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Climate Change Awareness and Coping Strategies of Cocoa Farmers in Rural Ghana

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Abstract
The study assessed the perception of farmers on the awareness, causes and impact of climate change on their farming activities. The study further identifies and describes the various coping strategies adopted by farmers and ways of improving upon them to effectively tackle change in climatic conditions. The collected data were analyzed using descriptive statistics, such as frequencies, and percentages. The other key technique that was employed to address the objective includes the Chi square X^2 analysis. The findings indicates that, the (X^2) calculated (25.846) is greater than X^2critical (18.307); implying that, respondents (cocoa farmers) in all the cocoa growing regions in the country are much aware of climate change and its impact on their farming activities ranging from the time of planting cocoa to the time of harvesting and drying cocoa beans. Main causes of climate change by farmers' perception include God's plan signifying the end of time, usage of heavy machines on land, air and water, deforestation, indiscriminate bush burning before farming or in search of game, farming alongside river bodies and illegal mining. Amongst the coping strategies identified include the soil fertility strategy, shade management strategy, land preparation strategy, farm size strategy and lining and pegging strategy. It evident that the existing agencies and government bodies have not been responsive enough in addressing the climatic problems, forecasting skills and opportunities facing cocoa farmers as crucial factors of risk posed by climate change. The study advocates that government and stakeholders should put up educational programmes tailored to meet the climatic information needs of farmers especially the causes to enable them cope with the emerging challenges to enhance their production. This could be realized through effective extension services.
Keywords: Cocoa Farmers, Climate Change, Chi square, Coping strategies, Rural Ghana.

1. Introduction

The United Nations Framework Convention on Climate Change (UNFCCC) year defines climate change as a change of climate which is attributed directly or indirectly to human activities that alter the composition of the global atmosphere and which are in addition to natural climate variability, observed over comparable time periods. The Intergovernmental Panel on Climate Change (IPCC) on the other hand defines climate change as a statistically significant variation in either the mean state of the climate or in its variability, persisting for an extended period (typically decades) (IPCC Working Group I, 2001). Cocoa production in Ghana is one of the major agricultural subsector which contributes significantly to the generation of employment and foreign exchange for the country. In 2003 production year, cocoa farmers really experienced a decrease in production output from 5000kg to 2000kg due to some climatic factors which affecting cocoa farm lands and cocoa trees source? In the cocoa production process, resources are required. These resources are classified as natural and man-made resources. Natural resources include all the materials and forces that are supplied by nature. Those that are most essential for cocoa production are land, water, sunshine, air, temperature and soil conditions. Man-made resources are supplied and influenced by man. They include labour (family or hired labour), Capital, management or entrepreneurship. Among the natural resources, climate is the predominant factor that influences cocoa production. Climate is the state of the atmosphere, which is created by weather events over a period of time.

The importance of cocoa in the economy of Ghana cannot be over emphasized. In Ghana, the popularity and earnings from cocoa have made this subsector an area of interest to policy makers especially due to its contributions to total Gross Domestic Product (GDP) and being the highest foreign exchange earner among all agricultural commodities. This study is meant to get a clearer understanding of the impact of irregularity in the climatic conditions on the production of cocoa in Ghana from farmers' perspective. This is necessary because a relatively large proportion of the labour forces in the rainforest areas in rural Ghana are engaged in Cocoa farming.

At the beginning of the Third Millennium, we live in an era of increased environmental awareness, in which governments and various international agencies have become aware of several major challenges, such as: population increase, poverty and climate change. Among these, climate change is perhaps the most insidious and least localized. Ghana stands the risk of losing its position as the third world leading producer of cocoa if the

current trends in climate change persist. In the face of these challenges, there have been modicum studies on the perception of cocoa farmers who are directly involved and depend solely on climatic factors for the progress of the work they do. As a result of climate change, only the Western Region is producing the bulk of the nation's cocoa as the other regions have lost their soil fertility. With the foregoing, this study endeavors to find answers to the following research questions:

- Are cocoa farmers aware of climate change and its impact on cocoa production?
- What are the effects of climate on cocoa production?
- What coping strategies are being adopted by cocoa farmers in sustaining crop failure and cocoa yield loses?
- What are the problems associated with the coping strategies and how do farmers intend to improve upon them?

