Octa Journal of Environmental Research
International Peer-Reviewed Journal
Oct. Jour. Env. Res. Vol. 5(3): 169-181
Available online http://www.sciencebeingjournal.com

Jul. – Sept., 2017
ISSN 2321 3655

Research Article

Octa Journal of Environmental Research
(Oct. Jour. Env. Res.) ISSN: 2321-3655
Journal Homepage: http://www.sciencebeingjournal.com

EVALUATION OF FARMERS' AWARENESS, PERCEPTION AND ADAPTATION STRATEGIES OF COCOA (*Theobroma cacao* Linn.) PRODUCTION TO CLIMATE CHANGE INTHE SOUTH WEST PARTS OF NIGERIA

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Received: 11th Jul. 2017 **Revised**: 27th Jul. 2017 **Accepted**: 30th Aug. 2017

Abstract: Climate change remains a strong menace to agriculture and food security in Africa. Therefore, the specific objectives of this study were to assess farmers' awareness, perception and adaption measures to climate change and also to determine the perceived causes and consequences occasioned by climate change in the areas of this study. A survey questionnaire was administered to 111 cocoa farmers using a multi-stage sampling technique in five villages from two local government areas in Osun and Oyo States. Direct observation, field visit and focus group discussion were conducted. Data collected during the survey were processed and subjected to various statistical analyses including frequencies, percentage, binary cross-tabulation and Chi-square.Findings reveal that a large percentage of respondents (95.5%) were aware of changes in climate through self-observation. 79.3% of farmers perceived decrease in annual rainfall over the past 10 years, 78.2% did perceive dry spell during the rainy season, and 56.8% of cocoa producers perceived that precipitation became unpredictable, while 72% of farmers interviewed perceive that temperature and heat has increased. The results of this work also indicate that farmers perceived low yield (87.4%), abortion of flowers (54.1%), drying of flowers (57.7%), small cocoa pods (21.6%) and only 4.5% and 1.8% of farmers attached these perceived consequences to insects/pathogen attack and plant death. 61.4% of farmers ascribed these perceived changes to natural evolution, while 28.8% assumed that the changes in climate are as a result of human activities, others (3.6%) are of the view that the changes is a true reflection of God' wrath and deforestation. The effects of changes in climate are evident and farmers applied different adaptation strategies to cope with the impacts of climate change. Breeders to develop and disseminate new cocoa varieties resistant to climate change.
Keywords: Adaptation measures; Awareness; Climate change; External support; Farmers; Perception.
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INTRODUCTION

Cocoa (*Theobroma cacao* Linn.) ranks first amongst agricultural export of Nigeria, which contributes significantly to her economy. Cocoa is mainly produced in Osun, Oyo, Ondo, Cross River, Ogun, Edo, Ekiti, Akwalbom, Edoand Delta States. Nigeria is the fourth largest producer of Cocoa, after Ivory Coast, Indonesia and Ghanain the world (Cadoni, 2013) and the third largest exporter, after Ivory Coast and Ghana (Verter and Becvarova, 2014). In 2010, Cocoa production accounted for only 0.3% of agricultural GDP (Cadoni, 2013). This important sector is exposed to severe drought and high temperature as result of climate change effects. Indeed, temperatures are escalating, precipitations are decreasing, rainfall patterns and distribution of pest and disease are changing, and extreme weather events are becoming more repeated and austere (CGIAR, CCAFS and CTA,

2013).Climate variability and the prevalence of extreme events are harsh reality for small farmers in West Africa, especially in Nigeria which depend exclusively on rainfed agriculture. Tol (2002) and fisher *et al*. (2002) demonstrated that the GDP of developing countries from agriculture sector will decline in developing countries and stressed that Asia and Africa would generally be negatively affected. The agricultural lands are well exposed to climatic variability nowadays and to climate change in the future according to FAO (2007). The irregular fluctuations in rainfall and temperature patterns with drought and flood as their resulting impacts have serious repercussions on plant production and future food availability. The trend of climate change is coupled with changes in the dissemination patterns of agro-ecological zones, soil moisture, soil quality, length of growing season, weed uprising and crop pests and diseases which will negatively affect crop production and food security in developing countries (FAO,2007; Ozor and Nnaji, 2011). Over the last decade, environmental stresses have become more frequent and are exacerbated by a rapid change in climate. It constitutes perhaps the most momentous environmental challenge of our time and poses serious threats to sustainable development worldwide and chiefly in most developing countries (FAO, 2007).With climate change whose signs are already visible, agricultural production is facing alarming threats which can lead to serious problems of food insecurity.

