WORLD ENVIRONMENTAL CONSERVATION CONFERENCE

2023

CLIMATE CHANGE PARTNERSHIP ACTIONS FOR SUSTAINABLE FUTURE AND RESTORING LIFE ON EARTH

Proceedings of the 6th edition of World Environmental Conservation Conference

18th – 21st October, 2023

EDITIORS: Agele, S. O. (PhD), Balogun, I. A. (PhD), Oluleye, A. (PhD) and Oladeji S. O. (PhD)

Production of Proceedings

Netlink Environmental Conservation Organisation

Room 21 Abubakar Adamu Bulding

Federal University of Technology, Akure.

Design amd Printing of Proceedings

Maryj Printing Press

ACAD Fagbote Filling Station Akure-Ilesha Expressway

Phone number: +23407063411658

Copies of Proceedings

Dr. S. O. Oladeji

President, Netlink Environmental Conservation Organisation (NECOR),

Room 21 Abubakar Adamu Building

Federal University of Technology, Akure.

P. M. b. 704, Akure, Nigeria

E-mail: sooladeji@fita.edu.ng.

sooladeji@necorng.org

info@necorg.org.

www.mecorng.org.

ISSN: 2705-2850

Scientific Review Committee

Prof. S. O. Agele- Chairman Scientific Committee
Department of Crop, Soil and Pest Management, FUTA
+2348035784751
soagele@futa.edu.ng

Prof. I. A. Balogun
Department of Meteorology,
Federal University of Technology,
Akure.
iabalogun@futa.edu.ng.

Prof. A. Oluleye
Department of Meteorology,
Federal University of Technology,
Akure.
aoluleye@futa.edu.ng.

Dr. S.O. Oladeji
Department of Ecotourism and Wildlife Management, FUTA.
Executive Director, NECOR
+2348030698896
sooladeji@futaedu.ng.
sooladeji@necorng.org

PREFACE

There is a growing concern on the adverse impacts of climate on biodiversity. This phenomenon is greatly manifested in form of shifting weather patterns threatening global food security, health and species existence. Humanity is at the receiving end of the consequences of climate change hence there is a need to step up actions on all fronts- overtime, everywhere all at once.

This calls for collaboration, partnership and networking to strengthening synergy among relevant stakeholders in a bid to tackling climate change menace. This forms the basis for the theme of this year world Environmental conservation conference: **CLIMATE CHANGE PARTNERSHIP ACTIONS FOR SUSTAINABLE FUTURE AND RESTORING LIFE ON EARTH.** The theme is conceived with a view to create an interface for information sharing and offer opportunities for participants to refine their commitments and pledges in the quest to achieving Sustainability in the face of climate change.

This year World Environmental Conservation Conference is memorable in the sense that it received overwhelming funding from the host - West African Science Service on Climate Change and Adapted Land use). WASCAL is posed to provide information and knowledge at the local, national and regional level to cope with the adverse impacts of climate change. Thus, this conference will offer opportunities for participants to learn from good practices demonstrated and showcase by WASCAL during the course of the conference. It will also strengthen staff-student exchange and provide prospect for Doctorate Research Doctoral Research in West Africa Climate System Programme (DRP WACS) – WASCAL among others.

Special appreciation goes to the management of The Federal University of Technology, Akure the host institution, National Park Service and African Regional Center for Space Science and Technology Education-English (ARCSSTE-E) that co-host this conference. We equally acknowledge other private, individual and corporate organizations that have contributed towards the success recorded in this event.

All the submitted articles were subjected to strict double blind peer-review process by the reviewers that are experts in the area of the particular submitted manuscript. The accepted manuscripts are published in WECC 2023 proceedings and also available for download on the organization website (www.necorng.org).

The accepted manuscripts fall within the underlisted subthemes:

- Climate change adaptation strategies in Agriculture, Forestry and Other Land Use (AFOLU)
- Climate smart city and architectural landscape design
- Retrofitting and decarbonization in tourism and hospitality industry
- Indigenous knowledge and local innovation in climate change adaptation
- Climate risk management, health, safety and hygiene
- Carbon credit-offset marketing/circular economy
- ICT development in environmental conservation (image processing and acquisition, computer vision, graphics, speed, interface technology, HMD devices, GIS: Body Tracking, AI and IOT, VRT, IVE).

