significant correlation with the use of CSA practice, this suggests that the higher the farmers annual income, the higher the use of CSA practices by the farmers. This finding aligns with (Adisalem & Dinku, 2021; Wu's 2022) assertion that the adoption or utilization of new agricultural technology may be influenced by the financial resources available to the farmer's household. Finally, contact with extension agent (p= 0.000), had a positive and significant correlation with the use of CSA practice, this suggests that the more contact the farmers have with extension agents the higher the adoption of CSA practices. The finding is in tandem with Mogaka & Muriithi (2021) that agricultural extension contacts are positively correlated with the use adoption of conservation agriculture by farmers.

Table 4: Correlation analysis of socio-economic characteristics and use of CSA practices

Socio-economic characteristics	R-value
Age	-0.080
Education	0.784 *
Annual income	0.163*
Years of experience	-0.096
Farm size	0.057
Contact with extension agents	0.584*

*P≤0.05. Source: Field Survey, 2023

Conclusion and recommendation

The climate-smart agricultural practices mostly used by smallholder farmers were minimum tillage, crop rotation, mulching, mixed cropping, planting of cover crops, compost and integrated pest management. The use of CSA practices was largely influenced by educational level, annual income and contact with extension agents. Constraints to the use of CSA practices were lack of supportive government policies, insufficient access to credit, lack of information and lack of finance to adopt the technology. The major source of information was the extension personnel followed by neighbours and friends, while mobile phones, television and radio were rarely sourced.

The national and state ministries of agriculture should provide effective and reliable access to timely information on CSA practices that farmers can use to adapt easily to climate change. Also, policymakers should provide support and fund extension services, develop infrastructure for better mobile connectivity in rural areas, and create educational content for TV and radio that is accessible and understandable to farmers.
Given the reliance on extension agents, there might be a need for ongoing training and capacity building for these agents to ensure they are up-to-date with the latest climate-smart agricultural practices and can effectively communicate them to farmers.

References

Abegunde, V. O., Sibanda, M., & Obi, A. (2019). Determinants of the adoption of climate-smart agricultural practices by small-scale farming households in King Cetshwayo District Municipality, South Africa. Sustainability, 12(1), 195.

Adeagbo, O. A., Bamire, A. S., Akinola, A. A., Adeagbo, A. D., Oluwole, T. S., Ojedokun, O. A., & Emenike, C. U. (2023). The level of adoption of multiple climate change adaptation strategies: Evidence from smallholder maize farmers in Southwest Nigeria. Scientific African, 22, e01971.

Adeagbo, O. A., Ojo, T. O., & Adetoro, A. A. (2021). Understanding the determinants of climate change adaptation strategies among smallholder maize farmers in South-west, Nigeria. Heliyon, 7(2).

Adisalem, S. T., & Dinku, A. M. (2021). Determinants of inorganic fertilizer use by smallholder farmers in South Wollo and Oromia special administrative zones, Ethiopia. Journal of Agricultural Extension, 25(4).

Ahmadzai, H., Tutundjian, S., & Elouafi, I. (2021). Policies for sustainable agriculture and livelihood in marginal lands: a review. Sustainability, 13(16), 8692

Akano, O., Modirwa, S., Oluwasemire, K., & Oladele, O. (2023). Awareness and perception of climate change by smallholder farmers in two agroecological zones of Oyo state Southwest Nigeria. GeoJournal, 88(1), 39-68.

Akinnagbe, O. M., & John, A. M. (2023). Use of Conservation Practices among Arable Crop Farmers in Oyo State, Nigeria. Journal of Agricultural Extension, 27(2), 104-113.

Aliyu, Mustapha & Ibilewa, Dada & Odiji, Caleb. (2021). Mixed Cropping: Food Security Solution for Developing Countries. Volume VI. 2454-6194. https://doi.org/10.51584/IJRIAS

Awe, T., Bamiro, O., Shittu, A., Kehinde, M., Olugbenga, O., & Abigail, A. (2023, April). Factors Affecting the Adoption of Multiple Climate-Smart Agricultural Practice in North-Central, Nigeria. In 2023 International Conference on Science, Engineering and Business for Sustainable Development Goals (SEB-SDG) (Vol. 1, pp. 1-7). IEEE.

Ayeni, M. D., Owolabi, A., Ayeni, O. T., & Alhassan, Y. J. (2023, April). Climate Smart Agriculture Strategies among Crop Farmers in North Central Nigeria: Implication on farm Productivity. In 2023 International Conference on Science, Engineering and Business for Sustainable Development Goals (SEB-SDG) (Vol. 1, pp. 1-8). IEEE.

Food and Agriculture Organization (FAO, 2022). Climate Smart Agriculture: Managing ecosystem for Sustainable Livelihoods. www.fao.org/climatechange/climatesmart (accessed on 30 June 2022).

