Farmers Utilization of Climate Change Adaptation Strategies Across Selected Agro-Ecological Zones in Nigeria

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This study examined farmers’ level of use of climate change adaptation strategies across selected agro-ecological zones in Nigeria. Edo and Ondo States were selected for the study with three major agro-ecological zones. A multi-stage sampling procedure was used. The correlation analysis revealed a significant relationship between year of education and level of use of adaptation strategies (r = 0.15, P = 0.02). The result of Analysis of Variance (ANOVA) revealed that significant differences existed in most of the adaptation strategies employed except planting different varieties (F = 1.672, P = 0.190), intercropping (F = 0.646, P = 0.525), crop rotation (F = 2.436, P = 0.090) and migration to different sites (F = 0.661, P = 0.517). The study recommended that the issue of climate change should not be taken lightly by all stakeholders as its effect differs among various agro-ecological zones.

Keywords: Adaptation strategies, Agro-ecological, Climate change, Utilization, Zones

Introduction

Agriculture in Nigeria is a major branch of the economy providing employment for 70 percent of the population and is the main source of food (Mayong et al., 2005). Agriculture contributes about 40% of the Gross Domestic Product (GDP) (Ozor, 2009) and plays an important role in generating household income, provision of raw materials for agro-based industries, attaining food security and impact on the overall economic growth of the country (Stewart, 2000; Olugbog, 2012).

This research intends to examine the adaptation measures utilized in improving productivity across some selected agro-ecological zones under consideration. Specifically, the study examined the socio-economic characteristics of the food crop farmers in the study area and examines farmers’ utilization of climate change adaptation strategies across the selected agro-ecological zones in Nigeria.

Literature Review

Ozor (2009) refers to climate change as any change in climate over time, whether due to natural variability or as a result of human activity and is widely recognized as the most serious environmental threat facing our planet today. In low-income countries, the climate is the primary determinant of agricultural productivity and adaptive capacities are low (Apata et al., 2009). The adverse effect of climate change can influence farming outputs at any stage from cultivation through the final harvest, even, if there is sufficient rain, its irregularity can affect yield adversely if rain fails to start during the crucial growing stage of crops (Molua and Lambi, 2007). The continued dependence of agricultural production on some climatic factors, such as temperature, moisture, sunlight, wind, evaporation and the significant magnitude as well as the rapid rate of climate change take into account the need for a comprehensive consideration of the potential impact of
climate on global agriculture (Rosenweig et al., 1994). In essence, any climate change will subsequently impact the agricultural sector in particular and further reflect on socioeconomic activities. The effects could be measured in terms of effects on crop growth, availability of soil water, health, availability of farm labour, soil fertility, soil erosion, sea-level rise, incidents of pests and diseases (Nwaijuba, 2002). Climate change has been identified as one of the most crucial factors that negatively affect sustainable agricultural production and the scope for reducing poverty in Nigeria (Obioha, 2009). Many African countries including Nigeria, which have their economies largely based on weather-sensitive agricultural production systems, are particularly vulnerable to climate change (Dinar et al., 2006). Also, Nigerian agriculture is facing varying climate change impacts which mainly worsens production conditions and adversely affects its economies (MOEFRN, 2003). The adverse consequent effects of climate change will take an irreplaceable toll on food production and as well as food security in developing countries like Nigeria which has a low capacity to cope and adapt to these challenges (Fisher et al., 2009).

Adaptation is widely recognized as a vital component of any policy response to climate change because, it helps farmers achieve their food, income and livelihood security objectives in the face of changing climatic and socioeconomic conditions (Kandlikar et al., 2000). Without adaptation, climate change is generally detrimental to the agricultural sector (Smit et al., 2002). Kreft et al. (2010) defined adaptation as an initiative approach, measures, practices to reduce the menace or vulnerability of natural and human resources to climate change. Adaptation is also identified as one of the policy options to reduce the negative impact of climate change (Kurukulasuriya et al., 2006).

Information about adaptation methods and factors influencing the choice of adaptation methods help in enacting policy to handle the challenges climate change is imposing on Nigerian farmers. Hence, supporting the adaptation strategies of local farmers through appropriate public policy, collective actions and investments can help increase the adaptation measures that will reduce the negative consequences of predicted changes in future climate with great benefits to vulnerable rural communities (Hassan et al., 2008).