We commend our keynote speaker Prof. Douda Kone Director Capacity Building Department, WASCAL Headquarter, Ghana and other guest speakers Prof. Babatunde Rabiu, Director General, Chief Executive Office, African Regional Centre for Space Science and Technology Education-English (ARCSSTE-E) and Dr. Goni I. M., Conservator General National Park Service.

It is hoped that researchers, students and policy makers will find the papers in this book very useful. Even though all the papers were reviewed and edited, the content and option expressed remain essentially that of the authors and not necessarily that of Netlink Environmental Conservation Organization.

Dr. Oladeji S. O.

President Netlink Environmental Conservation Organization

Convener World Environmental Conservation Conference

TABLE OF CONTENT

CLIMATE RISK MANAGEMENT STRATEGIES AMONG SMALLHOLDER FARMERS IN LAGOS STATE, NIGERIA

*Aminu, F. O., Morakinyo, A. F. and Balogun, E. O.

Department of Agricultural Extension and Management, School of Agriculture, Yaba College of Technology, Epe Campus, P. M. B. 2011, Yaba, Lagos State, Nigeria.

*E-mail: folaafe02@gmail.com

ABSTRACT

The risk of climate change has become more threatening, not only to the sustainable development of agricultural activities, but also to the totality of human existence globally. The study examined climate risk management strategies among smallholder farmers in Lagos State, Nigeria. The study used 120 respondents who were chosen using a multistage sampling procedure. Data were gathered via a pretested questionnaire, and descriptive and multiple regression models were used to analyze the data. Results revealed that majority (81.7%) of the farmers were male with a mean age of 53 years, mean years of schooling of 10.6 and mean annual income of ₦162,582.46. Prominent climate risks experienced by the farmers were poor yield (94.2%), loss of soil fertility (91.7%), changes in rainfall pattern (81.7%), high intensity of sunlight (77.5%), flood/erosion (73.3%) and pest and rodent attack (70.8%). Prayers (80%), agrochemicals (70.8%), river bed cultivation (62.5%), mulching (62.5%), crop rotation (55.8%), and building barriers and hedges (55%) were the major climate risk management strategies used by the farmers. Result of the multiple regression analysis revealed that education ($p<0.01$), farming experience ($p<0.05$), income ($p<0.01$), extension contacts ($p<0.05$) and credit access ($P<0.05$) were the significant factors influencing the adoption of different climate risk management strategies in the study area. The study concluded that, the study area's agricultural productivity and economic growth are seriously threatened by climate risks. Therefore, it is important to increase ability of the extension agents to visit farms and provide timely information about climate change.

Keywords: *Climate, change, management, risk, strategies*

INTRODUCTION

One of the main obstacles to the development of agriculture in Nigeria and other African nations is climate change (Oyekale, 2015). Climate change and agriculture interacting a bidirectional way: Climate change affects agriculture in a number of ways which include: changes in rainfall pattern, changes in atmospheric carbon dioxide and ground-level ozone concentrations, changes in the nutritional value of some foods, changes in sea level, pests and diseases outbreak, and changes in the health of farmers are all ways that climate change affects agriculture (Hoffmann, 2013; Oluwatunmise and Oparinde, 2022).

On the other hand, the agriculture industry is a major contributor to the land use changes and greenhouse gas emissions assumed to be responsible for climate change. Agriculture uses a lot of area and consumes a lot of fossil fuels, but it also directly produces greenhouse gas emissions through raising of livestock and rice production, for example. About 24% (or 10–12 GtCO2e per year) of anthropogenic GHG emissions are attributed to agriculture, forestry, and other land use (AFOLU), mostly due to deforestation and agricultural emissions from livestock, soil, and fertilizer management (IPCC 2014; Smith *et al.* 2014). About 14.5% of all human-induced GHG emissions come from the livestock industry alone (IPCC 2014; Gerber *et al.* 2013a, b).

