



# Perceived effect of climate change on cocoa production in south western Nigeria

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## Abstract

The study examines the perceived effect of climate change on cocoa production in South Western Nigeria. Information collected from 270 respondents residing in Ondo, Osun and Oyo states of Nigeria using well-structure questionnaires forms the primary data used in the analysis. Descriptive statistics, weighted means score and multiple regression analysis were the analytical techniques used. The result shows that more than 70 percent of the respondents were male, majority of them were 50years of age and 57.4 percent had no formal education. The major means of awareness about climate change are radio and co-farmers in Ondo State and Osun State while its radio and television in Oyo State. Livestock farming systems, weeding options, mixed cropping, remover of chupons, and pruning of old cocoa trees are the main preventive strategies adopted by farmers in the states under study. Applications of pesticides on cocoa and determining damage threshold for use of insecticides are part of the mitigating strategies used by the farmers in the study area. The inferential statistics shows that farmers' age, level of education, extension services, farming experience, farm and family size are significantly related to the farmers' perceived effect of climate change on cocoa production in the three States under study.

**Keywords:** Cocoa, Climate change, Perceived effect, Preventive, Mitigating and coping strategies

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## 1. Introduction

The available literature indicates that cocoa originates from central and South America (Afoakwa, 2014). The production of cocoa in West Africa was first identified in Ghana in 1868, and by 1879, a native brought more seedlings from the Fernando Po Island (Howes, 1946). The same author further indicates that by 1874, chief "SquissBanego" also brought the cocoa seed from the same Fernando Po Island into Nigeria. According to Howes (1946), this marked the beginning of establishing cocoa plantations in the Bonny District and cultivation of the crop spread to other agro-potential areas in Nigeria.. Other sources of the introduction were trading companies, soldiers, chiefs, farmer's association and cooperatives, Department of Agriculture and West Africa cocoa research Institute (WACRI) and the Cocoa Research Institute of Nigeria (Cocoa Research Institute of Nigeria (CRIN) bulletin, 2006).

According to Afoakwa (2014) and World Cocoa Foundation (2014), regions known for growing large volumes of cocoa are mostly those that experience tropical type of climate and these include Africa, Central and South America, and Asia/Oceania. Statistics from World Cocoa Foundation (2014) indicate that African countries including Nigeria contribute about 68% of global cocoa production.. In the early 1970s, production was concentrate more in Ghana, Nigeria, Cote d'Ivoire and Brazil, but it has now expanded to areas such as pacific region where country like Indonesia have shown spectacular growth rate in production.

**Table 1.** World Aggregate output of cocoa

Country	Amount produced	Percentage of world production
Cote D'Ivoire	1.33million tones	38.0%
Ghana	735thousand tones	21.0%
Indonesia	455 thousand tones	13%
Cameroun	175 thousand tones	5.0%
Nigeria	175thousand tones	5.0%
Brazil	140thousand tones	4.0%
Ecuador	105thousand tones	3.0%
Malaysia	35 thousand tones	1.0%
Others	350 thousand tones	10%

Source: UNTAD, based on the data from international cocoa organization (ICCO) quarterly bulletin of cocoa statistics

In their reports, Oyekale et al. (2009) and Oseni (2011) indicated that climate change greatly affects cocoa production both in hot and wet seasons, and during irrigation. The major three phases most affected by climate change include seedling, establishment and processing phases.. Therefore, for meaningful production this calls for skilled labour and proper application of agronomical practices. Codjoe et al. (2013) further

explain that climate changes may also alter bio-physiological processes of both the crop and rate of development of cocoa pests and pathogens; this may result in low cocoa yields. Low production may impact on farmers' incomes and farmers' livelihoods, and hence increased poverty and food insecurity. Findings by Akintunde et al. (2013) indicated that during hot seasons *solar heat warms the soil, plants, and accelerates metabolic processes, while rainfall and its characteristics influence crop growth and but also soil erosion*. Other climate related factors like atmospheric evaporability also determines the performance and survival of crops. Cocoa production is mostly rain-fed but also irrigated to add some economic value to the products (Oseni, 2011). Availability of sunshine is crucial for drying of cocoa seeds to reduce on the water content during the processing phase (Oseni, 2011). The contribution of weather and climate conditions directly or indirectly on cocoa production and processing are evident as indicated in this paragraph.

