

# Climate Variability and Cocoa Farmers' Livelihoods in Idanre and Odigbo Local Government Areas of Ondo State, Nigeria

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## Abstract

Cocoa production, which used to be the mainstay of Nigeria's economy, had suffered a serious setback in the recent past due to some factors among which is climate variability. This study aims at examining climate variability's effect on cocoa farmers' livelihoods in Ondo State, Nigeria. Multistage sampling techniques was used to sample 310 cocoa farmers in the study areas and data were collected using structured questionnaire to elicit information from cocoa farmers on their enterprise characteristics, awareness of climate variability, exposure to climate variability, and its effects on cocoa farmers' livelihoods. Data collected were analyzed and interpreted using descriptive statistics (such as mean, frequency counts, standard deviation, and percentages) and regression at  $p=0.05$ . Awareness of climate variation trends was highest for delayed onsets of rainfall (63.9%) and lowest for harmful gas emission (10.0%). Overall, awareness was high among 52.3 % of the farmers. Exposures to climate parameters were perceived to be highest in terms of temperature, incidences of soil erosion and mudslide. Negative impact of climate change on cocoa farmers' livelihoods was pronounced in terms of poor quality of produce ( $4.7\pm 0.7$ ), low yield ( $4.2\pm 0.6$ ) and reduced size of land cultivated ( $4.3\pm 0.9$ ). The impacts were perceived as high among 51.3% of the farmers. Integrated pest management ( $3.6\pm 0.8$ ) and use of fertilizer ( $3.4\pm 0.7$ ) were major adaptation measures used. The study concludes that climate change variability has moderate impact on cocoa farmers' livelihood in the study area. Impact on livelihood is more felt by larger households than smaller ones. It is recommended that improved awareness of climate-smart farming practices will reduce impact felt among cocoa farmers.

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### **Introduction**

Cocoa as a major cash crop in Nigeria has contributed greatly to Nigeria's economy. It has since been an important foreign exchange earner, remaining the second largest foreign exchange earner after crude oil (Central Bank of Nigeria, 1998). The crop has contributed immensely to infrastructural development in Nigeria and has imparted positively on the lives of those who work and live in the cocoa belt which Ondo state belongs (Sanusi & Oluyole 2005). Cocoa has also contributed greatly to the expansion of agro-based industries in Nigeria (Olayide & Falusi, 1975). It is a source of income and savings to many small-scale farmers and the industrial supports for various categories of workers, such as produce buyers, cooperative societies and their workers, workers in the agrochemical industry and the cocoa exporters and transporters (Sanusi, 1988). The main Cocoa producing states are Ondo, Ekiti, Oyo, Osun, Ogun, Delta, Edo, Kwara, Kogi, Abia, Taraba, Cross Rivers, Akwa-Ibom and Adamawa (Oluyole, 2010). According to Oyekale 2009, 50% of the total quantity of cocoa produced for export or utilised locally per annum comes from Ondo State.

Natural and man-made resources are required in the production processes of cocoa. Among the natural resources necessary for cocoa production are land, water, soil and climatic variables (rainfall, temperature, relative humidity, sunshine, air and so on). Of all the natural resources mentored, climate is the predominant factor that affects cocoa production. Cocoa is highly sensitive to rainfall, sunshine and temperature. Climate is the state of the atmosphere created by weather events over a period of time (Oyekale, 2009). A vary in the state of the atmosphere created by weather events over a period of time is known as climate change. Climate change is caused by the collection of the greenhouse gases in the lower atmosphere. A greenhouse gas is one that traps heat in the earth's atmosphere. The amplest greenhouse gases are carbon (iv) oxide, methane, nitrogen (i) oxide and chlorofluorocarbons (Intergovernmental Panel on Climate Change, 2001). However, the absorption of these gases is increasing

mainly due to human activities such as the combustion of fossil fuels and deforestation. When talking about climate change and its effects, it is necessary to make adjustments and interventions in order to manage the losses or take advantages of opportunities presented by it. These adjustments or interventions are known as adaptation (IPCC, 2007). In Nigeria, cocoa has been the second largest foreign exchange earner after crude oil and has also contributed immensely to infrastructural development in the country. Given this significance, one would expect that the crop will be produced on a large scale and its production should be on the increase to boost the nation's foreign exchange earnings. Despite the nation's commitment to increase its production, it is still being faced with the problems of climate change, which cannot be controlled by man (Oyekale, 2009). This situation has discouraged intensification and extensification activities in the cocoa industry in Nigeria leading to undesirable effects on the lives of most households whose livelihoods depends on it. Cocoa production in Nigeria remains a major economic activity for over 700,000 households, with around 6.3 million Nigerians (representing about 30 per cent of the total population) depending on cocoa for their livelihoods (Gockowski et al 2011). The falling revenue from crude oil which has overtaken cocoa production as major National foreign exchange earner has prompted the need to relaunch cocoa rebirth agenda in most cocoa producing states. While efforts toward the rebirth agenda have largely focused on awareness campaign, boosting extension services, and subsidizing input, not much has been done to understand how climate variability affects the livelihoods in the state.

