



**INDIGENOUS CLIMATE CHANGE COPING STRATEGIES OF SMALLHOLDER  
CASSAVA FARMERS IN AKWA IBOM STATE, NIGERIA**

**<sup>1</sup>Akpabio I A., I. J. Udousung, <sup>2</sup> G.I <sup>1</sup>Okoro, C.A. <sup>1</sup>Uwem and E.E. <sup>1</sup>Umoh**

Department of Agricultural Extension and Rural Development,

University of Uyo, Uyo, Akwa Ibom State

<sup>2</sup>Department of Agricultural Economics and Extension, Akwa Ibom State University,  
Obio Akpa Campus

Corresponding Author: [dr\\_akpabio2@yahoo.com](mailto:dr_akpabio2@yahoo.com)

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**Abstract**

The study ascertained the indigenous climate change coping strategies of smallholder cassava farmers in Akwa Ibom State of Nigeria. Primary data were collected with the aid of a structured questionnaire from 360 respondents affiliated with All Farmers Association of Nigeria (AFAN). Data were analysed using both descriptive and inferential statistics. Among other characteristics, respondents were found to be fairly educated, mixed-sexed individuals with mean age of 40 years and mean monthly income of N13, 202.76 but without access to credit facilities. Major indigenous coping strategies were; use of mixed cropping, cover-cropping and organic manure. Findings also revealed that age, gender, household size, land size, and income significantly influenced adoption of indigenous coping mechanisms. There was however no relationship between availability and utilization of indigenous climate change coping strategies. It is concluded that increased adoption of appropriate strategies would minimize vulnerability to the risks associated with cassava production enterprise in the State. Among others, it was recommended that farmers should be encouraged to utilize various available means to enhance the productivity of their small scale enterprises.

**Keywords:** Indigenous coping strategies, Climate change, Cassava farmers, Akwa Ibom State, Smallholders.

## 1.0 Introduction

In the first quarter of 2024, agriculture contributed 17.22% to Nigeria's nominal GDP, lower than the rate recorded for the first and fourth quarters of 2023 which stood at 19.63% and 24.65% respectively (Nigerian Bureau of Statistics (NBS, 2024). Ajala and Ajetomobi (2022) linked this depreciated performance to variation in climate. A very great challenge to food production and food security in the 21<sup>st</sup> century is the issue of climate change. Anyaegbu (2023) asserted that changing climate predisposes agriculture, especially rain-fed agriculture to danger since it depends on favourable climate conditions to remain productive (Lenis et al., 2020). Crop production is particularly disproportionately adversely affected by climate change as FAO (2024) views climate change as the principal immediate threat to global crop production. Simpson (2017- in FAO 2024) however clarifies that some crops are more tolerant than others to certain types of stresses.

Cassava (*Manihot esculenta*) is a major crop in Africa and Nigeria to be specific. Globally, Cassava has increased in production, in the last five decades to about 240 million tonnes per year (FAOSTAT 2020). Nigeria is the world's largest producer of cassava with approximately 59.4 million metric tons (MMT) in quantity that was produced in 2019 (PwC 2020) constituting 30% and 19% total production in Africa and on the globe, respectively. In Nigeria, cassava is a major cash crop that is often intercropped with other crops and is also well valued as an important staple food crop that is grown throughout the country and consumed by almost every household. The production of cassava in Nigeria is concentrated in the hands of numerous

resource-poor smallholder farmers concentrated mainly in the South and middle-belt regions of Nigeria.

The outstanding level of cassava production in Africa is well documented, as enunciated by Adebayo (2023); with reference to the fact that it dwarfs production levels in other climes and globally. African cassava production however suffers a low yield per hectare (tonnes/ha) challenge when compared to production figures for other continents. In essence, Adebayo (2023) asserted that cassava production in Africa and Nigeria (especially) is characterized by a wide gap between potential and actual cassava yields per hectare, arising from an inability to sustainably intensify cassava production. In 2020, global and African production figures was 11.3 tonnes/ha and 8.6 tonnes/ha respectively. In contrast, production figures for Nigeria was 7.8 tonnes/ha. The above reported production levels pale into significance when viewed against the reported potential cassava production level of 80 tonnes/ha under optimal conditions (Valk, 2017).