According to Nkang et al. (2007), Nigeria cocoa production growth rate was reported declining. The decline of Nigeria's cocoa has been mainly attributed to the oil discovery and exploitation of petroleum and this further seemingly has led to neglecting of the entire agriculture sector (Sekumade, 2014). Other factors responsible for the declining growth rate of cocoa production in Nigeria include Abolition of the Nigeria cocoa marketing board, aging of the farmers, rural to urban migration, scarcity and high cost of agricultural labour, and limited access to agricultural inputs, less investment in research important to eradicate incidence of pests and diseases, limited access to farmer credit facility and climate change (Sekumade, 2014).

Sekumade (2014) indicated that 46% of 120 respondents identified climate change as the most felt factor affecting cocoa production. Thus, climate change poses a serious threat on cocoa production and hence increasing food insecurity and persistent high poverty levels among farmers. This calls for increased research and innovations focused for improved cocoa production to improve on farmers' livelihoods including tackling the growing issue of climate change effects cocoa production in Nigeria. The paper is designed to describe the socioeconomic characteristics of the cocoa farmers, highlight the available means of awareness about climate change, investigate the various strategies adopted by the farmers in adjusting to the impact of climate change and determine the factors that affect the ways cocoa farmers perceive the effect of climate change on their production.

## 2. Methodology

In 1962, Nigeria was the second largest cocoa producer in the world with about 97% of its total production coming from the south-western region (Amos, 2007). According to Ogunleye and Oladeji (2007), by 2007, Nigeria was the fourth leading exporter of cocoa in the world. The south-western part of Nigeria comprises of six States namely Lagos, Ogun, Osun, Ondo, Oyo and Ekiti States. It has a land area of approximately 114,271 km<sup>2</sup> and falls between Latitude 60°N and 40°S as well as Longitude 40°W and 60°E. The total population of the Zone is 25,386,723 and more than 96% of the population is Yorubas (NPC, 2006). The dominant livelihood activities of households in the rural areas of the Zone are farming, trading and artisans.

Multi-stage random sampling technique was employed in the selection of three hundred respondents from three purposively selected States. The States are Oyo, Ondo and Osun States. According to NBS, 2012

these three States were identified as the largest cocoa producing area in South Western Nigeria. Oyo and Osun have three Agricultural zones each while Ondo has six Agricultural Zones.

From the selected States, random sampling was used to select an Agricultural Zone per State from which five villages each were also randomly selected. Twenty cocoa farmers were randomly selected from each of the villages making a total of a hundred respondents per State. A well-structured questionnaire was used to obtain relevant information from the three hundred respondents and only two hundred and seventy of them were found useful for the analysis.

Descriptive statistics was used to describe the socioeconomic characteristics of the farmers. The means of awareness about climate change, and the strategies adopted by the farmers in adjusting to the impact of climate change were measured by weighted means score (WMS) through the use of a five point Likert scale. The weighted means score was calculated by summing up the responses divided by the number of respondents. The perceived effect of climate change on cocoa production in the study area was measured using a four point Likert scale of very severe, severe, mild and 'not at all' responses to statements on climate change as it affect cocoa production. It was the sum of these scores per respondents that served as the dependent variables against other factors in the multiple regression analysis to determine the factors that affect the ways cocoa farmers perceive the effect of climate change on their production. The regression equation is implicitly given as:

$$Y=f(X)$$

where:

Y= Perceived effect of climate change on cocoa production

X<sub>1</sub> = Gender (female=0, male=1)

X<sub>2</sub> = Age (years)

X<sub>3</sub> = Years of schooling

X<sub>4</sub> = Family size

X<sub>5</sub> = Farm size (ha)

X<sub>6</sub> = No of visit by Extension Agent annually

X<sub>7</sub> = Years of experience in cocoa production

X<sub>8</sub> = Marital status (single, married, divorced)

X<sub>9</sub> = Average monthly income generated from other sources (Naira)

### 3. Result and discussion

Table 2 revealed that 70 percent of the total respondents are male, 39.6 percent are over fifty years of age while majority of the farmers farm size are less than one hectare. Few numbers of them (7.8%) have small household size and majority (34.1%) of them have between 21-30 years of farming experience in cocoa

production while 57.4% have no formal education. About 30.7 percent of the respondents experienced 3-6 extension visits per year.