## **Review of Literature**

### **Food production and climate change**

Nigeria is a country located in the Gulf of Guinea that is comprised of thirty-six states and it is the fourth largest cocoa exporter in the world (Nwachukwu, Agwu, Nwaru, & Imonikhe, 2010). Declining rainfall and rising humidity in Nigeria are negatively affecting the output of agriculture. Climate change is considered changes in atmospheric composition due to human impact that are greater than

natural changes in an equivalent period. (Intergovernmental Panel on Climate Change, 2012). Additionally, Mase, Gramig, and Prokopy (2016) noted that climate change is ceaseless and is negatively affecting the global viability of food production via farming. Climate directly influences the production of foods due to changes in soil, rainfall humidity, and temperature.

### **Climate perception and adaptation strategies**

Perception within the concept of this paper is the process of attaining full awareness or understanding of the environment by accepting, organizing and interpreting sensory information. Human perception of climate variation is a complex issue to climate adaptation. Adaptation involves adjustment to enhance the viability of social and economic activities and to reduce their vulnerability to climate including its current variability and extreme events as well as longer-term climate change (Fadairo et al 2021). Adaptation to climate is the process through which people reduce the negative effects of climate on their health and wellbeing and take advantage of opportunities that their climatic environment provides. The term adaptation means any adjustment, whether passive, reactive or anticipatory that is proposed as a means for enhancing the anticipated adverse consequences associated with climate change.

Ondo state being the highest cocoa producing state in Nigeria is highly sensitive to variation in climatic factors most especially drought, rainfall, temperature and sunshine. Several opinions have been expressed about the impacts of climatic factors on cocoa production (Olajide, 2021). Some claimed that rural and poor cocoa farmers are most affected; some affirmed that farmers who depend on traditional livelihood system such as farming, fishing and pastoralism are most affected while others have reported that small-scale cocoa farmers are the most affected. It is also well known that cocoa output is highly sensitive to changes in climate, from length and intensity of sunshine, to rainfall and water application, soil condition and temperature due to evapotranspiration effects. It has been widely reported that climate change also plays a major role in altering the growth of cocoa pests and pathogens and shifting their

interactions. This translates into lower crop yields, which in turn influence farm income and livelihoods (Fadairo et al, 2019).

### **Objectives of the study**

The main objective of this study is to examine the effects climate variability on cocoa farmers' livelihood in Idanre and Odigbo Local Government Areas of Ondo state. The specific objectives are to:

1. investigate cocoa farmers' level of awareness of climate variability and trends related to climatic change in the study areas,
2. ascertain the effects of climate variability and change on cocoa farmers' livelihood; and
3. analyse the adaptation strategies used by cocoa farmers to cope with climate variability in the study area.

### **Methodology**

**Study area:** The study was carried out in Idanre and Odigbo Local Government Areas of Ondo state, Nigeria. The state and the two Local Government Areas were purposively selected for this study because of their prominence in cocoa production. The state is made up of 18 Local Government Areas; it is located in the South-western zone of Nigeria. The state lies entirely in the tropical rainforest between longitudes 4°30' and 6° East of the Greenwich Meridian, 5° 45' and 8° 15' North of the Equator. Ondo state is bounded in the North by Ekiti/Kogi States; in the East by Edo State; in the West by Oyo and Ogun States, and in the South by the Atlantic Ocean. The land area of the state is 14,788.723 square kilometers (km<sup>2</sup>) (Ayoade, 2004). The state has a bimodal rainfall distribution but with less intensity.