Adequate knowledge on climate change and coping strategies would benefit the farmers and the economy as a whole through the following:

- The involvement of farmers in the research will go a long way to inform them on the impact of climate change on cocoa production.
- The farmers, by identifying their strength and weaknesses would strive to determine the ways and means of improving upon the adapted techniques to coping with climate change hence crop failure.
- This research will contribute to natural resource management by providing concepts, scientific information that would be valuable in formulating and implementing policies that would support sustainable management of natural resources for cocoa production. Lastly, the research would also serve as a valuable source of information for anyone seeking to be informed about the impact of climate change on cocoa production

2.0 Literature Review

2.1 Adaptation

This is the ability to respond and adjust to actual or potential impacts of changing climate conditions in ways that cause moderate harm or takes advantage of any positive opportunities that the climate may afford (IUCN *et. al.*, 2004). It includes policies and measures to reduce exposure to climate variability and extremes, and the strengthening of adaptive capacity. Adaptation can be anticipatory, where systems adjust before the initial impacts take place, or it can be reactive, where change is introduced in response to the onset of impacts (ibid). They should include local actions taken by the poor people themselves in response to changing market or environmental conditions. The process of adaptation includes learning about risks, evaluating response options, creating the conditions that enable adaptation, mobilizing resources, implementing adaptations, and revising choices with new learning (ibid). Adaptation activities can be of different types; from the purely technological (such as sea defence construction), through behavioural (such as shifts in choice of food or recreation), managerial (such as changes in farming methods) and policy (such as planning regulations). This has happened because people's taste and preference has changed due to globalization. (Environmental Protection Agency EPA *et al.*, unpubl. data).

2.2 Climate Change and Cocoa Production in Ghana

Farmers' perception of changes in rainfall pattern is supported by studies at Akim Tafo which indicated that annual rainfall (1938 – 86) followed a two year cycle with a weaker cycle of five years. Thus years of relatively low or high rainfall might occur every ten to twelve years when the two cycles reinforce each other (Brew, 1991). On a continental scale it has been shown that the change between 1931 – 60 and 1961 – 90 mean seasonal rainfall in the southern Coastal Regions of west Africa and parts of west Equatorial Africa has been dominated by an increase of Boreal Summer rains (June – July – August) with over 0.4mm per day, an increase of about 10 percent; and a decline of austral summer (December-January-February) rains by about 0.2mm per day, a decrease of about 0.2mm per day which is a decrease of about 15 percent. Autumn (September-October-November) rainfall rates have also declined around the Gulf of Guinea Coast by more than 0.4mm per day. Possible causes may be summarized as falling into three broad areas: namely land cover changes within the continent; changes in global ocean circulation which are associated with patterns of sea-surface temperatures; and changes in the composition of the global atmosphere (Hulme,1992). Land cover changes in Africa have occurred within two main biomes – the tropical rainforest and acacia savannah. Theoretical and empirical evidence that contemporary tropical rainforest destruction significantly reduces regional – scale rainfall remains inconclusive for Africa, although there is no doubt that moist micro-climate ideally suited to cocoa is lost when forest areas are opened up by felling and bush fire. It is well established that cocoa is highly sensitive to changes in climate from hours of sun, to rainfall and application of water, soil conditions and particularly to temperature, due to effects on evapotranspiration. Climate change could also alter stages and rates of development of cocoa pests and pathogens, modify host resistance and result in changes in the physiology of host – pathogen/pest

interaction. The most likely consequences are shifts in the geographical distribution of host and pathogen/pests, altered crop yields and crop loses which, will impact socio-economic variables such as farm income, livelihood and farm – level decision making. Hence, the need for an understanding of climate change impacts on cocoa production and the potential for adaption to climate change.