Above- reported scenario portends a dire situation for Nigeria's food security status and economic survival. This is because a very undesirable situation has arisen where the largest global cassava producer cannot produce enough to meet huge domestic demands, not to talk of exporting for much needed foreign earnings. PwC (2020) reported huge supply-demand gaps for cassava by-products and derivatives like ethanol, high quality cassava flour, gari, fufu, glucose syrup, ethanol, cassava starch, caustic soda, formaldehyde, hydrochloride acid and sodium silicate. Of utmost concern is the loss of potential revenue. It is reported that Nigeria can earn about US \$427.3Million (N188 Billion) from domestic value addition and derive

additional income of US\$ 2.98 Billion (NI.2 Trillion) in export of cassava and its derivatives. However, in 2021, Thailand, as the largest global exporter accrued \$1.6 billion in revenue, unlike Nigeria which earned a relatively paltry US\$ 4.45M to rank as the 64<sup>th</sup> highest exporter. Export figure for Nigeria rose to US\$ 7.33M in 2022, ranking Nigeria as the 61<sup>st</sup> largest exporter globally.

Cassava has been called “the drought, war, and famine crop” because it can be grown in challenging conditions and can be harvested at any needed time; essentially to cushion the effects of famine. It has also been suggested that cassava could be more resilient to climate change than other staple crops (Shackleford, 2018). However, FAO (2022) surmised that cassava production is being impacted by climate change on a global, regional, and local scale. This assertion is well amplified by Ajala and Ajetomobi (2022).

The reported very wide gap between potential and actual cassava yields per hectare means that a lot more has to be done to escalate production levels and close the ever-yawning gap. As a response, local farmers have developed a means of coping with the challenge of climate change using their indigenous methods. Indigenous knowledge in this respect refers to the knowledge that is attributed to a particular community while coping and adaptation strategies refer to reactive and proactive adjustments or adaptations in response to climate change (Fabricius, Folke, Cundill, & Schultz, 2007). The coping and adaptation strategies that emerge from the use of indigenous knowledge are what are referred to indigenous coping or adaptation strategies. Effective adaptation to climate change is a long process that involves sharing of experiences across all sectors and

in different groups within the affected communities (Reid et al., 2009). This involves a paradigm shift from imposing presumed solutions on seemingly helpless Indigenous people to a collaborative effort in proffering solutions to the menace of climate change. Therefore, community participation becomes an essential element in this case. From the community members’ experiences, scientists are able to draw some lessons on best and effective coping and adaptation strategies that can be replicated. But the process needs to start from the indigenous knowledge as informed from the local experience. This is an important element in the adaptation process and has a valuable contribution in science and in prioritization of the effective adaptation strategies (Gaspere, Bryceson, & Kulindwa, 2015). Unfortunately, there is no comprehensive documentation of the best indigenous coping and adaptation techniques in most of the developing countries including Nigeria and the existing indigenous knowledge base is still fragmented.

It is obvious that level of cassava production decreases with the intensification of climate change. Reliefweb (2023) attests to Nigeria as being one of the countries with the greatest biophysical potential for climate change mitigation from natural climate solutions (forestation, reforestation and improved natural forest management). It is however an irony that Nigeria is reported as the sixth least prepared to adapt to climate change and the 53rd most vulnerable nation, according to the 2021 Notre Dame Global Adaptation Index (ND-Gain Country Index, 2021). Bausch & Koziol (2020) trace the above-reported situation to weak regulatory capacity, little research on adaptation strategies, and a need for the appraisal of local ideas. The deleterious effects of these

scenarios for the attainment of the Sustainable Development Goals (SDGs) are clear, particularly in developing nations like Nigeria. The ability and inherent potential of the key stakeholders (including farmers) of a particular farming system to cope with potentially devastating and rapidly evolving weather conditions will ultimately impact their means of livelihood with far-reaching impact on food security. This necessitates a comprehensive strategy and a thorough process of raising awareness among Nigerian rural farming households on how to adapt to climate change (FMARD, 2021). To make up for lost ground in the global adaptation index, Nigeria urgently needs to embrace tried-and-true adaptation solutions. Against this background, it becomes imperative to explore and document farmers' use of Indigenous Knowledge. By this means we can seek deeper understanding of how they adapt or coexist with climate change. This study explores these indigenous coping and adaptive practices of cassava farmers to understand their consistent use and evaluate the outcomes with a view to documenting such and projecting such for inclusion in mainstream climate change adaptation plans.

