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***Research Article***

# Adaptation Strategies of Rain-fed Farmers to Climate Change across Four States in Nigeria

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**ABSTRACT**

Climate change puts food system at risk if there are no effective adaptation strategies. The study investigated influence of farmers' characters (education, age and gender) on twelve considerable factors for adaptation strategies across four (Edo, Ondo, Benue and Niger) States in Nigeria by subjecting 1600 copies of pretest questionnaire to stepwise multiple regression analysis. The factors are Years of Practice (YoP), Farm Size, (FS), Places of Selling Produce (PSP), Use of Family as Labour (UFL), Use of Hired Labour (UHL), Transportation Situation (TS), Diversification into Non-farming Activities (DINA), Substitutions of Scarce Resources (SSR), Government Agriculture Extension Services (GAES), Awareness of Climate Information (ACI), Access to Farm Input (AFI), and Access to Credit Services (ACS). The model entered UFL, PSP and ACI in Benue State, YoP, UHL, SSR, and TS in Edo State, UFL, PSP, DINA, ACS, AFI, UHL and SSR in Niger State, and UFL and ACS in Ondo State. The Durbi-Watson values of all the models were ranged from 1.568 in Benue State to 1.905 in Niger State, indicating positive autocorrelation. The ANOVA indicated that F-test was highly significant for each State's model and explained a significant variation in the influence of farmers' characters. Tolerance > 0.1 and Variable Inflation Factor < 10 showing there was multicollinearity and the variables were highly correlated. In conclusion, the adaptation strategies to tackle climate change effects were collectively determined by the farmers' characters.



## Introduction

The UNDP (2020) premiere goal is zero hunger. The effort of farmers whose reliance on meeting sufficient food production for the teeming population, agricultural systems and all spheres of human existence are threatened by the regional climate. As the large-scale farmers could financially settle scores with the lingering climate change effects, the small-scale farmers are affected in challenging ways across the developing nations. From Nigeria's central and middle belt, aridity increases up the North while flooding and erosion increase down the southern parts (Uyique and Agho, 2007). Flooding and erosion lead to crop failure by removing topsoil, making the soil more acidic, and washing away or submerging crops (Adelekan, 2009). Rising temperature is another climate change impact reported and experienced in Nigeria since 1901 (Odjugo, 2010). Agricultural practices and patterns are chiefly influenced by the duration of the rainy season and annual rainfall (Amanza et al., 2007). Poor performance of agriculture is directly climate-dependent (Ikpi, 2010). The influence of climate change on various sectors and daily human endeavours has been so grievous that adaptation to climate change effects is currently perceived as the way out. Climate change is not sparing farmers, who must devise working adaptation strategies with multifaceted approaches. Crop farmers across the agroecological zones of Nigeria are vulnerable to the climate change impacts such as

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those mentioned above because of their low adaptive capacity (Onyeneke and Madukwe, 2010).

Adaptation to climate change describes modification in ecological, social, and economic systems for coping with the changing environment; this had been generally helpful until the late 90s but is currently compromised because of the cost and benefit in the choice that everybody makes (Smit and Pilifosova, 2001). Agricultural adaptation is an option to reduce the negative impacts of climate change on agriculture (Kurukulasuriya and Mendelsohn, 2006). Adaptation makes the farmers sustainably cope with the adverse effects of climate change to lessen their vulnerability (Bryan et al., 2009). However, crop farmers' adaptation strategies are hindered and constrained by inadequate inputs, poverty, and a lack of information on climate change forecasts (Mohammed et al., 2014). Without strategic adaptation by the farmers, sustainable development goals (1: zero hunger and 13: actions on climate change) may not be attainable for better agricultural productivity. World Research Institute (Filiault, 2021) observed that the food system and sustainability are prospectively at risk from the influence of climate change.

Active adaptation as steps towards understanding and addressing climate change to assist farmers in coping strategy was formulated by the Federal Government of Nigeria (FEPA, 1998; FMARD, 2000; Manyong et al., 2003). The steps had been adopted by the State and local governments and the private sector to ensure increased crop production (Nigeria Vision 20: 2020, 2009). The results mostly benefit small-scale farmers, who account for 95 %. In comparison, large-scale farms are observed to be about 5 % out of those that practise agriculture in Nigeria, with crop yields between 0.6 to 1.5 tonnes per hectare (NAERLS, 2004; Federal Ministry of Agriculture, 2005).

For research on the farmers' adaptation to climate change, analysis of perception and adaptation to climate change in the Nile Basin, Ethiopia, was investigated and showed that 58 % of the farmers employed various adaptation strategies to climate change. These strategies include irrigation, planting trees, and early and late planting, with percentages of 4, 21 and 21, respectively (Deressa, 2010). An analysis of awareness and adaptation strategies to climate change among farmers in Borno State, Northeast Nigeria, was conducted. Result of the research suggested irrigation to augment the shortfall of rains, increase planting more than usual and ahead of the raining periods etc. (Idrisa et al., 2012). There was a study on awareness, vulnerability, and adaptation to climate change in Adamawa State, Northeast Nigeria. The result revealed adapting to seed-tolerant varieties, altering planting schedules, planting early maturing seeds, employing different tillage systems, and crop diversification (Adebayo et al., 2012). Socioeconomic dynamics influencing climate change adaptation among crop farmers in Abia State, Southeast Nigeria, were analysed. The result showed that cultivating the early maturing crop, mixed farming, increased use of family labour, diversification of livelihood, changes in planting and harvesting dates, irrigation practice, crop rotation, and riverside/ -bank cultivation (Anyola et al., 2013). However, none of the previous studies investigated the influence of farmers' characters (such as age, education and gender) on adaptation strategies as the research gap. Thus, objective of the research was to investigate influence of the farmers' characters on different adaptation strategies across four States in Nigeria.

## Materials and Methods

### *Study Areas*

The study conducted between 2018 and 2019 focused on four rain-fed agricultural (Benue, Edo, Ondo and Niger) States in Nigeria. They are in the derived savanna agro-ecological zones and known to yearly produce high agricultural crop yields. The study chose the four States because they practise rain-fed agriculture and are susceptible to the climate change effects. Most farmers in these States are small-scale farmers, who invest their efforts in agricultural productivity to meet demand of the Nigerian teeming population. The Nigerian Federal government agricultural allocation during the fieldwork of this study was #179,458,329,208 (< 5 % Federal Government Annual Budget) (CWP, 2021).

### *Questionnaire and Sample Size*

The questionnaire has two sections, which are

(1) Demographic Characteristics of Sampled Farmers with three variables

- Education of the Respondents
- Gender of the Respondents
- Age of the Respondents

(2) Farm Characters (Considerable Factors) for Adaptation Strategies of the Farmers with 12 variables

- Years of Practice (YoP); Farm Size (FS); Places of Selling Farm Produce (PSP);
- Use of Family as Labour (UFL); Use of Hired Labour (UHL); Transportation Situation (TS);
- Diversification into Non-farming Activities (DINA); Substitutions of Scarce Resources (SSR);
- Government Agriculture Extension Services (GAES); Awareness of Climate Information (ACI);
- Access to Farm Input (AFI); and Access to Credit Services (ACS).