3. Methodology

3.1 Study area

Cocoa as a tropical crop is specific in its climatic and soil requirement. For good growth, forests areas with deep well drained soils that vary from loamy sands to friable clays red or reddish brown in colour are preferred. Thus, Ghana cocoa can only be profitably grown in the tropical rain forest belt. The tropical rain forest of Ghana is divided into five major forest types namely: Wet evergreen, Upland evergreen, Moist evergreen, Moist Semi-deciduous (North –West and South-East subtypes) and Dry semi-deciduous (Fire Zone, inner Zone and marginal subtypes) (Hall and Swaine, 1981). The bulk of Ghana's cocoa is produced in the moist evergreen and moist semi-deciduous forest areas, thus for the purpose of assessing potential climate change effect on cocoa production in the country, six areas (cocoa districts) representative of these forest types are chosen for the study. These are:

1. Dunkwa (Moist evergreen- Western North region)
2. Brekum (moist semi-deciduous; Brong-Ahafo region)
3. Offinso (Moist semi-deciduous; Ashanti region)
4. Suhum (Moist semi-deciduous; Eastern region)
5. Assin Fosu (Moist evergreen-Central region) and
6. Hohoe (Moist semi-deciduous; Southeast subtype-Volta region).

The soils in these areas fall under the suitable to highly suitable cocoa soil classification of Adu and Mensah-Ansah (1969) as described above.

3.2 Sampling technique

Each cocoa district was zoned into fifteen (15) operational areas. Using simple random sampling, ten (10) operational areas were selected from each district within which five (5) communities /villages were randomly selected from each zone. From each village, with the help of cocoa co-operative leaders, ten (10) cocoa farmers were selected at random making a total of 300 farmers as respondents. Farmers' views on climate change and accounts of their means of coping with the changes were collected through semi-structured questionnaires, focus group discussions, interviews and field observations in the 30 rural cocoa growing communities

3.3 Method of data analysis

3.3. Farmers awareness on climate change

Here the Chi Square Distribution was employed and tested. The test statistic is given by: $X^2 = \sum \frac{(O-E)^2}{E}$

where x^2 = Chi-square statistics, Σ = summation sign, O = Observed frequency, E = Expected frequency. The degree of freedom for chi-square is computed as DF = (R– 1(C –1) where DF = Degree of freedom R = Row and C = Column

Farmers' opinions about climatic factors that affect their farming activities were sought and they were asked to indicate whether they have seen changes in these conditions over the years.

Statement of Hypothesis

Ho: Opinion concerning climate change and its impact on cocoa production depends on the region in which the farmer cultivates his/her cocoa.

Hi: Opinion concerning climate change and its impact on cocoa production does not depend on the region in which the farmer cultivates his/her cocoa.

Decision Rule

The chi–square (x^2) test represents the difference between the given frequencies and the expected frequencies obtained. If for instance the calculated value of chi square (x^2) is greater than the chi square (x^2) in the table, there is an association between the variables being measured. Thereby confirming the alternative hypothesis. On the other hand if the calculated value of chi- square is less than the chi-square (x^2) given in the table, there is no association between the variables in the hypothesis. Implying, rejecting the null hypothesis. The rejection of the null hypothesis means the acceptance of the alternative hypothesis. In this research therefore, 5% level of significance is employed.

3.2.3 Impact of climate change on cocoa production and coping strategies

Here farmers were made to indicate the weather variables that are suitable for their cocoa production and the effect of these variables on their production activities. They were again made to identify coping strategies that they have adopted because of climate change to ensure that crop failure is minimized. Things that could be done to help them sustained these coping strategies were also listed**.** Using a simple statistical tool SPSS, responses of farmers were analysed using frequencies, percentages and simple bar chart and graph.