The likelihood that a specific hydro-meteorological danger may disrupt the livelihood of farmers, livestock herders, fishermen, and forest inhabitants is known as climate risk in agriculture. Climate risks such as temperature shifts, precipitation variability, altering seasonal patterns, changes in disease distribution, desertification, impacts from the ocean, and deterioration of the soil and coastal areas increase susceptibility across multiple sectors in many countries (UNFCCS, 2017). Climate change exposes farmers to a variety of risks, including the potential loss of crops due to drought, flooding, and new pest and disease outbreaks (IFAD, 2010). Smallholder farmers in developing nations that depend heavily on agricultural production for their livelihoods face special hardships due to weather risks (IFAD, 2010; Omerkhil *et al.* 2020). Moreover, smallholder farmers tend to have very limited access to formal financial services, which increases their risk of climate and extreme weather vulnerability, slow economic development and poverty (IFAD, 2010). In agriculture, risks are entirely unavoidable. Farmers must continuously adopt some strategies to mitigate the effect of climate change on their farming enterprise. According to United State Department of Agriculture (2016), risk management entails choosing options that reduce the potential economic consequences of risks and uncertainties. By using effective risk management strategies, farmers may lessen the potential hazards caused by the consequences of climate change on their productivity. Over time, farmers have been managing climate risks by application of traditional methods, indigenous knowledge, and modern farming techniques (Ogunjinmi *et al.* 2022). The capacity of farmers to manage the effect of

climate change depends on factors such as wealth, technology, education, information, infrastructure, resource availability and managerial skills (Oluwasusi and Tijani, 2013).

The need to boost the resilience of smallholder farmers is rising as a result of the frequency and severity of shocks and strains resulting from climate change. Therefore, this study investigates how smallholder farmers in Lagos State, Nigeria, manage climate risk. In particular, the study sought to: (1) describe the socioeconomic traits of the smallholder farmers; (2) identify the risks that climate change poses to their farming operations; (3) evaluate the risk management strategies employed by the farmers; and (4) identify the factors that influence the adoption of these strategies by smallholder farmers in the study area.

METHODOLOGY

The study was conducted in Lagos state, Nigeria. Primary data collected by personal administration of questionnaire using a multistage sampling technique was employed to select smallholder farmers in the state. The first stage was the purposive selection of two Local Government Areas (LGAs) from the state due to the prevalence of agricultural activities in the LGAs. In the second stage, simple random sampling technique was used to select three communities from each of the LGAs. In the third stage, 20 smallholder farmers were picked at random from the preselected groups, for a total of 120 respondents for the study.

Analytical Techniques

Descriptive statistics was used to analyse objectives 1,2 and 3 while objective 4 was analysed using multiple regression analysis. The model was specified as:

$$Y = \beta0 + \beta1X1 + \beta2X2 + \beta3X3 + \beta4X4 + \beta5X5 + \beta6X6 + \beta7X7 + ei$$

Where, Y = Adoption index; derived as A= (S/T)x100. Where S = number of strategies adopted by each farmer, T is the total number of strategies available. X1 = Sex of farmer (1= male, 0 if otherwise); X2 = Age (Years); X3= Education (Years); X4 =Household Size (No of people); X5 = Farm size (ha); X6 = Farming experience (Years); X7 = Annual farm Income (Naira); X8 = Extension contact (Dummy); X9 = Membership of cooperative society (Dummy). X10 = Credit access (Dummy). e_i = Error term. Three functional forms: Linear, Semi log and Double log equations were fitted into the model and the double-log functional form was chosen as the lead equation based on econometric and statistical criteria.

RESULTS AND DISCUSSION

Socio-economic Characteristics of the Smallholder Farmers

Results in Table 1 reveal that 81.7% of the respondents were male, 51.7% were between the ages of 40 and 50. The mean age of about 53 years implies that the farmers were getting older.

Table 1: Socio-economic Characteristics of Farmers *n = 120*

Description	Frequency	Percentage	Mean
Sex			
Male	98	81.7	
Female	22	18.3	
Age			
≤40	28	23.3	53.08±12.374
41-50	62	51.7	
>50	30	25.0	
Educational Status			
None formally	30	25.0	10.6
Primary	23	19.2	
Secondary	46	38.3	
Tertiary	21	17.5	
Marital Status			
Single	8	6.7	
Married	95	79.2	
Divorced	4	3.3	
Widowed	13	10.8	
Household Size			
≤5	42	35.0	7±3.001
6-10	74	61.7	
≥10	4	3.3	