The Cochran (1977) method for sample size determination assisted in allocating 400 copies of the questionnaire to each State, making 1600 copies across the four States. For the pre-test study (10 %), 160 copies of the questionnaire went to the final year agriculture students at the Federal University of Agriculture, Abeokuta (FUNAAB), Ogun State.

$N = Z^2P\ (1\text{-}P)/\ (D^2)$ ------ (Cochran, 1977)

$$n = \frac{1.96^2 \times 0.50 \times 0.50}{0.05^2} = 384.16 \ldots\ldots\ldots 1$$

A non-response rate of 10% of

$$384 = \frac{384 \times 10}{100} = 38.4 \ldots\ldots (2)$$

where n = minimum sample size required, z= confidence limit of the survey at 95% (1.96), p = proportion of respondents/ -farmers, d= absolute deviation from true value (degree of accuracy) = 5%. Rounded off values from equations 1 and 2 were administered. The Cronbach's alpha of 0.87 was obtained from the pre-test analysis. The value indicated a good internal consistency.

### *Data Collection*

The study team distributed copies of the questionnaire using multistage techniques (Amujoyegbe, 2012). They explored the framework of Agricultural Development Programme (ADP) offices with the same structure across the thirty-six states in Nigeria to reach the farmers. The ADP classified Benue, Edo, Ondo, and Niger states into 3, 3, 4 and 3 zones with 23, 18, 18 and 25 local government areas. The headquarters of ADP is situated in the State capital, where the zonal manager reports. The reports contain activities and engagements of the ADP field officers with the farmers across their settlements, which is the cell. The farmers meet the officers at cell levels. The officers meet at the zonal levels, and the zonal managers lastly meet with the State director. However, there is a director for a specific department, such as research, statistics, welfare, etc. The trend of the ADP structure adheres to the up-down and bottom-up management approach for effective and efficient administration.

### *Statistical Analysis*

The copies of the questionnaire coded in the EXCEL spreadsheet were transferred into the SPSS v23, and data were statistically analysed in three phases: *Phase 1:* The stepwise multiple linear regression analysis was conducted to know which of the 12 farm's characters (as considerable factors) for adaptation strategies were collectively influenced by the farmers' characteristics. *Phase 2:* Descriptive analysis was conducted for frequency and percentage in cross tabulation. *Phase 3:* The Chi-square inferential statistics investigated levels of significance among the outputs in *phase 2* within each State to determine if the same policy could work for the farmers' responses.

## Results and Discussion

### *Phase 1: Regression Analysis of Farmers' Characteristics on Farm Characters*

Tables 1 to 6 are presented in the body of the work while Table 7 contains the 12 farm characteristics (considerable factors). The dependent variables are the farmers' characteristics (i.e., education, age and gender) while independent variables (i.e., IVs) are the 12 farm characters (i.e., considerable factors). Three IVs (use of family labour, place of selling agricultural produce and awareness of climate information) entered to predict influence of the farmers' characteristics in Benue State. Four IVs (year of practice, use of hired labour, resource substitution due to scarcity, and ease of transportation) in Edo State. Seven IVs (use of family labour, place of selling agricultural produce, diversification into non-farm activity, access to credit service, access to farm input, use of hired labour and substitution of scarce resource) in Niger State, while two IVs (use of family labour and access to credit facility) in Ondo State. Thus, the farmers' characteristics entered different farm characters into each State's model to convincingly strategise the appropriate adaptation to tackle the effects of climate change on farming (Table 1).

From the multiple linear regression model summary and overall fit statistics, the adjusted-$R^2$ of the Benue State estimated model was 0.271 with the $R^2$ = 0.279, which implied that the farm characters in Benue State accounted for 27.90 % of the variation in the predicted farmers' characteristics. The estimated regression for Edo State revealed that farm characters explained 22.00 % of farmers' characteristics with an adjusted-$R^2$ value of 0.231. The adjusted-$R^2$ and $R^2$ estimated from the Niger State's regression model were 0.387 and 0.399, respectively; this implied that the farm characters explained a 39.90 % variation in the farmers' characteristics. The adjusted-$R^2$ of the Ondo State regression model was 0.111 while the $R^2$ was 0.122, implying that the farm characters explained a 12.20 % of the variation in the farmers' characteristics in Ondo State data (Table 2). The Durbin-Watson (DW) value is $1.5 < DW < 2.5$. A value of DW less than 2 is positive autocorrelation, while greater than 2 is negative autocorrelation (Statistics Solutions, 2019).

From the current study across the four States, the DW value of the stepwise method of the multiple regression analysis models indicated all the value positive autocorrelation.

**Table 1**. The considerable factors entered by the influence of farmers' characters

| Model | Variables Entered | Method |
|---|---|---|
| | | **Benue State** |
| 1 | UFL | . Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100). |
| 2 | PSP (market) | . Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100). |
| 3 | ACI | . Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100). |
| | | Edo State |
| 1 | YoP | . Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100). |
| 2 | UHL | . Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100). |
| 3 | SSR | . Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100). |
| 4 | TS | . Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100). |
| | | Niger State |
| 1 | UFL | . Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100). |
| 2 | PSP (market) | . Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100). |
| 3 | DINA | . Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100). |
| 4 | ACS | . Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100). |
| 5 | AFI | . Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100). |
| 6 | UHL | . Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100). |
| 7 | SSR | . Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100). |
| | | Ondo State |
| 1 | UFL | . Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100). |
| 2 | ACS | . Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100). |

Years of Practice (YoP); Farm Size (FS); Places of Selling Farm Produce (PSP); Use of Family as Labour (UFL); Use of Hired Labour (UHL); Transportation Situation (TS);Diversification into Non-farming Activities (DINA); Substitutions of Scarce Resources (SSR); Government Agriculture Extension Services (GAES); Awareness of Climate Information (ACI); Access to Farm Input (AFI); and Access to Credit Services (ACS).

