
**IMPACTS OF CLIMATE CHANGE ON CROPPING SYSTEM PRODUCTION AND
FARMERS ADAPTATION IN SOUTH-EAST NIGERIA**

¹J. E.O. Ansa and ²P. Ugo

1. Department of Agriculture, Ignatius Ajuru University of Education, Port Harcourt, Rivers State

2. Department of Vocational and Technology Education, Niger Delta University, Wilberforce Island, Bayelsa State, Nigeria.

ABSTRACT

The Impacts of climate change on crop production and farm level adaptation practices was under taking in southeast Nigeria. The study adopted descriptive survey research design using three research questions on a sample of 160 crop farmers from Enugu and Imo States in South-east Nigeria. Data was collected using a 66-item questionnaire fashioned into 4-point rating scale to ascertain effects of climate change on cropping system, crop production, level of climate change awareness of farmers, and adaptive practices by the farmers. The instrument was face-validated by three experts and the Cronbach Alpha reliability coefficients of 0.81, 0.76 and 0.79 were respectively obtained for climate change awareness of farmers, effects of climate change on crop production and adaptation practices in crop production. The study established that Crop farmers have knowledge of climate change. The climate change indicators that farmers in southeast Nigeria are aware of include, intense heat, lengthy drought, reduced amount of rainfall, unusual heavy rainfall, flooding, drying up of rivers, lakes and streams. In spite of this awareness, the study also discovered that the adaptive ability of the crop farmers is still very low.

Keywords: climate change, awareness, adaptation, crop production, Southeast Nigeria

1. INTRODUCTION

Climate change is a change in the climatic conditions over a period of time due to the effects of natural variability and/or as a result of human anthropogenic activities (IPCC,2001).It is a significant alteration in the climatic conditions (precipitation, temperature, wind patterns) of a place or region over a long period of time resulting in changes in ecosystems and socioeconomic activities. Climate change has a global effect , but the most adverse effects is probably to be felt the most in developing world like Africa (Nwafor, 2007). Ayinde et al (2010) stated that the vulnerability of African farmers to the effects of climate change is expected to be most severe in Nigeria, due to their low coping capability.

The effects of climate change cut across all the sub-sectors of Nigerian agriculture such as livestock, crop production, agro forestry, fishery, and agricultural products processing (Amusa, 2014). In addressing this global threat, Tubiello and Rosenzweig (2008) stated that, a wide range of adaptation practices exist within farming system to help maintain or increase crop and other agricultural yields under climate change.

Nyong et al. (2007) explained that climate change adaptation in the cropping system encompasses techniques or practices that enable the cropping community or individual farmers to manage or adjust to the impacts of the change in climate. Some of these practices include cover cropping, early planting, timely weeding, controlled use of agro-chemicals and use of tolerant varieties (DeLPHE, 2010). Farmers' adaptation to the effects of climate change is a function of their awareness of the changes in the climatic conditions.

According to Oruonye (2011), "climate change awareness is a synthesis of the people's conception, interpretation and perceptions of climate change related issues which affect their behaviour, and the quality of responses and reactions to the problem. Insufficient information about climate change may limit farmer awareness of this global phenomenon and them more vulnerable to the devastating effects of climate change.

The traditional cropping system of the South-eastern Nigeria, the "slash and burn" farming technique is still practiced (Agwu, et al., 2011). This is a clear indication of lack of adequate knowledge of climate change, as the emission of carbon dioxide and other Green House Gases (GHG) in this practice, is among the factors that cause and aggravate climate change and its effects (Shrotriya and Prakash, 2011). This study therefore was carried out to determine the level of climate change awareness, effect of on crop production and level of adaptation among South-eastern Nigerian farmers.

