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# FARMERS' PERCEIVED EFFECTS OF CLIMATE CHANGE ON COCOA PRODUCTION IN KWARA STATE

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**ABSTRACT**

*The effects of climate change in Nigeria are already being felt as the frequency and intensity of extreme events like droughts and floods have increased. In mature cocoa plants, water deficit and excess result in low yield and increase the level of capsid and black-pod damage. Cocoa seedling mortality is encouraged by prolonged dry season due to changes in climate. The study investigated the perceived effects of climate change on cocoa seedling growth, flowering, pod development, yield, leaves, tree, insect pest and disease occurrence. It examined perceived climatic factors and amount realized from cocoa beans in Kwara State. A multi-stage random sampling procedure was used to select 60 cocoa farmers from three out of eight Local Government Areas producing cocoa in the study area. Interview schedule instrument was used in data collection and analyzed with descriptive statistics and correlation analysis. The results revealed that most (60%) of the farmers believed climate change retards cocoa seedling growth and lead to death. Half (50%) of them opined that climate change delays flowering of cocoa. Majority (70%) perceived it to delay pod development resulting in low yield. In terms of insect pest and diseases occurrence, 51.7 percent indicated that climate change altered crop yield and losses in cocoa farms. Many farmers (58.3%) feel it makes cocoa leaves to be abundant while more of them 65% claimed that climate change retards tree development for optimum production. However, 61.7% had high perception about the effect of climate change on cocoa production. Low Rainfall accounting for 61.7% was observed to be the main climatic factor contributing to climate change in the study area. The revenue realized from sales of cocoa beans was statistically related to farmers' perceived effect of climate change on cocoa production ($r = -0.412$, $p = 0.001$ at $p<0.05$). The farmers' perception of climate change is a reflection of the global problems posed by variations in weather impacting food production and income. There is need for concerted efforts that will mitigate the effects of climate change on cocoa production.*

**Keywords:** Climate change, perceived effect, farmers, cocoa production

## INTRODUCTION

Climate change is a change in the statistical distribution of weather over periods of time that range from decades to millions of years (Salman, 2011). It can be a change in the average weather or a change in the distribution of weather events around an average (for example, greater or fewer extreme weather events). Climate change arises from the release of Green House Gases, carbon dioxide (CO2), water vapour and nitrous oxide into the atmosphere due to human activities, such as burning of fossil fuel, gas flaring and deforestation (Wikipedia, 2011).

Climate change is one of the most serious environmental threats facing mankind worldwide. It affects agriculture and impact food production (Enete and Amusa, 2010). They further added that the adverse effects of climate change are felt by developing countries. This is due to over dependence on rainfall for farming. Changing climate and weather patterns are predicted to have severe negative impacts on food production, food

security and natural resources in the immediate and coming years (Akudugu *et al,* 2012 and Agbongiarhuoyi *et al,* 2013). At different levels and scales appropriate responses to climate change are needed. This includes adaptation, mitigation, production practices and land use change measures to curb the impacts of climate change and prevent further climate change to occur (Agbongiarhuoyi, *et al* 2013).

Anim-kwapong and Frimpong, (2008)., Oyekale, (2009)., Odjugo, (2010) and CTA, (2012) expressed several views about the impacts of irregularity of changing climate on cocoa production and farmers' adaptation to the climate change. Cocoa is highly sensitive to changes in climate from hours of sunshine to rainfall and application of water. It is also sensitive to soil condition particularly temperature due to effects on evapotranspiration.

Cocoa is susceptible to drought and the cropping pattern is associated with rainfall distribution. Significant correlations between cocoa yields and rainfall pattern over varying interval prior harvest of cocoa pods have been reported by Oyekale, *et al* (2009). Cocoa seedling mortality is encouraged by prolonged dry season (drought), short dry season affects pod growth and development which affects the bean size. In mature cocoa plant water deficit results in low yield and increases the level of capsid damage. Blackpod disease is prevalent in damps, affecting ripening cocoa pods. Prolonged wet season, windy or cloudy days and rains slow down drying and processing of cocoa seeds thereby reducing the value of the bean and increase the cost of processing. Empirical evidence as reported by Lawal and Emaku (2007) showed that rainfall, temperature and relative humidity were significant variables when correlated with yield and diseases incidence. Increase in rainfall brings about reduced yield. It means that high rainfall is detrimental to cocoa development. Increase in temperature increased yield while increased relative humidity brings about low yield.