Coping with climate change necessitates mitigation and adaptation strategies. As a matter of fact, adaptation to climate change means setting up the right actions and methods to lessen the negative impact of climate on human, plant, livestock, fisheries, soil and environment. Crop diversity is of paramount importance in developing new crop cultivars resistant to climate change mitigation and ensuring food security especially in developing countries. Therefore, FAO (2007) indicates that biodiversity in all its components such as genes, species, and ecosystems augment resistance to climate change. FAO further stated that Genetically-diverse populations and ecologies which are endowed with various species have advantage in adapting to adapt to climate change. Drought and flood resilient crop cultivars have been introduced to crop producers as adaptation methods to climate change in Nigeria, Senegal, Burkina Faso, Ghana and many other countries in the developing world (Ngigi, 2009). Soil organic matter is regarded as key element in improving and stabilizing soil structures in order to increase higher resilience against drought and flood as adaptation measures for agricultural cropping systems (FAO, 2007). Low ploughing and upkeep of permanent soil cover that can increase soil organic matter and reduce impacts from flooding, erosion, drought, heavy rain and winds are to be promoted as climate change strategies (FAO, 2007). It was observed on the course of this study that most of the cocoa producers cleaned and cleared away the cocoa plantation without allowing that dead debris to cover the land and decompose in order to fertilize the soil as strategic measures to climate change adaptation. Producers even ploughed regularly, especially when the cocoa plantation has not reached 10 years old to cultivate other crops such as maize, yams etc. These producers are yet to observe best agronomical practices for the preservation of soil moisture, stable organic matter and working out the adaptation strategies to climate change that increases as years go by. Most farmers do still not understand the importance of soil mulch as a protective measure and a manner of controlling high temperature, water evaporation, and transpiration of water through stomata and so as to preserve soil structure. There is a dire need to educate producers on these important agricultural production systems and practices in order to curb hunger and food insecurity. Furthermore, the storage of excess water through rainfall during rainy seasons and the use of resource efficient irrigation will definitely help produce crop year round and intensify crop productivity. Moreover, deforestation should be discouraged and reforestation should be encouraged because most perianal crops thrive more on forest areas. Indeed, deforestation is well pronounced in the area of

this study as there is need to educate farmers on this very aspect. In this vein, Fisher *et al*., (2002) stressed that forests can play a role in adaptation to climate change by helping human societies to adapt. Similarly, FAO (2002) illustrated that forests will contribute to sustaining the livelihood of over two billion people worldwide because not only the forests provide wood and non-wood forest products, but also significantly contribute to restoring soil fertility, and to preserving biological diversity, through its trees and shrubs forests ameliorate the microclimate. Therefore the objectives of this work was to (i) evaluate cocoa production systems, (ii) assess farmers' awareness, perception and adaption measures to climate change and (iii) determine the perceived causes and consequences occasioned by climate change in the areas of this study.

EXPERIMENTAL

Study area: The survey was conducted amongst cocoa producers in Ife-Odan, Ola-luwa and Ikonifin villages belonging toEjigbo local government in Osun State andLagbedu-Orile and Ajaawafrom Ogo-Oluwa local government in Oyo State in Nigeria. These villages produced predominantly cocao and cashew as perennial crops apart from annual crops such as maize, yam, groundnut, water melon, rice, cassava, etc.

Sampling techniques and data collection: A multi-stage sampling technique was used in the study. The first stage involved the purposive selection of the two Local Government Areas (Ejigbo and Ogo-Oluwa) known to be cocoa producing areas in the State. The second stage involves a random selection of 3 villages from each LGA. Finally, Selection of respondents was conducted via a purposive sampling method in which respondents who were less than 25 years old, between 25 and 50 years old and above 50 years old were considered as very young, young/adult and old people, respectively. A questionnaire was administered to sampled cocoa producers. Prior to the administration of the questionnaire, the objectives of the study were vividly explained to cocoa growers in local language and their informed consent was obtained. This was done in order to get reliable responses on different variables collected. The questionnaire was divided into five key sections namely: household characteristics, cocoa production, awareness and perception on climate change, adaptation strategies and external support for adaptation *e.g.* federal government/local government and NGO. In each village, focus group discussions, face-to-face interviews with key farmers were conducted. Interviews of farmers were conducted between September 2016 and January 2017. A total of 111 farmer households were interviewed using semi-structured questionnaires. The household heads were individually interviewed. The focus group discussions were held to double check the household survey data. The discussions was mainly on awareness and perceptions vis á vis climate and agro-ecological changes, potential impacts on cocoa production, adaptation practices currently being applied, and household characteristics.

