Journal of Agriculture, Environmental Resources and Management

Journal of Agriculture, Environmental Resources and Management
ISSN2245-1800(paper) ISSN 2245-2943(online)
6(3)1-800: **March**.2024; pp66-76

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Adaptation Strategies to Climate Change Amongst Yam Farmers in Akure - North Local Government, Ondo State, Nigeria.

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Abstract
Adaptation strategies in mitigating the effects of climate change by yam farmers in Akure - North Local Government Area of Ondo State, Nigeria was assessed. Multistage sampling procedure was used to select 120 yam farmers for the study. Primary data on socio-economic characteristics of the respondents, farmer's awareness about climate change, perceived effects of climate change on yam production and various adaptation strategies by the respondents in the study area were obtained using a questionnaire. Analysis involved descriptive statistics and Chi-square test. Findings revealed that a total of 73.3% respondents produced both yam and other crops and none of the farmers produced only yam in the study area. The findings concluded that almost all the respondents (98.0%) aware of climate change and its effects. The effects of climate change on yam production in the study area include loss of yield, loss of income, yam spoilage, flooding, disease and pest infestation. The adaptation strategies adopted by the farmers to mitigate the effects of climate change on yam farming in the study area include mulching, early planting, mixed cropping, early harvesting, and proper storage. These adaptation strategies were adopted by the farmers following their farming experience over the years. In view of the results of the study, meteorological information on climate change, agricultural extension services, as well as credit facilities to enhance the adoption of adaptation strategies by the yam farmers are therefore recommended.
Keywords: *Climate Change, Adaptation Strategies, Adoption and Yam Farmers.*

Introduction: Yam is an annual, stem tuber and monocotClimate change has become the new driver of plant. It belongs to the genus "*Dioscorea*" and the familypoverty, malnutrition and death. It is recognized as "*dioscoreacea*". The place of yam in the diet of theone of the greatest challenges of our time. It causes a people in West Africa and in Nigeria in particular cannothuge threat to all aspects of human development be overemphasized. According to Akinola, Oke,(Ahmed, Idayu and Yusri, 2020). Climate change has Adesiyan & Famuyini (2019), yam holds importantbeen observed to have serious direct impact on position as a food and industrial crop in the Nigerianagricultural production, because of the climate-economy. Unfortunately, yam production in Nigeria isdependent nature of agricultural production systems. among the most susceptible to the deleterious effects ofThis impact is particularly significant in developing climate change (Elijah, Osuafor and Anarah, 2018). countries like Nigeria where agriculture is the main source of income, employment and livelihoods for

majority of the population (Ibidapo, Ogunsipe, Oso and Akintade, 2018). The evidence of climate change is real, and its consequences are being felt globally, with poor rural households in developing countries bearing the brunt of the burden (Omerkhil, Chand, Valente, Alatalo and Pandey, 2020; and IPCC, 2021). Climate change affects all the dimensions of food security which are: availability, accessibility, utilization and sustainability. Rising temperatures and more variable rainfall patterns are expected to reduce crop yields, compromising food security and worsening malnutrition which accounts for 3 million deaths each year (Fact sheet, 2016). Food insecurity is becoming more prevalent in developing countries as a result of increased exposure and vulnerability to climate change (Abdela, 2022).

Farmers in poorer nations are especially vulnerable to the negative consequences of climate variability and change due to their low or non-existent resilience, poor governance, and weak institutions (Marini, 2018; and Partey, Dakorah, Zougmoré, Ouédraogo, Nyasimi, Nikoi and Huyer, 2020). Rain-fed farmers are more likely to become victims of climate change because of their reliance on rain-fed agriculture. Consequently, production suffers, resulting in decreased food supply and a rise in poverty (Sato, Joshua, Ngongondo, Chipungu, Malidadi and Monjerezi, 2020; Tumbo, Mutabazi, Mourice, Msongaleli, Wambura and Mzirai, 2020; Ureta, González, Espinosa, Trueba, Piñeyro-Nelson and Alvarez-Buylla, 2020).