**Table 2**. Variance (R-square), autocorrelation (Durbin-Watson) and analysis of variance

| Model | R | R-Square | Adjusted R-Square | Std. Error of the Estimate | Durbin-Watson |
|---|---|---|---|---|---|
| Benue | 0.528 | 0.279 | 0.271 | 0.7354 | 1.568 |
| Edo | 0.480 | 0.231 | 0.220 | 0.7509 | 1.741 |
| Niger | 0.632 | 0.399 | 0.387 | 0.6372 | 1.905 |
| Ondo | 0.350 | 0.122 | 0.111 | 0.8766 | 1.168 |

| Model | | Sum of Squares | Df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| Benue | Regression | 60.590 | 3 | 20.197 | 37.340 | 0.000 |
| | Residual | 156.856 | 290 | 0.541 | | |
| | Total | 217.446 | 293 | | | |
| Edo | Regression | 51.199 | 4 | 12.800 | 22.698 | 0.000 |
| | Residual | 170.863 | 303 | 0.564 | | |
| | Total | 222.062 | 307 | | | |
| Niger | Regression | 88.534 | 7 | 12.648 | 31.152 | 0.000 |
| | Residual | 133.168 | 328 | 0.406 | | |
| | Total | 221.702 | 335 | | | |
| Ondo | Regression | 17.223 | 2 | 8.611 | 11.206 | 0.000 |
| | Residual | 123.723 | 161 | 0.768 | | |
| | Total | 140.945 | 163 | | | |

Benue. Predictors: (Constant), UFL, PSP (market), ACI
Edo. Predictors: (Constant), YoP, UHL, SSR, TS
Niger. Predictors: (Constant), UFL, PSP (market), DINA, ACS, AFI, UHL, SSR
Ondo. Predictors: (Constant), UFL, ACS

Years of Practice (YoP); Farm Size (FS); Places of Selling Farm Produce (PSP); Use of Family as Labour (UFL); Use of Hired Labour (UHL); Transportation Situation (TS);Diversification into Non-farming Activities (DINA); Substitutions of Scarce Resources (SSR); Government Agriculture Extension Services (GAES); Awareness of Climate Information (ACI); Access to Farm Input (AFI); and Access to Credit Services (ACS).

The positive autocorrelation interpretation was that the ideas displayed by the respondents before is at the moment positively correlating with their ideas. So, if the idea previously backfired, it is again then possible to backfire at the moment (Kenton, 2019). It showed in the current study that the farmers have a restricted/ unchanged idea about their farming activities.

The models' Analysis of Variance (ANOVA) indicated that F-test was highly significant for the farmers in each study State showing that the model explained a significant variation in the farmers' characters.

In the stepwise multiple linear regression analysis (Table 3), the UFL and PSP (market) were significantly susceptible to the influence of the farmers' characteristics in the Benue State model; implying to every 1-unit increase in the influence of the farmers' characteristics, there would be a corresponding increase of 0.654 UFL and 0.171 PSP (market). The YoP, UHL, SSR and TS were significantly susceptible to the influence of farmers' characteristics in the Edo State model; this illustrated that every 1-unit increase in the influence of the farmers' characteristics, there would be a corresponding reduction of the four variables by 0.309, 0.565, 0.227 and 0.242 respectively.

The use of UFL, PSP (market), ACS, UHL and SSR were significantly susceptible to the influence of farmers' characteristics in Niger State; this illustrated that for every 1-unit increase in the influence of farmers' characteristics, there would be a corresponding increase in the five farm characters.

**Table 3**. Coefficients of multiple linear regressions and collinearity statistics

| Model | | Unstandardized Coefficients | | Standardized Coefficients | | | Collinearity Statistics | |
|---|---|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | t | Sig. | Tolerance | VIF |
| Benue | (Constant) | 1.500 | 0.244 | | 6.146 | 0.000 | | |
| | UFL | 0.654 | 0.112 | **0.353** | 5.840 | 0.000 | 0.681 | 1.468 |
| | PSP (market) | 0.171 | 0.057 | 0.178 | 2.993 | 0.003 | 0.703 | 1.423 |
| | ACI | -0.176 | 0.084 | -0.114 | -2.094 | 0.037 | 0.836 | 1.196 |
| Edo | (Constant) | 4.212 | 0.288 | | 14.643 | 0.000 | | |
| | YoP | -0.309 | 0.045 | -0.353 | -6.939 | 0.000 | 0.979 | 1.021 |
| | UHL | -0.565 | 0.108 | -0.268 | -5.214 | 0.000 | 0.958 | 1.044 |
| | SSR | -0.227 | 0.059 | -0.195 | -3.832 | 0.000 | 0.985 | 1.016 |
| | TS | -0.242 | 0.105 | **-0.120** | -2.301 | 0.022 | 0.930 | 1.076 |
| Niger | (Constant) | -0.095 | 0.352 | | -0.271 | **0.786** | | |
| | UFL | 0.623 | 0.083 | 0.338 | 7.534 | 0.000 | 0.908 | 1.101 |
| | PSP (market) | 0.349 | 0.050 | **0.341** | 6.932 | 0.000 | 0.758 | 1.320 |
| | DINA | -0.282 | 0.079 | -0.172 | -3.589 | 0.000 | 0.800 | 1.249 |
| | ACS | 0.344 | 0.082 | 0.208 | 4.200 | 0.000 | 0.746 | 1.341 |
| | AFI | -0.284 | 0.093 | -0.153 | -3.073 | 0.002 | 0.735 | 1.360 |
| | UHL | 0.280 | 0.112 | 0.126 | 2.510 | 0.013 | 0.731 | 1.369 |
| | SSR | 0.153 | 0.077 | 0.090 | 1.993 | 0.047 | 0.900 | 1.111 |
| Ondo | (Constant) | 0.908 | 0.343 | | 2.648 | 0.009 | | |
| | UFL | 0.624 | 0.175 | **0.264** | 3.568 | 0.000 | 0.998 | 1.002 |
| | ACS | 0.484 | 0.148 | 0.241 | 3.265 | 0.001 | 0.998 | 1.002 |

Dependent Variable: Characters

Years of Practice (YoP); Farm Size (FS); Places of Selling Farm Produce (PSP); Use of Family as Labour (UFL); Use of Hired Labour (UHL); Transportation Situation (TS);Diversification into Non-farming Activities (DINA); Substitutions of Scarce Resources (SSR); Government Agriculture Extension Services (GAES); Awareness of Climate Information (ACI); Access to Farm Input (AFI); and Access to Credit Services (ACS).

The UFL and ACS were significantly susceptible to the influence of farmers' characteristics in Ondo State; the implication was that for every 1-unit increase in the influence of farmers' characteristics, there would be a corresponding increase of 0.642 UFL involvement and 0.484 ACS. Tolerance was > 0.1 or VIF < 10 for all the variables, showing from the multicollinearity that the explanatory variables in a multiple regression model were highly and linearly related. Thus, the use of family labour was significantly (t = 5.840, Sig., = 0.000) prone to the farmers' characteristics in Benue State. Resource substitution due to scarcity was highly significantly (t = -3.832, Sig. = 0.000) prone to the farmers' characteristics in Edo State. Use of family labour (t = 7.534, Sig. = 0.000), market (t = 6.932, Sig. = 0.000), and access to credit service (t = 4.200, Sig. = 0.000) were significantly prone to the farmers' characteristics in Niger State. The use of family labour (t = 3.568, Sig. = 0.000) and access of credit service (t = 3.265, Sig. = 0.001) were significantly prone to farmers' characteristics in Ondo.

*Phases 2 and 3: Sampled Farmers' Characteristics*

*Education of the Respondents:* The highest levels of education attained by the respondents across the study locations are presented in Table 4. Most respondents had secondary education, followed by a high degree (which depicts anyone of Ordinary National Diploma (OND), Nigerian Certificate of Education (NCE), Higher National Diploma (HND) and Bachelor of Science (BSc.)) across Benue State; Benue North had the highest percentage of secondary education while Benue East had the highest percentage of high degree education.