Hossain, A., Krupnik, T. J., Timsina, J., Mahboob, M. G., Chaki, A. K., Farooq, M., Bhatt, R., Fahad, S., & Hasanuzzaman, M. (2020). Agricultural land degradation: processes and problems undermining future food security. In Environment, climate, plant and vegetation growth (pp. 17– 61). Springer.

Ifeanyi-Obi, C. C., & Corbon, B. L. (2023). Utilization of digital tools in extension service delivery amongst extension agents in Akwa Ibom State, Nigeria. Journal of Agricultural Extension, 27(4), 67-76.

Igene, C. A., Onymekonwu, R. C., & Belonwu, N. E. (2023). Assessment of climate change adaptation strategies used by rural farmers in edo state, nigeria. Journal of Agriculture and Environment, 19(1), 85-94.

Kansiime, M. K., Alawy, A., Allen, C., Subharwal, M., Jadhav, A., & Parr, M. (2019). Effectiveness of mobile agri-advisory service extension model: Evidence from Direct2Farm program in India. World Development Perspectives, 13(February), 25–33. https://doi.org/10.1016/j.wdp.2019.02.007

Makate, C. (2019). Effective scaling of climate smart agriculture innovations in African smallholder agriculture: A review of approaches, policy and institutional strategy needs. Environ. Sci. Policy,.96, 37–51.

Mogaka, H. R., & Muriithi, L. N. (2021). Factors affecting multiple climate change adaptation practices of smallholder farmers in lower Eastern Kenya. Journal of Agricultural Extension, 25(4).

Mthethwa, K. N., Ngidi, M. S. C., Ojo, T. O., & Hlatshwayo, S. I. (2022). The determinants of adoption and intensity of climate-smart agricultural practices among smallholder maize farmers. Sustainability, 14(24), 16926

Mutengwa, C. S., Mnkeni, P., & Kondwakwenda, A. (2023). Climate-Smart Agriculture and Food Security in Southern Africa: A Review of the Vulnerability of Smallholder Agriculture and Food Security to Climate Change. Sustainability, 15(4), 2882

NASA Earth Observatory(2020). Goddard Space Flight Centre United States. Available online: www.earthobservatory.nasa.gov (accessed on 15 May 2020)

Ogunyiola, A., Gardezi, M., & Vij, S. (2022). Smallholder farmers' engagement with climate smart agriculture in Africa: role of local knowledge and upscaling. Climate Policy, 22(4), 411-426.

Ojo, I. E., Akangbe, J. A., & Owolabi, A. O. (2023). Needs of Extension Agents on Techniques for Climate-Smart Rice Production in North-Central, Nigeria. *Journal of Agricultural Extension*, *28*(1), 86-92.

Ojo, I., Akangbe, J., Kolawole, A., Owolabi, A., Obaniyi, K., Ayeni, M., & Adeniyi, V. (2024). Constraints Limiting the Effectiveness of Extension Agents in Disseminating Climate-Smart Agricultural Practices among Rice Farmers in North-Central Nigeria. *Frontiers in Climate*, *6*, 1297225.

Oyawole, F. P., Ojo, A. M., Aminu, R. O., Oyawole, G. A. (2022). Adoption of good agricultural practices among cotton farmers in Ogun State, Nigeria. Journal of Agriculture and Human Ecology, Vol 6 No 2, . Shrestha, S. (2019). Effects of climate change in agricultural insect pest. Acta Sci. Agric, 3(12), 74–80.

Tadesse, B., & Ahmed, M. (2023). Impact of adoption of climate smart agricultural practices to minimize production risk in Ethiopia: A systematic review. Journal of Agriculture and Food Research, 100655.

Tofu, D. A., Woldeamanuel, T., & Haile, F. (2022). Smallholder farmers' vulnerability and adaptation to climate change induced shocks: The case of Northern Ethiopia highlands. Journal of Agriculture and Food Research, 8, 100312.

World Bank. (2023, February 25). A year in the lives of smallholder farmers. Retrieved from https://www.worldbank.org

Wahab, A. A., Abubakar, J. A., Angara, U. A., Qasim, O. A., & Yakubu, A. A. (2020). Adoption of climate-smart agricultural practices among smallholder farmers in the northwest agro-ecological zone of Nigeria. Nigerian J Agricultural Ext, 21(4), 39-45.

Chiaka, J. C., Zhen, L., Yunfeng, H., Xiao, Y., Muhirwa, F., & Lang, T. (2022). Smallholder farmers contribution to food production in Nigeria. Frontiers in Nutrition, 9, 916678.

Wu, F. (2022). Adoption and income effects of new agricultural technology on family farms in China. PLoS One, 17(4), e0267101.

Yusuf, O. J. , Shuaib, S. B., & Nofiu, N. B. (2022). Assessment of Agricultural Information Needs and Accessibility Methods Used by Smallholder Farmers in Ilorin West Local Government Area, Kwara State, Nigeria. 21(4).