Adaptation to climate change entails the adjustments in the natural or human activities in response to the actual or expected climatic changes and their effects which could cause harm or exploit the beneficial opportunities by the rural farmers (Oti, Enete, and Ebe, 2020; and Chevallier, 2024). Adaptation remains the most popular option to manage the impacts of climate change on agriculture in the world today, and it is location specific. Belay *et al.,* (2017) reported that farmers' awareness of climate change is a necessary prerequisite for climate change adaptation strategies. The choice of adaptation options in any location is shaped by the socio-ecological context, infrastructure and institutional factors (Ravera, Berta, Unai and Adam, 2016). Rural households in many rural communities in Africa are constantly changing their farm management operations in an attempt to mitigate the climate effects, majority of which are autonomous. Many of the techniques adopted by yam farmers in response to climate change are focused on established information and technologies (Kolawole and Okonkwo, 2021; Ikpoza *et al.*, 2022). Several studies (Ibidapo *et al.,* 2018; and IPCC, 2021) have reported that agricultural production across the globe and developing countries in particular is affected by climate change, but very few studies on adaptation strategies to climate change amongst yam farmers especially in rural area of South-Western Nigeria. Climate change had serious effects on yam production which might resulted into economics loss for the farmers and at large affect food security in the country. Hence the need for the adaptive measures to climate change to be put in place to ensure proper management of yam production. The study is therefore necessitated to assess adaptation strategies to climate change amongst yam farmers in Akure - North Local Government, Nigeria, as it provided answers to the following pertinent research questions: What are the socio-economic characteristics of yam farmers in the study area? Are the farmers aware of the effects of climate change? What are the perceived effects of climate change on yam production in the study area? What are the adaptation strategies that are adopted by yam farmers to mitigate the effects of climate change in the study area? The hypothesis which were stated in null form tested the significant relationship between the age, gender, educational status, farming experience and economic status of the farmers and adoption of adaptation strategies to mitigate the effects of climate change among yam farmers in the study area. The results of the study can help extension workers in giving advice or suggestions to the farmers including urban areas. It could as well be helpful for

policymakers and development practitioners in designing locally specific, actual adaptation options that shape adaptation to recent and future climate change risks in favour of yam production in Nigeria.

Methodology

The study was carried out in Akure - North Local Government Area of Ondo State, Nigeria. Iju/Itaogbolu is the Local Government headquarters of Akure - North which is 18 kilometers from Akure, the State capital. Other towns and villages are: Ogbese, Obaile, Ilu-Abo, Owode, Eleyowo, Igbatoro, Ala, Igoba, Isinigbo, Jegele, Odudu and Osi. It has a total land area of 676.7km^2 (Facts & Figures on Ondo State, 2010). Akure - North Local Government is bounded in the North by Ekiti State, in the South by Akure South Local Government, in the East by Akoko South - West Local Government and in the West by Ifedore Local Government respectively. According to the National Bureau of Statistics (2006), Akure - North Local Government has a total population of 176,500 people. Their major occupation in the Local Government is farming. The Local Government enjoys a tropical climate with rainy season from April to October and dry season from November to March every year. This climate supports yam production and some other arable crops such as cassava, maize, cocoyam, and sweet potatoes. Akure - North is typically Yorubas, but there are growing numbers of people from other ethnic groups such as the Igbos, Hausas, Fulanis, and Ebiras residing in the Local Government Area.