**Table 4**. Levels of education of the respondents (farmers) across the study areas

| Education | | Benue N140 | Benue C130 | Benue E130 | Total | Edo N130 | Edo C100 | Edo S170 | Total |
|---|---|---|---|---|---|---|---|---|---|
| Primary | Count | 15 | 13 | 8 | 36 | 39 | 24 | 39 | 102 |
| | % | 41.7% | 36.1% | 22.2% | 100.0% | 38.2% | 23.5% | 38.2% | 100.0% |
| Secondary | Count | 47 | 43 | 45 | 135 | 54 | 46 | 47 | 147 |
| | % | 34.8% | 31.9% | 33.3% | 100.0% | 36.7% | 31.3% | 32.0% | 100.0% |
| High degree | Count | 41 | 36 | 38 | 115 | 26 | 17 | 46 | 89 |
| | % | 35.7% | 31.3% | 33.0% | 100.0% | 29.2% | 19.1% | 51.7% | 100.0% |
| Postgraduate | Count | 5 | 4 | 37 | 46 | 4 | 4 | 8 | 16 |
| | % | 10.9% | 8.7% | 80.4% | 100.0% | 25.0% | 25.0% | 50.0% | 100.0% |
| Total | Count | 108 | 96 | 128 | 332 | 123 | 91 | 140 | 354 |
| | % | 32.5% | 28.9% | 38.6% | 100.0% | 34.7% | 25.7% | 39.5% | 100.0% |
| | | Chi-Square Tests for Benue State | | | | Chi-Square Tests for Edo State | | | |
| | | Value | Df | Asymp. Sig. (2-sided) | | Value | Df | Asymp. Sig. (2-sided) | |
| Pearson Chi-Square | | 41.176[a] | 6 | 0.000 | | 11.167[a] | 6 | 0.083 | |

| Education | | Niger N-S120 | Niger N-C160 | Niger N-E120 | Total | Ikare 100 | Okitipupa 100 | Ondo 100 | Owo 100 | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| Primary | Count | 58 | 54 | 42 | 154 | 25 | 13 | 0 | 4 | 42 |
| | % | 37.7% | 35.1% | 27.3% | 100.0% | 59.5% | 31.0% | 0.0% | 9.5% | 100.0% |
| Secondary | Count | 20 | 69 | 49 | 138 | 49 | 36 | 4 | 3 | 92 |
| | % | 14.5% | 50.0% | 35.5% | 100.0% | 53.3% | 39.1% | 4.3% | 3.3% | 100.0% |
| High degree | Count | 7 | 28 | 23 | 58 | 16 | 18 | 46 | 8 | 88 |
| | % | 12.1% | 48.3% | 39.7% | 100.0% | 18.2% | 20.5% | 52.3% | 9.1% | 100.0% |
| Postgraduate | Count | 0 | 7 | 3 | 10 | 10 | 2 | 11 | 4 | 27 |
| | % | 0.0% | 70.0% | 30.0% | 100.0% | 37.0% | 7.4% | 40.7% | 14.8% | 100.0% |
| Total | Count | 85 | 158 | 117 | 360 | 100 | 69 | 61 | 19 | 249 |
| | % | 23.6% | 43.9% | 32.5% | 100.0% | 40.2% | 27.7% | 24.5% | 7.6% | 100.0% |
| | | Chi-Square Tests for Niger State | | | | Chi-Square Tests for Ondo State | | | | |
| | | Value | df | Asymp. Sig. (2-sided) | | Value | Df | Asymp. Sig. (2-sided) | | |
| Pearson Chi-Square | | 31.696 | 6 | 0.000 | | 89.408[a] | 9 | 0.000 | | |

The level of education across the Benue State had a significant ($p < 0.05$) difference from the test of the Chi-Square. Most respondents had secondary education, followed by primary across Edo State; Edo North had the highest percentage of secondary education while Edo North and South had the same higher percentage of primary education. The level of education across Edo State had no significant ($p > 0.05$) difference from the test of the Chi-Square.

Most respondents had primary education, followed by secondary education across Niger State; Niger North had the highest percentage of primary education, while Niger Northcentral had the highest percentage of secondary education. The level of education across Niger State had a significant ($p < 0.05$) difference from the test of the Chi-Square. Most respondents had secondary education, followed by high degree (OND, NCE, HND and BSc.) across Ondo State; Ikare zone had the highest percentage of secondary education while Ondo zone had the highest percentage of high degree education. The level of education across the Ondo State had a significant ($p < 0.05$) difference from the test of the Chi-Square. The order of combined first-degree and postgraduate educational composition across the study States was 49 > 46 > 30 > 19 in Benue, Ondo, Edo and Niger, respectively. On the other hand, the order of combined primary and secondary levels of education was 81 > 71 > 54 > 52 in Niger, Edo, Ondo and Benue, respectively. There is an indication that areas with a higher percentage of levels of education search and utilise information more. Study locations with high degrees and postgraduate composition may be well-rated to perform and cope better in the era of climate change.

The measure to cope in the era of climate change by the inhabiting farmers of every region can rely on education prowess. States with high levels of primary education (such as Niger State with 43 %) may find it difficult for its farmers to search and utilise the newest ideas that could bring development and worthy adaptation to its activities and advise its members. The performance of the farmers could be better if their average composition had a robust and sound education. A group with a high level of educational composition

may gather and understand information better from different learning styles (Mok, 2003) or education training tools, including visual, auditory, reading/writing and kinesthetic/ hands-on activity (VARK model, 2010). Also, the group's thinking process with a high education level will continuously, consistently, mentally and physically develop (Yaakub and Hashim, 2004). As an outcome of differences within individuals over each learning method, a group with a high level of education composition would cope better to abate the unexpected influence (such as climate change) effect by using innovative ideas (Drago and Wagner, 2004).

*Gender of the Respondents:* The results indicated that a higher number of the respondents are male. The approximate females to males ratio in Benue State is 1:7, Edo State is 1:2, Niger State is 1:5, and Ondo State is 1:3. The Chi-square tests showed that participation of the two genders significantly ($p < 0.05$) differed in both Niger and Ondo States. The results showed that agriculture is still male dominated across the study locations. The society considers male as the breadwinner of the family. So, he is given more responsibilities than female across sectors such as agriculture.

The wide gap and imbalance in the number of males to females in farming could be linked to societal norms, which hardly realise that population increment is from the influence of both genders, whose roles would then have to readjust. Such adjustment can motivate the female to participate more in farming activities. In turn, female participation in agribusiness and agro-activity would increase with effective contribution from the two genders as their collective perspectives will contribute to positive changes.

