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Research Article

Impact of Climate Change and Adaption Strategies to Cocoyam Farmers in Anambra State, Nigeria

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Abstract

The study investigated the effect of climate change and adaptation strategies among cocoyam farmers in Anambra state, Nigeria. Specifically, it determined the adaptation strategies used by the farmers on climate change, ascertained their sources of information on climate change, identified the causes of climate change and determined the perceived effects of climate change on cocoyam production. A multistage random sampling was use to select 120 cocoyam farmers. Structured questionnaires were used for the study. Data collected were analyzed using descriptive statistics. Findings showed that majority (75%) of the farmers were female while 25% of them were male. The average mean age of the farmers was 37 years while the average farm size cultivated by the cocoyam farmers was 1.08 hectare. It also revealed that the farmers used personal experience (74.2%), friends/neighbours (66.7%), fellow farmers (54.2%), cooperatives (52.5%), research institute (50%) and extension agents (44.2%) as their major sources of information on climate change. The result further revealed that the adaptation strategies used by the farmers as regards to climate change were planting drought tolerant varieties (3.29), use of early maturity varieties (3.50), use of disease resistant varieties (3.45), use of mounds and ridges (3.23), migrating from flooding area to non flooding land (3.12) and construction of local dam/irrigation (3.10). However, flooding (3.02), deforestation (2.13), bush burning (2.45), rainfall (3.3), drought (2.20) and erosion (2.40) were identified as the major causes of climate change. Farmers identified the perceived effects of climate change on cocoyam production as high incidence of pest /disease (2.60), reduction in crop yield (2.55), rotting of cocoyam root (2.35), ill health status of the farmers (2.29). Lose of property by flood (2.32) and addition of soil nutrient. The study recommended the organization of capacity building programs relevant to climate change and mitigations among farmers, the timely generation and dissemination of information on climate change and mitigations among rural farmers and the reviewing of extension curriculum to accommodate the training of extension personnel on climate change issues as methods for enhancing climate change, adaptation and mitigations.

Keywords: Climate Change, Effects, Mitigations, Cocoyam Farmers.

INTRODUCTION

In many parts of the world, roots and tubers such as cassava, sweet potato, yam, and cocoyam are important staple crops. They are commonly planted by smallholder farmers and used as food security and income crops particularly in Africa. According to FAOSTAT (2021), global cocoyam production stood at 9.76 million tons in 2000 and reached 10.54 million tons in 2019 with Nigeria, Cameroon, China (mainland) and Ghana ranked 1st, 2nd, 3rd and 4th respectively (Otekunrin,*et al*,2021).

Cocoyam production in Nigeria has two edible aroid species called *Colocasia esculenta* (L.) Schott (Taro) and *Xanthosoma mafaffa* (Tania). They are perennial plants grown as annual crops. *Colocasia esculenta* is one of the oldest cultivated plants in the world. *Colocasia esculenta* originated in South East Asia while *Xanthosoma* is believed to have

originated in the American tropics. It was introduced into West Africa around 1840(Amadi, *et al*, 2015; Otekunrin, *et al*, 2021). In Nigeria, C. esculenta first became established as a staple in the South East followed much later by *Xanthosama* while *Xanthosoma* is the main cocoyam grown in the South West. They are popular and rich carbohydrate food crop (Amadi, *et al*, 2015; Enibe *et al*, 2019; Otekunrin, *et al*, 2021).

Nigeria is the number one cocoyam producer in the world with annual output of about 3,450,000 metric tons (Igbozulike, 2015). The leaves are used as vegetable and as feed to farm animals. This is used to feed animals because the leaves are soft textured and are reported to contain important mineral elements, vitamins and thiamine (Enibe *et al*, 2019; Otekunrin, et al, 2021). The leaves are rich source of vitamin A (β-carotene), C, calcium and micronutrients of nutritional importance due to their antioxidant properties. However, the leaves are reported to have medicinal values. Vitamin A in colocacia leaves is known to improve the immune system and reduce the rate of anemia in children (Ibeawuchi, et al, 2015). In addition, because of the low sodium, carbohydrates and gross energy content of colocasia esculenta, the leave is recommended for the hypertensive, diabetics, obese and normal people. Cocoyam corms are revealed to contain 31g of carbohydrate, 2.0g of protein, 1.0g of fibber and 20 mg of calcium (Ibeawuchi, et al, 2015; Enibe *et al*, 2019). The crop contains low starch; hence, it is recommended for the diabetics as against its close substitutes such cassava and yam (Igbozulike, 2015). The tubers have therapeutic value and are used to treat tuberculosis, ulcers, pulmonary congestion, fungal infections, to lower body temperature in a feverish patient, and other ailments. Phytochemicals are responsible for the healing effects of many plant species (Otekunrin, *et al*, 2021).