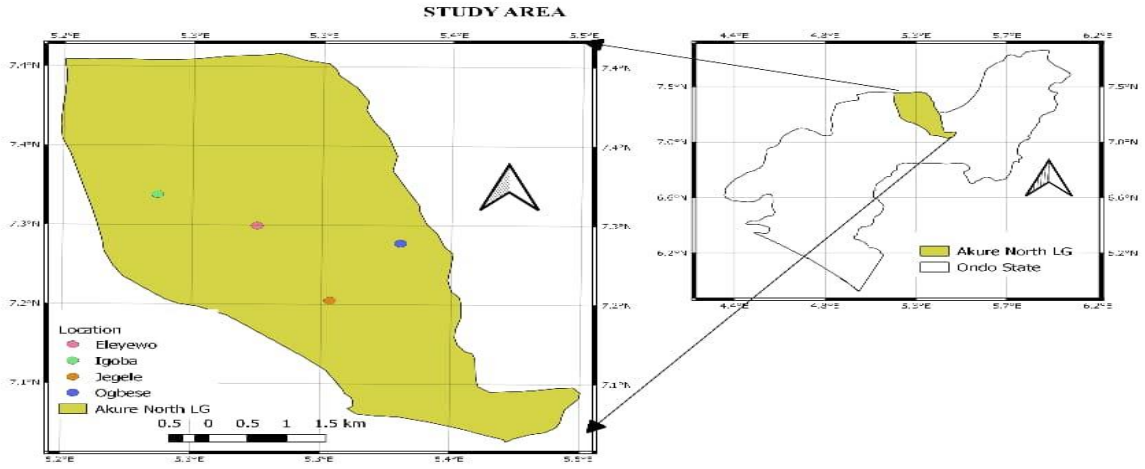

Figure 1: Map of Akure - North Local Government showing the Study Area
Source: Field Survey, 2023.

Sampling Techniques: A two - stage sampling technique was used for the study. The first stage was purposive selection of four farming communities due to their potentials in yam production. The communities were: Odudu, Jegele, Eleyowo and Ogbese (Fig 1). At the second stage, 30 farmers were randomly selected each from the four selected communities making a total of one hundred and twenty (120) respondents.

Data Analysis: Data were analyzed with the use of descriptive statistics method in form of table, percentage frequency and pie chart. In addition, Chi-square was used to carry out statistical test on the following stated hypotheses: There is no significant association between age, gender, educational qualification, farming experience, economic status and adoption of adaptation strategies to mitigate the effects of climate change among yam farmers in the study area.

Results and Discussions

Socio-Economic Characteristics of Respondents in the Study Area.

Table 1 shows that 32.5% (majority) of the respondents were between the ages of 41 and 50 years.

The mean age of the farmers was 46years. This implies that the respondents were in their economic active and productive age bracket. The finding is in line with that of Kalu, Nnabue, Edemodu, Agre, Adebola, Asfaw and Obidiegwu (2023) where the mean age of yam farmers was 46years. On gender distribution of the respondents, majority (72.5%) of the respondents were male while 27.5% of the respondents were female. This implies that the study area was dominated by male headed yam farmers. This affirms the claims of Ibidapo *et al.*, (2018) and Victor, Waiter and Thomas (2021) that there are more male than females in yam farming in Africa. The results further show that 87.5% of the respondents had one form of formal education or the other with 43.4% indicating they had undergone secondary education, while 19.2% of the respondents indicated that they had undergone tertiary education. This implies that majority of the respondents were literates. The findings corroborates the assertion of Robert, Chinyere, Chukwuemeka, Anurika, Chinenye, Precious and Uwazie (2019); and Nicholas, Desalegn, and Lydia (2021) that African farmers nowadays are literates. So also, 43.3% of the respondents had contact with extension agents once in a month while 27.5% had none. The mean yam farm sizes of the respondents in the study area was 0.8ha.

Table 1: Socio-Economic Characteristics of Respondents in the Study Area.

Socio-economics characteristic	Frequency	Percentage	Mean
Age			
<30	10	8.3	
31-40	28	23.3	
41-50	39	32.5	46
51-60	22	18.4	
>60	21	17.5	
Gender			
Male	87	72.5	
Female	33	27.5	
Educational Status			
No formal Education	15	12.5	
Pry. Sch.	30	25.0	
Sec. Sch.	52	43.3	
Tertiary	23	19.2	
Types of Crops			
Only Yam	32	26.7	
Other Crops	0	0.0	
Both Yam and Other Crops	88	73.3	
Farm Size (Ha)			
< 1	74	61.7	0.8
1.01 – 2.0	34	28.3	
2.01 – 3.0	12	10.0	
3.01 – 4.0	0	0.0	
Farming Experience			

< 5yrs	12	10.0	
6 –10yrs	20	16.7	
11 – 15yrs	30	25.0	
16 –20yrs	40	33.3	18
> 20yrs	18	15.0	
Number of Extension Contacts (Monthly)			
Non	33	27.5	
Once	52	43.3	
Twice	27	22.5	
> Twice	8	6.7	
Annual Income (₦)			
<250,000	18	15.0	
250,001-500,000	32	26.7	
500,001-750,000	57	47.5	553,000
> 750,000	13	10.8	

Source: Field Survey, 2023.