Data Analysis: Data collected during the survey were processed and subjected to various statistical analyses including frequencies and percentage for producers' characteristics, cocoa production systems, awareness and perception of climate change on cocoa production. To find out if statistically, significant difference exists between two sample variables, binary cross-tabulation and Chi-square conducted. Therefore, Pearson chi-square, the likelihood-ratio chi-square and linear-by-linear association chi-square was calculated. Thus, chi-squares for age of respondents and adaptation, area of cocoa production (farm size) and adaptation, years in cocoa farming and adaptation, and finally household size and adaptation were statistically examined.

RESULTS AND DISCUSSION

The results obtained from this study pinpoint farmers' characteristics, production of cocoa production, awareness and perception of farmers on climate change and its effects on cocoa production, adaptation measures, types of external support from federal and local governments and NGO or other agencies. The socio-economic characteristics of cocoa

growers are presented in Table 1. Three categories of respondents were identified based on their age [very young (< 25 years old), young/adult (25-50) and elders (> 50)]. The majority of respondents (57.8%) were between 25-50 years old followed by elders (37.7%). The low percentage of very young recorded is due to the fact that the activity of cocoa production is not meant for very young people. Few women (3.6%) were involved in the activity while 96.4% were mainly men. Most of farmers (80.1%) were educated with 30.6% in primary school followed by 29.7% secondary school dropouts. It should be also noted that 19.7% attended tertiary institutions and only 19.7% did not attend school at all. About 75.7% were alphabetized and only 24.3% were not. The majority of interviewed farmers (99.1%) were Yoruba and 96.7% were native of the study areas. The mainstream of the farmers (93.7%) investigated were married.

Table 1. Socio-economic Characteristics of Cocoa Producers in the Study area

Variables	Frequency	Percentage	Variables	Frequency	Percentage
Age			**Household size**		
< 25	5	4.5	< 5	13	11.7
25-50	64	57.8	5-10	77	69.4
> 50	42	37.7	> 10	21	18.9
Gender			**Number of active man**		
Male	107	96.4	< 2	38	34.2
female	4	3.6	2 - 5	52	46.8
Educational level			6-10	19	17.1
Primary	34	30.6	> 10	2	1.8
Secondary	33	29.7	**Number of active woman**		
Tertiary	22	19.8	< 2	49	44.1
None	22	19.8	2 - 5	57	51.4
Ethnic group			6-10	5	4.5
Yoruba	110	99.1	**Marital status**		
Others	1	0.9	Married	104	93.7
Migration Status			Single	7	6.3
Native	107	96.4	**Alphabetization Level**		
Foreign	4	3.6	Alphabetized	84	75.7
			Non-Alphabetized	27	24.3

Cocoa Production

Table 2 reveals various years of farmers' experiences in cocoa production and this ranges from 6 years to more than 20 years. The majority of farmers (68.4%) had more than 10 years of experience in cocoa production with farmers having more than 20 years of experience recorded the highest year (28.8%) while some other farmers had 11-15 and 5-10 years' experience. Most of producers (52.3%) had 2-5 acres of cocoa plantation followed by other farmers (25.2%) having 6-10 acres while le largest land size recorded low percentage (1.8%). A significant proportion of farmers (78.4%) increased their cocoa plantation recently while only (21.6%) did not. Also, in response to the question asked on reason for area increment majority of the farmers (52.3%) reported that their cocoa plantation was increased in order to get higher yield while others (29.5%) stated that they had to increase their income, 13.6% needed to replace the dead cocoa trees initially planted and 3.4%, and 1.1% for increase scale and safeguard land, respectively. Other findings revealed that 44.1%, 35.1%, 18% and 2.7% of farmers had one cocoa plantation, 2 cocoa plantations, 3 cocoa plantations and more than 3 cocoa plantations, respectively. Furthermore, 98.2% of farmers were owners of the lands while only 1.8% was lodgers. An overwhelming majority of farmers (97.3%) perceived that their lands were fertile while only 2.7% did not. To obtain some responses on cocoa production practices, a two-way question format including yes or no was used. Results of the study showed that 82.9 % of respondents had introduced new cocoa cultivars while only 17.1% did not. 53.3% reported that the new cocoa cultivars were of short life cycle and 46.7% of respondents did

say no. Moreover, 95.7% of participants opted for the new cocoa cultivars because of its high yield. Significant proportions of farmers did not use input (93.7%) and fertilizers (76.6%) only few (23.4%) did apply fertilizers. 91.9% of respondents sprayed pesticides to control diseases and pests attacking their cocoa plantations. Results also demonstrated that 96.4% of farmers did not irrigate their coca plantation and they only relied on rainfall whereas a slim proportion (3.6%) did irrigate their plantations in dry seasons or when the dry spell was long. Other findings indicated that a slim majority (51.5%) did intercropping especially at early stage of cocoa development while 48.5% did not observe intercropping practices at all. The analysis of the results of this table also illustrates that an overwhelming majority (80.2%) used farm workers as source of manpower in their plantations whereas only 19.8% did not. In addition, a slight majority (55%) of respondents did weed their plantation thrice followed by 21.6%, 18.9% and 3.6% who weeded twice, more than 3 times and once, respectively. Results of this study also illustrated that 82.9% of cocoa producers failed to get loan for their activities in the plantation, only 5.4% of farmers only managed to get loan from microfinance agencies whereas 11.7% did get fund from buyers before harvest.