Owing to the nutritional content and production capacity of cocoyam in Nigeria, its uses and potentials have made it a good raw material in industries for production of different products. This is because the crop has been approved as composite material for production of different products which include bread and biscuit baking, production of pasta, starch, salad cream and sausage binder (Ibeawuchi, *et al*, 2015; Enibe *et al*, 2019). Cocoyam creates employment for not less than 12% of the Nigeria working population and supply about 20% of the carbohydrate needs in the country (Amadi, *et al*, 2015; Ume, et *al*, 2016). It provides income for unemployed youths and returns that could otherwise be seen as unproductive by the society (Ume *et al*, 2016).

Despite the economic and nutritional values associated with the crop, the production of cocoyam had stagnated for few years now due to several production constraints, among which are neglect on the crops, climatic factor, low input, scarcity of planting materials, and various pre- and post-harvest biotic challenges, including the Cocoyam Root Rot Blight Complex (CRRBC), and Taro leaf blight (TLB) (Amadi, *et al*, 2015).

Climate change has gradually taken negative impacts on the various key socio-economic sectors in recent time and one of these sectors is agriculture, especially the crop sector, which appears to be most vulnerable to this effect. Climate change affects various aspects of plant growth and development. It has been predicted that climate change is likely to reduce yields and/or damage crops in the 21st century (Falola and Achem,2017), this situation calls for a serious concern, as the crop sector in most developing countries contributes immensely to the food security of the poor people. Therefore, adaptation remains the only option for most societies to cope with the projected impacts over the next 100 years (Falola and Achem,2017). Climate change is a change in global weather pattern which caused by more extreme weather events like storms, flood, drought, rainfall and temperature. Agriculture which is the pillar for nation building is extremely vulnerable to climate change. Climate change has a mixed effect on agriculture with some areas benefiting from moderate temperature increase and others being negatively affected (Udemezue, *et al*, 2023).

According to research, climate change is one of the most serious environmental threats facing mankind worldwide; it affects agriculture in several ways, especially, its direct impact on food production (Oyewole,2015). Therefore, what affects agriculture indirectly, affects all directly. In order to develop effective and sustainable policies on improving cocoyam production, a sound scientific knowledge of the present causes, effects and adaptation strategies used by the farming households is necessary in the study area. Therefore, this study was carried out to analyze impact of climate change and adaption strategies on cocoyam farmers in Anambra State, Nigeria. The specific objectives were to determine the adaptation strategies used by the farmers on climate change, ascertained their sources of information on climate change, identified the causes of climate change and determined the perceived effects of climate change on cocoyam production.

METHODOLOGY

The study area for this research is Anambra State. The State is presently located in the South-East of Nigeria. The State is bounded by Delta State to the West, Imo State to the South, Enugu State to the East and Kogi State to the North. It has estimated population of 4, 177, 828 million people which stretches over about 60kilometers between surrounding community. The State lies on the longitude 6^0 35E and 7^0 21E and latitude of 5.38N and 6^0 47E (Wikipedia. org/Wiki

anambra State, 2010). Anambra State comprises 21 local governments and is predominantly occupied by Igbo people who are farmers and business incline.

The target population for this study was cocoyam farmers in the State. Anambra State comprises 21 local governments. Multistage sampling techniques were used for this study. Two (2) local governments out of 21 local governments in the State were selected due to their effect on climate change; these are Anambra west and Ayamelum local government. However, four communities each from a local government were selected; this gave a total of 8 communities used for the study. Here, Omor, Anaku, Umuelum and Igbakwu from Ayamelum; Nzam, Umuem, Igbede and Nmiata Anam from Anambra west local government were used. This gave a total of eight (8) communities. Fifteen cocoyam farmers were selected from each community using simple random techniques and this gave a total sample size of one hundred and twenty (120) respondents. Data was collected through structured questionnaires. Data collected for the study were analyzed using descriptive statistics.