The Inter-governmental Panel on Climate Change IPCC (2007) reported that climate change exerts multiple stresses on the biophysical as well as the social and institutional environments that underpin agricultural production. The socio-economic impacts results in decline in yield, production and reduced marginal Gross Domestic Product (GDP) from agriculture. It brings fluctuation in world market price, changes in geographical distribution of trade regime, increased number of people at risk of hunger and food insecurity, migration and civil unrest. Busuioc *et al*., (2007) and Lobell *et al*., (2008) opined that climate change affects agricultural productivity, farm incomes and food security. Tunde *et al* (2011) described four ways in which climate change could affect agricultural production. These are: changes in temperature and precipitation which directly affect crop production. It can even alter the distribution of agro-ecological zones. Increased CO2 is expected to have a positive effect on agricultural production due to greater water use efficiency and higher rates of plant photosynthesis. The runoff or water availability is critical in determining the impact of climate change on crop production, especially in Africa. Agricultural losses can result from climate variability and the increased frequency of changes in temperatures and precipitation (including drought and floods. Some of the climate changes could have beneficial effects while others are likely to be detrimental.

Decreases in the suitability of current cocoa producing areas will likely have large impacts on Nigerian economy (Oluyole *et al,* 2013). According to Okelana(2012), cocoa contributes about 38% of the Gross Domestic Product of Nigeria, thus

serving as the largest non-oil foreign exchange earnings of the nation. The National Cocoa Development Committee NCDC, (2008), reported that cocoa accounts for about 2% of the national export earnings. Over 200,000 rural households in Cocoa-producing states depend on cocoa for the majority of their cash income and livelihoods. Across the supply chain, millions of people are involved in trade, transport, processing and export of cocoa beans. Cocoa beans are used in the production of cocoa powder, chocolate products, beverages, wine and livestock feeds. Cocoa is also used to produce cocoa bread, biscuits, soap, and cream, among others (Arueya1989, Olubamiwa *et al,* 2000 and Hamzat et al, 2003).

Millions of farmers across Africa are already living with, and attempting to adapt to the effects of climate change. The economic benefits of this crop are threatened by the global issue of climate change and there is need to understand what the farmers feel about its effects on cocoa production.

The study aimed at assessing the perceived effects of climate change on cocoa production in Kwara State. The specific objectives are to:

1. identify perceived climatic factors affecting the yield of cocoa.
2. describe farmers' perceived effects of climate change on: seedling growth, flowering, pod development, yield, leaves, trees and insect pest and diseases of cocoa.
3. ascertain farmers' perception of the effects of climate change on cocoa production.

The study hypothesised that there is no significant relationship between amount realised from the sales of cocoa beans and farmers' perceived effects of climate change in the study area.

**METHODOLOGY**

**Study Area:** The study was conducted in Kwara State Nigeria. Kwara State lies within the North central geopolitical zone of Nigeria. It has a land area of about 32,500 square kilometres and a population of 2,371, 089, comprising of 1,220,581 males, and 1,150,508 females (2006 National Population Commission). Kwara State shares local boundaries with five states and an international boundary with the Republic of Benin (Taiwo, 2005). Kwara State is located between latitudes $7^0$ 45'N and $9^0$30'N and longitudes $2^0$3'E and $6^0$25'E, its topography is mainly plain to slight gentle rolling lands. The annual rainfall ranges between 1000mm and 1500mm. Average temperature ranges between $30^0$C and $35^0$C (Kwara State ADP, 2007).

