

Climate Change Adaptation and Mitigation Measures Among Small Holder Farmers for Sustainable Crop Production in Ebonyi State

Benjamin O. Egbe, Chieme Chibueze Onwe Esheya, U. Agnes, and Martha O. Oku
Department of Technology and Vocational Education, Ebonyi State University, Abakaliki, Nigeria
Email: dregbepeno@gmail.com

doi: <https://doi.org/10.37745/bje.2013/vol13n28795>

Published February 02, 2025

Citation: Egbe B.O., Esheya C.C.O., Agnes U., and Oku M.O. (2025) Climate Change Adaptation and Mitigation Measures Among Small Holder Farmers for Sustainable Crop Production in Ebonyi State, *British Journal of Education*, Vol.13, Issue 2,87-95

Abstract: *This study identified climate change adaptation and mitigation measures among small holder farmer for sustainable crop production in Ebonyi State. Three specific purposes and three corresponding research questions guided the study. It adopted survey research design and used multi-stage and purposive sampling techniques to select 108 crop farmers, 36 extension agents and 54 elders giving a total of 198 respondents. Multiple data collection techniques which included questionnaire, oral interview and observation guides were utilized to collect data for the study. Data gathered for the study were analyzed using mean and standard deviation. Results indicated impacts of climate change on crop production as delay in the period of crop production infestation of pests, diseases and weeds depletion in soil nutrients, and poor crop yields. Ethno-science adopted by farmers were change of date in cultivation, early planting multiple cropping, dry planting and use of organic manures. While techno-science measures identified by the study were growing of high yielding crop varieties and application of chemical fertilizers. Mitigation measures adopted by farmers as identified by the study were integrated crop/livestock farming and planting of trees in homesteads. It was then recommended that government should provide farmers with resources with which to adapt and mitigate climate change and farmers should accept to be trained to cope with climate change.*

Keywords: climate change, adaptation, mitigation, crop production, farmers

INTRODUCTION

It is a general observation that millions of people in Nigeria are struggling with socio-economic problems such as poverty, hunger and unemployment. This observation corroborates the report by United Nation (UN, 2023) that estimated 25 million Nigerians as food insecure. This report

stressed that regional instability, inflation and climate change are the major striggers of food insecurity in Nigeria.

Food insecurity exists when people do not have enough available food and do not have economic ability to access sufficient food. This statement is in keeping with the opinions of Nafees, Shahnawaz and Alam (2021) who explained insecurity of food as limited or uncertain availability of nutritional adequate food, and limited ability to acquire enough food. According to food and agricultural organization (FAO, 2016) food insecurity is a situation when people do not have adequate physical and economic access to sufficient, safe and nutritional food for active and health life. The four pillars of food insecurity are unavailability of food, lack of ability to access enough food, instability of food supply, and low food utilization. Climate change adds to the pillars of food insecurity, especially unavailability of food because supply of food by smallholder farmers greatly depends on rain-fed agriculture, a sector that is badly affected by climate change.

The general conscious of experts is that climate change has negative impacts on agriculture (Onyeneke, Amadi and Njoku 2021; Orifah, Sani, Nasiri and Ibrahim, 2021 and Idu, Fadiji and Chimdi 2023). Onyeneke, et al (2021) defined climate change as irregular weather pattern, variation in climate parameters such as cloud, rainfall, temperature, sunshine and wind. According to Fehciano and Recha (2022) climate change is a long term shift in earth weather pattern that leads to heightened temperature and irregular rainfall. These changes leads to extreme events such as heat stress, drought, flood and presence of pests and diseases (Idu et al, 2023). To Yakubu, Akpoko, Akmola, and Abdulsalam (2021) climate is a change in weather conditions that alters crop growing seasons, increases presence of pests and diseases in farms and decreases crop yields. In the context of this study, climate change is a change in climate parameters such as annual rainfall, temperature, sunshine, cloud and wind which negatively affects crop production practices and puts food security at risks. It is a potential threat to agriculture because it causes, soil degradation, loss of farmland due to erosion and flood and reduces crop yields. It also has some physiological effects in agriculture such as increased weeds, pests and disease challenges to farmers (Egbe, 2017). Small holder agriculture is more vulnerable to impacts of climate change because agricultural activities of small holder farmers are rain-fed. With the failure of rain-fed agriculture of small holder farmers, the situation of food insecurity is worsened. It is therefore necessary to identify measures with which farmers cope with climate change to provide a base for policy making to address climate change risks among small holder farmers.