Table 2. Production Systems of Cocoa in the Surveyed Area

Variables	Frequency	Percentage	Variables	Frequency	Percentage
Years in Cocoa farming			**Farm Size (in acre)**		
< 5	6	5.5	< 1	8	7.2
5-10	29	26.1	2-5	58	52.3
11-15	29	26.1	6-10	28	25.2
16-20	15	13.5	11 - 15	13	11.7
> 20	32	28.8	16 - 20	2	1.8
Increase in production area			>20	2	1.8
Yes	87	78.4	**Raison for increase in Area**		
No	24	21.6	Higher yield	42	52.3
Number of cocoa plantation			Replaced dead trees	12	13.6
1	49	44.1	Increase scale	3	3.4
2	39	35.1	Higher income	26	29.5
3	20	18	Safeguard land	1	1.1
> 3	3	2.7			
Mode of land acquisition			**Perceived quality of land**		
Owner	109	98.2	Very fertile	54	48.6
Lodger	2	1.8	Fertile	54	48.6
Introduction of new cocoa varieties			Non fertile	3	2.7
Yes	98	82.9	If yes short life cycle		
No	19	17.1	Yes	49	53.3
If yes high yield			No	43	46.7
Yes	88	95.7	**If yes highly nutritious**		
No	4	4.3	Yes	2	2.2
Source of Cocoa variety			No	90	97.8
Extension Agents	24	26.1	**Use of Input**		
NCI	18	19.6	**None**		
IITA	4	4.3	Yes	7	6.3
Other farmers	44	47.8	No	104	93.7
Purchase	2	2.2	**Fertilizer**		
Irrigation Farming			Yes	26	23.4
Yes	4	3.6	No	85	76.6
No	106	96.4	**Pesticide**		
Family as Source of Manpower			Yes	102	91.9
Yes	54	48.6	No	9	8.1
No	57	51.4	**Bio-control**		
Farm workers as Source of Manpower			Yes	0	0
Yes	89	80.2	No	111	100

No	22	19.8	**Intercropping systems**		
Weeding of cocoa Plantation per year			Yes	56	51.5
Once	4	3.6	No	54	48.5
Twice	24	21.6	**Source of funding**		
Thrice	61	55	None	92	82.9
>3	21	18.9	Microfinance	6	5.4
			Buyers	13	11.7

Farmers' Awareness of changes in climate

Results of Figure 1 show farmers' awareness about the changes in climate. The analysis of the Figure 1 reveals that an overwhelming majority (95.5%) of respondents were aware of changes in climate through self-observation whereas only 2.7%, 0.9% and 0.9% of cocoa producers were aware of this through media, friends and schools, respectively.