**Table 5**. Gender of the respondents (farmers) across the study areas

| Gender | | Benue N140 | Benue C130 | Benue E130 | Total | Edo N130 | Edo C100 | Edo S170 | Total |
|---|---|---|---|---|---|---|---|---|---|
| Male | Count | 127 | 112 | 108 | 347 | 83 | 59 | 101 | 243 |
| | % | 36.6% | 32.3% | 31.1% | 100.0% | 34.2% | 24.3% | 41.6% | 100.0% |
| Female | Count | 12 | 15 | 23 | 50 | 47 | 41 | 52 | 140 |
| | % | 24.0% | 30.0% | 46.0% | 100.0% | 33.6% | 29.3% | 37.1% | 100.0% |
| Total | Count | 139 | 127 | 131 | 397 | 130 | 100 | 153 | 383 |
| | % | 35.0% | 32.0% | 33.0% | 100.0% | 33.9% | 26.1% | 39.9% | 100.0% |

| | Chi-Square Tests for Benue State | | | Chi-Square Tests for Edo State | | |
|---|---|---|---|---|---|---|
| | Value | Df | Asymp. Sig. (2-sided) | Value | Df | Asymp. Sig. (2-sided) |
| Pearson Chi-Square | 4.983[a] | 2 | 0.083 | 1.296[a] | 2 | 0.523 |

| Gender | | Niger N-S120 | Niger NC160 | Niger NE120 | Total | Ikare 100 | Okitipupa 100 | Ondo 100 | Owo 100 | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| Male | Count | 100 | 119 | 115 | 334 | --- | 81 | 51 | 72 | 204 |
| | % | 29.9% | 35.6% | 34.4% | 100.0% | --- | 39.7% | 25.0% | 35.3% | 100.0% |
| Female | Count | 20 | 41 | 5 | 66 | --- | 19 | 34 | 26 | 79 |
| | % | 30.3% | 62.1% | 7.6% | 100.0% | --- | 24.1% | 43.0% | 32.9% | 100.0% |
| Total | Count | 120 | 160 | 120 | 400 | --- | 100 | 85 | 98 | 283 |
| | % | 30.0% | 40.0% | 30.0% | 100.0% | --- | 35.3% | 30.0% | 34.6% | 100.0% |

| | Chi-Square Tests for Niger State | | | Chi-Square Tests for Ondo State | | |
|---|---|---|---|---|---|---|
| | Value | df | Asymp. Sig. (2-sided) | Value | Df | Asymp. Sig. (2-sided) |
| Pearson Chi-Square | 22.921[a] | 2 | 0.000 | 10.212[a] | 2 | 0.006 |

Another view is that agro-activity should not be seen as energy-required and consuming exercise, which was the scenario in the olden days. The result conformed to the perception of the traditional roles for males and females (Kroska and Elman, 2009). Improvement to gain equal participation of both genders in agri-activity is realisable when there can be equal assigning of roles in the private and public sectors (Scott, 2010). In turn, females can participate more in agricultural activities, thereby increasing their quota in the labour force (Boll et al., 2014; Goldscheider et al., 2015).

*Age of the Respondents:* The demographic characteristics of the respondents showed that the age group 36-45 had the highest frequency (and percentage) in Benue, Edo and Niger States, followed by 46-Above, 26-35 and 26-35 years, respectively. Age range of the farmers had significant ($p < 0.05$) difference except in Edo State. In Ondo State, the highest number of farmers was 26-35 years, followed by 36-45 years. Their response had significant ($p < 0.05$) difference (Table 6); this showed that a low percentage of the vibrant age still partake in farming activities if comparing the values of these highest numbers to the

administered questionnaire. The observation implies that the respondents perceived the agro-activities as low-income and distracted from making farming a priority. A catch them young campaign would be most effective in Edo and Niger States so that the age range 26-35 can be integrated into farming activities. Involvement of the vibrant age categories (25-36 and 36-45) was traced to 69 % except in Edo State, which was 61 %. The results meant the energetic and agile age range of people engaged in agricultural activities across the study States.

The 46 and above age range was enumerated to be 29 > 27 > 23 > 17 % across Benue, Edo, Ondo and Niger State respectively; this age range shows the old, traditional or customary experience to be handed over to the posterity. It also determines the respondents' years of experience in farming practices across the study locations. Characters of people and backgrounds need consideration in ideas for quality outcomes (Perry et al., 2011). However, the study of Fink et al. (2015) had no relationship between age and the extent to which experts tend to choose effectuation (emergent strategies) and causation (goal-driven) in innovative process steps.

### *Farm Characters for Adaptation Strategies by Farmers*

*Years of Practice of the Respondents:* The highest Year of Experience (YoP) was 6 to 10 across the study areas: 38, 31, 27 and 40 % in Edo, Ondo, Benue and Niger State, respectively (Table 7). The YoP indicates the wealth of experience available at the farmers' disposal in each State. It is an equivalence of the time every farmer should have faced various diversity in weather conditions and the test of time to adopt different adaptation techniques over the years. The YoP gives room to verify transferable adaptation strategy, which stands the test of time of knowledge sharing with farmer-colleague and other regions.

**Table 6**. Age of the respondents (farmers) across the study areas

| Age | | Benue N140 | Benue C130 | Benue E130 | Total | Edo N130 | Edo C100 | Edo S170 | Total |
|---|---|---|---|---|---|---|---|---|---|
| 15-25 | Count | 6 | 6 | 0 | 12 | 5 | 5 | 6 | 16 |
| | % | 50.0% | 50.0% | 0.0% | 100.0% | 31.3% | 31.3% | 37.5% | 100.0% |
| 26-35 | Count | 52 | 26 | 10 | 88 | 39 | 31 | 47 | 117 |
| | % | 59.1% | 29.5% | 11.4% | 100.0% | 33.3% | 26.5% | 40.2% | 100.0% |
| 36-45 | Count | 51 | 61 | 56 | 168 | 47 | 39 | 58 | 144 |
| | % | 30.4% | 36.3% | 33.3% | 100.0% | 32.6% | 27.1% | 40.3% | 100.0% |
| 45-above | Count | 23 | 22 | 64 | 109 | 38 | 24 | 41 | 103 |
| | % | 21.1% | 20.2% | 58.7% | 100.0% | 36.9% | 23.3% | 39.8% | 100.0% |
| Total | Count | 132 | 115 | 130 | 377 | 129 | 99 | 152 | 380 |
| | % | 35.0% | 30.5% | 34.5% | 100.0% | 33.9% | 26.1% | 40.0% | 100.0% |
| | | Chi-Square Tests for Benue State | | | | Chi-Square Tests for Edo State | | | |
| | | Value | Df | Asymp. Sig. (2-sided) | | Value | Df | Asymp. Sig. (2-sided) | |
| Pearson Chi-Square | | 65.995[a] | 6 | 0.000 | | 0.946[a] | 6 | 0.988 | |