Small holder farmers are farmers who manage areas of farm land varying from less than one hectare to 10 hectares (FAO, 2018). In Nigeria, a small holder farmer is one who operates on not more than two (2) hectares of land, relies on traditional farming methods, and are rain-fed farmers (Mgbenka and Mbah 2016). Nigeria small holder farmers produce up to 90% of the food in the country, produce a variety of crops and rear livestock. In fact, they are pivotal for food security in Nigeria; Ebonyi State inclusive. However, small holding farming system is characterized by limited access to modern farm inputs and its production depends on natural and climatic factors making farm yields to be reliant in rainfall, temperature and nature of soils. This suggests the need to identify adaptation and mitigation measures of the small holding

farmers to climate change. This will form a base for stakeholders to determine schemes for making these farmers resilience in the face of climate change. In this study, climate change resilience is built from both adaptation and mitigation measures.

Adaptation is a continuous and involving process to cope with climate change. According to Inter-governmental panel on climate change (IPCC, 2023) adaptation is an action or process taken to adjust to the current and future effects of climate change. It is a measure to respond to actual or expected effects of climate change, which have potential consequences. According to Matanga and Jere (2011) climate change adaptation measures are grouped into ethno-science and techno-science techniques. The ethno-science measures are indigenous knowledge system or measures based on local knowledge of the environment, such as early planting, local irrigation, growing of drought tolerant crops and multiple planting (Matanga, et al, 2011). The techno-science adaptive measures are the modern technologies such as modern irrigation system, flood barriers, new crop cultivars and water harvesting system (Bhatta, 2017). The author stated further that all support incentives for farmers to build adaptive capacity such as training, sharing of information, insurance policy and farm input subsidies are techno-science adaptive measures. It should be recalled that climate change adaptation measures only tackle the effects, and then to address the root causes of climate change, mitigation measures are needed.

Mitigation is explained as a human intervention to stop or reduce the source of climate change. Mitigation measures are the actions taken to directly reduce anthropogenic emission of green house gases (Feliciano, et al. 2022). The authors explained further that mitigation measures aim at replacing gas emitting fossil fuels like coal, oil and natural gas with clean renewable energies like solar, wind and geo-thermal devices and also to replace internal combusting vehicles with electric types. Mitigation measure, are explained in this study as those actions farmers take to reduce or stop greenhouse gas emission such as tree planting, preservation of forests, and crop rotation. But, what measures farmers in Ebonyi State take to adapt or mitigate climate change have not been identified empirically. There is no empirical record on the measures farmers adopt to cope with climate change in Ebonyi State for sustainable crop production.

Ebonyi is an agrarian state with over eighty percent estimated population earning their living directly from agricultural sector. The bulk of farmer are small holder crop producers who depend on rainfall for farming activities (Egbe, 2018). The farmers are characterized by widespread small holdings, high illiteracy, greatly depend on farmer labour for production and are affected by changes in rainfall patterns. It is therefore necessary to identify what measures small holder crop farmers take to cope with climate change for sustainable crop production.

Sustainable crop production is a system of food production that does not impose any harm to the environment, provides healthy and quality food adequate enough to sustain present population without compromising food needs of future generation (Imadi, Shazadi, Gul and Hakeen, 2016). It is explained in the context of this study as the ability of small holder farmers to produce enough food crops in the face of climate change for present population without endangering the food needs for the future generation. But, Makenzie and Williams (2015)

stated that to produce crop sustainably, the crop environment: soil, water and climatic factors need to be properly managed. It is believed that sustainable crop production is achieved through improved farming practices such as crop rotation, organic farming, planting cover crops and agro-forestry. It is now very important to determine which practices small holder farmers use to cope with climate change for sustainable crop production in Ebonyi State. It is against this background that this study was designed to identify adaptation and mitigation measures among small holder farmers for sustainable crop production in Ebonyi State.