The location, size and characteristics relief in Nigeria gives rise to a variety of climate change, ranging from tropical rainforest climate along the coasts to the Sahel climate in the northern part of Nigeria, each being differentiated by its annual precipitation, sunshine and other climatic elements (Adejuyge, 2004). The diverse nature of biological diversity results mainly in seven vegetation zones: the Mangrove swamp, Fresh water swamp, Tropical rainforest, Guinea savannah, Derived savannah, Sudan savannah and Sahel savannah (Adejuyge, 2004).

Hypotheses

The study tested the following hypotheses at the 0.05 level of significance

- There is no significant relationship between socioeconomic characteristics and use of adaptation strategies across agro-ecological zones,
- There is no significant difference in the level of use of adaptation strategies across agro-ecological zones.

Methodology

The study was carried out in Nigeria having so many agro-ecological zones. The population of the study comprises all food crop farmers in the study area.

A multi-stage sampling procedure was used in selecting the respondents in this study. The first stage involved a purposive selection of two (2) states having the three (3) major agro-ecological zones namely mangrove zone, Guinea savannah zone and rainforest zone. The second stage involved a proportionate (1/6) sampling selection of three (3) local government areas (LGAs) out of the 18 LGAs in each state. Hence, a total number of six (6) local government areas (LGAs) were sampled in the two states which fall into the identified agro-ecological zone. Local government areas with the highest production level were selected using the Agricultural Development Programme (ADP) data on production output of cassava, maize and rice in both states. The third stage involved random selection of four (4) communities from each of the LGAs and was identified through the help of ADP officers in both states. The last stage involved a purposive selection of ten (10) food crop farmers from each of the communities selected. The selection was based on farmers growing the three crops given one hundred and twenty (120) respondents in each state and a total number of two hundred and forty respondents (240) for the research work.

Both quantitative and qualitative methods of data collection were used in obtaining information from the selected respondents. The instrument for data collection was subjected to face and content validity. The reliability of the instrument was determined through the test–retest reliability method. Data collected were analysed using descriptive and inferential statistical tools. Chi-square test and Pearson Product Moment Correlation (PPMC) were used for hypothesis one while Analysis of Variance (ANOVA) was used to test for hypothesis two.

Results and Discussion

Socio-Economic Characteristics of Respondents

The results in Table 1 reveals that the number of male respondents (73.8%) was higher than that of the female farmers (26.2%), which implies that more males were involved in farming in the study area. This is in agreement with Osikabor et al. (2011) indicated that male participates more than female in agricultural production. The mean age of the respondents was 49.6 years, which means most of the respondents were middle-aged and were proactive. This agrees with that of Adejare and Arimi (2013) who reported that the majority of the agricultural labour force in Nigeria falls within 35 – 50 years.

The majority (85.4%) of the respondents were married. Adebayo et al. (2008) posited that more married are involved in farming. The study reveals that only 11.7% had no formal education hence indicates a high level of literacy among respondents and this could have implications for agricultural production. According to Allison et al. (2009), the vulnerability and adaptation of a nation to climate change impact depends on the level of education of its citizens.
Table 1. Distribution of Respondents’ Socio-Economic Characteristics