Results and Discussions

Socio-economic characteristics of cocoyam farmers

Table1 show that 75% of the farmers were female while 25% of them were male. This implies that female dominated farming activities in the study area. Majorities (41.7%) of the farmers were married while 29.2% of the farmers were single. This indicates that the farmers are more likely to have children that might have been affected by climate effect or more people that can help to secure their properties against climate change. This result is in consonance with the finding of Falola and Achem (2017) which found in their study that the majority (77.1%) of the respondents were married. The average mean age was 36 years. The indication is that farmers were predominantly in their active productive age and this could increase their stamina for production. Majorities (43.3%) of the farmers had no formal education while 30% of them completed primary education. High levels of illiteracy among farmers could deprive them chance to adopt the recommended strategies for climate change. The finding agreed with Falola and Achem (2017) that rural farmers were characterized with low level of literacy. However, 46.7% of the farmers cultivated less than 0.5-1 hectare while 33.3% of others cultivated2-3 hectare. The average farm size of the farmers was 2.1 hectare. This implies that farmers were still under small scale farming. This finding is in line with the findings of Chinaka and Udemezue (2015) which said in their study that farmers in Anambra State were small scale farmers. The mean year of farming experience was 20 years. This shows that the farmers had long period of farming experience and this could enhance their knowledge on farming activities as well as climate change adaptation. More so, the average household size of the farmers was 8 persons. This likely indicates that cocoyam production is a means of catering for the family in the study area. Majority (62%) of the farmers had access to extension services while 37.5% did not have access to extension services. Those of the farmers who did not have access could be as a result of the inability of extension workers to discharge their official duty diligently or it could be due to inadequate extension workers to cover a wide range of farmers within a stipulated time. On the other hand, 75% of the farmers did not have access to credit loan while the majority (66.7%) of them belonged to social organization.

Table 1: Socio-economic characteristics of cocoyam farmers

Variables	Frequency	Percentage	Mean
Sex			
Male	30	25.0	
Female	90	75.0	
Age			
18-25	30	25.0	
26-35	60	50.0	36 years
36-45	25	20.8	
46 and above	5	4,2	
Marital status			
Married	50	41.7	
Single	35	29.2	
Divorced	10	8.3	
Separated	15	12.5	
Widowed	10	8.3	
Educational level			
Non formal education	52	43.3	
Primary school	36	30.0	
Secondary school	10	8.3	
OND/HND	15	12.5	
First degree and above	7	5.8	
Farming experience			

1-10 yrs	20	16.7	20 years
11-20 yrs	15	12.5	
21-30 yrs	35	29.2	
31-40 yrs	30	25.0	
41 and above	20	16.7	
Farm size			
0.5-1 ha	56	46.7	
2-3 ha	40	33.3	2.1 ha
4-5 ha	24	20.0	
Household size			
1-2	21	17.5	
3-4	35	29.2	
5-6	40	33.3	8 persons
7-8	24	20.0	
Access to credit loan			
Yes	30	25.0	
No	90	75.0	
Access to extension service	75	62.5	
No	45	37.5	
Membership of social group			
Yes	80	66.7	
No	40	33.3	

Source: field survey, 2022.

Sources of Information on climate change

Table 2: shows that the majority (74.2%) of the cocoyam farmers sourced information on climate change from personal experience, while 66.7% of them also sourced information on climate change from friends/neighbours. Similarly, 54.2 and 52.5 of cocoyam farmers sourced information on climate change from fellow farmers and cooperatives, while 50% and 44.2% of the cocoyam farmers sourced information on climate change from research institute and extension agents respectively. However, 38.3% and 35% of the cocoyam farmers sourced information on climate change from radio and newspaper therein. The farmers used personal experience, friends/neighbours, fellow farmers, cooperatives, research institute and extension officers more than other information sources because they could be more convenient and reliable to them than other information sources on climate change. Since personal experience, friends, fellow farmers, cooperatives, research institute and extension officers dominated the information sources used by the cocoyam farmers in the area on climate change, it therefore would be appropriate to deliver information on climate change to farmers through used personal experience, friends, fellow farmers, cooperatives, research institute and extension officers respectively. In the light of these, the finding agreed with the research conducted by Yaseen, Xu, Yu and Hassan (2016) in Pakistan, which affirmed that a greater proportion of farmers ranked neighbor-friends-relatives as first source of information. Chinwoke and Togun (2018) also affirmed that personal experience, radio, fellow villagers and extension agents were the major sources of climate change information used by the cocoyam farmers in south East. Therefore, farmers' preference for any information source could be a stepping stone for agricultural production in a developing country like Nigeria and it could be also significantly influencing adoption of improved technologies in a social system provided that the social norms are not tampered with.