Purpose of the Study

The main purpose of this study is to determine climate change adaptation and mitigation measures among small holder farmers for sustainable crop production in Ebonyi State.

Specifically, the study sought to:

1. Identify impacts of climate change on crop production among small holders farmers in Ebonyi State
2. Ascertain adaptation measures adopted by small holder farmers for coping with climate change
3. Find out climate change mitigation measures adopted by small holder crop farmers in Ebonyi State

Research questions

These three research questions guided the study.

1. What are the impacts of climate change on crop production among small holder farmers in Ebonyi State?
2. What are the adaptation measures adopted by small holder crop farmers for coping with climate change?
3. What are climate change mitigation measures adopted by small holder crop farmers in Ebonyi State?

METHODOLOGY

The study was carried out in Ebonyi State. Ebonyi is a state in Eastern Nigeria, bounded in the North by Benue State, in South by Abia State, in the East by Cross River State and in the West by Enugu State. Ebonyi was chosen for this study because majority of the inhabitants are rain-fed small holder crop farmers who are affected by climate change.

This study adopted survey research design. Multi-stage sampling technique was used to select respondents. The first stage was the selection of two (2) local government areas from each of the three (3) educational zones of the state. In the 2nd stage, three (3) communities were randomly selected from each of the six (6) local government areas, giving 18 communities. The third and last stage involved purposive selection of 6 crop farmers, 2 extension agents and 3 elders from each of the 18 communities. This gave a total of 198 respondents made up of 108 crop farmers, 36 extension agents and 54 elders.

Multiple data collection techniques or instrument: questionnaire, oral interviews and observation guides were used to gather comprehensive information on the coping measures. Questionnaire solicited information from crop farmers and extension agents on adaptation and mitigation measures, types of crop grown and resources that assisted farmers to adopt each measure. Oral interview was used to gather data from the elders on the historical glimpse of weather and climate change; while observation guides were used during survey to collect data on climate change indicators, impacts of climate change and evidence of adaptation and mitigation measures adopted by farmers.

RESULTS

The results of this study are presented in order of research questions, using tables.

Research question 1

What are the impacts of climate change on crop production among small holder farmers in Ebonyi State?

Data for answering this research question are presented in table 1.

Table 1: Mean Ratings of Respondents' Opinion on Impact of Climate Change on Crop Production

S/N	Item Statements	\bar{x}	SD	Remarks
1	Changes in rainfall pattern affect period of crop production	2.83	0.40	Agreed
2	Drought slows crop growth and makes crop farms more sensitive to weeds and diseases	2.77	0.43	Agreed
3	Excessive rainfall leads to floods which erode and deplete soil nutrients	2.74	0.45	Agreed
4	High temperature and heat dry up and kill crops	2.71	0.49	Agreed
5	Storms and winds destroy crops and farm structures	2.69	0.51	Agreed
6	Changes in climatic conditions cause poor crop yields which leads to hunger and poverty	3.02	0.38	Agreed

Data presented in table one revealed that the six items had their means above 2.50, which is the cut-off point. This signifies that each item was accepted as impacts of climate change on crop production in the study area. The close range of standard deviations from 0.38 to 0.51 is an indication that the respondents were close in their opinions to one another; and each opinion is close to the mean.

Research question 2

What are the adaptation measures adopted by small holder crop farmers for coping with climate change?

Data for answering this research question are presented in table 2.