Total Farm Size			
<0.5	65	54.2	1.01±0.009
0.51-1	43	35.8	
>1	12	10.0	
Farming Experience			
≤20	61	50.8	22.51±17.977
21- 40	38	31.7	
>40	21	17.5	
Cooperative Society			
No	58	48.3	
Yes	62	51.7	
Credit Access			
No	88	73.3	
Yes	32	26.7	
Extension Contact			
No	78	65.0	
Yes	42	35.0	
Income			
<200,000	54	45.0	162,582.46±111.003
200,000 - 300,000	32	26.7	
>300,000	34	28.3	

Source: Field Survey Data, 2022.

and dealing with the rigours of farming activities may become too stressful for them. This result is consistent with the report of Okoye *et al.* (2014) that, farmer' ability to do manual work, take risk, and adopt innovation, especially in the era of climate change, declines with age. Majority (75%) of the farmers had formal education. This implies that the farmers were literate. This is in tandem with the findings of Emenyonu *et al.* (2020) that educated farmers have better understanding of variations in climate and its effects on farming activities. Majority (79.2%) of the respondents were married and the mean household size of 7 people may increase the source of family labour in the study area. The mean farm size of 1.01 hectares implies that the farmers were small scale farmers characterized by the use of crude implements and low income. This could impact negatively on their choice of climate risk management strategies in the study area. The mean farming experience of about 23 years implies that the farmers were well experienced in their trade, higher experience enhances better understanding of the terrain, risks, and sign of climate change as it applies to their trade. Furthermore, 48.3% of the respondents were not members of cooperative society, 73.3% had no access to credit facilities and 65.5% had no contacts with extension agents. This result corroborates the findings of Aminu *et al.*, (2021) that, the respondents were not likely to have opportunity to have effective interaction with other farmers, have poor access to production input, farm information, and untimely dissemination of research results and technical assistance on climate change in the study area.

Climate Risks Experienced by Farmers in the Study Area

Climate risks provide serious barriers to economic growth by hindering the effective and efficient agricultural production globally. Farmers faced a variety of climate risks in their farming operations in the study area (Table 2). Prominent of which were poor yield, experienced by 94.2% of the respondents, loss of soil fertility (91.7%), changes in rainfall pattern (81.7%), high intensity of sunlight (77.5%), flood/erosion (73.3%) and pest and rodent attack (70.8%). Other risks experienced by the farmers were drought, health problems, wind storm, rapid weed growth, high post-harvest losses and relocation of farms. These risks lead to reduced agricultural output and income, which could lower farmers' standard of living. This result agrees with the findings of Oluwatumise and Oparinde (2022) that climate risks pose serious challenges to the health and productive capacity of farmers.

Table 2: Climate Risks Experienced by Farmers

Risks	*Frequency	Percentage
Change in rainfall pattern	98	81.7
Increased temperature	87	72.5
High intensity of sunlight	93	77.5
Wind storm	81	67.5
Loss of soil fertility	110	91.7
Flood/erosion	88	73.3

Drought	83	69.2
Health problems	83	69.2
Rapid weed growth	71	59.2
Pest and rodent attack	85	70.8
Poor yield	113	94.2
High post-harvest losses	67	55.8
Relocation of residence/farms	62	51.7

Source: Field Survey Data, 2022 *Multiple responses

Climate Risk Management Strategies Adopted by the Farmers

The summary of the management strategies adopted by the farmers to mitigate climate risks in the study area is as presented (Table 3). The result reveals that, although farmers adopted multiple strategies, prayer was the most popular one, adopted by 80% of the farmers. It is widely believed among the respondents that climate change and its associated risks are natural phenomenon beyond human control and can only be solved by God. Such category of farmers therefore adopted minimal risk management strategy while hoping on God for miracles. Additionally, 70.8% adopted agrochemicals, pesticides to manage disease and pest infestations, and fertilizers to boost soil nutrients, while 37.5% adopted integrated pest management measures, which use natural predators and parasites to control pest with the use of selective pesticides only as a last resort. River bed cultivation and irrigation were adopted by 62.5% and 46.5% respectively by the farmers to manage drought. Mulching was adopted by 62.5% to lessen the intensity of sunlight on crops grown on ridges and heaps. Crop rotation was adopted by 55.8% to improve soil structure and increase soil fertility, and building barriers and hedges was adopted by 55% to reduce the impact of soil erosion. Meanwhile, 64.2% of the farmers diversified to other farm businesses to forestall total loss of their investments that could result from climate risks, and 68.3% adopted off-farm businesses to augment income from farming