| Variables                        | Frequency(n=240) | Percentage (%) | Mean |
|----------------------------------|------------------|----------------|------|
| **Sex**                          |                  |                |      |
| Female                           | 63               | 26.2           |      |
| Male                             | 177              | 73.8           |      |
| **Age (years)**                  |                  |                | 49.6 |
| 30 years and below               | 10               | 4.2            |      |
| 31-40                            | 35               | 14.6           |      |
| 41-50                            | 86               | 35.8           |      |
| 51-60                            | 79               | 32.9           |      |
| Above 60 yrs                     | 30               | 12.5           |      |
| **Marital status**               |                  |                |      |
| Single                           | 12               | 5.0            |      |
| Married                          | 205              | 85.4           |      |
| Widowed                          | 21               | 8.8            |      |
| Divorced                         | 1                | 0.4            |      |
| Separated                        | 1                | 0.4            |      |
| **Educational Level**            |                  |                |      |
| No formal education              | 28               | 11.7           |      |
| Attempted primary school         | 17               | 7.1            |      |
| Completed primary school         | 46               | 19.2           |      |
| Attempted secondary school       | 26               | 10.8           |      |
| Completed secondary school       | 88               | 36.7           |      |
| Attempted tertiary school        | 9                | 3.7            |      |
| Completed tertiary school        | 26               | 10.8           |      |
| **Year of Education**            |                  |                | 9    |
| 0                                | 28               | 11.7           |      |
| 1-6                              | 63               | 26.2           |      |
| 7-12                             | 114              | 47.5           |      |
| >12                              | 35               | 14.6           |      |
| **Household size**               |                  |                | 7    |
| 1-3                              | 8                | 3.3            |      |
| 4-6                              | 111              | 46.3           |      |
| 7-9                              | 89               | 37.1           |      |
| ≥ 10                             | 32               | 13.3           |      |
| **Farming experience (years)**   |                  |                | 12.3 |
| ≤ 10 years                       | 51               | 21.3           |      |
| 11-20                            | 93               | 38.7           |      |
| 21-30                            | 44               | 18.3           |      |
| 31-40                            | 29               | 12.1           |      |
| >40                              | 23               | 9.6            |      |

Source: Field Survey, 2018

The mean household size of the respondents was approximately seven persons. This implies a moderate household size. According to Kayunze (2000), large household size is an important asset in working together to reduce vulnerability to the effects of climate change. The mean farming experience of the respondents was approximately twelve years which implies that most farmers are relatively young in the farming business. Adesina and Zinnah (1993) postulated that younger farmers have greater tendencies to improve and adapt to new technologies because they are relatively more knowledgeable, more open to risk-taking and have longer planning horizons than their older counterpart.

**Utilization of Adaptation Strategies**

The study revealed major adaptation strategies practiced were as follows; use of agrochemical products (93.7%), use of pest/diseases resistant varieties (91.2%), planting of different varieties (90.0%), planting of the early maturing crop (87.7%), use of improved varieties (87.0%) and changing in planting and harvesting period (84.6%). Also, 78.3% used increased frequency of weeding as adaptation strategies while 72.5% used organic manure as shown in Table 2.

The study as shown in Table 2 also indicated the number of years respondents had practiced these adaptation strategies. Adaptation practices with the highest number of years of practice were; mulching (7.13 years), planting of different varieties (6.65 years), increased use of agrochemicals (6.47 years), use of organic manure (6.37 years), use of improved crop varieties (6.23 years). The average mean score of years of adaptation strategies was 4.18 years which indicated that these adaptation strategies had been used by farmers for more than 4 years and thus considered relatively too recent.

The study, furthermore, identified the level of improvement as perceived by the respondents in the use of adaptation strategies as in reducing the perceived effects of climate change as shown in Table 2. The grand mean of the measures is 0.99, with all the measures having high-level improvement and low-level improvement by the respondents.
Socio-economic characteristics | Calculated $\chi^2$ | Df | p-value | Decision |
--- | --- | --- | --- | --- |
Sex | 2.92 | 2 | 0.23 | Not significant |
Marital status | 4.68 | 8 | 0.79 | Not significant |
Religion | 6.72 | 4 | 0.15 | Not significant |

The increased use of agrochemicals ($\chi^2 = 1.60$) was ranked first among the adaptation strategies as having high-level improvement in production. This is likely because inorganic fertilizers have a direct effect on output by increasing soil nutrients and other agrochemicals like pesticides and herbicides provide favourable environment for crops to grow. The second strategy that had high-level improvement on crop production is the use of pest and disease-resistant varieties ($\chi^2 = 1.54$), while the use of improved crop varieties ($\chi^2 = 1.50$), planting of different varieties ($\chi^2 = 1.41$) were ranked third and fourth respectively.

Test of Hypotheses
The result of the chi-square analysis presented in Table 3 reveals that socio-economic characteristics such as sex ($\chi^2 = 2.92, P = 0.23$), marital status ($\chi^2 = 4.68, P = 0.79$) and religion ($\chi^2 = 6.72, P = 0.15$), were not significant with the level of use of adaptation strategies at the 0.05 level of significance. Hence, their level of use of adaptation strategies was not influenced by these socio-economic characteristics.