4. Results and Discussion

4.1 Farmers awareness of climate change and its effects on their cocoa production

Table 1 displays the chi square distribution of the respondents in the study area. The X^2calculated (25.846) is greater than X^2 critical (18.307); this means that the null hypothesis is rejected in favor of the alternate hypothesis which states that opinion concerning climate change and its impact on cocoa production does not depend on the region in which the farmer cultivates his/her cocoa. By implication, respondents (cocoa farmers) in all the cocoa growing regions in the country are much aware of climate change and its impact on their farming activities ranging from the time of planting their cocoa, emerging pest and diseases to time of harvesting and drying their cocoa beans. Thus change in climatic factors is not restricted to the region in which a cocoa farmer resides and cultivates his/her cocoa.

4.3 Farmers Perception on causes of climate change

In seeking the general views of farmers on the causes of climate change in the study area to support the claim that farmers are much aware of climate change, it is revealed in the data in figure 1 that, majority (28.33%) of the respondents are of the general view that, the change in climate is as a result of God's plan to signifying the end time. Thus farmers are of the view that, climate change is a true reflection of God's plan to change nature and that is something that is bound to happen which man cannot do anything about it. This is followed by 20% of the respondents, reporting the usage of heavy machines on land, air and water and urbanization as causes of climate change.

However about 18% of the farmers attribute climate change to deforestation, while about 12% attribute climate change to the sinful nature of man. They are of the view that, it is the wrath that God is bringing upon mankind as a result of our wicked, corrupt, untruthful and stubborn ways.

Additionally 10% also attribute climate change to the manipulation by the whites. They are of the strong view that the numerous launching of space crafts and suspension of satellites disorganizes nature's arrangement causing these varied changes. Depletion of the ozone layer accounted for (6.67%) while 5% of respondents could not identify factors that have brought about changes in climatic factors which they depend solely to cultivate their crop. These causes stated by farmers are evidential of their awareness of climate change. By implication even though there exist an appreciable level of awareness about climate change, farmers do not have the real knowledge and capacity to cope with these changes in climatic factors which are inexhaustible to their work (farming).

4.3.1 Perception of Farmers on Human Activities that causes Climate Change

Figure 2 shows the distribution of the perception of farmers on human activities that cause climate change. Majority (30.67%) of the respondents attributed the change in climatic factors to deforestation, followed 26.67 percent of farmers who found indiscriminate setting fire to bushes before farming or in search of game as human activity that contributes to climate change, with farming alongside river bodies been 16%.

Furthermore, 13.33% of the respondents also consider land degradation activities such as illegal mining as human activity that causes climate change while 8.83% attributed it to farming activities such as excessive tillage. Even though 5% of the respondents are aware about climate change they do not know the actual cause. This goes on to corroborate the earlier assertion of the general awareness of climate change and its impact on cocoa production. By implication, farmers are much aware of the increasing population where human activities such as land clearing for food crop production and building to provide shelter, increasing infrastructure development to meet the demands of the growing population has led to the depletion of the vegetation cover. The behavior or attitude of cultivating around river bodies and lack of jobs compelling majority of the population to engage in illegal mining at the detriment of the forest cover is also a worrisome cause.

Farmers are complaining that in the yore, when these human activities were not being carried out at all or were done at controlled and minimal levels, they had rains and sunshine in due seasons and these supported their production or farm establishments. However, comparing now to then, they have seen that these observed patterns have changed overtime and is having a multitudinous effect on their activities as it has brought varied cocoa production problems with their concomitant cost.

4.4 Effects of climate Change on Cocoa Production from the Farmers Perspective

Figure 3 illustrates the perception of farmers on the relative importance of weather variables to cocoa production. Farmers admitted the phenomenal role climatic factors such as temperature, wind, humidity, rainfall and sunshine play in their cocoa cultivation. Majority (60%) of the respondents regard rainfall as the most important weather variable in their cocoa production, followed by relative humidity (21.67%), sunshine(11.67%), temperature(4.33%) and wind (2.33%).On the contrary, the respondents admit the fact that, the excessiveness of these weather variable could affect their production and argued that moderate portions of these at the right time in the varied phases of their production ranging from seedling phase, establishment phase and processing phase are what is desirable. This is because weather and climate influence most of the processes involved in cocoa production for example: solar radiation produces energy for warming the soil, plants, air and metabolic

processes; rainfall and it characteristics in terms of amount, intensity, reliability and distribution influence crop growth and soil erosion. Atmospheric evaporability determines the performance and survival of crops. Planting date of cocoa seeds is determined by start of the rains Sun drying reduces the water content of cocoa seed and makes its processing easier. Piecing up these information shows that all cocoa production processes are directly or indirectly weather and climate dependent (Oyekale et al. 2009).