## 2.0 Methodology

This study was conducted in Akwa Ibom State, Niger Delta, Nigeria; which situates between latitudes 4°33' N and 5°3' N and Longitudes 7°25' E and 8°25' N. It is located in the South-South region of Nigeria and covers a landmass of 8,421 square kilometers. Akwa Ibom lies within the tropical rain forest zone with two major seasons: the wet or rainy season (April to October) and a dry season (November to March). Based on geographical location, the climate of the state can be described as a

tropical rainy type, which experiences abundant rainfall with very high temperatures. The mean annual temperature lies between 26°C and 29°C, and average sunshine cumulates to 1,450 hours per year, while annual rainfall ranges between 2400mm along the coast (Southern Part) to 2000mm in the North. The economy of Akwa Ibom is largely driven by agriculture, which remains the primary activity for a significant portion of the residents. The fertile soil supports the cultivation of crops such as cassava, yam, and palm oil, which are staples in both local consumption and trade. Fishing is also a critical activity, given the state's extensive coastline and network of rivers. Majority (more than 70%) of farming activities are carried out on smallholder farms of a mean average size of two (2) hectares. In essence this group of farmers is indispensable to the economic development of the state.

The study population for this study was cassava-based farmers affiliated with the All Farmers' Association of Nigeria (AFAN) from all the local government areas (LGAs) in Akwa Ibom State. Data was collected from 360 purposively chosen cassava based farmers operating on less than two (2) hectares (ha) of farmland. Collated data was analysed with the aid descriptive (percentages, frequencies, Means, ranks) and inferential (logit regression model, paired t-test) statistical tools.

Descriptive statistics such as frequency counts and percentages were used to analyse socio-economic characteristics of the respondents. Logit regression model was adopted in testing for the relationship between socio-economic characteristics of the respondents and the probability of the respondents adopting indigenous methods in coping with climate change. The logit regression model is a unit or multivariate

technique that allows for estimating the probability that an event occurs or not by predicting a binary dependent outcome from a set of independent variables. Logit model ensures the production of a probability of choice within the (0, 1) range. The logit

model is based on the cumulative logistic probability function, and it is computationally tractable. According to Gujarati and Porter (2009), it is expressed as:

$$P_i = E(Y=1/X_i) = \beta + \beta_2 X_2 + \beta_3 X_3 \dots\dots\dots(1)$$

For ease of estimation, equation (1) was further expressed as:

$$P_i \frac{1}{1 + e^{-Z_i}} = \frac{e^{Z_i}}{1 + e^{Z_i}} \dots\dots\dots (2)$$

Where

$P_i$  = Probability of an event occurring

$$Z_i = \beta_1 + \beta_2 X_2$$

The empirical model of the logistic regression for this study assumed that the probability of the cassava farmer's adoption of mitigation strategies can be expressed as;

$$P_i = \frac{e^{(\beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \dots + \beta_{10} X_{10})}}{1 + e^{(\beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \dots + \beta_{10} X_{10})}} \dots\dots\dots(3)$$

$P_i$  ranges between zero and one, and it is nonlinearly related to  $Z_i$ .  $Z_i$  is the stimulus index, which ranges from minus infinity to plus infinity, and it is expressed as:

$$\frac{Z_i}{1 - P_i} = \frac{\ln(P_i)}{\beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \dots + \beta_{10} X_{10}}$$

Where  $P_i$  = Probability of cassava farmers' adoption of indigenous coping strategies.

$1 - P_i$  = Probability of not adopting indigenous coping strategies.

$B_0$  = intercept.

$B_1 (1, 2, 3 \dots 10)$  = regression coefficients

$X_1 (1, 2, 3 \dots 10)$  = independent variables

$e$  = error term

The independent variables specified as factors affecting the adoption of climate change indigenous coping strategies are defined thus:

$X_1$  = Age (years)

$X_2$  = Gender (Dummy)

$X_3$  = Religion (Dummy)

$X_4$  = Marital status (Years)

$X_5$  = Level of education (years)

$X_6$  = Total Income (₦)

$X_7$  = Cooperative membership (Number)

$X_8$  = farming experience (years)

$X_9$  = Extension visit (dummy)

$X_{10}$  = farm size (ha).

### 3.0 Results and Discussion

#### 3.1 Socio-Economic Characteristics of Respondents

Socio-economic characteristics of the cassava farmers in Akwa Ibom State presented in Table 1 reveals that 53.3% of the respondents were male while 46.7% were female. A large proportion (59.4%) of the respondents was within the age range of 40 -50 years. The mean age for the farmers in the study area was 40 years. With regards to marital status, majority of the respondents (63.9%) were married. This may be as a result of high labour requirement in agricultural production in which family labour is highly employed and partly due to the expected benefits derived in feeding members of their family from what they produce. Regarding education, 98.9% of the respondents had acquired formal Education, indicating that, cassava farming activities in Akwa Ibom State is handled by enlightened persons which enable them to apply their acquired skills in combating climate change in order to increase their productivity.

