Women's Participation in Climate Smart Agriculture (CSA) in Southeast, Nigeria

C. C Apeh[1], I. K Agbugba[2], A. C Apeh[3], R. A Okere[4], C Mzuyanda[5]

Correspondence author: apehchikamso@yahoo.com

Abstract

Climate change (CC) impacts are complex, it affects ecosystems and crops growth and development. Farmers must understand its potential impacts on their crops and climate-smart measures that they can implore to be able to adapt such as the gender approach in the development of CSA policies. This study aimed at identifying the traditional CC adaptation information-sharing mechanisms and the CSA practices adopted by female farmers in Southeast, Nigeria. A well-structured questionnaire was used to collect data from 300 female farmers using a double huddle sampling technique. Data were analysed using descriptive statistics and a Likert scale method on a four-point Likert-type scale with a 2.5 decision point. Descriptive statistics result showed that most of the female farmers were young, with the mean average age of 28 years. The result of the Likert scale show that farmers relied on community leaders (mean=3.27), women groups (mean=2.68) and relatives (mean=4.05) for direction on immediate climate adaptive measures. It further identified high-yielding crop varieties (mean=3.06), crop diversification (mean=3.08), change in planting calendar (mean=2.96), fertilizers and manure application (mean=4.35), minimum/zero tillage (mean=3.06), cover cropping (mean=2.80), mulching (mean=3.18), fallowing (mean=2.81), mixed cropping (mean=2.74) and crop rotation (mean=2.54) as CSA practices used by farmers to enhance their yield and CC resilience. There is a need for CC solutions to start with the human dimensions in recognition of women as participants and contributors. Equally, CC should be tackled through a gender lens in defining, designing and implementing CSA activities that centre around: enhanced women's access and control of agricultural productive resources; equal access to information and services, and enhanced ability to innovate in response to evolving climate challenges and opportunities.

Keywords: *climate vulnerabilities, climate-smart agriculture, sustainable agriculture, women farmers, gender equality, women empowerment*

[1]Department of Agricultural Economics, University of Agriculture and Environmental Sciences, Umuagwo, Imo State, Nigeria

[2]Department of Agricultural & Applied Economics, Faculty of Agriculture, Rivers State University, Port Harcourt, Nigeria

[3]Department of Mass Communication, Enugu State University of Science and Technology, Enugu, Nigeria

[4]Agricultural Economics Division, Nigerian Institute for Oil Palm Research, Benin, Edo State, Nigeria,

[5]School of Agricultural Sciences, University of Mpumalanga, Mbombela, 1200, South Africa

Introduction

Climate change is a serious threat to national development in developing countries and globally. With about 4% contribution to global greenhouse gas (GHG) emissions, developing countries are the most vulnerable and adversely affected by climate alteration due to their low economic and technological advancement (MoGD, 2012). Climate change causes are mainly man-made. Its impact on agriculture is very high, especially in developing countries whose agriculture largely depends on rainfall and climate (IPCC, 2014; Nzeadibe *et al*., 2011; Williams *et al*., 2015).

Any climate alteration may result in low agricultural productivity which may adversely affect the food supply and income of smallholder farmers who depend solely on subsistence agriculture (Mutoko *et al*., 2015). Female farmers are even worse off and least capable of dealing with the adverse effects of climate change compared to men who are culturally, economically and socially advantaged (Onah et al., 2023). This alteration in climate if not abated would continue to limit the capacity of agriculture as a major food supplier. Therefore, a climate-smart measure needs to be taken in agriculture to abate the adverse effects of climate change on agriculture (Tiamiyu *et al*., 2018).

This climate-smart measure in agriculture according to FAO is called Climate Smart Agriculture (CSA) (FAO, 2010). It involves the reorientation of agricultural approaches to help farmers deal with the impacts of climate change to sustainably maximize production, improve resilience (adaptation) and minimize greenhouse gas emissions (mitigation) (FAO, 2013). It covers agricultural practices mainly focusing on farmers' adaptation to specific climatic alterations, and practices that concurrently minimize production risks and reduce GHG emissions. The majority of these practices help in preserving the environment by reducing carbon emissions into the atmosphere, boosting soil and water conservation; and enhancing agricultural productivity. This agricultural approach involves all gender but more attention should be given to female farmers given the unequal impacts of climate change on them and their critical role in the Nigeria agricultural sector. Female farmers account for about 70% of food production in Nigeria which involves the cultivation, processing and marketing of agricultural products (Ekong, 2003). Though, there might not be a consensus on the level of contribution to food security in the country it has been empirically proven that women contribute significantly to agricultural production and food security (Mougeot, 2000; de Zeeuw, 2004; Adedayo & Tunde, 2013).