Table 2: Source of information on climate change

Information source	Frequency	Percentage
Personal experience	89	74.2
Friends/neighbours	80	66.7
Fellow farmers	65	54.2
Cooperatives	63	52.5
Research institute	60	50
Extension agents	53	44.2
Radio	46	38.3
Newspaper	42	35.0
Television	40	33.5
Face book	27	22.5
WhatsApp	18	15.0

Source: field survey, 2022

Causes of Climate Change

Table 3 shows that the respondents perceived flooding (M=3.02), deforestation (M=2.13), drought (M=2.20), excessive rain fall (M=3.3), application of excess nitrogenous fertilizers (M=2.16), bush burning (M=2.45) and use of excessive agro-chemical (M=2.40) were the adverse cause of climate change to great extent. Other causes of climate change such as overgrazing, depletion of ozone layer, crude oil spillage, changes in land use and CO2 emissions from transportation, with low mean (M) scores of 1.4,1,3,1.33,1.22,1.11, and 1.10, did not cause climate change (perceived as to no extent).

Table 3: Causes of climate change

Variables	Mean
Flooding	3.02
Deforestation	2.13
Bush burning	2,45
Excessive rainfall	3.3
Drought	2.20
Overgrazing	1.40
Depletion of ozone layer	1.30
Over application of nitrogen fertilizers	2.16
Use of excessive agro-chemical	2.40
Crude oil spillage	1.33
Change in land use	1.11
Co2 emission from engine	1.10

Source: field survey, 2022

Perceived effects of climate change on cocoyam farmers

Figures in table4 indicate the various perceived effects of climate change by the farmers in the study area. The effects were categorized as very serious = 3, serious = 2 and not serious = 1. The effects were later ranked in the descending order of their sequence. Rotten of cocoyam tuber with a weighted mean score 2.35 was ranked first, declined in crop production with a weighted mean score 2.55, incidence of poverty among farmers(3.12), high incidence of pest/diseases with a weighted mean score 2.60 , high incidence of poverty (2.45).Change in weather which brought about malaria disease (2.29), loss of properties (2.32),reducing marketing values of the crops (2.40) and causing damages on road with a weighted mean score 2.20 were perceived as serious effects of climate change to farmers in the study area. This finding is in line with that of Udemezue (2017) that loss of property, reduction in market value, high incidence of poverty and damages on the roads as the perceived effect of climate change in the study area. However, the finding is also in line with Chinwoke and Togun(2018) who saw increased pest and disease attacks, decay of coms and cormels, reduction in output, crop losses, increased incidence of pests and diseases as some of the negative impacts of climate change on small scale cocoyam farmers south East, Nigeria.

Table 4: Perceived effects of climate change on cocoyam farmers

Variables	Mean
Declined in crop yield	3.20
Rotten of cocoyam tubers	3.45
Causing cholera and meningitis	2.30
Loss of lives and properties	2.55
Brought about food insecurity	3.10
Causing too much manure to soil	1.30
Reducing market value of crops	2.40
Displacement from natural domain	2.12
High incidence of poverty among farmers	2.14
Causing damages on road	2.6
High incidence of pests and diseases	3.11

Source: field survey, 2022.

Adaptation strategies to climate change

Figures in Table 5 indicate the coping strategies used by farmers as regards to climate change. The coping strategies were grouped into always, sometime, and not at all, respectively. Shifting from high flooding areas to the less one with a weighted mean score 3.12, planting of disease/pest resistant varieties with a weighted mean score 3.45, planting on mounds and ridges with a weighted mean score 3.23, planting drought tolerant crops with a weighted mean score 3.29

and practicing of planting early maturity crops with a weighted mean score 3.50 were adopted by the farmers as the best option for managing the climate change in the study area. In the light of the above, this finding, therefore, disagreed with Ifeanyi-Obi *et al* (2017) who said that the most commonly used coping strategies by cocoyam farmers in southeast were increase use of organic manure, frequent weeding, use of information from extension agents, use of fallowing and application of multiple cropping.