2. METHODOLOGY

The study was undertaken in Southeast Nigeria made up of; Abia, Anambra, Ebonyi, Enugu and Imo States. This region is located within longitudes 5°30' & 9°30' E and latitudes 4°30' & 7°00' N (Enete et al 2013). The study adopted descriptive survey research design Nworgu (2006). Three research questions were formulated for the purpose of this study as follows:

- i. What is the awareness level of climate change among small holder crop farmers in Southeast Nigeria?
- ii. What is the impact of climate change on crop production activities of farmers in Southeast Nigeria?

iii. What is the levels of adaptation practices for sustainable crop production in Southeast, Nigeria? Sampling technique used was the Multistage random Sampling technique. The sampling size was 180 crop farmers selected out of two states from the five south-eastern states namely Enugu and Imo states. Secondly, from each of the selected two states, two agricultural zones were randomly selected making four agricultural zones for the study. In Enugu State, Nsukka and Awgu agricultural zones were selected while in Imo State, Okigwe and Owerri agricultural zones were selected. Thirdly, two Local Government Areas (LGAs) were randomly selected from each of the four agricultural zones making eight LGAs for the study. The fourth stage of the sampling involved the random selection of two farming communities from each of the eight LGAs making 16 farm communities. The fifth stage of the sampling involved purposive random sampling of 10 farmers from each of the 16 farming communities totaling 160 small holder farmers for the study. The Department of Extension services (ESD) in the two states facilitated the drawing of the list of farmers engaging in crop production cropping system enterprise.

Structured questionnaire of a 4-point rating scale was used for data collection. To determine level of awareness of climate change, the instrument was structured into: High Awareness, (HA); Moderate Awareness (MA); Low Awareness (LA) and Very Low Awareness (VLA). For the impact of climate change on crop production, the instrument was structured into: Very Serious (VS), Serious (S), Less Serious (LS) and Not Serious (NS). Level of adaptation practices put in place by the farmers, was structured into: Highly Practiced (HP), Moderately Practiced (MP), Less Practiced (LP) and Not Practiced (NP) with corresponding values of 4, 3, 2, and 1 in each of the cases for High, Moderate, Low and Very Low respectively. The instrument was face-validated by three experts. In order to ascertain the internal consistency of the instrument, Cronbach Alpha reliability method was used and it yielded a coefficient of 0.81 for climate change awareness cluster, 0.76 for effects of climate change on crop production cluster, and 0.79 for adaptation practices in crop production cluster. Means of answered research questions was adopted for the analysis of data collected.

In decision making of the research questions, boundary limit was used. Mean values within 3.50 – 4.00 was regarded as High Awareness, Very Serious or Highly Practiced as the case may be. Items with mean values between 2.50 – 3.49 were regarded as Moderate Awareness, Serious or Moderately Practiced as the case may be. While mean values within 1.50 – 2.49 were regarded as Low Awareness, Less Serious or Less Practiced and items with mean values within 1.00 – 1.49 were regarded as Very Low Awareness, Not Serious or Not Practiced.

3. RESULTS AND DISCUSSION

Research Question One :Level of awareness of climate change among small holder farmers in South-east Nigeria?

Table.1 highlights the rating of awareness of south eastern cropping system farmer. The table indicates that the farmers have High Awareness (3.50-4.00) in 6 of the 20 indicators, while Awareness is either Moderate or Low (2.50- 3.49 or 1.50- 2.49) in 10 or 4 climate change factors respectively out of the 20. The standard deviation of 0.45 to 0.87 for response indicates that the level of awareness among the farmers is almost the same and not significantly different. The table also shows that the farmers of the study area are aware of the climate change phenomenon. Indicators with high awareness include erratic or unpredictable rainfall; high or increase in temperature or heat; prolonged drought or dry period; delay in onset of annual rainfall; reduction of the harmattan period and reduction in ice falling during rainfall. Farmers have low awareness in, rise in river surface temperature; rising sea level and crop species extinctions. The findings above is related to Ozor&Nnaji (2011) who reported that farmers in Enugu State, Nigeria had awareness of climate change indicators such as heat from high temperature, drying of rivers, lakes and surface water bodies, drought and change in storage quality of fruits and vegetable, which is similar to those observed in this study. Sofoluwe, et al (2011) has recognized and stated that most Nigerian farmers are at present aware of the changes in climate. This collaborate the findings of this study.

Research Question Two: Impact of climate change on food crop production activities of farmers in Southeast Nigeria?

