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### Indigenous and Modern Adaptation Strategies to Climate Change among Cocoa Farmers in Southwest Nigeria.

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#### Abstract

*The study examined the capability for the use of indigenous and modern adaptation strategies to climate change among cocoa farmers in Southwest, Nigeria. A multistage random sampling technique was used to select 300 respondents from Southwest, Nigeria. An interview schedule was used to collect the data. Data collected were analysed using percentage and Pearson Product Moment Correlation. The result reveals that 90% were aware of climate change in the study area. The indigenous adaptation strategies used were prayer (100%), respect and humility to gods (99%), mulching (92%), mixed cropping (90%), weeding (88%), shade and shelter (85%) and cutting of branches (81%). Also, modern adaptation strategies used were fungicide spray (99%), insecticide spray(90%), agro forestry (80%), bush burning restriction (80%), planting drought resistant varieties (50%), fertilizer application (48%), weather forecasts (20%), irrigation (20%), and farm agricultural insurance policy (10%) The major constraints were the inadequate funds and lack of knowledge of modern adaptation strategies to climate change. The use of indigenous strategies was positively correlated with age ( $r=0.351$ ,  $p=0.05$ ), while the use of modern adaptation strategies had a negative correlation with age ( $r=-0.759$ ,  $p= 0.01$ ). It is concluded from the study that despite farmers' awareness of climate change, the use of modern adaptation strategies was low due to inadequate knowledge and fund. The study therefore recommended training in the use of modern adaptation strategies to climate change*

**Keywords:** Climate change, Adaptation, Mitigations, Cocoa farmers, Southwest

#### Introduction

Climate change and its ramifying threats remain a global challenge whose search for permanent solution by scientists and researchers is still elusive. These effects of climate change range from changes in the frequency and intensity of drought, flooding, water shortage, worsening of drought, worsening soil condition, desertification, diseases and pests outbreaks on crops and livestock. Specifically, the erratic rainfall pattern also took its toll on cocoa yield which decreases with low rainfall (Ruf,.; Schroth,.; Doffangui 2015:, Salifou, Metuge , Cao, and Zhang Ya Bin, 2017; Adelodun, 2017). More importantly climate change is a threat to food security particularly cocoa production has suffered from the impacts of climate change characterized by erratic rainfall pattern, drought and flood. (Eregha , Babatolu, Akinnubi, 2014: Gateau-Rey

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et. al ,2018); These impacts varied from one region to the other.( Elum et al 2017) The impacts on the farmers is determined by the level of vulnerability to the effect of climate change . Nigeria has been one of the most vulnerable part of the Sub Sahara Africa because of the low adaptive capacity of the farmers. The impacts of climate change on food security can be reduced by mitigation and adaptation (IPCC, 2014).

Mitigation is a policy measure that has long effects on the environment while adaptation is an intervention to reduce the immediate effects of climate change. These interventions may be either indigenous (i.e farmers' local intervention through their philosophical behaviour) or modern methods (scientific provision to reduce the effects of climate change). Moreover, Adaptations can be defined as interventions or adjustments which occur in order to take advantage of the opportunities or to manage the losses that take place as a result of any external change. Also, adaptation can also be defined as the process of improving society's ability to cope with changes across time scale, from short term to the long term (Elum Z.A, David M. Modise &, Ana Marr (2017.)

Indigenous adaptation strategies are the intervention made by individual farmers or group locally to reduce the negative effect of the climate change or to capitalize on the positive effect. These actions may be generated by indigenes or non-indigenes of a particular community through his or her interference with nature or through try and error mechanism. This action may be based on attitude, knowledge and perception of an individual cocoa farmers and majorly on their abilities. This ability is called adaptive capacity. .Adaptive capacity is the ability of a system to adjust to change in order to minimize the effects of climate change or take advantage of these events . Some works have been done on cocoa and climate change but little work has been done on indigenous adaptation strategies when combine with modern methods of reducing the effects. For instance, Ademola and Oyesola (2012) identified the adaptation strategies adopted by cocoa farmers in Oyo State, Nigeria as: use of organic manure, early harvesting, planting of different varieties, mulching, increased irrigation, crop diversification, shifting cultivation, changing planting dates, increased use of agrochemicals. However, this finding did not covered this region of study and did not find indigenous adaptation strategies in detail. Moreover, the adaptation strategies were not categorized into indigenous and modern adaptation strategies. Which specified the source of the coping strategies. . It is on this note that this study focussed on the two adaptation strategies used by the farmers in the area of study in order to provide policy guideline and the way forward for the nation Therefore , there is need to comparatively look at the indigenous and modern approaches to see how they complement each other so as to blend a more robust synergetic approach to adapting to the climate change challenges Climate change has been reported to have a considerable effect on agricultural production (Ademola, and Oyesola 2012; Oluwatusin, 2014, Muhammad *et al*, 2017). Cocoa production requires favorable climatic conditions to produce maximally. Cocoa production has been reported to be means of livelihood for the people of south west ,Nigeria. ( Adelodun 2017) cocoa yield has drastically reduced due to inconsistent rainfall, temperature relative humidity and other management practices. Cocoa tree needs well distributed rainfall throughout