The population of the study consisted of cocoa farmers in the cocoa producing local Government Areas (LGAs) of Kwara State. These include: Asa, Isin, Ifelodun, Irepodun, Oke-Ero, Ekiti, Offa and Oyun (Kwara State Ministry of Agriculture, 2011). A multi-stage sampling technique was utilized in the study. The first stage involves the selection of three out of the eight LGAs where cocoa is being produced in Kwara State. The second stage involves a random selection of two villages from each of the LGA. The final stage involves a random selection of ten farmers from each village, thus making a total sample size of sixty respondents. Interview schedule was used in field data collection.

Data collected were analysed with descriptive statistics and Pearson Product Moment Correlation (PPMC). The farmers' perception of the impact of climate change was calculated by adding all the positive and negative percentages separately. This was later divided by the total number of variables involved. The result was used to obtain the overall impact value.

**RESULTS AND DISCUSSION**

**Farmers' perceived effects of climate change on cocoa development and yield**

Data in table 1 reveals that most (60%) of the farmers believed that climate change retards cocoa seedling growth and death while half (50%) of them opined that climate change delays flowering of cocoa. Majority (70%) perceived it to delay pod development resulting in low yield. Many farmers (58.3%) feel it makes cocoa leaves to be abundant while 65% claimed that climate change retards tree development.

In terms of insect pest and diseases attack, 51.7 % indicated that climate change altered crop yield and losses in cocoa farms. The perception of the respondents shows that change in climate had negative effect of 72.1 % on the overall cocoa development and production while 27.9% accounted for positive impact. The overall farmers' perception of impact was 44.2 % which explains the low yield opinion of farmers. This situation makes them to be afraid because the effect reduced yield and loses of cocoa in the field. It therefore calls for appropriate strategies to be put in place to allay the fear of farmers in the study area.

**Table 1: Distribution of farmers' perceived effects of climate change on cocoa production (n=60)**

| Variables Impact | Frequency | Percentage |
|---|---|---|
| 1. **Cocoa seedling growth** | | |
| Increases growth + | 24 | 40.0 |
| Retards growth & lead to death - | 36 | 60.0 |
| 2. **Flowering** | | |
| Delays flowering - | 30 | 50.0 |
| It does not affect flowering + | 30 | 50.0 |
| 3. **Pod development** | | |
| Delays development - | 42 | 70.0 |
| Enhances development + | 10 | 16.7 |
| Low pod survival - | 8 | 13.3 |
| 4. **Yield** | | |
| High + | 18 | 30.0 |
| Low - | 42 | 70.0 |
| 5. **Leaves** | | |
| It makes leaves to be abundant + | 35 | 58.3 |
| It make leaves to be sparse - | 25 | 41.7 |
| 6. **Cocoa tree** | | |
| Retards tree development - | 39 | 65.0 |
| Withering of tree - | 21 | 35.0 |
| 7. **Insect pests and diseases** | | |
| Alters crop yield and losses - | 31 | 51.7 |
| Encourages blackpod diseases - | 15 | 25.0 |
| Shifts distribution of pests in the farm - | 14 | 23.3 |
| **Overall impact** | | **72.1** |

Field survey, 2011

The result in Table 2 revealed that low rainfall was the main climatic factor attributable to cocoa yield in the study area. Ajewole and Iyanda (2010) studied the effects of climate change on cocoa yield with the use of correlation and regression analysis and concluded that optimal temperature and minimal rainfall will give better yield of cocoa in Nigeria.

**Table 2: Distribution of farmers' perceived climatic factors attributable to cocoa yield**

| Climatic factors | Frequency | Percentage |
|---|---|---|
| Increasing sunshine intensity | 3 | 5.0 |
| Low rainfall | 37 | 61.7 |
| Prolong rainfall shortage | 15 | 25.0 |
| Hotter environment | 5 | 8.3 |
| Total | 60 | 100 |

Field survey, 2011

The results in Table 3 showed the mean rating of 14 perception statements calculated from individual scores were ranked from 3.88 to 2.62, indicating that farmers were favourably disposed to

effects of climate change on cocoa production in the study area. When the mean of the14 perception statements were ranked, it was found that the statement: 'Change in climate retards growth of cocoa seedling' came first with a mean of 3.88. It means that a variation in climate could retard the growth of cocoa seedling at early field establishment. The other ranked 2nd and 3rd statements are a pointer to the fact that cocoa is affected by low rainfall that could lead to declining yield. This is true according to past studies of Anim-kwapong and Frimpong (2008) and Oyekale, *et al* (2009). However, there was a tie in the ranking of some of the statements which are found in Table 3. The rating of most of the other statements confirms the descriptive results in Table 1 and the summary of the farmers' perception with regards to effects of climate change on cocoa production.