The average awareness of South-eastern Nigerian small holder crop farmers to the impact of climate change on crop production is showed in Table 2. The table indicate that the farmers pointed out that Very serious(within the boundary limit of 3.50 – 4.00 on 4-point rating scale) impacts of climate change on crop production in the area were as a result of Unusual heavy rainfall affecting crops on the field; Higher temperature and heat stress (wilting) on crops; Increased cases of flooding in crop fields; Prolonged drought resulting in crop failure; Deceased soil moisture for plant growth;Drying up of rivers, lakes and streams for crop production; Poor quality of stored farm produce as a result of heat; Increased drying up of seedlings after germination; Increased heat stress on crops and Increased soil erosion resulting from unusual heavy rains. Five awareness indicators were reported Serious (2.50 – 3.49); while 7 factors were Less Serious (boundary limit of 1.50 – 2.49). These findings show that climate change has a serious impact on crop production in southeast Nigeria. The standard deviation values 0.46 to 0.86 also that farmer in this region have observed similar impact of climate change on cropping systems ad crop production, This findings validates the report of Ishaya and Abaje (2008), thatclimate change is more likely to affect food production, health, biodiversity lost and fuel (wood) availability rather than affect businesses or cause disasters. This is also in line with the report of Adebayo, et al (2011), that 60% of farmers interviewed in southwest Nigeria, indicated that they experienced crop yield reduction due to climate change effects.

Research Question Three: Level adaptation practices for sustainable crop production in Southeast, Nigeria?

The adaptation strategies to climate change adopted by small holder farmer in the south-eastern Nigerian cropping system are displayed in Table 3. The table reveals that adaptation measures to effects of climate change by south-eastern farmers in crop production are still generally low. This is indicative of the fact that only 5 of the possible 20 adaptation measures at the disposal of the farmers are highly practiced. The standard deviation values of between 0.52 to 0.90 shows that the responses of the farmers on the items are close to the mean and one another and mean that all the farmers have adopted similar few adaptation measures. This is similar with the case of farmers in the south-western Nigeria, whereAmusa (2014) reported that their coping capacity to the effects of climate change among the farmers in western Nigeria is still low.

Table 1: Responses of Farmers in Southeast Nigeria on their Level of Awareness of Climate Change Phenomenon

S/N	Climate change indicators	Mean	Standard Deviation	Remarks
1	Decreased rainfall amount in the continental interiors	2.95	0.44	MA
2	Increased rainfall in the coastal areas	2.82	0.82	MA

3	Unpredictable rainfall patterns	3.52	0.80	HA
4	Increase in temperature (heat)	3.62	0.62	HA
5	Prolonged drought than before	3.58	0.75	HA
6	Delay in onset of annual rainfall	3.61	0.70	HA
7	Reduction of the usual harmattan periods	3.65	0.63	HA
8	High winds and heat waves	3.46	0.87	MA
9	Fast water evaporation from the ground	2.87	0.55	MA
10	Unusual heavy rainfall	3.20	0.53	MA
11	Reduced length of growing season	3.21	0.80	MA
12	Reduction in ice fall during rainfall unlike before	3.59	0.42	HA
13	River surface temperature rise	2.42	0.64	LA
14	Variations infruiting bloom date	2.44	0.63	LA
15	Rising sea level	2.41	0.60	LA
16	Increased flooding/erosion menace	3.41	0.86	MA
17	Crop species extinctions	2.23	0.61	LA
18	Increased desertification	2.77	0.80	MA
19	Drying up of rivers, lakes and streams	3.33	0.73	MA
20	Increased post-harvest deterioration of crops	3.44	0.83	MA

Note: *HA = High Awareness; MA = Moderate Awareness; LA = Low Awareness*

Table 2: Mean Ratings of the Responses of Farmers in Southeast Nigeria on their Perception of Effects of Climate Change on Crop Production.