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the growing season. For optimum development of the crop, a hot and humid atmosphere is necessary. ( Oluwatusin, 2014,; Zelda et al 2018 ). The quality and yield of crop production especially cocoa has been drastically reduced. It is against this background that this study focused on the indigenous and modern adaptation strategies to Climate Change among Cocoa farmers in Southwest, Nigeria.

The specific objectives were to:

- (i) examine level of awareness of climate change;
- (ii) identify the indigenous and modern adaptation strategies used in the study area; and
- (iii) identify the constraints to the use of indigenous and modern adaptation strategies by the cocoa farmers.

## Hypotheses of the study

H<sub>01</sub>: There is no significant relationship between age of the farmers and the use of indigenous adaptation strategies

H<sub>02</sub>: There is no significant relationship between age of the farmers and the use of modern adaptation strategies

## Methodology

The study was carried out in the Southwest Geo-Political Zone of Nigeria. The Southwestern Nigeria comprises Oyo, Osun, Ogun, Ondo, Ekiti and Lagos States. This zone lies between longitude 2°42' and 6°03' East of Greenwich and latitude 5°49' and 9° 77' North of the equator. The multistage sampling technique was used to select the respondent from these states. The first stage was purposive selection of three states (Ondo, Osun and Ekiti) from six states in the geo-political zone due to records of cocoa production in the zone. Ondo State lies between latitudes 5°45' and 7°52' north of the equator and longitude 4°20' and 6°05' East of Greenwich Meridian. Edo and Delta States bound the state in the east, on the west by Ogun and Osun States; on the North by Ekiti and Kogi State and to the South by the bight of Benin and the Atlantic Ocean. Osun State lies within latitude 7° and 9° North of Equator and longitude 2.75° and 6.75° East of Greenwich Meridian. It is bounded in the east by Ekiti and Ondo States, in the west by Oyo State while Kwara and Ogun States are its boundaries in the north and south respectively. Ekiti State is located between longitudes 4°5' and 5°45' east of the greenwich meridian and latitudes 7°15' and 8° 5' north of the equator. The second stage involved the adoption of ratio 2:2:1 in selection of 4 local Government Areas from Ondo and 4 Local Government areas from Osun States while 2 Local Government area was selected from Ekiti. State. This selection was based on the records that Ondo and Osun are categorized among the highest cocoa producing zone while Ekiti state was among lowest or moderate cocoa producing zone. (Adelodun,2017) The third stage involved the use of simple random sampling technique to select 30 communities from each of the selected local government areas. Also, stratified random sampling technique was used to select 10% of 3,000 registered cocoa farmers for collection of hybrid seedling of the Growth Enhancement Support Scheme of the Agricultural Development Programme of the

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three states. This selection resulted to selection 300 cocoa farmers as the sample size for the study.

Data were collected from 300 cocoa farmers through the use of interview scheduled. Data collected were analyzed with descriptive and inferential statistical tool such as percentage, means while Pearson Product Moment Correlation was used to test for the significance

Measurement of variable: Cocoa farmers' level of awareness of climate change was measured using 5 indicators of climate change over the past decades. The indicators are: change in temperature, noticed change in rainfall, noticed erosion, noticed drought, noticed flood. They indicated Yes or No. The percentage of awareness was calculated using the frequency count. Modern and indigenous adaptation and mitigation strategies were measured as farmers' response to yes or no question about the usage of the strategies.