Furthermore**,** this finding supports the research by (Oyekale et al. 2009) which explains further the importance of these weather variables. In their work, they stated that, cocoa is highly sensitive to changes in climate from hours of sunshine to rainfall and application of water, soil condition and particularly to temperature due to effects on evapotranspiration. Climate change could also alter stages of rates of development of cocoa pests and pathogens, modify host resistance and results in changes in physiology of host pathogen or pest interaction and this altered cocoa yields and resulted to crop loses which, will impact socio-economic variables such as farm income, farm level decision making, marketability and farmers' livelihoods.

This study reveals the way climate change may affect cocoa production in our cocoa communities. Figure 4 shows that, majority (94%) of farmers totally agree to the fact that optimum temperature/sunshine reduce the incidence of black pod on their farms. According to Dakwa (1977), relative humidity is associated with the development of black pod disease across cocoa growing belt of West Africa. This finding supports the research conducted by Dakwa. However, a seemingly high number of farmers (91%) also agree and attest to the fact that increasing black pod infestation is highly aided by high rainfall (high humidity) on their farms. It is worth mentioning that; black pod is an infectious disease which spreads to other cocoa farms if not controlled early. It can destroy a cocoa farm within eighteen to twenty-four (18-24) months. It is caused by a fungus called *phytophtora spp.* However, a few of the respondents do not know whether rainfall, humidity, temperature or sunshine is what brings about incidence of black pod in their farms.

4. Coping Strategies of farmers

The research revealed that, the coping strategies (adaptation options) adopted by Cocoa farmers to sustain adverse effect imposed on cocoa production by climate change can be categorized into shade management strategy, soil fertility strategy, land preparation strategy, farm size strategy(diversification of crop) and lining and pegging strategy. The specific methods embedded in each of these strategies are elaborated below.

4.5.1 Shade management strategies

In finding out the coping strategies that have been adopted by farmers in minimizing crop failure as a result of climate change, it was revealed that 87.33% of the total respondents employ shade management on their farms. This somewhat implies that farmers have adopted the education given to them by the cocoa extension workers on excessive tree removal and maintaining adequate number of trees required in an acre of farm (5-8 trees) as well as adequate pruning of branches and chupons. However 11% do not employ shade management, this is attributed to lack of knowledge on how to manage shade in their farms or difficulties in removing some of the excessive trees due to old age of the farm and farmer him/herself. About 1.66 percent of the respondents representing a relatively small proportion however, did not comment due to lack of knowledge in shade management issues. Shade management is crucial for good growth and subsequent crop yield.

Figure 6 illustrates the distribution of the various shade management coping strategies adopted by the farmers. Majority (39%) combine thinning of existing forest and natural regeneration, 35 percent practice only thinning of existing forest as a strategy while only 10 percent practice natural regeneration. The natural regeneration of vegetation is a dynamic process by which life recolonises land when the vegetation has been partially or totally destroyed. Life recovers the lost ground through the mechanism of the succession of species. In this process woodlands are restocked by trees that develop from seeds that fall and germinate in-situ. Restocking by natural regeneration is often unsatisfactory, this is because dispersed seeds may either be eaten up by birds or destroyed thereby having few germinating. This is followed by 5 percent of the farmers employing tree planting and only a percent combining thinning of existing forest and tree planting as a strategy. By implication the forestation attitude of the farmers is very poor even though they tend to remove most of the forest trees during land preparation.