**Table2.** Socio-Economic Characteristics of Respondents

	<b>Frequency</b>	<b>Percentage</b>
<b>Gender Male</b>	189	70.0
<b>Female</b>	81	30.0
<b>Age 21-30</b>	59	21.9
<b>31-40</b>	20	7.4
<b>41-50</b>	84	31.1
<b>&gt;50</b>	107	39.6
<b>Farm Size &lt;1ha</b>	154	57.0
<b>1-2ha</b>	65	24.1
<b>3-4ha</b>	14	5.2
<b>&gt;4ha</b>	37	13.7
<b>Household Size ≤ 3</b>	21	7.8
<b>4-5</b>	66	24.4
<b>&gt; 5</b>	183	67.8
<b>Experience 1-10</b>	33	12.2
<b>11-20</b>	67	24.8
<b>21-30</b>	92	34.1
<b>&gt;30</b>	78	28.9
<b>Education No Formal</b>	155	57.4
<b>Adult</b>	24	8.9
<b>Primary</b>	41	15.2
<b>Secondary</b>	35	12.9
<b>Tertiary</b>	15	5.6
<b>Yearly Extension Visit &lt;2</b>	159	58.9
<b>3-6</b>	83	30.7
<b>&gt;7</b>	28	10.4

Source: Field Survey 2012

Table 3 shows that in terms of various means of awareness available on climate change to the farmers, information through co-farmers, relatives and acquaintances ranked highest among farmers in Ondo and Osun States whereas extension visit, farm facilitators and supervisors to cocoa farmers were the major means of awareness on climate change to farmers in Oyo State.

As regards farmers strategies adopted in adjusting to climate change, Table 4 indicated that livestock farming systems, weeding options, mixed cropping, remover of chupons, and pruning of older cocoa trees are the main preventive strategies adopted by farmers in the States under consideration.

Table 5 shows the mitigating strategies to include mainly maintaining personal protective equipment, decision to be applying pesticides on cocoa, determining damage threshold for use of insecticides as well as calculating pesticides dosage and tank load among others.

Table 6 revealed the coping strategies. For cocoa farmers in Ondo and Osun States, access to extension service was ranked highest among the coping strategies with weighted means scores of 0.68 and 1.37 respectively while access to credit was the main coping strategy for cocoa farmers in Oyo State.

**Table 3.** Rank Order of Means of Awareness about Climate Change Climate

Individual/Group Method	Oyo State( WMS)	Ondo State(WMS)	Osun State( WMS)
Co-farmers	0.78(7 <sup>th</sup> )	2.97(1 <sup>st</sup> )	2.56(1 <sup>st</sup> )
Relatives	2.49(5 <sup>th</sup> )	2.73(3 <sup>rd</sup> )	2.40(2 <sup>nd</sup> )
Acquaintances	1.30(6 <sup>th</sup> )	2.81(2 <sup>nd</sup> )	1.90(3 <sup>rd</sup> )
Ministry of agriculture	0.24(9 <sup>th</sup> )	1.41(6 <sup>th</sup> )	1.70(5 <sup>th</sup> )
Extension agents	3.06(1 <sup>st</sup> )	1.56(4 <sup>th</sup> )	1.77(4 <sup>th</sup> )
Farmer facilitators	2.83(2 <sup>nd</sup> )	1.52(5 <sup>th</sup> )	1.49(7 <sup>th</sup> )
Institute of Tropical Agriculture	0.14(10 <sup>th</sup> )	1.17(9 <sup>th</sup> )	1.10(9 <sup>th</sup> )
Coordinators	2.73(4 <sup>th</sup> )	1.23(8 <sup>th</sup> )	1.56(6 <sup>th</sup> )
Supervisors	2.74(3 <sup>rd</sup> )	1.26(7 <sup>th</sup> )	1.12(8 <sup>th</sup> )
Master trainer	0.68(8 <sup>th</sup> )	1.11(10 <sup>th</sup> )	1.70(10 <sup>th</sup> )