## **Results and Discussion**

### **Level of awareness of climate change by the respondent**

Figure 1 reveals that the majority (90%) of respondents were aware of the changing climate. The farmers claimed that they experience the impacts on their farm and more so, that their interaction with development agency such as Cocoa Research Institute of Nigeria, extension agents, social groups such as cooperative society and farmers' unions has increased their awareness. More importantly radio and television, broadcasting has helped them to respond to the challenges of climate change. This underscores the importance of interpersonal communication in creating awareness of climate change impacts and creating appropriate technology. The result shows that cocoa farmers are aware of climate change. The outcome demonstrates that cocoa farmers are very much aware of environmental change. Christian *et al*/2017 .revealed comparative outcomes on farmers' familiarity with climate change. The result also agree with finding of Elum et al.(2017).

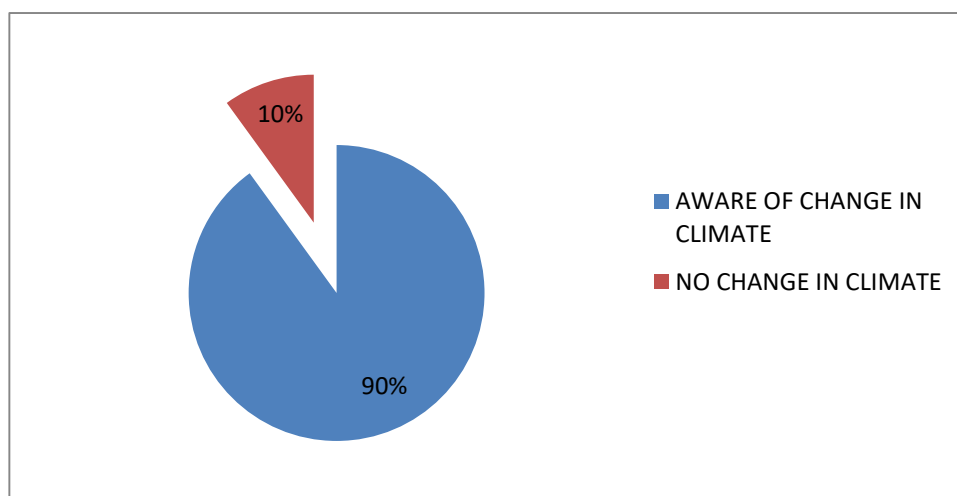
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**Figure 1: Awareness level of climate change**

**Source:** Field Survey, 2018

### Indigenous Adaptation Strategies to Climate Change among Farmers

Table 1 shows various indigenous adaptation strategies used by cocoa farmers in the study area. Twenty-four indigenous strategies were identified to have been used by cocoa farmers in the study area (Table 1). According to the finding, prayer to God recorded the highest used (100%). The farmers claimed that God is good and generous to them as he used to answer their prayers during the time of drought and sudden stoppage of rainfall during the growing seasons by pouring water on their cocoa farm. Moreover, other claimed that whenever they couple their prayer with fasting is always effective.

The second highest was cultural respect and humility to God Table 1 reveals that 99% indicated that they used their relationship with God and humanity to control climate change. According to them they said the behaviour of some kings in the holy book leads to the wrath of God, which made him to stop rains from falling on their land and when they repented they enjoyed favourable weather. According to them this strategy is real, but it is not scientific in nature but because it originated from farmers' discretion it is indigenous strategies of adapting and mitigating climate change.

The third was mulching (92%) which the farmers claimed to be effective in reducing the mortality rate of seedling during early stage. Farmers used dry pods and leaves to cover the root zones of the cocoa seedlings, thereby ensuring their survival during drought. Other indigenous strategies used by cocoa farmers in the area of study include mixed cropping (.90%), weeding ( 88%), shade and shelter (85%) ,cutting of branches to provide ventilation (81%), frequent harvest of infected pods (80%), soil conservation (75%), Agro forestry ( 72%). changing of planting date (70%), acquiring of land

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(64%). delay harvesting (63%), early to farm (60%). organic manure. (56%) delay drying of cocoa beans (54%) delay fermentation process (50%), intercropping (50%) manual watering (45%) water harvesting (43%) and ritual (10%) According to table i all these twenty-one strategies were used by farmers to an extent in responding to the impacts of climate change. The benefits of using indigenous adaptation strategies such as mulching, agro forestry, soil conservation, organic manure, provision of shade and shelter. should be communicated to all farmers in order to encourage and sustained the usage This calls for the public awareness by government, non-governmental agencies and extension agents on the importance of the practices not fully used by farmers in the study area. This finding corroborate that of Codjoe et al (2013) that mulching, organic manure and provision of shade as coping strategies used against climate change in Ghana.