Table 4 further analysis reveals that only the educational level which was positively and significantly related to the level of use of adaptation strategies, such that the higher the years of education, the higher the level of use of adaptation ($r = 0.15, P = 0.02$), Hence farmers that are educated were more likely to adjust to climate change than non educated farmer. This agreed with the finding of Aemro et al. (2010), who posited that there was a positive and strong relationship between education and utilization of adaptation strategies.

$H_0$: There is no significant difference in the level of use of adaptation strategies across agro-ecological zone.
| S/N | Adaptation strategies                        | Source of variation     | Sum of squares | df | Mean square | F     | p-value | Decision |
|-----|--------------------------------------------|-------------------------|---------------|----|-------------|-------|---------|----------|
| 1   | Years mulching                             | Between groups          | 551.57        | 2  |             | 275.788 | 4.247   | 0.015 S  |
|     |                                            | Within groups           | 15388.675     | 237|             | 64.931  |         |          |
|     |                                            | Total                   | 15940.250     | 239|             |         |         |          |
| 2   | Years organic manure                       | Between groups          | 325.908       | 2  |             | 162.954 | 3.732   | 0.025 S  |
|     |                                            | Within groups           | 10348.087     | 237|             | 43.663  |         |          |
|     |                                            | Total                   | 10673.996     | 239|             |         |         |          |
| 3   | Years different varieties                  | Between groups          | 62.308        | 2  |             | 31.154  | 1.672   | 0.190 NS |
|     |                                            | Within groups           | 4415.987      | 237|             | 18.633  |         |          |
|     |                                            | Total                   | 4478.296      | 239|             |         |         |          |
| 4   | Years planting and harvesting              | Between groups          | 87.300        | 2  |             | 43.650  | 3.864   | 0.022 S  |
|     |                                            | Within groups           | 2677.100      | 237|             | 11.296  |         |          |
|     |                                            | Total                   | 2764.400      | 239|             |         |         |          |
| 5   | Years intercropping                        | Between groups          | 20.908        | 2  |             | 10.454  | 0.646   | 0.525 NS |
|     |                                            | Within groups           | 3833.075      | 237|             | 16.173  |         |          |
|     |                                            | Total                   | 3853.983      | 239|             |         |         |          |
| 6   | Years mixed farming                        | Between groups          | 154.225       | 2  |             | 77.113  | 8.979   | 0.000 S  |
|     |                                            | Within groups           | 2035.337      | 237|             | 8.588   |         |          |
|     |                                            | Total                   | 2189.562      | 239|             |         |         |          |
| 7   | Years use irrigation                       | Between groups          | 162.133       | 2  |             | 81.067  | 11.964  | 0.000 S  |
|     |                                            | Within groups           | 1605.850      | 237|             | 6.776   |         |          |
|     |                                            | Total                   | 1767.983      | 239|             |         |         |          |
| 8   | Years afforestation                        | Between groups          | 285.808       | 2  |             | 142.904 | 12.906  | 0.000 S  |
|     |                                            | Within groups           | 2624.188      | 237|             | 11.073  |         |          |
|     |                                            | Total                   | 2690.996      | 239|             |         |         |          |
| 9   | Years crop varieties                       | Between groups          | 442.268       | 2  |             | 221.129 | 9.847   | 0.000 S  |
|     |                                            | Within groups           | 5322.138      | 237|             | 22.456  |         |          |
|     |                                            | Total                   | 5764.396      | 239|             |         |         |          |
| 10  | Years use of fertilizers                   | Between groups          | 378.133       | 2  |             | 189.067 | 12.379  | 0.0003 S |
|     |                                            | Within groups           | 3619.800      | 237|             | 15.273  |         |          |
|     |                                            | Total                   | 3997.933      | 239|             |         |         |          |
| 11  | Years agrochemicals                        | Between groups          | 155.808       | 2  |             | 77.904  | 6.349   | 0.002 S  |
|     |                                            | Within groups           | 2907.988      | 237|             | 12.270  |         |          |
|     |                                            | Total                   | 3063.796      | 239|             |         |         |          |