| Age | | Niger N-S120 | Niger N-C160 | NigerN-E120 | Total | Ikare 100 | Okitipupa 100 | Ondo100 | Owo 100 | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| 15-25 | Count | 45 | 7 | 3 | 55 | 14 | 7 | 2 | 2 | 25 |
| | % | 81.8% | 12.7% | 5.5% | 100.0% | 56.0% | 28.0% | 8.0% | 8.0% | 100.0% |
| 26-35 | Count | 55 | 50 | 20 | 125 | 26 | 24 | 40 | 34 | 124 |
| | % | 44.0% | 40.0% | 16.0% | 100.0% | 21.0% | 19.4% | 32.3% | 27.4% | 100.0% |
| 36-45 | Count | 15 | 78 | 57 | 150 | 27 | 29 | 37 | 19 | 112 |
| | % | 10.0% | 52.0% | 38.0% | 100.0% | 24.1% | 25.9% | 33.0% | 17.0% | 100.0% |
| 46-above | Count | 5 | 23 | 40 | 68 | 33 | 29 | 12 | 5 | 79 |
| | % | 7.4% | 33.8% | 58.8% | 100.0% | 41.8% | 36.7% | 15.2% | 6.3% | 100.0% |
| Total | Count | 120 | 158 | 120 | 398 | 100 | 89 | 91 | 60 | 340 |
| | % | 30.2% | 39.7% | 30.2% | 100.0% | 29.4% | 26.2% | 26.8% | 17.6% | 100.0% |
| | | Chi-Square Tests for Niger State | | | | Chi-Square Tests for Ondo State | | | | |
| | | Value | Df | Asymp. Sig. (2-sided) | | Value | df | Asymp. Sig. (2-sided) | | |
| Pearson Chi-Square | | 145.996[a] | 6 | 0.000 | | 43.858[a] | 9 | 0.000 | | |

The number of YoP reveals possible changes that every farmer observes in the agricultural calendar and responds to climate variability and change. It is also seen as the factor dictating decision-making from the wealth of experience. The history of agriculture in different regions and adaptation series are better related when YoP is considered (Wall and Smith, 2005). The longer the YoP or cropping periods, the better the personal experience from the self-adapted ideas over agricultural calendars or the better the decision the farmers might make (Yegbemey et al., 2014). Adjustment to the climate change effects for farmers to have high produce, profit and livelihood security is a dictate of YoP (IPCC, 2001). There is a possibility of irregularity in strategies developed by farmers to cope despite the YoP in the era of climate change (Gnanglè et al., 2012) because the functioning of such decision

relies on characteristics of the growing crops farming system and farmland location (Yegbemey et al., 2014).

*Farm Size of the Respondents:* Responses of the farmers indicated that the highest number of respondents cultivated 3 plots (2006.61 $m^2$) of land in Benue State (128 out of 370 i.e., 43 %) and Ondo State (103 out of 330 i.e., 31 %). Two plots (1337.73 $m^2$) were mostly cultivated in Edo State (111 out of 376 i.e., 30 %) and Niger State (210 out of 396 i.e., 53 %) (Table 7). The percentage of the farm size indicated that land is scarce for farming activities, and any threat of degradation from climate change leaves a devastating effect on farming produce. The size of the farm cultivated by the respondents indicated the structure of agricultural systems and the approach the farmers would require for their farm management. The farm size that most farmers keep depends on farmers' affordability to pay. Restrictive measure for land acquisition from the government contributes to the small size of land available for the farmers to acquire for agro-activity. The decision to lease pieces of land to farmers is a complex question for the landowners as the sector is viewed as low-profit yielding (Latruffe et al., 2013). Eurostat's (2014) data showed that investors acquire nearly 90 % of the cultivated agricultural area with agricultural holding sizes (AHS) of more than 1500 plots, which made up 11 % of the total number of AHS.

*Places of Selling Respondents' Farm Produce:* The respondents showed that the village market (except in Niger State) is mostly patronised as the major avenue to supply their produce to the demanding customers. The highest village market in Benue State was 147 out of 363 (i.e., 40.00 %). It was 168 out of 368 (i.e., 46 %) respondents in Edo State. In Ondo State, 183 out of 294 (i.e., 62 %) respondents were enumerated. However, the urban market indicated the highest number of respondents in Niger State, with 169 out of 387 (i.e., 44 %) (Table 7). The market as a place for selling farm produce is the utmost factor every stakeholder in farming activities considers and prioritises. Availability of market enhances production and harvesting, relieves probable pressure of transportation and storage, and fosters appropriate strategy for agribusiness planning. Choosing of village markets might be a way to avoid bad transportation road network, high cost of transporting the farm produce and spoilage of the farm produce before reaching distant markets. Village markets are opened on specific days when most farmers are certain of selling their goods, seen as cost-effective links to the buyers and many a time nearer to the farm settlements. A village market is an important tool for the sustainable development of rural areas (Shiraisi and Razaq, 2005). It is where a similar approach towards culture preservation (Farmers Discussion Group, 1989), a training session for farmers' discussion groups (Farmers Discussion Group, 1992) and dissemination of the latest information are at ease (Shiraisi and Razaq, 2005).

*Use of Family as Labour by the Respondents:* The results indicated that the respondents across the study locations did explore family members to assist as labour in their farming activities. The order of highest number of "Yes" to the use of family labour was Ondo > Niger > Benue > Edo State with 79, 75, 74 and 56 %, respectively (Table 7). The trends generally indicated the engagement of family members in farming activities, with the possibility of retaining the inherited culture and providing affordable running expenses in the management of farming activities. The adoption of family labour shows that the service rendered by every family member for agriculture production is free and with well-defined concepts and roles (Angemi, 2002). Family farming is mostly a small farm (World Bank, 2007), and changes in the agricultural landscape and resource access are possibly conserved in its operations (Berdegué and Fuentealba, 2011). The syndrome of personal property makes family farming unique due to the capable and oriented ties to the local culture within the rural community (Garner and O'Campus, 2014). Decision-making on crop choice and overall production (Bélières et al., 2002) and migration affect family-participating farms (Radel et al., 2012).

*Use of Hired Labour by the Respondents:* The respondents again indicated the use of hired labour in their farming activities. Number of the respondents that used to hire labour was indicated to be 332 (83 %) out of 399 Niger State, 302 (80 %) out of 378 in Edo State, 297 (76 %) out of 393 in Benue State, and 203 (74 %) out of 274 in Ondo State (Table 7). Activity on farmland may either be skilled or unskilled; the former entails the principal work, such as the pre-planting operation, while the latter is mostly required during the plant growing. Pre-planting operation (such as ploughing, harrowing and ridging) is a tedious activity that requires a high number of hired labour assigned the work within the stipulated time. The activity requires highly skilled personnel who might have done the work over time, giving broad views to the hired labour to develop striking strategies to efficiently tackle emerging issues such as climate variability or change effects.

The need for hired farm labour depends on factors not limited to farm characteristics and natural and environmental conditions (Bagamba et al., 2009). Thus, some labour-intensive technologies require more labour for work like planting and harvesting, while others are for input procurement and farm produce sales (Anim, 2011).