The agricultural sector in Nigeria may be underperforming today because women who represent a crucial and fundamental resource in the sector are often marginalized (FAO, 2011). The persistent existence of a wide gender gap between women and men in access and control of agricultural production assets, and the discrimination against them throughout history, are presently comprehended as a hindrance in both national and international development agendas (Aina, 2011). Gender gaps have been identified in

access and control over the six major factors of agricultural production or inputs: land, labour, credit, extension services, information, and technology (World Bank, 2009; Sheahan & Barrett, 2014). However, if women were given the same enabling environment as their male counterparts, they would equally utilize them to increase their production and earn greater profits (Ajani 2008). Traditionally, women in Nigeria do not usually have direct and easy access to land, their main access to land is often temporal and they are usually bound by the decision of the land owners (Aluko & Amidu, 2006). Key strategic emphasis should be given to their empowerment through CSA participation given the empirical suggestions that they suffer many agricultural production barriers including culture, domestic responsibility, access to land, education, information, and poor income which adversely affects their adoption of agricultural technologies (Bidogeza *et al*., 2009; Chukwuone & Amaechina, 2019; Murage *et al*., 2015; Ndamani & Watanabe, 2015; Obayelu et al., 2014; Tenge *et al*., 2004). Hence, the need for a policy consideration of women at the core of CSA to ensure that gender-sensitive techniques are adopted to minimize women's exposure to the risks of climate change and its related natural disasters. Climate change impacts on agriculture are complex, it affects not just the ecosystems but the crops' growth and development alike. Therefore, farmers must be made to understand its potential impacts on their crops and climate-smart measures that they can implore to be able to abate it. These choices of a certain climate-smart measure or practice are based on its impact on crop production and resilience to changing climatic conditions. A gender-sensitive approach in the development of CSA policy is essential. This is because women farmers play a critical role in the agricultural sector and need to benefit equally from climate change policies. It creates enormous potential for gender-sensitive innovative ways of tackling the major causes of gender inequality and contributes to the realisation of gender equality, social change and food security. This study aims to identify the traditional climate change adaptation information-sharing mechanisms and ascertain the climate-smart agricultural practices adopted by female farmers in the southeastern zone of Nigeria.

The Need for Women's Participation in CSA

The important role of women in agriculture in Nigeria, cannot be overemphasized. This coupled with their traditional household management role gives them a huge additional responsibility of ensuring that their households cope with food shortages and other challenges associated with farm failures. They face complex and multiple challenges such as unequal resource distribution and power imbalances further aggravated by the adverse effects of climate variabilities. Due to the adverse gender roles on women farmers' climate change knowledge and prioritization, there's a need to ensure CSA practices and policies work for them with their significant percentage in Nigeria's agriculture. The continued agricultural inequalities in women's access and control of productive

resources reduce productivity and cost millions to the country in procuring foods that can comfortably be grown by women. Therefore, ensuring women equal control and access to productive resources and CSA practices in Nigeria would help minimize the farming burden, enhance crop production and reduce importation, essential for improved food security. We need to overcome the gender gap in agriculture and encourage equality, while also understanding the vital role women play in adapting and mitigating climate change. Therefore, for climate change to have a transformative impact on the agricultural sector, women farmers need to be carried along in its development and distribution (McOmber *et al*., 2013). This can be achieved by enhancing their capacity to engage in CSA to make it a gender-smart practice for effective results.