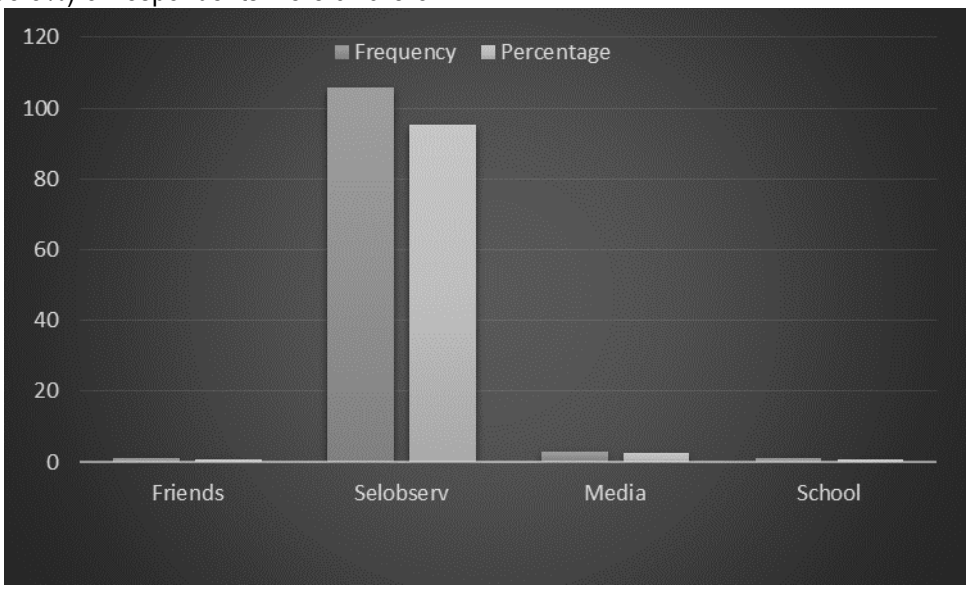

Figure 1. Farmers' Awareness of Climate Changes

Farmers' Perception on Climate Change

In response to the question asked on perception of changes in climate, the farmers perceived various degrees of changes in climate as shown in Table 3. The majority of farmers (79.3%) perceived decrease in annual rainfall over the past 10 years, whereas 91.9% of farmers perceived no increase in annual rainfall and 86.5% of participants reported that rainfall did not start early as in the past. A significant majority (98.2%) perceived no late termination of rainfall, 78.2% of farmers did perceive dry spell during the rainy season, and 56.8% of cocoa producers perceived that precipitation became unpredictable and a huge percentage of farmers (86.5%) did also perceive that harmattan has become unpredictable. Most farmers (72%) interviewed perceived that temperature and heat increased in the past 10 years whereas 97.3% of farmers perceive no decrease in temperatures. The results of this study also illustrates that significant majority (97.3%) perceive no violent winds. When asked about the period at which they started observing these changes in climate pattern, respondents answered differently according to their levels of understanding and keeping records. 52.3%, 44.1%, 2.7%, 0.9% of farmers have been observing these changes for the past 5 years, 10 years, 15 years and 20 years, respectively.

Farmers' Perception of Consequences of change in climate trends on cocoa Production

Perceived consequences, environmental factors and causes of climate changes on cocoa production are presented in Table 4. An overwhelming majority of respondents perceived that environmental factors such as increase in temperature patterns (76.6% of farmers), inadequate rainfall (75.5% of Farmers) and violent winds (68.5% of Farmers)

affected significantly the productivity of cocoa in the areas of study. The results of this work also indicate that the exacerbation of these environmental factors via climate changes resulted in low yield (87.4% of farmers), abortion of flowers (54.1% of respondents), drying of flowers (57.7%), small cocoa pods (21.6% of farmers) and only 4.5% and 1.8% of farmers attached these perceived consequences to insects/pathogen attack and plant death, respectively (figure 3). Total 61.4% of farmers ascribed these perceived changes to natural evolution, while 28.8% assumed that the changes in climate are as a result of human activities, others (3.6%) are of the view that the changes is a true reflection of God wrath and deforestation.

Farmers' Adaptation measures and External Support for Adaptation

About 64.9% of farmers who perceived climate change have offered prayers to Almighty God as adaptation measures for the situations to change for better like of the old. Practically, 40% of farmers did weed their cocoa plantation as adaptation measures and a slim proportion of farmers had invested in climate change adaptation practices as shown in Table 5. The analysis of Table 5 indicates that 12.6%, 7.3%, 3.6%, 1.8% and 0.9% of farmers adapted mulching, integrated pest management (IPM), irrigation systems, manure application, intercropping, pruning of branches and soil erosion prevention measures as adaptation practices. The results also show that an overwhelming majority of farmers (98.2%) did not received any backing from the federal/local government and NGO to face the challenges posed by climate changes. Also, there are no joint efforts in local government areas to combat climate change.

The results of the Chi square tests conducted between adaptation and farmers' characteristics are as presented in Table 6. The findings reveal highly significant difference ($p < 0.003$) between adaptation and age of respondents and significant difference ($P < 0.05$) was observed between adaption and farm size. No significant difference ($P < 0.33$) observed between adaptation and years in cocoa farming and household size.

Table 3. Farmers' Perception on Climate Change

Designation	Response	Frequency	%age
Decrease in annual rainfall	Yes	88	79.3
	No	23	20.7
Increase in annual rainfall	Yes	9	8.1
	No	102	91.9
Early start of rainfall	Yes	15	13.5
	No	96	86.5
Late start of rainfall	Yes	55	49.5
	No	56	50.5
Late termination of rainfall	Yes	2	1.8
	No	109	98.2
Dry spells in the rainy season	Yes	80	78.2
	No	31	22,8
Increase in drought frequency	Yes	15	13.5
	No	96	86.5
Unpredictable rainfall	Yes	63	56.8
	No	48	43.2
Flooding	Yes	2	1.8
	No	109	98.2
Decrease in flood frequency	Yes	1	0.9
	No	110	99.1
Increase in Temperature & heat	Yes	80	72.1
	No	31	27.9
Decrease in temperature	Yes	3	2.7
	No	108	97.3
Violent winds	Yes	3	2.7
	No	108	97.3
Increase frequency of violent winds	Yes	7	6.3
	No	104	93.7
Long and sharp harmattan	Yes	17	15.3
	No	94	84.7
Short and less vigorous harmattan	Yes	49	44.1
	No	61	55.9
Unpredictable harmattan	Yes	15	86.5
	No	96	13.5