Table 2: Mean Ratings of Respondents' Opinion on Adaptation Measures for coping with climate change

S/N	Item Statements	\bar{x}	SD	Remarks
A	Ethno-science adaptation measures: Farmers engage in each of these ethno-science adaptation measures			
1	Change date of cultivation	2.67	0.49	Accepted
2	Early planting of crops	2.65	0.51	Accepted
3	Late planting of crops	2.44	0.59	Not Accepted
4	Dry planting	2.52	0.57	Accepted
5	Adopt zero or minimum tillage	2.36	0.60	Not Accepted
6	Adopt multiple cropping	2.58	0.53	Accepted
7	Fallow the garden	2.54	0.55	Accepted
8	Use organic manure to boost crop production	2.78	0.47	Accepted
B	Techno-science measures: Farmers engage in each of these techno-science measures			
1	Plant heat tolerant crop varieties	2.33	0.68	Not Accepted
2	Plant drought tolerant crop varieties	2.31	0.69	Not Accepted
3	Grow high yielding crop varieties	2.52	0.50	Accepted
4	Use irrigation system in crop farms	2.36	0.61	Not Accepted
5	Engage in climate literacy training	2.37	0.60	Not Accepted
6	Engage in water harvesting	2.22	0.71	Not Accepted
7	Ensure crops farms against climate change	2.38	0.63	Not Accepted
8	Use early warning climate information	2.34	0.65	Not Accepted
9	Use weather-based agro-advisory services	2.35	0.64	Not Accepted
10	Apply chemical fertilizers in crop farms	2.58	0.48	Accepted

Data presented in table 2 were grouped into A and B for items in ethno-science (indigenous) technologies and techno-science respectively. The data revealed that 6 out of the 8 items in group A (ethno-science) had their means above the cut-off point of 2.50. This implies that the 6 items were accepted as measures adopted for coping with climate change, while the remaining two (2) were not adopted.

Only two (2) out of the ten (10) items in group B (techno-science) had means above the cut-off point of 2.50. Thus signifies that the two items (number 3 and 10) were adopted as techno-science measures for coping with climate change. The remaining eight (8) items had each a mean less than 2.50, showing that each was not accepted as a measure adopted by farmers to cope with climate measures.

The close range of standard deviations in the two groups (A & B) as 0.47 to 0.60 and 0.48 to 0.71, shows closeness of opinions of respondents to each other.

Research Question 3

What are the climate change mitigation measures adopted by small holder crop farmers in Ebonyi State?

Data for answering this research question are presented in table 3.

Table 3: Mean Ratings of Respondents' Opinions on Climate Change Mitigation Measures Adopted by Small holder Crop Farmers

S/N	Item Statements	\bar{x}	SD	Remarks
	Crop farmers engage in these mitigation measures			
1	Forestry preservation	2.44	0.69	Not Accepted
2	Planting and maintaining trees in homesteads	2.55	0.51	Accepted
3	Integrate crop/livestock farming	2.58	0.49	Accepted
4	Avoid veld fires	2.37	0.73	Not Accepted
5	Avoid bush burning	2.45	0.65	Not Accepted
6	Use renewable energies like solar in their homes	2.11	0.77	Not Accepted

Data presented in table 3 revealed that two (2) out of the six (6) items had means above the cut-off point of 2.50, signifying that the two items are accepted as the mitigation measures adopted by farmers in the study area. The remaining four items had their means below the cut-off point, indicating that each of the four items is not accepted as a measure adopted by farmers to mitigate climate change.

DISCUSSION OF FINDINGS

The findings of this study are discussed under the impact of climate change, adaptation and mitigation measures.

The study identified impacts of climate change on crop production as delay in the time and period of crop production, slow growth of crops, depletion in soil nutrients, physiological effects like weeds, pest and diseases on crop farms and poor yields of crops. These finding agree with the results of Egbe (2018) that climate change negatively impacts crop farms leading to low output and low incomes. These effects have made it increasingly difficult to decide on date of planting and selecting crop varieties to grow.

The study also identified that farmers change date of cultivation, engage in early planting, dry planting, multiple planting and use organic manure to adapt to climate change. These indigenous knowledge practices assist farmers to copy with climate change. These findings are in keeping with the results of Mushore et al (2021) that ethno-science techniques, such as early planting, multiple planting and growing of drought tolerant crops help small scale farmers to adapt to changes in climate.

The findings of this study on the techno-science measures indicate that farmers only engage in growing high yielding crop varieties and apply chemical fertilizers in crop farms. The remaining eight items techno-science adaptive measures were identified as not adopted by farmers. These findings agree with the common observations of farm practices of small holder farmers who are mostly illiterate and lack resources, to adopt techno-science (modern technologies) in farm production. In fact, these farmers have limited resources to fund modern adaptation programmes.