**Table 3: Ranked mean of farmers' perception of climate change effects on cocoa production**

| Statements | Mean | Std Dev | Rank |
|---|---|---|---|
| Change in climate retards growth of cocoa seedling | 3.88 | 1.44 | 1 |
| Cocoa is sensitive to changes in sunshine and rainfall delaying pod development | 3.48 | 0.83 | 2 |
| In mature cocoa plant, water deficit and excess results in low yield | 3.38 | 0.98 | 3 |
| Changes in weather retards cocoa development of cocoa tree | 3.38 | 0.92 | 3 |
| High sunshine intensity promotes good leaves colouration for better cocoa production | 3.22 | 0.94 | 5 |
| Black pod disease is mostly destructive to cocoa during wet season | 3.07 | 0.99 | 6 |
| Weather variability does not shift the distribution of insect pests in cocoa farm | 3.05 | 0.96 | 7 |
| Flowering of cocoa is delayed as a result of prolong drought | 2.92 | 1.15 | 8 |
| Cocoa is not susceptible to drought | 2.85 | 0.9 | 9 |
| Sparsely distribution of cocoa leaves on the tree is attributable to low temperature | 2.78 | 1.04 | 10 |
| Cocoa tree will not wither during long dry period | 2.78 | 1.01 | 10 |
| Short dry season reduces cocoa yield | 2.68 | 0.98 | 12 |
| Climate change encourages cocoa seedling growth | 2.65 | 1.29 | 13 |
| It is only rainfall that can enhance cocoa pod survival | 2.62 | 1.03 | 14 |

Field survey, 2011

Table 4 indicated that 61.7 % of the farmers had high perception while 38.3 % indicated low perception level about the effects of climate change on cocoa production.

**Table 4: Level of farmers' climate change perception on cocoa production**

| Level of perception | Scores | Frequency | Percentage |
|---|---|---|---|
| High | ≥ 42.75 | 37 | 61.7 |
| Low | < 42.75 | 23 | 38.3 |

Field survey, 2011 Mean 42.75 Standard Deviation 4.17

Minimum score 33 Maximum score 52

Correlation analysis in Table 5 revealed a significant relationship between farmers' perceived effects of climate change on the amount realised from the sales of cocoa beans. It implies that the lesser the climate change effects, the better for farmers to get more money from the sales of cocoa beans yield. This result is similar to Oyekale, *et al* (2007). They found out that most cocoa farms examined in Ondo State had declining yield as a result of unfavourable climate changes.

**Table 5: Correlation of farmers' perceived effects of climate change on cocoa production**

| Variables | r | p |
|---|---|---|
| Amount realised from sales of cocoa beans | -0.412 | 0.001** |

Field survey, 2011

**CONCLUSION AND RECOMMENDATION**

The study concluded that many farmers perceived the effect of climate change to retard cocoa seedling growth, reduce pod development and yield. Inadequate rainfall was a major climatic factor influencing cocoa yield. Farmers had high perception about the effect of climate change on cocoa production which means that they were observant about negative changes in climatic variables in their farms.

The amount realised from the sales of cocoa beans was found to be an important factor on the perceived effects of climate change. The farmers' perception of climate change effect is a reflection of the challenges posed by variations in weather impacting food production and income.

There is need for appropriate strategies that will mitigate the effects of climate change on cocoa production. A community based early warning system from relevant bodies that will reduce the negative impact of weather on production needs to be put in place. This will help alleviate the fear of farmers about the negative effect of climate change on cocoa development.

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