Materials and methods

The southeastern zone of Nigeria was the area of this study. The zone encompasses five states; Enugu, Anambra, Imo, Ebonyi and Abia. It occupies a land mass of about 10,952,400 hectares (Apeh, 2018) with an estimated cumulative population of about 21,955,414 persons (NBS, 2016). It lies in the tropical rainforest between the 4^{o} 30' to 7^{o} 00' N latitude and 5^{o} 30' to 9^{o} 30' longitude. The inhabitants especially women heavily depend on agriculture for their livelihood. They contribute significantly to agriculture in the area as farmers, labourers, and principal marketers of agricultural products like cassava products, rice, vegetables, fruits, meat etc. The study adopted a double huddle sampling technique as shown in Table 1. Firstly, one agricultural zone was purposively selected from each of the states based on the concentration of female farmers and their level of agricultural production. Secondly, 60 female farmers were randomly selected from each of the selected agricultural zones thereby making a total of 300 female farmers studied. Data was collected through a focus group discussion guided by a well-structured questionnaire in two agricultural periods during pre- and post-planting seasons. Data were analysed using descriptive statistics and the Likert scale method on a four-point scale with a mean score of 2.5 as the decision point. The mean score was calculated based on the rating of their responses and dividing the total ratings by its number as follows; 4 for strongly agree 3 for agree plus 2 for disagree plus 1 for strongly disagree which is 10 divided by 4 to give a cut-off point of 2.5. Therefore, accept if the mean score is equal to or greater than 2.5 and reject if the mean score is less than 2.5.

Table 1. ***Sampling Procedure***

State	Agricultural zones	Women farmers
Abia	Umuahia	60
Anambra	Aguata	60
Ebonyi	Ebonyi North	60
Enugu	Nsukka	60
Imo	Okigwe	60
Total		**300**

Results and Discussion

Demographic and socio-economic features of the participants

The results on the demographic and socio-economic features of the participants are presented in Table 2. As shown in Table 2, the findings demonstrate that the mean average age of the female farmers was 28 years, and 7 months. This infers that they are in their productive/active age and open to innovations that can better boost their agricultural production and general well-being (Onyekuru and Apeh, 2017). The results equally demonstrated that the majority (72%) of them were married with about 52% of them having more than four (4) household members which burdened them with more responsibilities of fending for their families. The majority (56%) were shown to be educated, having agreed to have attained formal education. This explains that the farmers have improved abilities to read and make rational decisions that can impact positively their agricultural production and well-being (Apeh et al., 2023a; Apeh et al., 2023b; Apeh, 2018).

Similarly, 53% of them relied on farming for their well-being. This means that the female farmers depend on agriculture for their livelihood and would be open to using any innovations that enhance their production to meet their economic and social demands and those of their families (Ugwuoti et al., 2023). Also, the result further demonstrates that they had an average of 7 years, and 3 months of farming experience with the majority (58%) farming on less than one (1) hectare, 81% were members of a farm group and a few 38% accessed credit. This infers that those farmers can gain useful farming tips in their farm groups which would help them in using improved farming innovations to improve their production. However, with a limited farm size and access to credit, their production potential can be hindered (Tikon et al., 2023; Anyiam, *et al.,* 2019; Christian et al., 2019; Apeh, 2018).

Table 2. ***Farmers' demographic summary***

Demographic features	Description	Mean ($\bar{x}$) (n = 300)
Age	Years	28.7
Marital status	Dummy; married = 1	0.72
Education	Dummy; formal edu = 1	0.56
Occupation	Dummy; farming = 1	0.53
Farming experience	Years	07.3
Farm size	Dummy; less than one hectare = 1	0.58
Household size	Dummy; less than 4 members = 1	0.48
Farm group membership	Dummy; yes = 1	0.81
Access to credit	Dummy; yes = 1	0.38

Survey, *2022; Please note that the percentages for the dummy variables were derived by multiplying the mean value of the individual variables by 100*

Traditional Climate Change Adaptation Information-sharing Mechanisms in the Face of extreme weather events

The result of the traditional climate change adaptation information-sharing mechanisms in Table 3 demonstrates that in the face of extreme weather events occasioned by climate change,

the female farmers relied on community leaders (mean (M) = 3.27), women groups (M = 2.68) and relatives (M = 4.05) for direction on immediate adaptive measures to adopt.