**Sampling procedure:** Multi-stage sampling procedure was used to select all cocoa farmers who had been involved in cocoa production for 15 years and above in the study area. The first stage involved the grouping of the communities in the study areas into clusters giving five clusters each in Odigbo (Kajola, Obado, Ajue, Leege, and Ayesan) and Idanre (Farm Settlement Poun, Erijo, Ayede, Ipoba, and Imolumo) local government areas. At the second and third stages, a

list of cocoa farmers in each cluster were compiled with the help of the cocoa farmers association after which a simple random sampling technique was used to select a representative proportion (30%) of the farmers who had been involved in cocoa production for minimum of 15 years. This gives a total of 310 cocoa farmers (210 from Odigbo and 100 from Idanre) used for the study.

**Data collection, measurement and analysis:** Data were collected using structured questionnaire on cocoa farmers enterprise characteristics, awareness of climate variability, exposure to climate variability and impacts on their cocoa farming livelihoods and adaptation strategies used. Awareness of climate variability was measured by asking respondents to indicate if they have observed changes in any of the climate parameters such as rainfall, temperature etc. on “yes” or “no” basis. Exposure to climate variability and impacts on their cocoa farming livelihoods was assessed by using proxy indicators of respondent’s perception of increasing/decreasing intensity for all climate parameters on a three-point scale of greatly increased, moderately increased and no change using 15 years as benchmarks. For instance, temperature was measured in terms of duration and quantity; windstorm in terms frequency and force; water source in terms of number, abundance, and quality; flood in terms of volume, damage to farmlands. Mean values representing intensity of change over the last 15 years for each parameter indicate respondent’s degree of exposure to climate variability in the area. Impact of climate variation on cocoa farming livelihoods was determined by asking respondents to indicate how climate change is perceived to affect parameters such as revenue, quality of produce, quantity of produce etc. on a five-point scale of strongly agreed (5) to strongly disagreed (1). Parameters with high mean scores were adjudged as high impacts. A list of adaptation strategies available in literature were presented to respondents for them to indicate their employ ability of each strategy on a four-point scale of never (0), rarely (1), sometimes (2) and always (3). Adaptation strategies with high mean scores were adjudged as most used in the area. Data collected were analysed and summarized using descriptive statistics

(such as mean, frequency counts, standard deviation and percentages) and regression at  $p=0.05$ .

### **Results**

Table 1 shows the respondents' personal characteristics, the study revealed the proportion of cocoa farmers who were aged between 0–30 years was 6.1%, 31–40 years was 21.6%, 41–50 years was 46.8%, 51–60 years was 22.9% 61–70 years was 1.9% and 70 years and above was 0.6%. The mean age of cocoa farmers was 46.3 years. There were aged about 75 years on the average with the oldest being 90 years and the youngest being 20 years. Majority of the farmers are within the age of 41–50 years and about 46.8% of the farmers were within the economically active age of 60 years.

The sex variable revealed that, there are more male farmers participating in cocoa farming. 84.4% of the respondents were male. Few females were into cocoa farming, revealing that males were mainly the carriers of responsibilities of household needs. While 15.2% are females. In terms of education, 5.8% of farmers in the study area had no formal education, 22.8% had education up to primary school, majority (68.4%) had senior high school education and only 2.3% had tertiary education and 1.0% had other means of education. The result obtained from the study indicated 20% of the farmers had less than 10 years of experience, while majority (51.3%) of the cocoa farmers had experience between 11–20 years, 23.5% had experience between 21–30 years, 4.8% had experience between 31–40 years and 0.3% of the farmers had farming experience above 41 years with a mean of  $18.1 \pm 8.3$  years of experience.

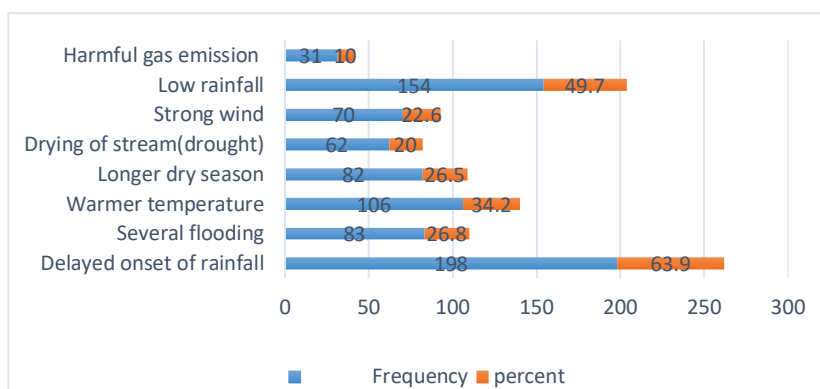
**Table 1: Socio-economic and Demographic Characteristics of Respondents**