Table 3: Climate Risk Management Strategies

Strategies	***Frequency**	**Percentage**
Crop rotation	67	55.8
Mulching	75	62.6
River bed cultivation	78	65.0
Irrigation	56	46.5
Building barriers and hedges	66	55.0
Pest resistant seeds	54	45.0
Agrochemicals	85	70.8
Integrated pest management measures	45	37.5
Diversification to other farm business	77	64.2
Off-farm business	82	68.3
Prayers	96	80.0

Source: Field Survey Data, 2022 *Multiple responses

Factors Influencing Adoption of Climate Risk Management Strategies (CRMS)

The result of the multiple regression analysis on factors influencing the adoption of CRMS in the study area is presented in Table 4. The double-log functional form was chosen as the lead equation because the model had the highest values of coefficient of determination (R^2), highest F value and highest number of significant variables conforming to the *a priori* expectations. The coefficient of determination value of about 0.765 implies that about 77% of the variation in number of CRMS adopted by the farmers was jointly explained by the socio-economic variables included in the model. The F value of 22.333 was significant at 1% alpha level indicating that the model provides a good fit for the data.

The coefficient of the farmers' years of education was positive and statistically significant at 1% level of probability. This implies that the adoption of different CRMS increases with the years of education of the farmers. This is in line with the reports of Famuyini and Akinola (2018) that educated farmers should be better knowledgeable about the appropriate decisions to make in order to mitigate the impact of climate variability. In the same vein, there was a positive significant correlation between the numbers of CRMS adopted by the farmers and the coefficients of farming experience ($p<0.05$) and income ($p<0.01$).This suggests that when farmers gain more expertise and earn high income, they adopt more climate risk management strategies This corroborates the findings of Aminu *et al.,* (2021) that high income earner and experienced farmers are better equipped to device coping mechanisms and undertake investments that quickly lessen the impact of climate risks. Furthermore, adoption of different CRMS increases with frequency of extension-farmer interactions and credit access at 5% alpha levels respectively, in the study area.

Table 4: Factors Influencing Adoption of Climate Risk Management Strategies

Variables	Coefficient	T-ratio
Constant	12.189	2.206
Sex	1.312	1.444
Age	0.650	1.270
Education	2.181***	2.572
Household size	0.036	1.375
Farm size	2.664	1.315
Farming experience	1.036**	2.191
Income	0.152***	5.739
Extension contacts	-0.182**	-2.011
Coop membership	0.056	1.632
Credit access	-3.332**	-2.341
R^2	0.765	
Adj. R^2	0.636	
F-Stat	22.333	

Source: Computed from Field Survey Data, 2022

, * indicate significance at 5% and 1% levels, respectively

CONCLUSION

As evidenced by the variety of risks experienced by farmers in the study area, climate risks pose serious concerns to agricultural productivity and economic growth. Various strategies such as prayers, agrochemicals, crop rotation, engagement in off-farm business, diversification to other farm businesses, among others, were adopted by the farmers to manage climate risks. Education, farming experience, income, extension contacts and access to credit facilities were the significant factors influencing adoption of climate risk management strategies in the study area. Therefore, adult education program should be formulated and domiciled in the local government area councils, and the farmers should be adequately encouraged to attend such program in order to enhance their knowledge about climate risks as well as the appropriate strategies to adopt in managing these risks. The extension agents should also be given additional support in the area of visitation and timely dissemination of information on climate change to the farmers. Finally, government should provide credit facilities in form of loans or inputs such as agrochemicals at subsidized rate to empower the farmers in adopting effective strategies to mitigate climate risks and shocks in the study area.