Most times, rural farmers or communities rely on their village heads, chiefs and elders to provide leadership and direction in times of drought or flooding (Okere et al., 2021). In a disaster situation, they use their networks as leaders in those communities to garner and share coping measures with their community members for immediate solutions. At the community level, they actively champion the enforcement of adaptation measures and their integration into the community laws as a standard of living. For instance, during the COVID-19 crisis between 2019 and 2020, the village heads played a critical role in the dissemination of preventive messages among their subjects which were instrumental in dealing with the crisis. Women groups at the village level also played a key role in knowledge sharing in terms of adaptation practices relating to agriculture. Many of these CSA practices are indigenous traditional knowledge that has been handed down through generations (Tikon et al., 2023. During periods of crop failures, loss of livestock, floods or drought as a result of climate change, farmers rely mostly on family members, friends and relatives for support in developing a collective resilience strategy. Some of the support that can be provided includes contributions to the immediate needs of the affected households such as seeds, cash and food (Chiemela et al., 2022). They can provide accommodation for family members whose houses have been destroyed by storms and mobilize support to enable them to recuperate.

Table 3. ***Traditional CC Adaptation Information-sharing Mechanisms***

CC Adaptation Information-sharing Mechanisms	**Mean ($\bar{x}$) (n = 300)**
Radio	2.43
Television	1.87
Community Leaders	3.27*
Extension officers	2.39
Women groups	2.68*
Social media	1.54
Family, friends and relatives	4.05*

Survey, *2022; (**NB:** *accepted having mean score above 2.5)*

Climate-Smart Agricultural Practices Adopted by Female Farmers

The result of the CSA practices used by farmers in Table 4 identified that their practised agricultural practices relevant to CSA include; the use of high-yielding or drought-resistant varieties (M = 3.06), crop diversification (M = 3.08), change in planning calendar (M = 2.96), application of fertilizers and manure (M = 4.35), minimum or zero tillage (M = 3.06), cover cropping (M = 2.80), mulching (M = 3.18), fallowing

(M = 2.81), mixed cropping (M = 2.74) and crop rotation (M = 2.54). Irrigation (M = 2.04) and agroforestry (M = 1.98) weren't considered because their mean scores were below the decision point.

This implies that the use of improved high-yielding or drought-resistant crop varieties, crop diversification, change in planning calendar, application of fertilizers and manure, minimum or zero tillage, cover cropping, mulching, fallowing, mixed cropping and crop rotation were used by farmers maybe because it helps to enhance their yield and resilience against climate change. They practised crop rotation, diversification, fallowing, and cover or shade tree cropping as a way of enhancing fertility, resistance and prevention of water losses which serves as a protection against erratic rains. In areas where farmers have access to weather information either through traditional or formal sources, they adjust their farming calendar regarding land clearing, preparation and harvesting based on available information. Some have also indulged in intercropping cropping – farming different crops on the same plot; shifting cultivation – allowing the farms to fallow for about 5 – 7 years; mulching – using plant materials such as leaves to cover the land and shifting cultivation – moving from one farming area to another to allow it to fallow for a while.

Irrigation and afforestation even though some farmers are getting adapted to their use, particularly the vegetable farmers who transfer water from the creeks or harvested rain storage to the farm using watering cans to cushion the effects of erratic or unavailability of rain due to climate change as it didn't meet the threshold for acceptance. Equally, for afforestation and agroforestry, farmers tend to plant more trees to adapt to climate change and improve soil fertility to raise more food crops and forests. However, it failed to meet the threshold for acceptance.

Table 4. ***Climate-Smart Agricultural Practices Adopted by Female Farmers***

Climate Smart Agricultural Practices	**Mean ($\bar{x}$) (n = 300)**
Use of high-yielding or drought-resistant varieties	3.06*
Aforestation	1.98
Irrigation	2.04
Crop diversification	3.08*
Changing in planting calendar	2.96*
Contour bunds	1.08
Mounds	2.01
Fertilizers or manure application	4.35*
Terraces	2.33
Minimum or zero tillage	3.06*
Cover cropping	2.80*
Strip cropping	1.97
Use of pesticides	2.49
Mulching	3.18*
Fallowing	2.81*
Mixed cropping	2.74*
Crop rotation	2.54*