**Table1: Indigenous adaptation strategies used by farmers.**

Strategy	Percentage
Prayer	100
Cultural value of respect and humility to God	99
Mulching	92
Mixed cropping	90
Weeding	88
Shade to reduce sunlight intensity	85
Cutting of branches to create ventilation	81
Frequent harvesting of infected pod	80
Soil conservation (contour and ridges)	75
Agro forestry	72
Changing of planting dates	70
Acquiring more lands	64
Delay harvesting	63
Early to farm	60
Organic manure	56
Delay drying of cocoa bean	54
Delay fermentation process	50
Intercropping	50
Manual watering	45
Water harvesting	43
Ritual	10

Source: Field Survey, 2018

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### Modern Adaptation Strategies to Climate Change among Farmers

Table 2 shows that the modern adaptation strategies used were the application of fungicide (99%) to the developing pods in order to control Black pod diseases (*phytophthora palmivora*). *According to farmers this chemical is effective only when there was no rain during the time of spraying because should in case rain fall during the spraying exercise all the chemical used for that day is considered wasted and money lost. What we do is to pray to God to prevent the occurrence of rain during the spraying exercise. Sometimes when rain is about to fall during the exercise and when we pray to God, God sometimes drove the rain to another place to fall. They further said as long God is the father of rain, he has power to control it and that is what we having being enjoyed, otherwise we will be running at lost. This statement by the farmers underscore the importance of integrating the indigenous strategies to modern adaptation strategies, in controlling the effects of climate change,*

The second modern adaptation strategies used by farmers to control pest (mirids) which is as a result of dry season caused by climate variability is the use of Insecticide. Table 2 shows that 90% of farmers used different types of insecticide. *Also, farmers stated that similar procedures of praying to God before application must be follow in order to prevent lost of capital invested in buying the chemical.* Other methods used by farmers in adapting to climate change effects was agroforestry which include planting food crops and tree together , 80% of the farmers practiced this method..According to them it helps them to generate income from two sources as it build resilience against the effects of climate change , Another method introduced to farmers is prevention of bush burning exercise, of which 80% of the farmers adopted, as the practise of bush burning can lead to total loss of soil nutrient and destructions of nearby farms and subsequently caused farmers bankruptcy. Moreover, this exercise contributes to climate change as carbon is being released to the atmosphere during burning and global warming is exacerbated. Furthermore, Table 2 shows that 50% of the farmers used planting of drought resistant varieties of cocoa released by Cocoa Research Institute of Nigeria, CRIN. This may be as a result of low awareness of this varieties. The agricultural extension agent may play their roles in sensitizing farmers about this opportunity (Ayotunde et al, 2019) .Table 2 further reveal that only 48% of the farmers used fertilizers on their farms. The importance of fertilizers is to improved the soil for higher productivity as the majority of the soil nutrients have been lost due to erosion that as a result of flood caused by climate change and variability. Adelodun 2017 reported that the reason while Ghana is having higher cocoa productivity is as a result of proper usage of fertilizers. Therefore, extension agent should sensitize farmers on the importance of fertilizer in restoring the lost glory of the soil due to erosion as a result of climate change

In addition, only 20% of the farmers used weather forecast information in adapting to climate change This is ridiculously low and the major reason given for not using it is lack of awareness of such services to farmers. They also reported that even though they are broadcasted, the language barrier has prevented them from having access to them. Therefore, weather forecast station information should be decentralized to villages with appropriate interpreters. This will go a long way in reducing the impact of



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climate change on farmers as farmers can use information from weather forecast in planning when to plant, harvest and process their cocoa..

Similarly, only 20% of the farmers used irrigation system to supplement rainfall that was irregular and inconsistent. Nigeria is one of the country that depend on rain fed agriculture and that is one of the reasons why our cocoa production rate is low. The major reasons given by farmers was that irrigation facility are capital intensive facility that is beyond their financial status. They submitted that raining season was the only time they have bumper harvest from their farms. They reiterated that during drying season, non-availability of water around their farms have been major constraints

In the same vein, only 10% of farmers claimed to have insured their farms against the impact of climate change .some of the farmers claimed that the premiums is high while some said they were not aware of such opportunity.