Table 4. Perceived Consequences, Environmental Factors and Causes of Climate change on Cocoa Production

Designation		Response	Frequency	%age
Perceived consequences	Abortion of flowers	Yes	60	54.1
		No	51	45.9
	Drying of flowers	Yes	54	57.7
		No	47	42.3
	Small cocoa pods	Yes	24	21.6
		No	87	78.4

	Low yield	Yes	97	87.4
		No	14	12.6
	Low quality of pods	Yes	51	45.9
		No	60	54.1
	Insect/pathogen attacks	Yes	5	4.5
		No	106	95.5
	Plant death	Yes	2	1.8
		No	109	98.2
Environmental factors	Increase in temperature pattern	Yes	85	76.6
		No	26	23.4
	Violent winds	Yes	76	68.5
		No	35	31.5
	Inadequate rainfall	Yes	84	75.7
		No	27	24.3
Causes	Forest destruction		4	3.6
	Natural evolution		68	61.3
	Human activities		32	28.8
	Wrath of God		4	3.6
	Nothing		3	2.7

Table 5. Farmers' Adaption Measures and External Adaptation for Adaptation

Designation	Response	Frequency	%age
Mulching	Yes	14	12.6
	No	97	87.4
Irrigation	Yes	4	3.6
	No	107	96.4
Soil erosion prevention measures	Yes	1	0.9
	No	110	99.1
IPM	Yes	8	7.3
	No	103	92.7
Used of improved seed variety	Yes	0	0
	No	111	100
Forest conservation	Yes	0	0
	No	111	100
Sacrificing to idols	Yes	0	0
	No	111	100
Consulting rain markers	Yes	0	0
	No	111	100
Prayers to God	Yes	72	64.9
	No	39	35.1
Adaptation binary	Yes	68	61.3
	No	43	38.7
Fertilizer application	Yes	0	0
	No	111	100
Manure application	Yes	2	1.8
	No	109	98.2
Intercropping	Yes	2	1.8
	No	109	98.2
Pruning of branches	Yes	2	1.8
	No	109	98.2
Regular weeding	Yes	45	40.5
	No	65	59.5
Doing nothing	Yes	3	2.7
	No	108	93.7
Political backing	Yes	2	1.8
	No	109	98.2
Joint effort to combat climate change in LGA	Yes	0	0
	No	111	100

Table 6. Chi Square Tests for Adaptation Measures by Farmer Characteristics

Chi-square test	df	Chi-square	P value
Adaptation with age of respondents	2	11.49	< 0.003
Adaptation with farm size	5	10.27	<0.05
Adaptation with years in cocoa farming	4	4.58	<0.33
Adaptation with household size	3	3.42	< 0.33