**Table 7.** Considerable Factors for Adaptation Strategies of the Respondents

| Variables of the farm characters | | Edo | Ondo | Benue | Niger |
|---|---|---|---|---|---|
| Year of Practice | 1 to 5 | 98 (26 %) | 86 (26 %) | 82 (23 %) | 71 (18 %) |
| | 6 to 10 | 141 (38 %) | 105 (31 %) | 98 (27 %) | 157 (40 %) |
| | 11 to 15 | 85 (23 %) | 76 (23 %) | 78 (21 %) | 96 (24 %) |
| | ≥ 16 | 46 (12 %) | 69 (21 %) | 105 (29 %) | 73 (18 %) |
| Farm Size | A plot | 78 (21 %) | 58 (18 %) | 81 (22 %) | 74 (19 %) |
| | Two plots | 111 (30 %) | 67 (20 %) | 104 (28 %) | 210 (53 %) |
| | Three plots | 109 (29 %) | 103 (31 %) | 128 (43 %) | 83 (21 %) |
| | ≥ Three plots | 78 (21 %) | 102 (31 %) | 57 (15 %) | 29 (7 %) |
| Place of Selling Farm Produce | Farm gate | 82 (22 %) | 54 (18 %) | 34 (9 %) | 44 (11 %) |
| | Village market | 168 (46 %) | 183 (62 %) | 147 (40 %) | 143 (37 %) |
| | Urban market | 72 (20 %) | 52 (18 %) | 128 (35 %) | 169 (44 %) |
| | Outside state | 46 (13 %) | 5 (2 %) | 54 (15 %) | 31 (8 %) |
| Use of Family Labour | Yes | 212 (56 %) | 217 (79 %) | 290 (74 %) | 301 (75 %) |
| | No | 166 (44 %) | 54 (20 %) | 101 (26 %) | 98 (25 %) |
| Use of Hired Labour | Yes | 302 (80 %) | 203 (74 %) | 297 (76 %) | 332 (83 %) |
| | No | 76 (20 %) | 68 (23 %) | 95 (24 %) | 67 (17 %) |
| Transportation Situation | Yes | 86 (23 %) | 88 (34 %) | 65 (17 %) | 32 (8 %) |
| | No | 292 (77 %) | 172 (66 %) | 327 (83 %) | 366 (92 %) |
| Diversification into Non-farming Activities | Yes | 254 (66 %) | 200 (53 %) | 198 (52 %) | 145 (38 %) |
| | No | 127 (33 %) | 139 (37 %) | 176 (45 %) | 238 (62 %) |
| Scarce Resources Substitution | Yes | 184 (51 %) | 196 (53 %) | 254 (64 %) | 303 (76 %) |
| | No | 128 (36 %) | 97 (26 %) | 121 (31 %) | 87 (22 %) |
| Government Agriculture Extension Services | Yes | 282 (74 %) | 296 (78 %) | 244 (62 %) | 336 (84 %) |
| | No | 100 (26 %) | 65 (17 %) | 148 (38 %) | 63 (16 %) |
| Awareness of Climate Information | Yes | 258 (68 %) | 246 (67 %) | 167 (42 %) | 204 (51 %) |
| | No | 115 (30 %) | 103 (28 %) | 221 (55 %) | 195 (49 %) |
| Access to Farm Input | Yes | 186 (49 %) | 199 (53 %) | 254 (64 %) | 309 (77 %) |
| | No | 196 (51 %) | 173 (46 %) | 142 (36 %) | 90 (23 %) |
| Access to Credit Services | Yes | 170 (45 %) | 149 (39 %) | 216 (55 %) | 251 (63 %) |
| | No | 211 (55 %) | 226 (59 %) | 177 (44 %) | 149 (37 %) |

The results were presented as frequency (percentage)

Hired labour-operated farming encourages high production, cultivation of large expanses of land and coverage of more work. The share of hired labour in agriculture is reported to have decreased and declined agricultural productivity owing to changes in wages (Emran and Shilpi, 2016). The implication is low crop yield which would not meet human demand for consumption (Adhvaryu et al., 2013). The availability of hired labour in agriculture is affected by non-farming work (Corsi and Salvioni, 2012).

*Transportation Situation around Respondents' Farm:* Transportation situation of the respondents indicated that the road network of most farmland was not in

good condition, with 327 (83 %) out of 393 of the respondents in Benue State, 292 (77 %) out of 378 in Edo State, 366 (92 %) out of 398 in Niger State, and 172 (66 %) out of 273 in Ondo State. The farmers' response showed that none of the States was free from bad road networks because farming activities in the study areas are individually managed (Table 7).

Conveyance of the farm input to and from the farmland across the locations under study would be slow, and there is a tendency for non-development in their agricultural sectors. Poor transportation network distorts activities and chain of agriculture if the available roads are narrow, poorly drained, undulating and not tarred, making it difficult to move produce from the farm settlements to the markets. The provision of the necessary information for rural services could suffer a drawback. The respondents would hardly produce in large quantities because of the spoilage susceptibility of their perishable farm produce. High losses from damage to the perishable agricultural produce before getting to the selling stations (markets) are possible from bad road networks (Ighodaro, 2009). There is an increase in poverty from the lack of a good road network as the profit from the farmers' investment would dwindle because of a drop in sales of agricultural produce (Ogunleye et al., 2018). Thus, the campaign of SDG 1: Zero Poverty (UNDP, 2020) will be compromised.

*Diversification into Non-farming Activities by the Respondents:* The respondents positively asserted engaging in diversification into non-farming activities (DINA) except in the Niger State, where a higher number chose 'No.' So, 66, 53 and 52 % respondents engaged in DINA in Edo, Ondo and Benue State, respectively. The number of farmers that indicated not engaging in DINA was 62 % in Niger State (Table 7). The DINA was indicated for attraction to increase farmers' income sources. The agricultural sector is suffering an interruption because of limited rural infrastructure (the feeders' roads, communication facility or electricity), the high cost of facilities procurement, and alternative highly paid non-agricultural jobs. The DINA reduces the labour force for farming engagement, contributes to the non-development of rural areas where agriculture is predominant, and especially promotes the urban migration of young people. In turn, there will hardly be a significant strategy to handle environmental threats not limited to climate change on farming activities. However, DINA has remarkable economic growth (ADB, 2013), a facelift in the farmers' lives (NIS, 2011), development of the rural economy (IFAD, 2011), high generation of revenue to the government (Tong, 2011), self-insurance mechanism to farmers (Alasia et al., 2009), and positive effects on household food consumption (Seng, 2015).

*Scarce Resources Substitutions (SRS) by the Respondents:* All the respondents confirmed that they usually substituted scarce resources to stay productive and relevant in their chosen planting activities. The number of the respondents that practised SSR in Benue State was 254 (64 %) out of 394, Edo State had 184 (51 %) out of 360, Niger State had 303 (76 %) out of 398, while Ondo State had 196 (53 %) out of 293 (Table 7). The factors that necessitate SRS (such as plant seeds and seedlings) vary across the study locations, where the experienced threats to farming activities vary (Liu et al., 2016). Resources shortage threatens farming activities, causing food security problems (Nechifor and Winning, 2018) and compromising SDG 2: Zero Hunger (UNDP, 2020). Magnitude of the scarce-resource threats depends on their usefulness to and predictions on agriculture yield in favour of other sectors (Calzadilla et al., 2010). The number of likely farms requiring such scarce-resource determines threats to farming activities (Wada and Bierkens, 2014). The OECD (2015) suggested that it is worth prioritising the users of scarce-resources based on historical patterns for necessary action to lessen the posed threats.