S/ N	Effects of climate change on Crop Production	Mean	Standard Deviation	Remarks
1	Decreased rainfall amount for Crop production	2.83	0.63	S
2	Unusual heavy rainfall affecting crops on the field	3.65	0.82	VS
3	Higher temperature and heat stress (wilting) on crops	3.67	0.65	VS
4	Heavy winds causing damage to crops	2.41	0.81	LS
5	Increased cases of flooding in crop fields	3.58	0.52	VS
6	Prolonged drought resulting in crop failure	3.63	0.69	VS
7	Increased desertification	2.53	0.57	S
8	Increase in pest and disease problems of crops	2.11	0.84	LS
9	Extinction of crop species as a result of climate change	1.84	0.69	LS
10	Deceased soil moisture for plant growth	3.58	0.59	VS
11	Premature ripening of fruits	1.66	0.46	LS
12	Reduction in crop yield	2.73	0.80	S
13	Poor quality of stored farm produce as a result of heat	3.52	0.60	VS
14	Stunted growth of crops	2.50	0.68	S
15	Drying up of rivers, lakes and streams for crop production	3.51	0.72	VS
16	Increased drying up of seedlings after germination	3.50	0.59	VS
17	Increased heat stress on crops	3.64	0.85	VS
18	Intense weed growth	2.40	0.55	LS

19	Increased soil erosion resulting from unusual heavy rains	3.62	0.83	VS
20	Storage losses in roots and tubers	2.45	0.81	LS
21	Increased salinity/water pollution due to climate variability	1.81	0.68	LS
22	Increased post-harvest spoilage of harvested crops	2.85	0.72	S

Note: *VS = Very Serious; S = Serious; LS = Less Serious*

Table 3: Climate Change Adaptation Practices of South-eastern Nigerian Farmers for Sustainable Crop Production.

SN	Climate change adaptation practices in crop production	Mean	Standard Deviation	Remarks
1	Use of irrigation system	2.43	0.76	LP
2	Early or late planting of crops as adaption strategies	2.45	0.52	LP
3	Planting different varieties of crop (multiple cropping)	3.70	0.50	HP
4	Planting of trees (afforestation, reforestation, agroforestry)	2.34	0.63	LP
5	Planting cover crops to help conserve soil moisture	3.33	0.66	MP
6	Minimum/zero tillage for conserving soil nutrients	2.47	0.60	LP
7	Increased mulching for conserving moisture and reduce heat	3.40	0.54	MP
8	Staking of crawling crops such as yam to avoid heat burns	3.61	0.56	HP
9	The use of organic manure	3.69	0.90	HP
10	Mixed farming / diversification of farm enterprise	3.58	0.70	HP
11	The use of inorganic manure (fertilizers)	3.56	0.90	HP
12	Making ridges across farms to reduce effects of erosion	3.43	0.65	MP
13	Planting pest and disease resistant crops	2.40	0.80	LP
14	Planting of drought tolerant crop varieties	2.36	0.85	LP
15	Making of contour bunds around farmland	2.48	0.63	LP
16	Planting of fast maturing crop varieties	2.31	0.68	LP
17	Avoiding eroded/erosion prone area for farming	2.42	0.88	LP

18	Adopting recommended planting distance	2.13	0.75	LP
19	Changing crop harvesting dates	2.27	0.60	LP
20	Processing of crops to minimize post-harvest losses	2.28	0.54	LP
21	Construction of drainages across the farmland	2.37	0.59	LP
22	The use of wetlands/river valleys for production	2.56	0.58	MP
23	Consultation with rain maker during prolonged drought	1.52	0.68	LP

Note:*HP = Highly Practiced; MP = Moderately Practiced; LS = Less Practiced*

4. CONCLUSION AND RECOMMENDATIONS

The survey was carried out to assess the effect, level of awareness of climate change and coping strategies, in the Cropping System among small Holden Crop farmer in the south eastern region of Nigeria. The survey found out that a reasonable percentage of farmers in Southeast Nigeria are aware of climate change phenomenon; it also indicated that the impact of climate change is grave as it has greatly affected food production, supply and storage. The survey also brought to light that the adoption of coping practices among the farmer is very low.

Though the farmer exhibited awareness of climate change, there is still room for intensified effort in creating awareness and education on this global phenomenon. The farmer needs to understand the causes of climate change in order to desist from cropping practices that may worsen the present extent and impact on the ecosystem. The following recommendations are therefore proposed:

- i. Active use of media such as radio/television, newspapers, internet and farmers' cooperatives to educate and create more awareness causes, effects, prevention and adaptation practices to the effect of climate change.
- ii. Government involvement in capacity building of the farmers through improved education and extension visits.
- iii. Effective Agricultural extension on farm adaptive training on coping practices to the observed effects of climate change on crop production activities of the farmers.