A majority (67.8%) of the respondents earns between ₦11, 000 – ₦30, 000 per month while the mean monthly farm income for the cassava farmers was ₦13, 202.76. This result

is in line with the result of Akinro, *et al.*, (2018) with reference to the Niger Delta Region of Nigeria and reported a mean monthly income for cassava farmers was about ₦13, 000.00. Most of the respondents (80.0%) did not belong to any cooperative society which could have opened more avenues for the farmers to learn and adopt various strategies to cope with climate change in their locality. This corroborates the findings of Akinro, *et al.*, (2018). Results also revealed that a higher proportion (59.4%) of the respondents had farming experience range of 6-10 years and a greater proportion (83.3%) of the respondents had no contact with extension agent over the years. Oladipo (2015) asserted that extension services in the entire Niger Delta Region of Nigeria needed a total review in order for farmers to benefit from the information that they can offer to increase productivity as well as control climate change effects. A greater proportion (80.6%) of the respondents did not have access to credit facility. This result is in tandem with Umoren *et al.*, (2014) who found out that most farmers including cassava farmers in the State had no access to credit facilities.

**TABLE 1: Socio-Economic Characteristics of Respondents**

<b>Variables</b>	<b>Frequencies</b>	<b>Percentages</b>	<b>Means Score (<math>\bar{X}</math>)</b>
<b>Age</b>			
20-30	42	11.7	40
31-40	52	14.4	
41-50	214	59.4	
51-60	28	7.8	
61 & above	24	6.7	
<b>Gender</b>			
Male	192	53.3	
Female	168	46.7	
<b>Marital Status</b>			
Single	98	27.2	
Married	230	63.9	
Divorced	6	1.7	
Widowed	26	7.2	
<b>Education</b>			
No formal Education	4	1.1	
Primary	90	25.0	
Secondary	204	56.7	
Tertiary	62	17.2	
<b>Total income(₦)</b>			
11,000-30,000	244	67.8	13,200.76
31,000-50,000	78	21.7	
51,000-70,000	24	6.7	
71,000-90,000	8	2.2	
91,000-110,000	6	1.7	
<b>Farmers' cooperatives</b>			
No	288	80.0	
Yes	72	20.0	
<b>Farming Experience</b>			
1–5	24	6.7	8
6–10	214	59.4	
11–15	74	20.6	
16 & above	48	13.3	
<b>Extension Visit</b>			
Yes	60	16.7	
No	300	83.3	
<b>Access to credit</b>			
Yes	290	80.6	
No	70	19.4	

Source: **Field Survey data (2024)**

### 3.2 Indigenous Coping Strategies to Climate Change Adopted by Cassava Farmers in Akwa Ibom State

With reference to Table 2 the major strategies practiced by cassava farmers to mitigate the effect of climate change were; mixed cropping ( $\bar{x} = 3.878$ ; rank 1) cover cropping ( $\bar{x} = 3.878$ ; rank 1) and use of improved varieties ( $\bar{x} = 3.850$ ; rank 3). Literature review reveals that farmers utilized various adaptation measures against climate change, including; mixed cropping,

crop rotation and organic manure (Ajaero, *et al.*, 2013); mulching, organic manure and mixed cropping (Okon et al., (2024); planting of improved cassava varieties, variety of crops and diversified livelihoods (Osuji et al., (2023); and use of improved varieties (Henri-Ukoha, 2020). The respondents generally indicated their level of dependence on the indigenous strategies currently in practice because of their attributes of low cost and ease of practice.