Table 5: Adaptation strategies used by the farmers

Variables	Mean
Planting of disease/pest resistance variety	3.45
Planting on mounds and ridges	3.23
Creation of dams	1.30
Shifting from high flooding area to less ones	3.12
Use of multiple cropping	1.25
Moderate use of agro-chemicals	1.31
Practice of early cropping method	3.50
Diversification in crop production	1.40
Planting drought tolerant crops	3.29
Use of excessive agro-chemicals	1.11
Planting of trees	1.32

Source: field survey, 2022.

Table 6: Constraints to climate change adaptation

The constraints faced by farmers in cocoyam production practices are presented in Table 6 below. Those constraints are inadequate government interventions (M=3.01), traditional beliefs (M=3.00), lack of access to information(M=2.11), high illiterate levels among farmers (M=2.10), low knowledge on climate change adaptation (M=2.09 and low knowledge of weather forecast (M=2.06) respectively. Other constraints that are not so much effective are; lack of credit facilities, inadequate canoe for transportation, communal way of land ownership, inadequate extension knowledge by the farmers and high cost of speed boat.

Table 6: Constraints to climate change adaptation

Variables	Mean
Inadequate government interventions on climate change	3.01
Traditional belief	3.00
Lack of access to information on climate change	2.11
High illiterate level among farmers	2.10
Low knowledge on climate change adaptation	2.09
No knowledge of weather forecast by the farmers	2.06
Lack of credit facilities	1.24
Inadequate canoe for transportation	1.16
Communal way of land ownership	1.15
Inadequate extension knowledge by the farmers	1.13
High cost of speed boat	1.10

Source: field survey, 2022.

Conclusion and recommendations

Climate change is a change in global weather pattern which caused by more extreme weather events like storms, flood, drought, rainfall and temperature. Agriculture which is the pillar for nation building is extremely vulnerable to climate change. If the world's Carbon emission and greenhouse gas generation continues at the current pace with its reciprocate effect on climate change, rough estimates suggest that over the next 50 years or so, climate change may pose a serious threat on global food than other constraints on agricultural production. In view of this, Findings of the study indicated that majority (75%) of the cocoyam farmers were females while 25% of the rest were males. The mean age, years of farming experience, household size and farm size of the OFSP farmers were 32years, 20years, 8 persons and 2.1hectares respectively. However, 41.7% of the farmers were married, 29.2% were singles while 8.3% were widowed. It also revealed that the farmers used personal experience, friends/neighbors, fellow farmers, cooperatives, research institute and extension agents as their major sources of information on climate change. The result further revealed that the adaptation strategies used by the farmers as regards to climate change were planting drought tolerant varieties, use of early maturity varieties, use of disease resistant varieties, use of mounds and ridges, migrating from flooding area to non flooding land and construction of local dam/irrigation. However, flooding, deforestation, bush burning, rainfall, drought and erosion

were identified as the major causes of climate change. Farmers identified the perceived effects of climate change on cocoyam production as high incidence of pest /disease, reduction in crop yield, rotting of cocoyam root, unhealthy status of farmers, Lose of property by flood and addition of soil nutrient. This paper recommends that stakeholders of weather forecast in collaboration with extension agents should make it known to farmers in order to be abreast with weather condition. Some other coping strategies stated by intergovernmental panel on climate change (IPCC) should be articulated into their beliefs and norms of the farmers in order to have a wider knowledge on climate change and mitigation. Stakeholder and extension agents should organize a workshop on climate change for farmers in the study area to enable them have a proper knowledge on climate change and mitigation. Human activities that cause climate change such as deforestation, burning, and illegal opening of dams, among others should be discouraged. Organization of capacity building programs relevant to climate change and adaptation strategies among farmers should be encouraged. Extension curriculum should as well be reviewed to accommodate the training of extension personnel on climate change and adaptation strategies.

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