None of the respondents only produced other crops in the study area. The 26.7% of the respondents produced only yam. Conversely, majority of the respondents (73.3%) produced both yam and other crops in the study area. This implies that farmers in the study area combine yam farming with other crops (mixed cropping) to maximize productivity and optimal utilization of farm land. This is in accordance with Ibidapo *et al.,* (2018) and Otekunrin, Ayinde, Sanusi, Onabanjo, Ariyo (2021) that subsistence farmers in Africa practices mixed cropping to sustain their livelihoods. The largest percentage (33.3%) of the respondents had yam farming experience between 16 and 20 years. And the mean years of experience of the yam farmers were 18years. This implies that the farmers were fairly experienced in their yam farming activities. Farmers' years of experience is very important because their management skills improve with acquired experiences. This is similar to the findings of Ibidapo *et al.,* (2018); and Adeagbo, Ojo, and Adetoro (2021) that farmer's performance depends on their farming experiences.

General annual income to a large extent determines the economic status of a man. The more the income, the more the economic and capital strength of yam farmers and vice vasa. Majority (47.5%) of the respondents generated between ₦500,000:00–₦750,000:00/year. And ₦553,000:00 was the mean annual income generated by yam farmers in the study area.

Awareness of Farmers on Climate Change and its Effects on Yam Production in the Study Area.

The distribution of respondents' awareness about climate change and its effects on yam production is presented in Figure 2. The result shows that majority (98.0%) of the respondents were aware of the climate change and its effects on yam production in the study area. It implies that almost all the respondents were well familiar with climate change and its effects on yam production in the study area. This is not unconnected with their literacy and farming experience over the years.

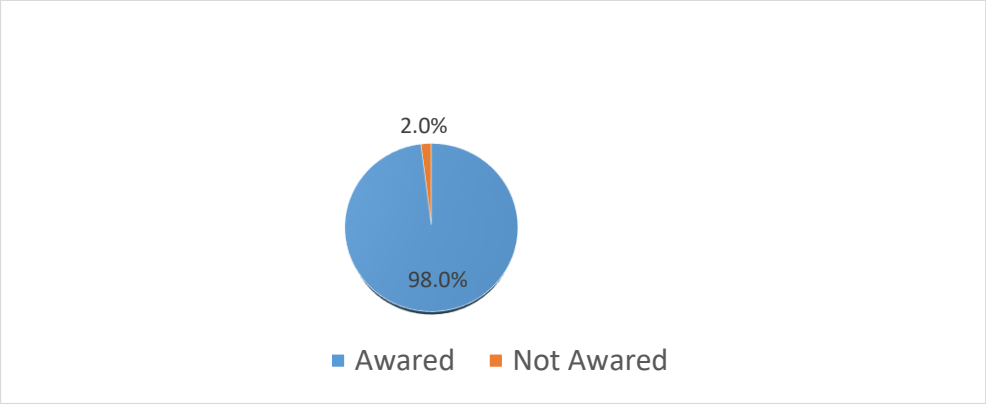

Figure 2: Farmers awareness about climate change and its effects on yam production. Source: Field Survey, 2023.

Perceived Effects of Climate Change on Yam Production in the Study Area.: The results in Table 2 identified the perceived effects of climate change on yam production according to the respondents in the study area. Spoilage of yam tubers in the soil was 87.5%, disease and pest infestation was 75.0%, loss of yield and loss of income were 97.5% and 93.3% respectively. Others include destruction of yam stakes and vines by storms which was 55.0%, high rate of weed growth (65.8%), flooding (45.8%), extreme soil heat and extreme soil moisture with 94.2% and 61.7% respectively. The results are similar to the findings of Ibidapo *et al.*, (2018); and Victor, Waiter and Thomas, (2021) where farmers agreed that the effects of climate change include increase rate of pest and disease attacks, unusual drought, extreme soil moisture, and loss of yield which all result into economy loss of the farmers. These results are indications that climate change had serious effects on yam production which might resulted into economics loss for the farmers and on a long run affect food sufficiency in the country. Therefore, there is need for the adaptive measures to climate change to be put in place to ensure suitable process of yam production.