**Table 2: Indigenous Coping Strategies to Climate Change Adopted by Cassava Farmers in Akwa Ibom State. Nigeria**

S/N	Indigenous coping Strategies	Never	Rarely	Regularly	Mean	Std. Deviation	Rank
1	Organic manure	2(0.6)	8(2.2)	350(97.2)	3.817	0.521	6
2	Changes in the planting period	102(28.3)	204(56.7)	54(15.0)	2.117	0.755	14
3	Terracing/land location	24(6.6)	24(6.6)	314(87.2)	2.367	0.8	12
4	Mulching	2(0.6)	2(0.6)	356(98.8)	3.822	0.461	6
5	Pests and diseases resistant varieties	18(5.0)	20(5.6)	326(90.6)	3.706	0.456	7
6	Tillage	102(28.3)	204(56.7)	54(15.0)	2.117	0.755	14
7	Improved varieties	12(3.3)	14(3.9)	334(92.8)	3.850	0.372	3
8	Total dependence on rainfall	14(3.9)	14(3.9)	332(92.2)	3.656	0.599	9
9	Mixed cropping	4(1.2)	8(2.2)	348(96.6)	3.878	0.328	1
10	Early maturing varieties	8(2.2)	10(2.8)	342(95.0)	3.839	0.410	4
11	Cover cropping	6(1.7)	8(2.2)	346(96.1)	3.878	0.328	1
12	Early planting	16(4.4)	18(5.0)	326(90.6)	3.061	0.701	11
13	Relay cropping	12(3.3)	14(3.9)	334(92.8)	3.678	0.544	8
14	Use of bio control measures	34(9.4)	192(53.3)	134(37.2)	2.267	0.735	13
15	Planting of trees	90(25.0)	188(52.2)	82(22.8)	3.067	0.757	10

Source: Field survey, 2024

### 3.3 Test of Hypotheses

#### 3.3.1 Logit Regression Analysis Result for Hypothesis One

**HO<sub>1</sub>:** There is no significant relationship between socio-economic characteristics of the respondents and the probability of the respondents adopting indigenous methods to cope with climate change

Table 3 shows the socioeconomic variables of adopting indigenous coping mechanisms of reducing the effects of climate change among smallholder cassava farmers. The binary logistic regression model revealed that the probability of the respondents adopting the indigenous coping practices was 73.95 %, which implies that a significant percentage (about 74%) of the variability in the adoption of the indigenous coping practices is due to the independent variables included in the model. This implies that a combination of these variables has a significant predictive effect on the probability of farmers taking up conventional climate resilience practices.

The variable age was positively related to the level of adoption, and the relationship was found to be significant at the 1% significance level ( $dy/dx = 0.0139$ ;  $p = 0.005$ ). This means that the probability of farmers adopting indigenous coping strategies grows by about 1.4 percentage points with every year of age, perhaps as a result of experience and traditional knowledge. This observation concurs with the results of Osuji et al. (2023), who found age to be a major factor in determining the adaptation strategies. Gender also had a positive and significant relationship at the 5-percent level ( $dy/dx = 0.2228$ ;  $p = 0.012$ ), although the direction was not consistently positive when considering different quartiles of the relationship (see Figure 9 below), which may indicate that the effect of male

or female identity on adoption behavior is larger but not consistently in one direction.

Although education demonstrated a positive relationship ( $dy/dx = 0.0056$ ), it was not statistically significant ( $p = 0.602$ ), and thus, greater educational attainment might positively affect adoption, but only at an insignificant level of confidence. The observation is in agreement with Osuji et al., (2023) and Omodara et al., (2023) who identified education as prominent in shaping climate change adaptation decisions among cassava farmers. The level of adoption was also positively and significantly associated with household size ( $dy/dx = 0.0649$ ;  $p = 0.0091$ ) and total income ( $dy/dx = 1.83 \times 10^{-6}$ ;  $p = 0.048$ ) at the 1% and 5% significance levels, respectively. Both of these indicate that households with more members might possess more labour ability to put the indigenous strategies into practice, and the income level might increase the financial flexibility to adopt or continue practising such indigenous strategies.

The size of land also depicted a positive and significant relationship ( $dy/dx = 0.2623$ ;  $p = 0.003$ ), meaning that farmers with larger landholding had higher probabilities of using the native coping mechanisms. It may be explained by the fact that on bigger plots, they are more exposed to climate risks, which can encourage them to use various indigenous resilience strategies. This result aligns with those of Omodara et al. (2023) and Osuji et al. (2023), who listed farm size among the crucial factors defining the choice of adaptation strategies. On the contrary, cooperative society membership ( $p = 0.397$ ) and extension visits ( $p = 0.059$ ) were not significant, though the latter was close to being significant. This is contrary to Omodara et al's., (2023) finding which espoused the importance of cooperative membership to adaptation practices. The

difference may be explained by the fact that the cooperatives in different regions may be more or less effective or active. The known significance of extension contact in the or the quality of extension service.

spread of adaptation knowledge was not statistically significantly influential in this study, perhaps because of limitations in the frequency of contact, relevance of contact,