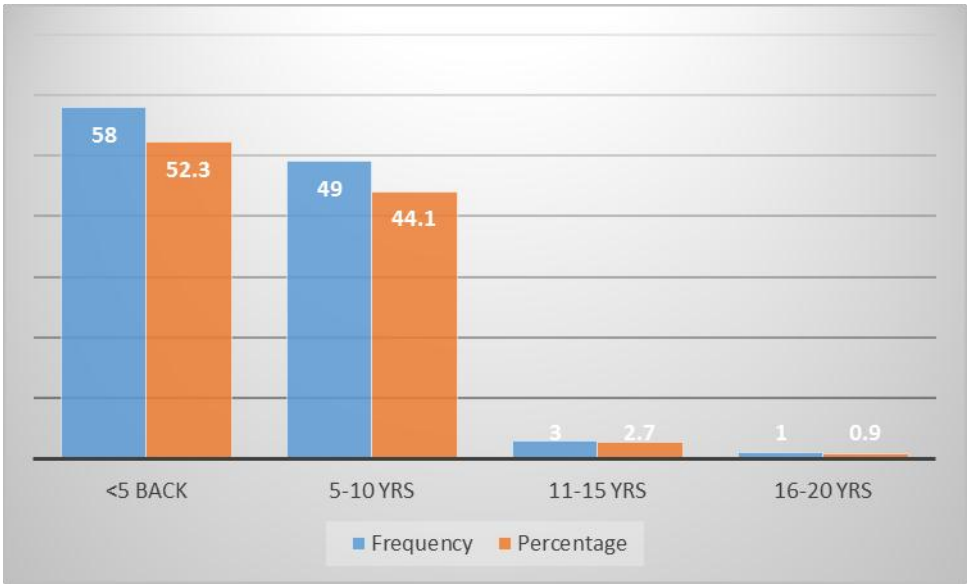

Figure 2. Duration in observing change in Climate Pattern

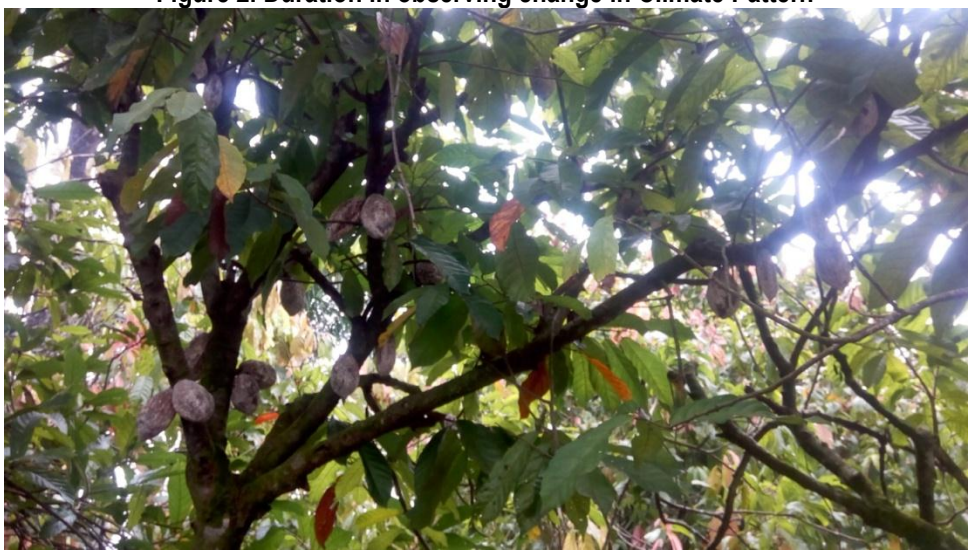

Figure 3. Cocoa pods attacked by pathogens

The heads of the households interviewed in this survey were in majority males and only 3.6% of females produced cocoa. The participation of women in cocoa production is very low. One possible explanation for this could be that women do not have easy access to land. Another contributing factor is that women are much more involved in household activity. Our results are similar with those of Muthoni *et al.* (2013) reported that over 60% of the farmers surveyed were men in their study in Kenya. The majority of the farmers producing cocoa are in their active and energetic age that is in the working age. This indicates that cocoa production necessitates intensive labor and energy, which the respondents got to face the challenge cocoa production with the use of elementary tools. The outcome of this study is similar to that of Nkang *et al*. (2007) who reported that the majority of surveyed cocoa

producers were in their prime age and who were full of physical energy and strength. Same results were also obtained by Amalu and Abang (1997) who worked on the constraints analysis of yam-based cropping practices in two rainforest communities of south-east Nigeria. Most (80.1%) of the respondents were literate and only 19.7% did not go to school, therefore, these are above the mean national literacy level of adults to adopt some agricultural technologies. These results are consistent with those of Gebru *et al.* (2017) who reported that Most (54.2%) of the interviewed households completed primary education in southern Ethiopia, same results were obtained by Doss (2003).

Most of farmers introduced new cocoa cultivars and increased the areas of cocoa plantation in order to increase their yield and income. This could be due to the fact that old cocoa trees were not productive as expected by respondents and by increasing the lands this could correlate with high yields. This result is consistent with Nwachukwu *et al.* (2010) in their study, observed declined in coco production in Nigeria due to low yields, unpredictable production patterns, disease incidence, pest attack and little agricultural mechanization. They further stated that, the ageing of cocoa trees in the areas of their study was also a key factor in the decrease of productivity. It is also expected that with a significant majority of farmers reporting on fertility of the soils there should be increase in yield. This indicates that soil fertility (edaphic factor) is necessary but not enough when environmental factors' requirements for productivity are not met due to the effect of climate change, so obviously there will be decline in yield. The results of this study also show that farmers complained not to have access to agricultural loan in order to enlarge their plantations. Most of farmers asked if we could help them with agricultural loans as they were in dire need of it. Limantol *et al*. (2016) also indicated that funding and agricultural mechanization is major problems in the agricultural sector policy. They further suggested that farmers should have access to credit through financial agencies that have extensive expertise over management of credit to farmer-based organizations.