Source: Field Survey, 2012

**Table 4.** Rank Order of Respondents Based on Preventive Strategies

Preventive Strategies Adopted	Oyo State( WMS)	Ondo State(WMS)	Osun State( WMS)
Mixed cropping	2.46(2 <sup>nd</sup> )	2.40(4 <sup>th</sup> )	2.63(1 <sup>st</sup> )
Removing chupons	2.43(4 <sup>th</sup> )	2.56(2 <sup>nd</sup> )	2.60(2 <sup>nd</sup> )
Pruning older cocoa trees	2.44(3 <sup>rd</sup> )	2.48(3 <sup>rd</sup> )	2.57(3 <sup>rd</sup> )
Weeding options	2.10(6 <sup>th</sup> )	2.91(1 <sup>st</sup> )	2.17(7 <sup>th</sup> )
Use of water resistance crops	1.41(8 <sup>th</sup> )	1.13(7 <sup>th</sup> )	2.18(6 <sup>th</sup> )
Crop diversification	1.98(7 <sup>th</sup> )	2.27(5 <sup>th</sup> )	2.22(5 <sup>th</sup> )
Livestock farming system	3.15(1 <sup>st</sup> )	1.42(6 <sup>th</sup> )	1.87(8 <sup>th</sup> )
Using different crop varieties	2.36(5 <sup>th</sup> )	0.79(8 <sup>th</sup> )	2.24(4 <sup>th</sup> )
Using drought resistance varieties	1.68(7 <sup>th</sup> )	0.78(9 <sup>th</sup> )	0.28(9 <sup>th</sup> )

Source: Field Survey, 2012

Table 7 highlighted the factors that affect the ways cocoa farmers perceive the effect of climate change on their production. In Oyo State, level of farmers' education and extension services significantly affect the farmers' perception of climate change effect on their production at 1 percent level while age has a negative influence on farmers' perception at 5 percent level of significant. But among cocoa farmers in Ondo State, farm size and farming experience have a positive relationship with farmers' perception at 10 percent level of significant and farmers' level of education have similar effect at 1 percent significant level. In Osun State, family size and extension services determines farmers perception at 5 and 10 percent significant levels respectively.

**Table 5.** Rank Order of the WMS of the Respondents Based on Mitigating Strategies

Mitigating Strategies Adopted	Oyo State	Ondo State	Osun State
Calibration and performance of sprayers	2.00(4 <sup>th</sup> )	2.11(5 <sup>th</sup> )	2.10(7 <sup>th</sup> )
Maintaining personal protective equipment	2.41(1 <sup>st</sup> )	2.70(3 <sup>rd</sup> )	2.84(1 <sup>st</sup> )
Determining damage threshold for use of insecticides	1.07(7 <sup>th</sup> )	0.68(6 <sup>th</sup> )	2.82(2 <sup>nd</sup> )
Pesticides resistance role play	1.45(5 <sup>th</sup> )	0.53(7 <sup>th</sup> )	2.71(4 <sup>th</sup> )
Calculating pesticides dosage and tank load	2.19(2 <sup>nd</sup> )	2.72(2 <sup>nd</sup> )	2.77(3 <sup>rd</sup> )
Proper Storage and disposal of agrochemical containers	1.31(6 <sup>th</sup> )	2.63(4 <sup>th</sup> )	2.16(6 <sup>th</sup> )
Deciding to apply pesticides on cocoa	2.11(3 <sup>rd</sup> )	2.79(1 <sup>st</sup> )	2.36(5 <sup>th</sup> )

Source: Field Survey, 2012

**Table 6.** Rank Order of Respondents Based on coping strategies

Coping Strategies Adopted	Oyo State( WMS)	Ondo State(WMS)	Osun State( WMS)
Access to extension service	2.46(2 <sup>nd</sup> )	0.68(1 <sup>st</sup> )	1.37(1 <sup>st</sup> )
Access to credit facilities	2.48(1 <sup>st</sup> )	0.39(2 <sup>nd</sup> )	1.20(2 <sup>nd</sup> )
Help from the government	2.10(3 <sup>rd</sup> )	0.21(3 <sup>rd</sup> )	1.18(3 <sup>rd</sup> )