<b>Variable</b>	<b>Frequency</b>	<b>Percent</b>	<b>Mean± SD</b>
<b>Age</b>			
≤ 30	19	6.1	
31-40	67	21.6	
41-50	145	46.8	46.3±9.3
51-60	71	22.9	
61-70	6	1.9	
71 and above	2	0.6	
<b>Sex</b>			
Male	263	84.4	
Female	47	15.2	
<b>Education</b>			
No formal	18	5.8	
Primary	70	22.6	
Secondary	212	68.4	
College/university	7	2.3	
Others	3	1.0	
<b>Years of cocoa farming</b>			
Less or equal 10	62	20	
11-20	159	51.3	
21-30	73	23.5	18.1±8.3
31-40	15	4.8	
41 and above	1	0.3	
<b>Source of planting materials</b>			
Previous harvest	83	26.8	
Research institute	51	16.5	
Extension workers	171	56.1	
Others	5	0.6	
<b>Contact with extension workers</b>			
Weekly	131	42.3	
Few times	28	9.0	
Monthly	24	7.7	
Bi-monthly	40	12.9	
Quarterly	41	13.2	
Others	46	14.8	
<b>Household size</b>			
1-3	85	27.4	
4-6	166	53.5	4.8±1.9
7 and above	59	19.0	

Figures in parentheses are in percentages; f represents the frequency

### Awareness of Climate variability and trends related to climate change

Farmers’ awareness on climate change is important for climate change adaptation. Respondents were asked about their awareness and trends on climate change (i.e., temperature, delayed onset of rainfall, severe flooding, warmer temperature, longer dry season, drought, strong wind, low rainfall that occur by harmful gas emission) over the last 15 years. Figure 1 reveals the respondents’ awareness to climate variability and trends related to climate change. The study revealed that (63.9%) respondents were aware of delayed onset of rainfall as a result of climate change, several flooding (26.8%), warmer temperature (34.2%), longer dry season (26.5%), drought (20%), strong wind (22.6%), low rainfall (49.7) and harmful gas emission (10%). Furthermore, this finding supports the research carried out by Oyekale (2009) which explains further the significance of these weather variables. In his work, he stated that, cocoa is highly susceptible to changes in climate from hours of sunshine to rainfall and application of water, and soil condition.



**Fig. 1: Awareness of Climate variability and trends Perceived impacts of climate related changes and trends on the respondents**

Table 2 shows the respondents perception of climate change impacts on their cocoa enterprise. The table shows that poor quality of yield followed by change in rainfall pattern and threat to their livelihoods

ranked as the most important of the climate change impacts among the cocoa farmers. The results is consistent with previous works on climate change impact on agriculture which shows that crop failure and displacement of farming livelihoods were major challenges faced by farmers due to rainfall unpredictability arising from the problem of climate change (Fadairo et al, 2021, Ladele and Fadairo, 2013).

**Table 2. Perceived impacts of climate related changes and trends on the respondents**

SN	Perceived impacts	Mean±SD
1	Poor quality produce	4.7±0.7
2	Low yield	4.2±0.6
3	Fallen net revenue	4.1±1.3
4	Change in rainfall	4.6±0.7
5	Difficulty in land preparation	2.0±0.8
6	Resulting to cocoa yield	3.3±0.8
7	Incidences of poverty and low income	3.6±1.6
8	Incidences of poor nutrition	2.2±1.4
9	Sedimentation experience	3.8±1.0
10	Livelihood threat	4.3±0.9
11	Unpredictability of rainfall	3.5±1.5
12	Incidences of silting and erosion	3.2±1.5
13	Heavy destruction of crops	2.3±1.3

### Cocoa Farmers' Adaptation Strategies

Adaptation is essential in curbing the potential impacts of climate variability on the smallholder farmers. Jiri et al. (2015) argued that the vulnerability of smallholder cocoa farmers would continually increase without adaptation to the changing weather.

Climate change adaptation strategies of farmers in cocoa production. Table 3 reveals that the major climate change strategies adopted by cocoa farmers include water conservation ( $\bar{x}$ =1.9), traditional dam ( $\bar{x}$ =1.7), soil conservation practices ( $\bar{x}$ =2.9), integrated pest management ( $\bar{x}$ = 3.6), weather and, meteorological reports ( $\bar{x}$  =1.7). Others are use of fertilizer ( $\bar{x}$ =3.4), construction of

channel ( $\bar{x}=2.2$ ), reduce space of land ( $\bar{x}=2.5$ ), and crop diversification ( $\bar{x}=3.0$ ). The use of weather and meteorological reports (55.8%), construction of channels (53.5%) and traditional dam (56.5%) were however minor strategies of farmers. From this finding it is clear that the farmers are already involved in proactive measures for coping with possible challenges of climate change which is affecting all crops including cocoa. The high adaptation could be attributed to farmers' educational level and the importance farmers placed on cocoa production.

