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Climate Adaptation Strategies Used by Banana and Plantain Farmers in Delta State of Nigeria

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Authors' contributions

This work was carried out in collaboration between both authors. Author MAA performed the statistical analysis, managed the analyses of the study and produced the final draft of the manuscript. Author CEO designed the study and wrote the first draft of the manuscript. Both authors read and approved the final manuscript.

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ABSTRACT

Climate variation is already a threat to agricultural production and employment of appropriate adaptation strategies could help reduce its effect. Hence, this study was conducted to determine the adaptation strategies being used by banana and plantain farmers in Delta state of Nigeria. Multistage sampling techniques were used to sample 136 respondents on whom interview schedule were administered. Descriptive and inferential statistics were used to analyze the data. Results show that 67.6 % of respondents were male, 64.7 older than 50 years of age, 80.1 % were married, only 7.4 % had no form of formal education and 72.1% had over ten years of farming experience. Of all the 16 items used to test knowledge of climate variation events, 8 had score above mean (0.5±0.4). Similarly, 9 of the 18 adaptation strategies had score above mean (0.4±0.4). Majority of the respondents (50.7%) had high level of knowledge of the climate variation events (7.6 – 11). However, majority (53.7%) had low level of adaptation strategies utilization (3 – 7.4). It can be inferred from the result that the utilization of adaptation strategies by the respondents was

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low. Therefore, it is recommended that further education be provided to farmers on the use of climate variation adaptation strategies to reduce the effect of the climate variation on agricultural production.

Keywords: Climate variation; adaptation strategies; banana and plantain; farmers in Delta State.

1. INTRODUCTION

1.1 Background

Weather is the state of the atmosphere at a specific time in a specific place. Temperature, cloudiness, humidity, precipitation and wind are examples of weather elements. Thunderstorms, tornadoes, and monsoons are also part of the weather of some places during some seasons. The synthesis of weather at a given location or area over a period of at least 35 years is known as climate. Standardized climatic means or averages can be gotten through systematic observation, recording and processing of the various elements of climate such as rainfall, temperature, humidity, air pressure, winds, clouds and sunshine before [1,2]. Climate as a synthesis of weather is not static. It varies from one month to another, one season to another and from one year or decade to another. Consequently, there are monthly, seasonal, annual and decadal variations in climate. Then, the variation established over a long period of time becomes the phenomenon generally referred to as climate change.

Climate variability is observed in such climatic factors as temperature which will change at different rates; changes in the expected flow of the seasons; changes in the timings, intensities, and locations of precipitation [3,1]. However, Intergovernmental Panel on Climate Change [4] attributed climate change to direct or indirect human activity that alters the composition of the global atmosphere in addition to natural climate variability observed over a long period of time. Anthropogenic factors such as gas flaring, burning of fossil fuels and deforestation are the major promoters of climate change.

As a result of the climate change, the earth has become warmer over the last century. The surface temperature of the earth is said to have increased during the 20^{th} century by about $0.6\pm0.2^{\circ}C$ thereby making many parts in the World to be warmer than at any time in the last 1000 years [5]. This increase in temperature impacts negatively on rainfall in many parts of the World and also triggers outbreak of diseases such as meningitis in many developing countries such as Nigeria. Similarly, sea level across the globe is noted to have risen by between 4 and 8 inches (0.1 and 0.2 metres) over the past 100 years and much of this increase is attributable to rising globe average temperature [4]. At the same time, drought incidence in the arid regions becomes more intense.

Climate change can neither be wished nor legislated away as some of the issues that make life comfortable for mankind are the very activities that promote climate change. It behoved nations to find a way of coping with the challenges – adapting to the situation, while working on measures to mitigate its effects on the long run.

The word “adaptation” to climate is the process through which people reduce the adverse effects of climate on their health and well-being and take advantage of the opportunities that their climate environment provides [6]. According to [7] adaptation involves adjustments to enhance the viability of social and economic activities and to reduce their vulnerability to climate, including its current variability and extreme events as well as longer-term climate change. Hence, adaptation involves taking action to minimize the negative impacts of climate change and taking advantage of new opportunities that may arise. Adaptation can be spontaneous or planned and can be carried out in response to or in anticipation of change in conditions [8]. According to [7], adaptations vary not only with respect to their climatic stimuli but also with respect to other, non-climate conditions (intervening conditions) which serve to influence the sensitivity of systems and the nature of their adjustments.