These results on climate change highlight the observations reported by other studies on changes in climate. Therefore, 95.5% of farmers surveyed (Figure 1) principally self-observed changes in climate and then others in a slim proportion by radio/television broadcast.Thus the farmers in the study areas are aware of changes in climate.In the similar vein, Codjoe (2013) revealed that cocoa farmers in all the cocoa growing regions in Ghanawere aware of changes in climate and its subsequent effects on their agricultural activities. Similar results were obtained by Ogunsola *et al*. (2015). Furthermore, many authors demonstrated the significance of farmers' awareness is a foundation for adaptation strategies and implementation of agricultural technologies (Hassan and Nhemachena, 2008; Maddison, 2006).A significant majority of farmers perceived decrease in annual rainfall over the past 10 years and above, they also perceived no increase in annual rainfall and further stated that rainfall failed to start early and stopped earlier than in the past. These findings are in accord with many studies. IPCC (2007) indicated that West Africa, recorded a drastic drop of 20 to 40% of the precipitation in the periods 1931-1960 and 1968-1990 and a drop in the flow of the main running water of 40 to 60% since 1970 years. The results of this study are also similar to those of Gbetibouo (2009); Nyanga *et al*. (2011) Kemausuor *et al*. (2011); Moyo *et al*. (2012); Zampaligré *et al*. (2014), Allahyari *et al*. (2016). Farmers also mentioned that there have been long period of dry spells during the rainy season, and they perceived that precipitation has become unpredictable in the area of study. Similarly, Dugué (2012) demonstrated that the global warming has caused delay in the commencement of rains, modifications in the amount of precipitation received annually in many regions of the globe, coupled with drought spells which has become more pronounced and more frequent.

Most interviewed farmers did perceive increase in temperature and heat especially in

the course of dry season in the past 10 years. This result is consistence with that of Limantol *et al*. (2016) who reported that most farmers (89.5%) interviewed perceived that temperature has increased over the past 30 years in their area of study. similar perceptions of farmers in other parts of Africa was also observed (Bryan *et al*., 2009; Mengistu, 2011; Juana *et al*. 2013; Kalungu *et al*. 2013; Zampaligre *et al*. 2014). Also Bello *et al*. (2016) reported the analysis of climate data for the annual mean temperature recorded in the synoptic stations has showed a continuing rise from 1993 to 2016. Same result was also obtained by Agbongiarhuoyi *et al*. (2013) in Kwara State in Nigeria. The results of this work also shows that the above mentioned environmental factors resulted in serious perceived consequences such as low yield, abortion of flowers, drying of flowers, small cocoa pods and insects/pathogen attack and plant death. These are consistent with the results of Issa *et al*. (2015), Elum *et al*. (2016), Balogoun *et al.* (2016) and Limantol *et al.* (2016). Most farmers attached these perceived changes to natural evolution, human activities, God' wrath and deforestation. Similar results were obtained by Tunde (2011) and Codjoe *et al*. (2013) who reported that about 18% of the farmers attribute climate change to deforestation, while about 12% attribute climate change to the sinful nature of man. They further stated that, it is the wrath that God is bringing upon mankind as a result of our wicked, corrupt, untruthful and stubborn ways.

This work also demonstrated that farmers utilized many coping strategies to mitigate the deleterious impacts of climate changes on cocoa production. Amongst these are prayers to God, mulching, irrigation, integrated pest management, pruning of branches, intercropping practices and increase in the area of cocoa production etc. Rupa *et al*. (2013) reported that mulching, irrigation and green manures are very important in keeping the moisture and temperature of the soil. Burke and Lobell (2010) obtained similar results. However, it should be noted that only a scanty proportion of interviewed farmers do adapt coping strategies as many farmers reported that they did not use dead leaves/debris to cover the soil in order to keep the moisture of the soil. These farmers need to be educated on mulching and other coping strategies for them to be able face the challenges of climate change.

CONCLUSION

The study concludes that farmers are aware of climate change and did perceive the negative effect of climate change on cocoa production, which its performance depends mainly on adequate climate. Farmers demonstrated that coca has become sensitive to environmental factors resulting in the decline of yield and yield components of cocoa. They also believe that this change is as a result of natural evolution, forest destruction, and sinful nature of man. Unfortunately, farmers are not getting external supports from Federal/Local Governments, and NGO. Therefore, it is of paramount importance that governments and private agencies to help farmers with adequate and efficient irrigation systems, education on adaptation measures, agricultural credits, meteorological stations in all the local governments for timely weather forecast information. The development of new cocoa varieties resistant to climate change by breeders is of vital importance to help farmers cope with adverse effects of changes in climate.

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Source of Support: None.
Conflict of interest: None**.** Declared**.**