When a forest is thinned, the decrease in shade allows much more sunlight to reach the forest floor, causing the foliage and small trees to dry out, creating entire forests full of tinder. When left alone, forests are naturally moist places, making them less prone to rampaging fires. Thinning also allows more wind to hit remaining trees, causing them to crack and fall. Despite all this drawbacks majority of the farmers combine thinning of existing forest and natural regeneration as a major coping strategy.

4.5.2 Soil Fertility Management strategy without Fertilizer Usage

Commenting on the soil fertility improvement strategy by the respondents without the use of fertilizers in figure 8, it shows that majority (52.7 percent) of the respondents depend on cleared weeds and litter from shed cocoa leaves as mulch. Farmers are most interested in the without fertilizer use strategy as a way of improving soil fertility as it is not expensive and there is rapid decomposition of mulch materials thereby increasing nutrient

absorption of the plants. Despite the difficulties in getting poultry manure, its transportation and application, 15 percent of the farmers prefer using poultry manure to other strategies due to the fact that it contains high amount of soil nutrients. Additionally, 23.7 percent of farmers use other crop residues as a source of fertilizer upon decomposition. It was argued that, using chemical fertilizers for a long period of time renders the soil infertile hence the preference of green manuring over chemical fertilizers by some of the farmers. As majority of the respondents were specific about the type of soil improvement strategies they were using, others (8.6%) did not indicate which strategy they were using due to lack of knowledge about it.

4.5.3 Land Preparation Strategy

Table 1 presents the various land preparations strategies employed by the respondents. Majority (64.67%) of the respondents slash, gather and burn stamps on their farm land before planting. By implication the ash produced after burning which contains potassium serves as a source of nutrients for the plant. Farmers are of the view that this practice allows the land to be free from wild animals such as snakes. The possible problem with this practice however is the destruction of the soil microorganism. Burning produces smoke and this serves as pollutant as well as a factor in destroying the ozone layer.

On the contrary, 34.33% of the respondents slash and allow the bush to rot on the farm land with the reason that, the rot will help maintain the soil through mulching for optimum plant growth. By implication farmers practice these two methods depending on the vegetation in which they situate their farming activity. It further shows that slashing and burning is the most practiced and this is a good cause of climate change.

4.6.4 Farm Size Strategy

Table 2 displays that, majority (54.7 percent) of the farmers are increasing their farm size by expanding their existing farms and establishing new farms in addition to old and low yielding ones. Thus adhering strictly to crop diversification as a measure to take advantage of poor climatic conditions. Crop diversification involves engaging in production activities that are drought tolerant and or resistant to temperature stresses as well as activities that make efficient use and take full advantage of prevailing water and temperature conditions, among other factors. Crop diversification can serve as insurance against rainfall variability as different crops are affected differently by climate events. 45.3 percent of the farmers are also replanting their missing stance in order to increase the population of their crops.

4.6. 5 Lining and Pegging Strategy

Table 3 shows the distribution of lining and pegging strategy farmers have adopted in order to adapt to crop failure as a result of climate change. Lining and pegging is a best farming practice that is important in cocoa cultivation. 47.04 percent of farmers use the lining and pegging strategy whereas 52.96 percent of them do not use the strategy of lining and pegging. Farmers are of the view that when they line and peg before planting, it helps prevent the rapid infestation of their crops with disease and pest compared with when planted otherwise. Furthermore, it ensures that they have the right numbers of plants to avoid overestimation and underestimation of the inputs that would be needed on their farm.

4.7 Reliability of Weather Information

Figure 14 displays the reliability of update of weather variables information from the Ghana Meteorological Agency to farmers. Majority (33.67%) of the respondents find reliable the information disseminated to them on the various climatic factors which they depend solely for their farming activities. 32.33% of the respondents find it very reliable, followed by not reliable (20.67%) and 13.33% somewhat reliable. By implication majority of the respondent depend on the update of these weather variables to be able to know when to plant, harvest and process their beans. A quite substantial number of them however also find unreliable this information. This would either directly or indirectly affect their activities since their production is weather and climate dependent. Information is very important in increasing the capacity of farmers to survive external shocks or changes as a result of the climate change. It is therefore an important tool in managing a variety of risks associated with climate change.