| 12  | Years weeding                              | Between groups          | 213.808       | 2  |             | 106.904 | 5.583   | 0.004 S  |
|     |                                            | Within groups           | 4538.187      | 237|             | 19.148  |         |          |
|     |                                            | Total                   | 4751.996      | 239|             |         |         |          |
| 13  | Years maturing crop                        | Between groups          | 181.608       | 2  |             | 90.804  | 6.133   | 0.003 S  |
|     |                                            | Within groups           | 3508.888      | 237|             | 14.805  |         |          |
|     |                                            | Total                   | 3690.496      | 239|             |         |         |          |
| 14  | Years crop rotation                        | Between groups          | 75.600        | 2  |             | 37.800  | 2.436   | 0.090 NS |
|     |                                            | Within groups           | 3677.800      | 237|             | 15.518  |         |          |
|     |                                            | Total                   | 3753.400      | 239|             |         |         |          |
| 15  | Years technologies                         | Between groups          | 299.325       | 2  |             | 149.662 | 12.654  | 0.000 S  |
|     |                                            | Within groups           | 2803.138      | 237|             | 11.828  |         |          |
|     |                                            | Total                   | 3102.463      | 239|             |         |         |          |
| 16  | Years farming to non farming               | Between groups          | 54.308        | 2  |             | 27.154  | 2.745   | 0.090 S  |
|     |                                            | Within groups           | 650.625       | 237|             | 2.745   |         |          |
|     |                                            | Total                   | 704.933       | 239|             |         |         |          |
| 17  | Years diversification                      | Between groups          | 180.700       | 2  |             | 90.350  | 6.769   | 0.001 S  |
|     |                                            | Within groups           | 3163.550      | 237|             | 13.348  |         |          |
|     |                                            | Total                   | 3344.250      | 239|             |         |         |          |
| 18  | Years pest diseases                        | Between groups          | 270.025       | 2  |             | 135.013 | 8.593   | 0.000 S  |
|     |                                            | Within groups           | 3723.575      | 237|             | 15.711  |         |          |
|     |                                            | Total                   | 3993.600      | 239|             |         |         |          |
| 19  | Years labour                               | Between groups          | 160.133       | 2  |             | 80.067  | 5.399   | 0.005 S  |
|     |                                            | Within groups           | 3514.662      | 237|             | 14.830  |         |          |
|     |                                            | Total                   | 3674.796      | 239|             |         |         |          |
| 20  | Years cover cropping                       | Between groups          | 177.808       | 2  |             | 88.904  | 7.293   | 0.001 S  |
|     |                                            | Within groups           | 2889.125      | 237|             | 12.190  |         |          |
|     |                                            | Total                   | 3066.933      | 239|             |         |         |          |
| 21  | Years migration different sites            | Between groups          | 26.108        | 2  |             | 13.054  | 0.661   | 0.517 NS |
|     |                                            | Within groups           | 4677.875      | 237|             | 19.738  |         |          |
|     |                                            | Total                   | 4703.983      | 239|             |         |         |          |
| 22  | Years shifting cultivation                 | Between groups          | 183.658       | 2  |             | 91.829  | 3.543   | 0.030 S  |
|     |                                            | Within groups           | 6142.075      | 237|             | 25.916  |         |          |
|     |                                            | Total                   | 6325.733      | 239|             |         |         |          |

Source: Field Survey, 2018
The result of Analysis of Variance (ANOVA) in Table 5 revealed that significant differences existed in most of the adaptation strategies employed except planting different varieties (F = 1.672, P = 0.190), intercropping (F = 0.646, P = 0.525), crop rotation (F = 2.436, P = 0.090) and migration to different sites (F = 0.661, P = 0.517). Therefore, the null hypotheses which stated that there is no significant difference in the level of adaptation strategies employed across the three agro-ecological zones were rejected.

Conclusions and Recommendation

The conclusion of the findings indicated that farmers had been using different adaptation strategies to reduce the negative effect of climate change. It is important to aggressively pursue the issue of climate change as its effect differs along agro-ecological zone to achieve increase productivity of food crops in all agro-ecological zones in Nigeria. The issue of climate change should not be taken with negligence from all stakeholders.

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