1.2 Problem of the Study

Adequacy of food production could be affected by climate variation and change as a result of geographical shifts in the agro climatic zones suited to the successful cultivation of specific crops. This consequently affects changes in crop yield, livestock production and fisheries productivity. It also leads to significant reduction in the quantity of water available for irrigation. It

also leads to loss of farm land (potential and actual) through rise in sea level and consequent flooding. The negative impact of climate change such as temperature rise, erratic rainfall, sand storms, desertification, low agricultural yield, drying up of water bodies and flooding are real in many states of Nigeria [9]. The exposure of the farmers' field, residence and other properties to constant flooding and wind storms will not only affect *musa* production activities but also leads to susceptibility of the farmers to multiple stresses and diseases. Similarly, their loss of farm settlement brings about a reduction in crop production and encourages diversification into other non-farming livelihood activities.

Many climate variation strategies have been suggested by different researchers. Crop diversification, mixed farming, mixed cropping, changing planting and harvesting dates and planting of drought resistant varieties were identified by [10] as useful strategies that can help cope with the problem of climate variation facing crop production. Similarly, [11] suggested developing drought resistant crops, managing scarce water supplies, protecting forest and coastal ecosystems, and improving access to energy. It was believed that application of those adaptation strategies by the farmers would drastically reduce the effect of the climate variation on them and their business. Therefore this study was carried out to find out the adaptation strategies being used by banana and plantain farmers in Delta state of Nigeria.

2. METHODOLOGY

2.1 Study Area

Delta state was carved out of the defunct Bendel state on 27th October, 1991. The state has a total population of 3,669,218 [12]. It has 25 Local Government Areas with many ethnic groups such Urhobo (the dominant tribe), Isoko, Ijaw, Aboh, Ukwani and Igbo. The state is bordered to the north by Edo State, Ondo to the northwest, Anambra to the east, Rivers to the southeast and on its southern flank is the Bight of Benin, which covers approximately 160 km of the State's coastline.

Delta State is located in the rain forest zone and the vegetation varies from mangrove swamp along the coast to evergreen forest in the middle. The area is characterized by heavy rainfall, the settlement pattern consists of concentrated or nucleated dwellings, the demarcation between one village and another is very distinct with communities separated from each other by stretches of forests, rivers and in some cases surfaced and un-surfaced road networks.

The major economic activity of the people is agriculture; the main occupation being farming and fishing. Those involved in fishing are mostly found in the riverine areas. Food crops grown in the area includes yam, maize, cassava, plantain, banana, groundnut and cocoyam. These crops are usually intercropped with three or more crops grown on the same piece of land. The main farming system is shifting cultivation continuous cultivation is increasingly being practiced in some areas. Cash crops such as rubber and oil palm are also grown in the area. Delta State is purposefully selected as the study area being one of the states in the country where banana and plantain are grown as identified by [13] and because of its peculiarity as a coastal area where the effect of climate change is pronounced.

2.2 Sampling Procedure and Sample Size

Multi-stage sampling technique was used to obtain respondents for the study. Purposive sampling technique was employed to select 5 Agricultural Development Project (ADP) cells; 1 in Delta North, 2 in Delta South and 2 in Delta Central, where banana and plantain were major crops as identified by [13]. The selected cells were Irri, Owhe, Obiaruku, Agbara-Otor and Olomu. Snowball sampling technique was used to generate list of banana and plantain farmers in the cells to obtain population of 120, 132, 100, 112 and 84. Then, simple random technique was used to select 25% of each of the population as 30, 33, 24, 28 and 21 to arrive at a total sample of 136 respondents.

3. RESULTS AND DISCUSSION

3.1 Personal Characteristics of the Respondents

Respondents' personal characteristics are shown in Table 1. The Table indicates that 67.6% of the respondents were males while only 32.4 % were females. Results in the Table shows that 7.4% of the respondents were within 30-39, 27.9 % within 40-49, 31.6 % within 50-59 and 33.1% within 60 years and above. Majority (80.1%) of the respondents were married, 11.8% single, 0.7% separated, 5.9% widows and 1.5% widowers. Only 7.4 % of the respondents have no form of

formal education, 5.1% acquired adult education, 9.6% primary, 44.9% secondary and 33.1% tertiary education. Half of the respondents (50.0%) have being farming for 11-20 years, 27.9% 1-10 years, 13.2% 21-30 years, 3.7% years and 5.2% 41 years and above.