*Government Agriculture Extension Services to the Respondents' Farm:* The farmers indicated that the government agricultural extension officers usually visited them; 244 (62 %) out of the 392 farmers were visited in Benue State, 282 (74 %) out of 382 in Edo State, 336 (84 %) out of 399 farmers in Niger State, while 296 (78 %) out of 361 in Ondo State (Table 7). As the prime movers of agricultural development, the agricultural extension brings tested effective strategies and real growth into farming activities across the rural areas known as the base of farming activities. Works of the agricultural extension could be categorised for effective usage. The category include information dissemination, hands-on practical to resolve agricultural problems and revenue generation for the government (Danso-Abbeam et al., 2018). The agency facilitates a starring role in agricultural development efforts (Bonye et al., 2012). The administration of effective extension fosters agricultural development against climate change threats and better methods for agricultural produce preservation (Anaeto et al., 2012).

*Awareness of Climate Information of the Respondents:* Responses of the farmers showed that 258 (68 %) out of 373 were aware of the climate information (ACI) in Edo State, 204 (51 %) out of 399 in Niger State, 246 (67 %) out of 375 in Ondo State, but 221 (55 %) out of 388 denounced having ACI in Benue State (Table 7). The low percentage of ACI from the respondents in Benue State indicated that they were not convinced, while the Niger State respondents were contemplating. Opinion affects acceptance of the effects, thereby lessening the level of

ACI. Some see climate change as naturally driven. Others see it as humanly (Carrington, 2014). The observation was that the ACI by the farmers still faces contemplations and denials for not being understood. So, there is a need to improve ACI with proper content and appropriate media, as the ACI is necessary not only because climate change is a global issue causing by a natural or an anthropogenic driving force (IPCC, 2007) but also as it affects human (D'Amato et al., 2007), environment (Chan and Ryan, 2009) and socioeconomic (Githeko et al., 2000). Increasing level of ACI improves climate change education (Harker-Schuch and Bugge-Henriksen, 2013). Climate change information can be disseminated and its level of awareness can be increased through outreach at household levels (Jones *et al.,* 2011) and television programmes (Pandve et al., 2011). The IPCC (2007) reported that ACI is the foremost tool to understand vulnerability and craft adaptation to climate change effects. Levels of ACI dictate proper engagement of the concerned groups and are a measuring tool to build adaptive capacity (Williams et al., 2015).

*Access to Farm Input by the Respondents:* The response of the farmers on Access to Farm Input (AFI) was enumerated to be 254 (64 %) out of 396 in Benue State, 309 (77 %) out of 399 in Niger State, 199 (53 %) out of 380 in Ondo State, but 196 (51 %) out of 383 in Edo State did not have AFI (Table 7).

Examples of farm inputs are not limited to seeds, fertilizers and agrochemicals, which are needed to improve the productivity and incomes of various farmers. Order of the AFI across the study States was observed to follow Niger > Benue > Ondo > Edo. Reversal of this order indicates the tendency of being affected as the threats of climate change become severe because farmers' survival and prosperity rely on the availability of affordable and good-quality AFI. Supplying farm inputs is a critical factor in general agriculture and farm settlement development, which is why AFI supports initiatives to improve farmers' productivity (World Bank, 2007, 2010; FAO, 2020). Belt et al. (2015) indicated that market-based farm input supply has three approaches. (1) agro-dealer approach driven by profit-seeking agro-dealers that serves a minimum number of farmers with a specific estimation of buying power and provides a stable supply of inputs on reasonable terms, (2) chain leader approach driven by a specific commodity supply on a value chain that revolves around a powerful actor and a remunerative market for farmers assured by their leader who ascertains that the input will be purchased, and (3) local trader approach driven by low-value addition, high price and demand, unregulated market and no spokesperson. Thus, the AFI across the study States relies on the prevailing approaches mentioned above. The first approach is prone to a setback if there is no targeted number of farmers, and the need for the available specific input from the second approach could assist the farmers in having AFI. The third approach suffers from side-buying, which denies the farmers with buying capacity and the willingness to pay.

*Access to Credit Services by the Respondents:* The number of respondents who indicated that they moderately had access to credit services (ACS) was 216 (55 %) out of 393 in Benue State, and 251 (63 %) out of 400 in Niger State. In contrast, the number of respondents who showed that they did not have ACS was 211 (55 %) out of 381 in Edo State, and 226 (60 %) out of 375 in Ondo State (Table 7).

From the indications of the farmers' responses, capital to start and maintain farm are possible in both Benue and Niger, unlike in Edo and Ondo States. The pre-farming engagement, such as land clearing, harrowing, ploughing, and ridging, could be realised if farmers have ACS to hire pieces of machinery. Ability of the farmers to procure the necessary farm inputs (such as seeds, agrochemicals, and fertilizers) would be easy when they have ACS, which can be bearably refunded. The ACS provides short-term savings for individual farmers' productivity, asset realisation and food security. The results are successive income and sustenance for the farmers (Kimuyu and Omiti, 2000). There was a report that crop types, education level, and group membership were statistically significant with positive effects of ACS (Kiplimo et al., 2015).

Low profit-yielding peculiar to the agricultural sector needs a framework with a subsidy through ACS to relieve the smallholder farmers of financial constrain. In turn, ACS fosters contribution of the agricultural sectors to the national domestic product (Adam et al., 2010). Having ACS would locally assists the agricultural sectors to produce a high proportion of industrial raw materials (e.g. pieces of cotton for textiles, jute for rubber, cocoa for beverages) (FAO, 2014). Lastly, the ACS would better the lives of farmers to attain some Sustainable Development Goals (SDGs) 1: no poverty, 3: good health and well-being, 7: affordable and clean energy, 10: industry, innovation and infrastructure, 13: climate change, and 17: partnerships for the goals (UNDP, 2020).

## Conclusion

The stepwise multiple regression analysis of each of the four study States entered different considerable factors as variables into the model; this indicated that farmers' interest were not the same at tackling the issues of climate change.

The Durbin-Watson (DW) values of all the models were within the positive autocorrelation: $1.5 < DW < 2.5$. The F-test was highly significant from the ANOVA for model

of each State; this clarified that there was a significant variation in the farmers' characters influence on the 12 considerable factors. In addition, there was multicollinearity as the variables in each State's model were highly correlated for having Tolerance > 0.1 and Variable Inflation Factor < 10.

From the farmers' characters, males were observed to participate more than the females, average number of the farmers were agile (from 26 to 46 years old) and learned across the four States and can benefit if given climate education.

The observed variations on the 12 farm characters for adaptation on the climate change effects indicated that different policies may be specifically required in each study State, and generally across Nigerian States.

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## Competing interest

The authors have declared that no competing interests exist.

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