REFERENCES

- Adebayo, K; Dauda, T. O; Rikko, L. S; George, F. O.A; Fashola, O. S; Atungwu, J. J; Iposu, S. O; Shobowale, A. O and Osuntade, O. B. (2011).Emerging and Indigenous Technology for Climate Change Adaptation in Southwest Nigeria.Research Paper, No. 10. Nairobi: African Technology Policy Studies Network.
- Agwu, E.A., Egbule, C.L., Amadu, F.O., Morlai, T.A. Wollor, E.T. and Cegbe, L.W. (2011). What Policy Options can Promote Agricultural Innovations for Climate Change and Adaption and Food Security in the West African Sub-region.BRIEF No. 29. Nairobi Kenya: African Technology Policy Studies Network (ATPS).
- Amusa, T. A. (2014). Gender and Climate Change Adaptation Decisions among Farm Households in Southwest Nigeria. An Unpublished Ph.D Thesis, Submitted to the Department of Agricultural Economics, University of Nigeria Nsukka.

- Ayinde, O. E; Ajewole, O. O; Ogunlade, I and Adewumi, M.O. (2010). Empirical Analysis of Agricultural Production and Climate Change: A Case Study of Nigeria. *Journal of Sustainable Development in Africa*. 12 (6): 275 – 283.
- Development Partnership in Higher Education (DePHE, 2010). A Framework for Agricultural Adaptation to Climate Change in Southern Nigeria, Project 326, University of Nigeria, Nsukka, Nigeria.
- Enete, A. A, Amusa, T. A and Nwobodo, C. E (2013). Climate Change and Cassava Processing in Southeast, Nigeria. *TROPICULTURA*, 31 (4): 272-282.
- Intergovernmental Panel on Climate Change (IPCC) (2001). Climate Change: Impacts, adaptation, and Vulnerability, A Summary for Policymakers, A Report of working Group II, Geneva, Switzerland: Intergovernmental Panel on Climate Change.
- Ishaya, S and Abaje, I. B. (2008). Indigenous People's Perception of Climate Change and Adaptation Strategies in Jema's Local Government Area of Kaduna State, Nigeria. *Journal of Geography and Regional Planning* 1 (18): 138-143.
- Nwafor, J. C. (2007) Global climate change: The driver of multiple causes of flood intensity in Sub-Saharan Africa. Paper presented at the International Conference on Climate Change and Economic Sustainability held at Nnamdi Azikiwe University, Awka, Nigeria, 12-14 June 2007.
- Nworgu.B.G. (2006). Educational Research; Basic Issues and Methodology. Nsukka: University Trust Publishers.
- Nyong, A; Adesina, F and Osman-Elasha, B. (2007). The value of indigenous knowledge in climate change mitigation and adaptation strategies in the African Sahel. *Mitig Adapt Strat Glob Change*. 12: 787–797.
- Oruonye, E. D. (2011). An assessment of the level of awareness of the effects of climate change among students of tertiary institutions in Jalingo Metropolis, Taraba State Nigeria. *Journal of Geography and Regional Planning*, 4 (9): 513-517.
- Ozor, N and Nnaji, C. (2011). The role of extension in agricultural adaptation to climate change in Enugu State, Nigeria. *Journal of Agricultural Extension and Rural Development*. 3 (3): 42-50.
- Shrotriya, G.C. and Prakash, D. (2011). Climate change and Agricultural Cooperatives. New Delhi: India IFFCO Foundation.
- Sofoluwe, N.A; Tijani, A.A and Baruwa, O. I. (2011). Farmers' Perception and Adaptation to Climate Change in Osun State, Nigeria. *African Journal of Agricultural Research*, 6 (20): 4789-4794.
- Tubiello, F. N and C. Rosenzweig. (2008). Developing climate change impact metrics for agriculture. *Integrated Assessment Journal*. 8 (1): 165–184.