Majority of the respondents were in their active years as they were below 60 years of age. This agrees with the reports of [14,15] that most Nigerian farmers are between the ages 45-50. This implies that those engaged in farming activities are in their productive years and can make a significant increase in food security. Majority of the farmers were married. [16] reported that getting married in Nigeria is not only because of children and continuation of family name but because women form a vital source of unpaid labour in some areas. Acquisition of one form of education or the other by the respondents is an indication that they had opportunities of quick understanding of any new farming technique that might be introduced to them. Education is an important characteristic, especially in the acquisition of knowledge and skill in different areas of human endeavours [17]. According to [18] respondents' attained educational status is expected to influence positive growth and development of their society. The respondents were experienced farmers with majority having being involved in farming for not less than eleven years. The result is similar to the observation of [19,20] where majority of respondents were not less than ten years in farming business. Since majority of the respondents were experienced farmers, it would be easy for them to detect any negative effect of the climate change on their business and consequent adoption of recommended adaption strategies.

3.2 Level of Knowledge of the Respondents on Climate Variation Events

Table 2 shows the respondents' knowledge of each of the 16 climate variation events. With the mean score 0.5±0.4 of all climate variation events, 8 had scores of mean and above. The 8 climate variation events are identification of increase in the intensity of sunshine (0.9±0.2), more hot days and nights during the dry season (0.9±0.3), experience shorter harmattan period (0.9±0.3), intensity of the harmattan has reduced (0.9±0.3), intensity of rainfall has increased (0.7±0.5), increase in the amount of rainfall (0.5±0.5), timeliness of rainfall has reduced (0.5±0.5) and increased incidence of heat waves (0.5±0.5). Consequently, 50.7% of the respondents had high level of knowledge while 49.3% had low knowledge level of the climate variation events (Table 3).

Table 1. Personal characteristics of respondents

Variable	Frequency	Percentage
Sex		
Male	92	67.6
Female	44	32.4
Age range (year)		
30-39	10	7.4
40-49	38	27.9
50-59	43	31.6
60 and above	45	33.1
Marital status		
Single	16	11.8
Married	109	80.1
Separated	1	0.7
Widow	8	5.9
Widower	2	1.5
Level of education attained		
No formal education	10	7.4
Adult education	7	5.1
Primary school	13	9.6
Secondary school	61	44.9
Tertiary institution	45	33.1
Number of years of farming		
1-10	38	27.9
11-20	68	50.0
21-30	18	13.2
31-40	5	3.7
41 and above	7	5.2

Source: field survey data, 2011

Respondents' having some knowledge of the climate variation events might evolve from their experience of flood in the area. Confirming the recent problem of flood in the area, [21] reported that a sizeable hectare of farmland and farmers properties were lost in the area yearly due to flood. Though plantain and banana require much rainfall, [13] was of the opinion that their production is impossible in flooded areas. However, there is still the need to improve upon the farmers' knowledge about the climate variation event because when farmers are not properly informed about the indicators of a climate variation, their adoption of coping strategies might be very low.

Table 2. Percentage distribution of the respondents' knowledge of climate variation events

Variable	No	Yes	Mean
1. The intensity of rainfall has increased	45 (33.1)	91 (66.9)	0.7±0.5
2. The frequency of rainfall has reduced	79 (58.1)	57 (41.9)	0.4±0.5
3. The rate of flooding has increased.	113(83.1)	23 (16.9)	0.2±0.4
4. We experience more frequent thunderstorm.	112 (82.4)	24 (17.6)	0.2±0.4
5. More hot days and nights during the dry season.	14 (10.3)	122 (89.7)	0.9±0.3
6. There is increase in the intensity of sunshine.	7 (5.1)	129 (94.9)	0.9±0.2
7. We experience stronger winds now than before.	104 (76.5)	32 (23.5)	0.2±0.4
8. There is increased humidity now compared to before.	121 (89.0)	15 (11.0)	0.1±0.3
9. There is increase in the amount of rainfall.	64 (47.1)	72 (52.9)	0.5±0.5
10. The timeliness of rainfall has reduced.	68 (50.0)	68 (50.0)	0.5±0.5
11. There is increased incidence of rainstorms	86 (63.2)	50 (36.8)	0.4±0.5
12. We experience shorter harmattan period.	10 (7.4)	126 (92.6)	0.9±0.3
13. The intensity of the harmattan has reduced.	18 (13.20)	118 (86.8)	0.9±0.3
14. We experience reduced cloudiness.	117 (86.0)	19 (14.0)	0.1±0.3
15. We experience long periods of drought.	113 (83.1)	23 (16.9)	0.2±0.4
16. There is increased incidence of heat waves	71 (52.2)	65 (47.80	0.5±0.5