Survey, *2022; (**NB:** *accepted having mean score above 2.5)*

Conclusion

The study accessed women's participation in climate-smart agriculture in Southeast, Nigeria. The results demonstrated that female farmers in the area are in their productive age and engage full-time in agriculture. However, they lack access to farmland and credit to fully utilize their full potential in agricultural production. The study further shows that in the face of extreme weather events occasioned by climate change the female farmers relied on community leaders, women groups and family, friends and relatives for direction on immediate adaptive measures and survival. Furthermore, the result of the study found that female farmers use the following climate-smart agricultural practices in their farming; improved high-yielding or drought-resistant crop varieties, crop diversification, change in planning calendar, application of fertilizers and manure, minimum or zero tillage, cover cropping, mulching, fallowing, mixed cropping and crop rotation to enhance their yield and resilience against climate change. Some of these practices have been used by farmers as a climate change adaptation strategy for many years. Exploring strategies to cope with climate change are very important to smallholder farmers, especially female farmers in Southeast, Nigeria where these strategies are not often documented or recognized by service and input providers as gender equality was first mentioned in the UN Framework Convention on Climate Change (UNFCCC) in 2001 and subsequent COPs targeted raising awareness of gender-responsive climate policy among delegates. Finally, in the Paris Agreement adopted in COP 21 of 2015 "gender-responsive" was used in the climate change context. Meanwhile, this failed to move beyond considering women as victims of climate change to important agents of change and innovators and some other reasons. The reasons for this are many. According to the World Bank, there is a growing empirical evidence that the overall low access to farming assets by women makes them more vulnerable than men to climate change effects. The three critical climate change implications for women are:

- women are unduly exposed to the effects of climate change because of their unfair treatment, unequal rights and socio-economic status to the men combined with their lack of voice and influence in policy decision-making and prioritizing how climate finance is used;
- women empowerment is a critical ingredient for climate resilience building, and
- a gender-sensitive approach is more effective and equitable in the design of any low carbon footprints.

Therefore, a gender-sensitive approach to climate change is not only about policy effectiveness but fundamental as a matter of justice. This is because women have the right to be included in climate change policy decision-making and benefit equally. Climate change offers an opportunity to transform existing gender power imbalances. There is enormous potential for newly emerging institutions and processes to work in innovative, gender-aware ways that tackle the root causes of inequality and by doing so, contribute to the realisation of greater gender equality, women's rights and social

change. Above all, women's rights and gender equality must be promoted, rather than undermined, through all climate change policies and interventions. Gender equality is an important development goal in itself as well as being a fundamental condition for the achievement of sustainable development. Therefore, a "transformative approach" can make CSA a major contributor towards women's empowerment especially in the agricultural sector. We, therefore, recommend that climate change needs to start with the human dimensions and that any solutions should also recognize smallholder women farmers as participants and contributors. Finally, climate change is a gender issue and should be tackled through the gender lens to define, design and implement CSA activities that centre around: enhanced women's access and control of assets, institutions and entitlements to key productive resources; equal access to information and services, and enhanced ability to innovate in response to evolving climate challenges and opportunities.

References

Adedayo, A. & Tunde, A. M. (2013). Challenges of Women in Urban Agriculture in Kwara State, Nigeria. Sustainable Agriculture Research. 2(3), 8.

Aina, O. I. (2011). Promoting Gender Equality for Sustainable Development. A Paper Presented at a 2-Day Gender Summit Organised by the Ministry of Women Affairs, Social Development and Gender Empowerment, Ekiti State, Adetiloye Hall, Trade Fair Complex, Ado – Ekiti.

Ajani, O. I. Y. (2008). Gender Dimensions of Agriculture, Poverty, Nutrition and Food Security in Nigeria. Nigeria Strategy Support Program FAO – ILO-IUF 2005. (NSSP) Background Paper No. NSSP 005.

Aluko, B. T. & Amidu, A. (2006). Women and Land Rights Reform in Nigeria. Promoting Land Administration and Good Governance 5th FIG Regional Conference. Accra, Ghana, March 8–11, 2006.

Anyiam, K.H., Igwe, K.C. & Henry-Ukoha, A. (2019). Determinants of Productivity of Farmland in Imo State. Journal of Agriculture and Food Sciences, 17(2), 74 – 85. https://dx.doi.org/10.4314/jafs.v17i2.7

Apeh, C. C., Ugwuoti, O. P. & Apeh, A. C. (2023a). Analysis of the Consumption Patterns of Cassava Food Products amongst Rural Households in Imo State, Nigeria. Ghana Journal of Agricultural Science (GJAS), 58(1), 100 - 110. https://dx.doi.org/10.4314/gjas.v58i1.9

Apeh, C.C. (2018) Farmer's perception of the health effects of the use of agrochemicals in South East Nigeria. Journal of Health & Pollution (JH&P), 8(19): 180901. https://doi.org/10.5696/2156-9614-8.19.180901

Apeh, C.C., Agbugba, I.K. & Mdoda, L. (2023b). Assessing the Determinants of Adopting Urban Tree Planting as Climate Change Mitigation Strategy in Enugu Metropolis, Nigeria.