**TABLE 3: Logit Regression Analysis for Hypothesis One**

Variables	dy/dx	Standard error	Z	P>/z/
Age	0.0139	0.0049	2.8300	0.0050
Gender	0.2228	0.0888	2.5100	0.0120
Education	0.0056	0.0110	0.5200	0.6020
Cooperative	0.0761	0.0893	0.8500	0.3970
Marital Status	-0.0445	0.1149	-0.3900	0.6980
Household size	0.0649	0.0247	2.6300	0.0091
Total Income	1.83x10 <sup>-6</sup>	0.0000	1.9800	0.0480
Extension Visit	0.1738	0.0921	1.8900	0.0590
Land size	0.2623	0.0892	2.9400	0.0030
Y(Predicted)	0.7395			

Source: Field survey 2024

**3.3.2 Paired T-test Analysis result for Hypothesis Two**

climate change and the level of utilization of the indigenous coping strategies.

**HO<sub>2</sub>:** Relationship between cassava farmers' indigenous coping strategies to

**TABLE 4: Paired t-test Result for Hypothesis Two**

Group	N	Mean	Std Deviation	Standard Error of Mean	of composite Index
Climate Change					
Indigenous Coping Strategies	180	94.0000	0.5625	0.0171	0.4261
Level of utilization	180	2.6416	0.1241	0.0154	0.8486
Difference		91.3584	0.4384	0.0017	0.4236

Sig (2-tailed) = 0.013; F = 6.564; df = 358; P $\alpha$  = 0.05

Data were analyzed using SPSS and Expert Choice software to determine whether there exists any statistically significant relationship between the identified indigenous coping strategies and the degree to which they are used by the cassava

farmers in reducing the impact of climate change. A paired samples t-test and a composite index analysis were applied. The p-value (0.013) obtained in the test was found to be less than the standard significance level at a 5 %, and therefore,

the null hypothesis, which hypothesized that there is no significant difference between the indigenous coping strategies adopted and their degree of utilization, was rejected. This was also supported by the values of the composite index, where a big gap was recorded between coping strategies (Index = 0.4261) and their use (Index = 0.8486), indicating that although most of the indigenous techniques are known or at hand, their actual implementation among farmers is still low.

This outcome concurs with those of Nwaobiala and Nottidge (2013) who asserted that there was a statistically significant difference between indigenous climate coping strategies that were identified by the cassava farmers and the level to which these strategies were adopted in Abia State. Their analysis also emphasized the existence of a utilization gap, which could hurt the overall performance of local adaptation initiatives to climate change. In short, although the indigenous climate resilience coping mechanisms of cassava farmers are very much established, they must be better enabled through farmer education, as well as policy and capacity-building initiatives, so that availability can be transformed into action.

#### **4.0 Conclusion**

Climate change still remains a great threat to the productivity of poor smallholder cassava farmers, judging by the paltry mean monthly income of ₦13,200.76 accruing to them from their livelihood enterprise. Indications are that socioeconomic characteristics like age, gender, household size, land size, and income have a significant role to play regarding the adoption of indigenous coping mechanisms. There is, however, a large disparity between the availability and

knowledge of these coping strategies and their implementation of the same. This discrepancy was reflected in both the t-test and the composite index results, thus showing the importance of putting more effort into the promotion of the use of these strategies. Consequently, greater use of relevant indigenous norms would not only make the farmers less vulnerable but also more productive, thus attracting more investments in the cassava value chain in the State.

#### **5.0 Recommendations**

- i. Efforts by government and agricultural extension services should be intensified in the education of cassava farmers on the indigenous coping strategies as well as on the manner of their appropriate use. This can be done in the form of community-based training programs, farmer field schools, and locally based awareness campaigns that emphasize climate-smart practices.
- ii. Despite the little significance depicted by extension visits, better frequency, quality, and relevance of extension services might narrow the gap between knowledge on coping strategies and their practical implications. Particular consideration must be provided to the advice customized to the particular needs of older and female farmers, which demonstrated a considerable impact on the levels of adoption.
- iii. Although cooperative membership was not a strong factor in determining adoption in this research project, the groups can offer a platform of peer learning, resources, and collective action in adopting

coping strategies when revitalized and strengthened. These networks may provide an important vehicle to disseminate good practice.

- iv. Since land size was a large factor in the adoption, policies to assist in land access and tenure security, as well as encouraging expansion of farmland, can encourage more adoption of indigenous practices. This may involve land reform schemes and land development credit schemes.

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