Source: Field Survey, 2012

**Table 7.** Regression Analysis result

Variables	OYO			ONDO			OSUN		
	Estimated Coefficient	t-ratio	Level of Sig	Estimated Coefficient	t-ratio	Level of Sig	Estimated Coefficient	t-ratio	Level of Sig
Constant	7.851	4.382	0.002	2.852	2.397	0.032	5.011	2.011	0.067
Age	-1.325	2.711	0.043**	-0.568	1.774	1.097	1.441	0.816	1.232
Farm Size	0.968	1.942	0.322	2.135	2.215	0.051***	-2.282	0.907	0.813
Level of Education	3.112	5.336	0.003***	4.498	8.498	0.001***	-0.781	1.565	1.059
Family Size	0.003	0.726	2.365	0.045	0.643	0.772	0.426	2.455	0.028**
Extension Services	1.624	3.001	0.008***	0.933	1.830	0.105	1.007	1.982	0.099*
Farming Experience	2.497	1.359	0.669	1.852	1.971	0.093*	1.323	1.110	0.512

Source: Data Analysis, 2011

\*\*\* Significant at 1% level

\*\* Significant at 5% level

\* Significant at 10% level

#### 4. Conclusions and recommendations

In conclusion, provision of educative programmes through extension agents' activities, encouraging young farmers into cocoa production, and assisting farmers, especially those with relatively large farm size, with farming incentives will be useful ways to reducing the effect of climate change on the tree crop.

#### References

- Afoakwa, O.E. (2014), *Cocoa Production and Processing Technology*, CRS Press, Taylor and Francis Group, LLC.
- Akintunde, O.K., Okoruwa, V.O. and Adeoti, A.I. (2013), "The Effect of Agroclimatic Factors on Cash Crops Production in Nigeria," *Journal of Central European Agriculture*, Vol. 14 No. 3, pp.52-74.
- Amos, T.T. (2007), "An analysis of Productivity and Technical Efficiency of Smallholder Cocoa Farmer in Nigeria", *Journal of Social Science*, Vol. 15 No. 2, pp. 127-133.
- Cocoa Research Institute of Nigeria (2006), *Information bulletin of Cocoa Research Institute of Nigeria*, CRIN Ibadan.
- Codjoe, F.N.Y., Ocansey, C.K., Boateng, O.D. and Ofori, J. (2013), "Climate Change Awareness and Coping Strategies of Cocoa farmers in Rural Ghana", *Journal of Biology, Agriculture and Healthcare*, Vol. 3 No. 11, pp. 2013.
- Howes, F.N. (1946), "The Early Introduction of Cocoa to West Africa", Paper presented at the Annual General Meeting held in the Council Room of the Royal Empire Society, available at: [afraf.oxfordjournals.org](http://afraf.oxfordjournals.org) (accessed 19 October, 2010).
- Nkang, N.M., Ajah, E.A., Abang, S.O. and Edet, E.O. (2007), "Investment in Cocoa Production in Nigeria: A Cost and Return Analysis of Three Cocoa Production Management Systems in the Cross River State Cocoa Belt", *Journal of Central European Agriculture*, Vol. 8 No. 1, pp. 81-90.
- Ogunleye, K.Y. and Oladeji, J.O. (2007), "Choice of Cocoa Market Channels among Cocoa Farmers in Ila Local Government Area of Osun State, Nigeria," *Middle East Journal of Scientific Research*, Vol. 2 No. 1, pp. 14-20.
- Oseni, J.O. (2011), "Effects of Climate Change on Cocoa Production in Ondo State Nigeria", Conference paper presented in Impacts of climate change on agriculture conference in Rabat, Morocco December 6-7, 2011, available at: [http://www.wider.unu.edu/events/past-conferences/2011-conferences-/en\\_GB/06-12-2011/](http://www.wider.unu.edu/events/past-conferences/2011-conferences-/en_GB/06-12-2011/).
- Oyekale, A.S., Bolaji, M.B. and Olowa, O.W. (2009), "The Effects of Climate Change on Cocoa Production and Vulnerability Assessment in Nigeria," *Agricultural Journal*, Vol. 4 No. 2, pp. 77 -85.
- Sekumade, A.B. (2014), "Comparative Analysis Of Owner Managed And Lease Managed System Of Cocoa Production In Ekiti State Nigeria," *IOSR Journal of Agriculture and Veterinary Science*, Vol. 7 No. 3, pp. 01-06.
- UNCTAD (2007), *Based on the Data from International Cocoa Organization, Quarterly Bulletin of Statistics*.
- World Cocoa Foundation (2014), "Cocoa Market", available at: [www.WorldCocoa.org](http://www.WorldCocoa.org) (accessed 1 April, 2014).