Sustainability, 15, 12224. https://doi.org/10.3390/su151612224

Bidogeza, J. C., Berentsen, P. B. M., De Graaff, J., & Oude Lansink, A. G. J. M. (2009). A typology of farm households for the Umutara Province in Rwanda. Food Security, 1(3), 321–335. https://doi.org/10.1007/s12571-009-0029-8

Chiemela, S. N., Chiemela, C. J., Apeh, C. C., & Ileka, M. C. (2022). Households Food Security and Perception of Food Nutrition in Enugu State, Nigeria. Journal of Agricultural Extension, 26(2), 11-23. https://doi.org/10.4314/jae.v26i2.2

Christian, M., Obi A. & Agbugba I.K. 2019. Adoption of Irrigation Technology to Combat Household Food Insecurity in the Resource-Constrained Farming Systems of the Eastern Cape Province, South Africa. South African Journal of Agricultural Extension, 47(2), 94-104.

Chukwuone, N. A., & Amaechina, E. C. (2019). Factors affecting climate change coping strategies used by smallholder farmers under root crop farming systems in derived savannah ecological zone of Nigeria. Rising to Meet New Challenges: Africa's Agricultural Development Beyond 2020 Vision, 1–36.

de Zeeuw, H. (2004). The development of urban agriculture: Some lessons learnt. In: Keynote paper for the International Conference Urban Agriculture, Agri-Tourism and City Region Development. Beijing: RUAF.101 Gender, Productive Resources and Agricultural Development in the Urban Area.

Ekong, E. E. (2003). An introduction to rural sociology. 2nd ed. Uyo: Dove Educational Publishers.

FAO (2011). Notes on livestock, food security and gender equity. Food and Agriculture Organization Animal Production and Health Working Paper. No. 3, Rome.

FAO. (2010). Climate-Smart Agriculture: Policies, Practices and Financing for Food Security, Adaptation and Mitigation. Food and Agriculture Organisation of the United Nations.

FAO. (2013). Climate Smart Agriculture Sourcebook. Food and Agriculture Organisation of the United Nations (FAO). http://www.fao.org/3/a-i3325e.pdf

IPCC. (2014). Climate Change 2014: Mitigation of Climate Change. Intergovernmental Panel on Climate Change (IPCC).

McOmber, C., Panikowski, A., McKune, S., Bartels, W., & Russo, S. (2013). Investigating Climate Information Services through a Gendered Lens (CCAFS Working Paper No. 42). CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS).

MoGD. (2012). Climate Change Gender Action Plan of Liberia. Ministry of Gender and Development.

Mougeot, J. A. L. (2000). Urban agriculture: Definition, Presence,

Potentials and Risks, and Policy challenges. In: Bakker, N., Dubbeling, M., Gundel, S., Sabel-Koschella, U. & de Zeeuw, H. (eds.) Growing Cities, Growing Food, Urban Agriculture on the Policy Agenda, A Reader on Urban Agriculture. Feldafing, Germany: Deutsche Stiftung Internationale Entwicklung (DSE). Pp. 1–42.

Murage, A. W., Midega, C. A. O., Pittchar, J. O., Pickett, J. A., & Khan, Z. R. (2015). Determinants of adoption of climate-smart push-pull technology for enhanced food security through integrated pest management in eastern Africa. Food Security, 7(3), 709–724. https://doi.org/10.1007/s12571-015-0454-9

Mutoko, M. C., Rioux, J., & Kirui, J. (2015). Barriers, incentives and benefits in the adoption of climate-smart agriculture: Lessons from the MICCA pilot project in Kenya (No. 9; pp. 1–14). Food and Agriculture Organisation of the United Nations. http://www.fao.org/3/a-i4396e.pdf