Mean = 0.5±0.4, source: field survey data, 2011

Table 3. Respondents' level of knowledge of climate variation events

Level	Frequency	Percentage (%)
Low (4–7.5)	67	49.3
High (7.6–11)	69	50.7
Total	136	100.0

Source: field survey data, 2011

Table 4. Distribution of respondents by the adaptation strategy they employ in coping with climate variation

Variable	No Freq. (%)	Yes Freq. (%)	Mean
1. I take early rain into consideration.	20 (14.7)	116 (85.3)	0.9±0.4
2. I plant different types of crops.	6 (4.4)	130(95.6)	1.0±0.2
3. I shift to crops better suited for the environment	53(39.0)	83(61.0)	0.6±0.5
4. I tackle land degradation problems.	96(70.6)	40(29.4)	0.3±0.5
5. I avoid deforestation practices.	75(55.1)	61(44.9)	0.4±0.5
6. I take weather insurance.	136(100.0)	0 (0.0)	0.0±0.0
7. I take part in capacity building/training.	88(64.7)	48(35.3)	0.4±0.5
8. I use non timber forest products as fuel sources.	32(23.5)	104(76.5)	0.8±0.4
9. I plant drought resistant varieties.	107(78.7)	29(21.3)	0.2±0.4
10. I plant crops on wetlands.	90(66.2)	46(33.8)	0.3±0.5
11. I use organic manure on my crops.	98(72.1)	38(27.9)	0.3±0.5
12. Use of early warning on variations in climate.	29(21.3)	107(78.7)	0.8±0.4
13. I encourage communal management of resources.	120(88.2)	16(11.8)	0.1±0.3
14. I engage in several income generating activities	54(39.7)	82(160.3)	0.6±0.5
15. I carry out water control projects.	120(88.2)	16(11.8)	0.1±0.3
16. I apply soil conservation practices.	118(86.8)	18(13.2	0.1±0.3
17. I use fertilizers on my crops	81(59.6)	55(40.4)	0.4±0.5
18. I move to new areas when resources no longer meet needs.	106(77.9)	30(22.1)	0.2±0.4

Mean = 0.4±0.4, source: field survey data, 2011

3.3 Adaptation Strategies Used by Respondents in the Study Area

Table 4 shows the adaptation strategies employed by the respondents in coping with the effect of climate variation in their farming activities (mean = 0.4±0.4). The table shows that 9 of the strategies had score of mean and above. The strategies are I plant different types of crops (1.0±0.2), I take early rain into consideration (0.9±0.4), I use non timber forest products as fuel sources (0.8±0.4), Use of early warning on variations in climate (0.8±0.4), I shift to crops better suited for the environment (0.6±0.5), I engage in several income generating activities (0.6±0.5), I avoid deforestation practices (0.4±0.5), I take part in capacity building/training (0.4±0.5) and I use fertilizers on my crops (0.4±0.5). Similarly, Table 5 reveals that 46.3% of the respondents had high level while 53.7% had low level of adaptation strategies utilization.

Most of the strategies discovered to be in use by the respondents were those that form farming system in Nigeria. For instance the most utilised adaptation strategy, planting of different types of crops, is an application of multiple cropping systems which is indigenous to our farmers in Nigeria. Also, it is easy for the farmers to take early rain into consideration because their business as local farmers has so far being dependent on nature. Similarly, their engaging in several income generating activities is a characteristic feature of rural farmers. According to [22] combining several income-generating activities to meet household responsibilities has been found to be a common practice in rural areas. If other adaptation strategies could be brought to the level of the farmers, there is no doubt that they will embrace them.

Table 5. Level of adaptation strategies utilization

Level	Frequency	Percentage
Low (3 – 7.4)	73	53.7
High (7.5 – 17)	63	46.3
Total	136	100.0

Mean = 7.5 ± 3.1, source: field survey data, 2011

4. CONCLUSION

The respondents were experienced farmers with majority having being involved in farming for not less than eleven years; making easy for them to detect any negative effect of the climate change on their business and consequent adoption of recommended adaption strategies. More than half of the respondents had high level of knowledge of the climate variation events. Less than half of the respondents had high level of adaptation strategies utilization. Hence, it can be inferred from the result that the utilization of adaptation strategies by the respondents was low.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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