**Table 2: Modern adaptation strategies used by farmers**

Modern technologies	%
Fungicide spray	99
Insecticide usage	90
Agroforestry	80
Bush burning restriction	80
Planting drought resistant varieties	50
Fertilizer application	48
Weather forecasts	20
Irrigation	20
Farm agricultural insurance policy	10

Source: Field Survey, 2018

### Constraints associated with the Choice of Indigenous and Modern Adaptation Strategies

Table 3 shows that the major constraints to the use of modern technology in adapting and mitigating climate change was lack of knowledge about the modern technology ( $\bar{x} = 4.26$ ) and capital constraints' ( $\bar{x} = 4.26$ ).. The majority of farmers lack the knowledge about the modern adaptation strategies such as weather forecasts and

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insurance policy. Therefore, there is need to sensitize the community by private and public extension services on the usefulness of this modern adaptation strategies in planning their farming operation, Moreover, adult education, seminar and conferences should be organized for farmers in their local languages. Furthermore, this result also established the importance of adaptive capacity theory which suggested knowledge level of new technology and financial status of farmers as tools in any adaptation or mitigation process against climate change. This result is in line with the findings of Oluwatusin (2014 and Adebisi et al 2018) that financial constraints was the major constraints to adaptation to climate change among the cocoa farmers in Ondo and Oyo States respectively. This means that cocoa farmers have limited information on climate change and adaptation strategies in the study area. Other barriers to climate change adaptation indicated by the cocoa farmers were lack of financial resources to meet the high cost of climate change adaptation, high cost of input such as provision of water for irrigation. Other severe constraints include farmland insecurity and water constraint with mean of 4.16 followed by lack of information on the usage of indigenous and modern technology

**Table 3: Constraints to indigenous and modern adaptation strategies.**

Constraints	$\bar{x}$	Std. Deviation
lack of knowledge about technology	4.26	.439
Capital constraint	4.26	.439
Insecurity constraint	4.16	.367
Water constraint	4.16	.579
Information constraint	4.06	.507
Market constraint	3.08	1.442

( $\bar{x} \geq 3.5$  .Source: Field Survey, 2018

### Relationship between Respondents' Age and Use of Indigenous and Modern Adaptation Strategies.

The results of correlation show that the use of indigenous strategies was positively correlated with age ( $r=0.351$ ), while the use of modern adaptation strategies had a negative correlation with age ( $r=-0.759$ ). This implies that the older the farmers the more he is inclined to the use of indigenous adaptation strategies to climate change but the younger the farmers the more he is inclined to the use of modern adaptation strategies This result further established the fact that older farmers are conservatives and do not want to give it to change but younger farmers are adventurous and they are eager to try any innovations. This result supports Raufu *et al* (2015) and Adebisi *et al* (2018) who discovered that age is significant in the use of farmers adaptation strategies. Therefore, the null hypothesis that “*there is no significant relationship between age of farmers and uses of indigenous and modern adaptation strategies*” is hereby rejected.

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**Table 4: Relationship of respondents' age and use of indigenous and modern adaptation strategies.**

Variable	Indigenous Adaptation strategies	Modern Adaptation strategies
Age	.351(**)	-.759(**)
Pearson Correlation(r)		

Source: Field survey, 2018 \*\* : P≤0.05,

## Conclusion and Recommendations

Cocoa farmers' level of awareness of climate change was high (90%) but the level of usage of modern adaptation and mitigation strategies in reducing the impacts of climate change was low. due to capital constraints and lack of knowledge about the use of the modern adaptation strategies in the area of study The indigenous adaptation strategies to climate change used in the study were twenty-one in number while only ten modern adaptation strategies to climate change were used in the study Therefore, training of cocoa farmers on the use of both indigenous and modern adaptation strategies to climate change through seminar, village visit and campaign programmes should be organized by public and private extension providers such as Cocoa Research Institute of Nigeria,(CRIN).. Moreover, the Nigerian Meteorology Agency (NIMET) Should make weather forecast information available to farmers in their local languages before the beginning of the year. In addition, insurances company should work with government to provide services to farmers at low cost by reducing their premium and bureaucratic process in getting loans and insured money backed from insurance company . Finally, Indigenous strategies that have been found profitable, effective and efficient to farmers such as the use of prayer in mitigating climate change should be integrated into modern adaptation strategies as this will forestalled the natural occurrence aspect of climate change ..

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