**Table 3: Adaptation strategies**

<b>Adaptation strategies</b>	<b>Never</b>	<b>Always</b>	<b>Sometime</b>	<b>Rarely</b>	<b>Mean±SD</b>
	<b>r</b>	<b>s</b>	<b>s</b>	<b>y</b>	<b>D</b>
	<b>%</b>	<b>%</b>	<b>%</b>	<b>%</b>	
Water Conservation	46.8	7.1	19.7	26.5	1.9±1.1
Traditional Dam	56.5	5.8	13.5	24.2	1.7+1.0
Soil Conservation Practice	11.3	33.2	39.4	16.1	2.9+1.1
Integrated pest Management	5.8	73.5	18.4	2.3	3.6+0.8
Weather and Meteorological Report	55.8	7.4	12.6	24.2	1.7+1.0
Use of Fertilizer	2.3	53.2	36.8	7.7	3.4+0.7
Construction of Channels	53.5	11.3	11.6	23.5	1.8+1.0
Crops Insurance	27.1	7.7	27.4	37.	2.2+0.9
Reduce Space of Land	17.7	12.3	42.6	27.	2.5+0.9
Crop Diversification	24.5	57.4	13.2	4.8	3.0+1.3
Others	30.6	30.3	17.1	21.3	2.5+1.2

### Factors determining respondents' perception of climate change impacts and their livelihood

It is significant to understand factors determining cocoa farmers' perception of climate change on their livelihood in order to enhance suitable adaptation strategies to mitigate effects and impacts on their livelihood.

Table 4 shows the contribution of independent variables (such as awareness scores, adaptation scores, local government, villages, age, education, years of cocoa farming, sources of planting materials, extension contacts, household size and average total income) to the dependent variable (perceived impact of climate change on cocoa farmers' livelihoods). The results show that respondents' awareness of climate change ( $\beta=0.026$ ;  $\text{sig}<0.05$ ), and adaptation score ( $\beta=-0.016$ ;  $\text{sig}<0.05$ ) significantly and negatively influenced their perception of climate variability impacts on their livelihoods.

Further revealed, respondents' household size such as research institutes and extension workers, age, education, years of cocoa farming, sources of planting material and average total income significantly but positive influenced the respondents' perception of climate variability on their livelihood.

**Table 4: Factors determining respondents' perception of climate change impact and their livelihood**

Variables	Standardized Coefficients		
	Beta	t-value	p-value
Constant		16.890	000
awareness scores	0.026	0.591	0.555
adaptation scores	-0.016	-0.365	0.716
Local government	0.780	9.321	0.000
district/Villages	-0.161	-1.894	0.059
Age	0.061	0.809	0.419
Education	0.008	0.172	0.864
years of cocoa farming	0.062	0.837	0.403
Sources of planting materials	0.030	-0.658	0.511
extension contact	0.042	0.932	0.352
Household size	-0.114	-2.185	0.030
average total income	0.020	0.418	0.677

R=0.678<sup>a</sup> R Square=0.460 Adjusted R Square =0.440 Standard Error =3.42410

### **Discussion**

Climate change is likely to affect global food production. Agriculture is threatened by extreme climatic events such as, extreme temperature, weather, droughts, excessive rainfall or floods enhanced by climate variability. The impact of climate variability and change and their significant contribution to cocoa production cannot be overemphasized in ensuring poverty alleviation, food security and household livelihood impacts in the community and nation at large. Moreover, rural household members' participation in cocoa farming has not yielded sufficiency in their standard of living compared to the cost, time and resources invested in cocoa farming since it is their major source of their livelihood. This is because of the devastating effect of climate change and variability, which poses in, measures a high economic loss to members of the households. The multiplier effect is evident in the setback in agricultural and rural development of Nigeria. This has placed in limelight, the adaptation strategies to climate variability and change for cocoa farming systems in Nigeria. The general perception of cocoa farmers in Idanre and Odigbo local government shows that the location and beliefs of the respondents influenced their perceptions either negatively or positively. Eight percent of the respondents in Idanre region perceived that climate variability has low impact on their production and their livelihood while 92.0% perceived that climate variability has high impact on their livelihood and income generating activities. About 58% of the cocoa farmers in Odigbo study area considered that climate variability has low impact on their production and livelihood while 31.9% of the respondents considered that climate variability has high impacts on their livelihood and production with average mean of  $46.6 \pm 4.6$ . The study revealed that 26.8% got their planting materials from previous harvest, 16.5% from research institutes, while a large percentage (56.1%) of the cocoa farmers got their planting materials from extension workers. This shows that source of planting material had a negative significant effect on perception of cocoa farmers on their livelihood. This shows that majority of the cocoa farmers got their nursery seedling from extension workers. Education is a variable that widens, influences the totality of the mind, and inclines farmers to new ideas (Tirfe, 2014).