REFERENCES

Aminu, F. O., Ladapo, H. L., Akhighe-Ahonkhai, E. C. and David, M. O. (2021). Climate change variability and associated health effects among farming households in Ondo State, Nigeria. *Innovare Journal of Agricultural Science*, 9(4): 10-13

Emenyonu, C. A., Eze, C.C. and Ejike, O. U. (2020). Factors Influencing Cassava Farmers' Climate Change Risk Perception in Anambra State, Nigeria. *American Journal of Climate Change*, 9: 217-227

Famuyini C. A. and Akinola A. A. (2018). Determinants of Climate Risk Management Strategies among Rural Communities in Ekiti State, Nigeria. *Ife Journal of agriculture*, 30(2): 44-52/

Gerber, P. J., Henderson, B. and Makkar, H. P. (2013a). Mitigation of greenhouse gas emissions in livestock production. A review of technical options for non-CO2 emissions. Rome: FAO.

Gerber, P. J., Steinfeld, H., Henderson, B., Mottet, A., Opio, C. and Dijkman, J. (2013b). Tackling climate change through livestock: A global assessment of emissions and mitigation opportunities. Rome: Food and Agriculture Organization of the United Nations (FAO).

Hoffmann, U. (2013). Wake up before it is too late: Make agriculture truly sustainable now for food security in a changing climate, Geneva, Switzerland: United Nations Conference on Trade and Development (UNCTAD),ISSN 1810-5432. Archived 28 November, 2014

IFAD. (2010). The potential for scale and sustainability in weather index insurance for agriculture and rural livelihoods. https://www.ifad.org/documents/38714170/40239486/The+potential+for+scale+and+sustainability+in+weather+index+insurance+for+agriculture+and+rural+livelihoods.pdf/7a8247c7-d7be-4a1b-9088-37edee6717ca

IPCC. (2014). Climate change 2014: Mitigation of climate change. In O. Edenhofer, R. Pichs-Madruga,Y. Sokona, E. Farahani, S. Kadner, K. Seyboth, A. Adler, I. Baum, S. Brunner, P. Eickemeier, B.Kriemann, J. Savolainen, S. Schlömer, C. von Stechow, T. Zwickel, & J. C. Minx (Eds.), Contribution of working group III to the fifth assessment report of the intergovernmental panel on climate change. Cambridge, New York, NY: Cambridge University Press, Intergovernmental Panel on Climate Change (IPCC).

Ogunjinmi, K.O., Fakoya, E.O., Banmeke, T.A.O., Fapojuwo, O. E. and Ogunjinmi, A.A. (2022). Gender differentials in the determinants of usage of climate change adaptation strategies in farming communities of Ekiti and Ogun States, Southwest Nigeria. *Ghana Jnl Agric. Sci.,* 57(1): 30 – 54

Oluwasusi, O. J. and Tijani, S. A. (2013). Farmers' adaptation strategies to the effects of climate change variation on yam production. A case study in Ekiti State, Nigeria. *Agrosearch,* 13(2): 20 – 31.

Olutumise, A. I. and Oparinde, L. O. (2022). Climate information and health variables as determinants of technical efficiency: insight from food crop farmers. *IJASRT,* 12(3): 127-137

Okoye, F. U. (2014). Gender and Resource Use Efficiency in Cocoyam Production in Anambra State. Nsukka: An M.sc Dissertation Faculty of Agriculture, Agricultural Economics University of Nigeria.

Omerkhil, N., Chand, T., Valente, D., Alatalo, J. M. and Pandey, R. (2020). Climate change vulnerability and adaptation strategies for smallholder farmers in YangiQala District, Takhar, Afghanistan. *Ecological Indicators,* 110, 105863. https://doi.org/10.1016/j.ecolind.2019.10586

Oyekale, A.S. (2015). Climate change induced occupational stress and reported morbidity among cocoa farmers in South-Western Nigeria. *Annals of Agricultural and Environmental Medicine,* 22(2): 357–361

Smith, P., Bustamante, M., Ahammad, H., Clark, H., Dong, H., Elsiddig, E. A. (2014). Agriculture, forestry and other land use (AFOLU). In Climate change 2014: Mitigation of climate change. Contribution of working group III to the fifth assessment report of the intergovernmental panel on climate change (pp. 811–922). Cambridge University Press.

UNFCCC. (2017). Land use and climate change [WWW Document]. Issues Relate to Agric. URL http://unfcc c.int/land_use_and_climate_chang e/items /8792.php. Accessed September 4, 2018.