The findings also indicated that most of the mitigation measures were not adopted. Farmers only contribute to mitigation of climate change by planting and maintaining trees and integrate crop with livestock farming. The inability of small scale farmers to mitigate climate change streams from poverty, inefficient institutions, remoteness of the areas and low education level; which limit their access to climate change information.

Recommendation and conclusion

Based on the findings, it was recommended that:

1. Government should train small holder farmers and provide resources with which to adapt and mitigate climate change.
2. Extension agents should constantly give information on climate change adaptation and mitigation strategies.
3. Farmers should accept to be trained and seek for modern resources to cope with climate change.

REFERENCES

- Bhatta, G. D. (2017). Agricultural innovation and adaptation to climate change in South Asia. *Journal of Environment, Development and Sustainability*; 119(2), 497-525.
- Egbe, B. O. (2018). Competency training needs of small scale rice farmers for adapting to climate change for food security in Ebonyi State, Nigeria. *Journal of Education and Entrepreneurship* 5(4), 78-83.
- Feliciano, D. and Recha, J. (2023). Assessment of agricultural emission climate change mitigation and adaptation practices in Ethiopia Climate policy, 22(4), 427-444.
- Food and Agricultural Organization of United Nations (F.A.O) (2018). The status of farms and farmers in Nigeria. FAO, Rome.
- Food and Agricultural Organization of United Nations (F.A.O) (2016). The state of food insecurity in developing country. F.A.O Rome.
- Idu, E. E., Fadiji, T. O. and Chimdi, A. (2023). Effects of climate variability on rice production in north central, Nigeria, from 1980 – 2020. *Journal of Agricultural and Food Science*, 11(4), 78-89.
- Imadi, S. R., Shazadi, K, Guul, A. and Hakeem, K. R. (2016). Sustainable crop production system. Switzerland, Singer International Publisher.
- Intergovernmental Panel on Climate Change (IPCC) (2023). Synthesis climate change report. IPCC, Geneva: Switzerland Press.

- Matanga, E. and Jere, S. (2011). The effectiveness of ethno-science based strategies in drought mitigation in Mberengwa district of southern Zimbabwe. Clarion, PA: Clarion University of Pennsylvania.
- Mckenzie, F. C. and Williams, J. (2015). Sustainable food production: Constraint, challenges and choices by 2050. *Journal of Food Science*, 7(2), 221 – 233.
- Mgbenka, R. N. and Mbah, E. N. (2016). A review of small holder farming in Nigeria: Need for transformation. *International Journal of Agricultural Extension and Rural Development Studies* 3(2), 43-45.
- Nafees, A., Shahnawaz, G. and Alam, Z. (2021). Food insecurity: Concepts, causes, effects and possible solutions. *Journal of Humanities and Social Sciences*, 2(2), 105 – 113.
- Oluseyi, O. O., Sunnbo, O. and Olarewaju, T. O. (2021). Contribution of small-scale farming and local food supply to sustainable production and food security in Nigeria. *Journal of Agri-business*.
- Onyeneke, R. U., Amadi, M. U, Njoku, C. L. and Osuji, E. E. (2021). Climate change perception and uptake of climate smart agricultural in rice production in Ebonyi state. *Journal of Atmosphere* 12, (11), 67 – 79.
- Orifah, M. O, Sani, M. H., Nasiru, M. and Ibrahim, A. A. (2021). Perceived effectiveness of adaptation strategies to climate change among rice farmers in Jigawa State, Nigeria: Implications to rice production. *Sciend*, 54(1): 122-135.
- United Nation (UN) (2023). Statistical report on Nigeria food security outlook. FEWS NET.
- Yakubu, D, Akpoko, J. G., Akamola, M. O. and Abdulsalm (2021). Assessment of perceived effects of climate change on rice production among farmers in North-West zone, Nigeria. *Ghana Journal of Agricultural Science*, 56(1): 48-64.