Education is an important factor in alleviating the effects of climate change on livelihood activities. Falola et al. (2017) affirmed that educated people are more aware of climate change, its variation, its causes, its effects, its impacts and the measures required to reduce exposure to its impacts than their uneducated counterparts. In terms of education, 5.8% of farmers in the study area had no formal education, 22.8% had education up to primary school, majority (68.4%) had senior high school education and only 2.3% had tertiary education and 1.0% had other means of education. This shows that literacy level in the study area is high, although, very few farmers had tertiary education. It is noted that educated farmers tend to be more efficient and effective in production and readily to accept new ideas when compared to uneducated ones that rely on their experience (Enete & Igbokwe, 2010; Martey et al., 2013). This means that adaptation to climate change would not be a major challenge in relation to education.

From this finding, it is clear that the farmers are already involved in proactive measures for coping with possible challenges of climate change which is affecting all crops including cocoa. The high adaptation could be attributed to farmers' educational level and the importance farmers placed on cocoa production. It is not surprising that cocoa farmers relied on prayers to God for rainfall and predicting climate change because most people call on God for solutions to problems at difficult times in Nigeria and West Africa. This is an indigenous measure classified as others measure which is not scientific but Oluyole, (2017) attested to this in a study where farmers used different means to know the beginning and end of rain and future events. Bradshaw et al (2004) and Ngigi (2009) reported most of these adaptation options as part of measures used in climate change. It was also observed that the adoption of coping strategies requires expensive labour techniques, household members should be encouraged in giving out their assistance support to family on farm.

### **Conclusion**

The positive prospects for Nigeria's Agriculture will not be actualized without concerted and purposeful policy action, especially if agricultural growth is to be sustained and if it is to result in

sustainable development. This study examined the perception of farmers on the negative impact of climate change on cocoa production in Ondo state, Nigeria. The study substantiated that all cocoa farmers irrespective of their geographical locations are aware about climate change and its multiple effect on their farming activities. They however hold varied perspectives about activities of man and nature that causes this change. Despite this, effort by government and stakeholders have been very minimal in sensitizing and educating farmers in order to make informed decisions in adopting appropriate adaptation strategies. Climate change has really been the substantial factor which has affected the production of cocoa in particular as a result of climate variation which does not favour the production of cocoa particularly. The major effects perceived by the farmers are irregular rainfall pattern, high temperature, variation in sunshine hours and excessive rainfall. The common adaptation methods used by the farmers are integrated pest management such as: spraying cocoa with chemicals, switching to other sources of income, crop diversification and use of fertilizer.

### **Recommendations**

From the preceding, it is recommended that government and stakeholders should put up educational programmes tailored to meet the climatic information needs of farmers to enable them cope with the newly challenges to enhance their output. To achieve this, Cocoa Research Institute of Nigeria should be well equipped to give proper information about the seedlings. NGOs and other private partners in and outside the cocoa sector should be fully involved in the education and sensitization of farmers on issues bordering on climate change, causes and controls. Government policies should ensure that farmers have access to adequate and appropriate information on climate changes in order to increase their ability and flexibility to change in adaptation strategies in response to perceived climate change. Also, Ministry of Agriculture in collaboration with research institutes could collect, dissect, analyze and disseminate timely information on sound adaptation strategies to mitigate the effects of climate change on cocoa production and cocoa farmers' livelihood. This could be through radio, newspapers and bulletins. Also, agricultural extension

providers should renew their services particularly in providing information and packages that will help cocoa farmers adjust and readjust to climate change. All these will improve the technical knowledge and skills of the farmers on causes of climate change, its effects, and measures to mitigate its effects.

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