Table 2: Perceived Effects of Climate Change on Yam Production in the Study Area. N=120

Effects of Climate Change on Yam Production	Frequency (f)	Percentage (%)
Loss of yield	117	97.5
Loss of income	112	93.3
Spoilage of yam tubers in the soil	105	87.5
Destruction of yam stakes and vines by storms	66	55.0
Disease and Pest infestation	90	75.0
High rate of weed growth	79	65.8

Extreme soil heat	113	94.2
Extreme soil moisture	74	61.7
Flooding	55	45.8

Source: Field Survey, 2023.

Adaptation Strategies Adopted by Yam Farmers in the Study Area: The results in Table 3 show that all the respondents adopted various adaptation strategies to mitigate the effects of climate change in the study area. According to the results, 88.3% of the respondents adopted mulching of yam after planting to protect it from too much of heat. This was followed by strong yam staking (85.0%) to prevent the yam plants from being destroyed by strong wind and storm that always come with rainfall in the study area. Others include mixed cropping (81.7%), proper storage of the yam tubers after harvesting (68.3%), early planting (79.2%) and early harvesting of yam (82.5%) to prevent destruction of yam by either extreme heat or too much of soil moisture. The multiple responses recorded (Table 3) indicated that majority of the farmers who implemented adaptation measures have a propensity of implementing multiple adaptation strategies in combination. The results conform to the findings of Chete (2019), Kolawole and Okonkwo, (2021) and Ikpoza *et al.*, (2022) who opined that many of the techniques adopted by yam farmers in response to climate change are focused on established information, experience and technologies. And that many farmers adopted the use of early and late planting, mulching, crop rotation and intensive use of organic manure to mitigate the effects of climate change.

Table 3. Distribution of Respondents According to their Adaptation Strategies Adopted to Mitigate the Effects of Climate Change in the Study Area. N = 120

Adaptation strategies	Frequency (f)	Percentage (%)
Mulching	106	88.3
Mixed cropping	98	81.7
Strong yam staking	102	85.0
Fadama planting	71	59.2
Intensive use of organic manure	43	35.8
Crop rotation	101	84.2
Early planting	95	79.2
Proper storage	82	68.3

Early harvesting	99	82.5

Source: Field Survey, 2023.

Tested Hypothesis of the Study: Chi- square test (p> 0.05) shows that age, gender, education and economic status of respondents have no significant association with the adoption of adaptation strategies (Table 4). It means that they are not important determinants in adaptation strategies to climate change among yam farmers in the study area. Conversely, there is a significant association between farming experience and adaptation strategies adopted to mitigate the effects of climate change in the study area (Table 4). This implies that adaptation strategies adopted to mitigate the effect of climate change is determined by their farming experience.

Some of the adopted strategies in mitigating the effects of climate change in the study area were usual practices for yam production. And they are not based on gender, age, educational qualification and economic status of the farmers. Only that yam staking is a bit difficult for women. That is the reason men were into yam production than women in the study area.

Table 4: Chi-square Values of Tested Hypotheses

Hypotheses	$\chi 2$ Cal.	$\chi 2$ Tab	DF	Remark
1. Association between respondent's age and X	19.16	35.20	12	Not significant
2. Association between respondent's gender and X	17.18	21.00	13	Not significant
3. Association between respondent's educational level and X	22.16	37.04	16	Not Significant
4. Association between respondent's farming experience and X	68.07	24.12	15	Significant
5. Association between respondent's economic status and X	18.30	26.14	14	Not Significant

Source: Field Survey, 2023.

Key: X = Adoption of adaptation strategies to mitigate the effects of climate change among yam farmers in the study area.

Conclusion and Recommendations

The study has shown that farmers in the study area were well knowledgeable about climate change and its effects on yam production. And the perceived effects of climate change in the study area include spoilage of yam tubers in the soil due to extreme heat and extreme soil moisture, disease and pest infestation, loss of yield and loss of income, destruction of yam stakes and vines by storms, high rate of weed growth, and flooding. Consequently, the findings established that yam farmers have employed various adaptation strategies which include mulching, strong yam staking, mixed cropping, crop rotation, proper storage, early planting and early harvesting to combating the effects of climate change in the study area. The adaptation strategies adopted by the yam farmers to mitigate the effect of climate change were based on climatic information and farmers' farming experience over the years. Following the results of the study, it is recommended that there should be government intervention through availability

of meteorological information on climate change, agricultural extension services, as well as credit facilities to enhance the adoption strategies of the yam farmers in the study area.

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