NBS. (2016). National Population Estimates. The National Bureau of Statistics. Retrieved from https://nigeriastat.gov.ng/download/474

Ndamani, F., & Watanabe, T. (2015). Farmers' Perceptions about Adaptation Practices to Climate Change and Barriers to Adaptation: A Micro-Level Study in Ghana. Water, 7(12), 4593–4604. https://doi.org/10.3390/w7094593

Nzeadibe, T. C., Egbule, C. L., Chukwuone, N. A., & Agu, V. C. (2011). Climate Change Awareness and Adaptation in the Niger Delta Region of Nigeria (Working Paper No. 57; pp. 1–27). African Technology Policy Studies Network. http://www.atpsnet.org

Obayelu, O. A., Adepoju, A. O., & Idowu, T. (2014). Factors influencing farmers' choices of adaptation to climate change in Ekiti State, Nigeria. Journal of Agriculture and Environment for International Development, 108(1). https://doi.org/10.12895/jaeid.20141.140

Okere, R.A., Akparanta, C.D., Apeh, C.C., Okeke, C.O. & Ovie, S. (2021). Willingness to Pay for Extension Services by Smallholder Oil Palm Farmers in Okada, Ovia North-East Local Government Area of Edo State, Nigeria. Journal of Agriculture and Food Environment (JAFE), 8(4): 28-36. https://doi.org/10.5281/zenodo.8022903

Onah, M., Jeiyol, E. , Adimanyi, O. & Ukange, C. (2023). Gender Perspectives of Vulnerability to Climate Change: A Descriptive Evidence from Farming Households at Ikpayongo Community in Gwer Lga, Benue State, Nigeria. American Journal of Climate Change, 12, 116-139. https://doi.org/10.4236/ajcc.2023.121007

Onyekuru, A.N. & Apeh, C.C. (2017). Assessing the Use and Determinants of Households' Adoption of Improved Cook Stove in Nigeria: Empirical Evidence from Enugu State. Asian Journal of Environment & Ecology, 5(1).

https://doi.org/10.9734/AJEE/2017/35281

Sheahan, M. & Barrett, C. B. (2014). Understanding the Agricultural Input Landscape in Sub-Saharan Africa: Recent Plot, Household, and Community-Level Evidence. Policy Research Working Paper 7014. World Bank, Washington, DC.

Tenge, A. J., De Graaff, J., & Hella, J. P. (2004). Social and economic factors affecting the adoption of soil and water conservation in West Usambara highlands, Tanzania. Land Degradation & Development, 15(2), 99–114. https://doi.org/10.1002/ldr.606

Tiamiyu, S. A., Ugalahi, U. B., Eze, J. N., & Shittu, M. A. (2018). Adoption of Climate Smart Agricultural Practices and Farmers' Willingness to Accept Incentives in Nigeria. International Journal of Agriculture and Environmental Research (IJAER), 4(4), 198–205.

Tikon, F. U., David, A. H., Gadu, H. O. & Apeh, C. C. (2023). Adoption and Challenges Associated with Organic Farming in Bogoro Local Government Area, Bauchi State, Nigeria. Journal of Agripreneurship and Sustainable Development (JASD). 6(2), 132 – 139. https://doi.org/10.59331/jasd.v6i2.442

Ugwuoti, O. P., Apeh, A. C., Apeh, C. C., Osuagwu O. C. (2023). Analysis of the Smallholder Farmers Information Needs on Climate Change in Southeast, Nigeria. RJOAS: Russian Journal of Agricultural and Socio-Economic Sciences, 2(134), 107 – 113. https://doi.org/10.18551/rjoas.2023-02.11

Williams, T. O., Mul, M., Cofie, O., Kinyangi, J., Zougmore, R., Wamukoya, G., Nyasimi, M., Mapfumo, P., Speranza, C. I., Amwata, D., Frid-Nielsen, S., Partey, S., Girvetz, E., Rosenstock, T., & Campbell, B. M. (2015, October). Climate Smart Agriculture in the African Context. Climate Change, Agriculture and Food Security. Feeding Africa Conference, The Netherlands. https://hdl.handle.net/10568/68944

World Bank (2009). Gender in Agriculture Sourcebook. Agriculture and rural development. Retrieved from http://siteresources.worldbank.org/intgenagrliv-soubook/Resources/CompleteBook.pdf