4.9 Farmers Participation in Climate Change Programme Organized by Government or any NGO.

From the interaction with farmers, it is realized that majority (97%) have not benefited in any climate change training/programme either by a Governmental or Non-Governmental organization. Why focus on farmers? Because the consensus, as you will see, is that climate change will hit agriculture and developing countries hardest. Unsurprisingly, Ghana's economy, as with that of most developing nations, depends on agriculture for survival. Therefore a programme tailored to meet the climatic information needs of farmers and how to cope with the emerging challenges would enhance their production

5. Conclusion

This study considered the perception of farmers on the impact of climate change on cocoa production in Ghana. The study established that all cocoa farmers irrespective of their geographical locations are aware about climate change and its multitudinous effect on their farming activities. They however hold varied views about activities

of man and nature that causes this change. Despite this, effort by government and stakeholders have been very minimal in sensitizing and educating farmers in order to make informed decisions in adopting appropriate coping strategies. Mostly farmers depend on members, past experience, the Ghana meteorological agency for weather updates but the reliability of this is sometimes in big doubt thereby affecting farming activities.
Climate change has really been the major factor which has affected the production of cocoa as a result of change in weather conditions which does not favour the production of cocoa particularly, by decreasing the seedlings i.e. cocoa pods expected of the trees to produce and germination of new cocoa trees.

6. Recommendations

From the foregoing, it is recommended that government should increase subsidy to cocoa farmers to enable them purchase pesticides, fertilizers and the needed farm inputs that can help farmers cope with emerging pest and diseases that have emanated as a result of climate change to improve production of cocoa.
It is recommended that government and stakeholders should put up educational programme tailored to meet the climatic information needs of farmers to enable them cope with the emerging challenges to enhance their production. To achieve this, the Ghana Meteorological Agency should be well equipped to give accurate information about the weather. NGOs and other private partners in and outside the cocoa sector should be fully involved in the education and sensitization of farmers on issues bordering climate change, causes and controls.

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Table 1: Chi-Square Distribution

	AWARE	NOT AWARE	CAN'T TELL	ROW TOTAL
DUNKWA	47 (45.8)	1 (3.2)	2 (1)	50
BEREKUM	41 (45.8)	7 (3.2	2 (1)	50
ASSIN FOSU	50 (45.8)	0 (3.2)	0 (1)	50
HOHOE	42(45.8)	8 (3.2)	0 (1)	50
SUHUM	46 (45.8)	2 (3.2)	2 (1)	50
OFFINSO	49 (45.8)	1(3.2)	0 (1)	50
COLUMN TOTAL	**275**	**19**	**6**	**300**

- ***Chi Sq = 25.846, DF = 10 P – value =0.05 Source: Computed from survey data 2010-11***

Table 2: Distribution of Land Preparation Strategy by Respondents

LAND PREPARATION STRATEGY	FREQUENCY	PERCENTAGE
SLASH,GATHER AND BURN STUMPS	80	34.33
SLASH AND ALLOW TO ROT	153	65.67
TOTAL	**233**	**100**

Table 3: Distribution of Farm Size Strategy by Respondents

INCREASING FARM SIZE STRATEGY	FREQUENCY	PERCENTAGE
NEW ESTABLISHMENT OF COCOA	157	54.7
REPLACING MISSING STANDS OLD ESTABLISHMENT	130	45.3
TOTAL	287	100

Table 4: Distribution of Lining and Pegging Strategy by Respondents

LINING AND PEGGING BEFORE PLANTING STRATEGY	FREQUENCY	PERCENTAGE
EMPLOY LINING AND PEGGING	135	47.04
PLANT WITHOUT LINING AND PEGGING	152	52.96
TOTAL	**287**	**100**

Fig 1: Farmers perception on the causes of climate change

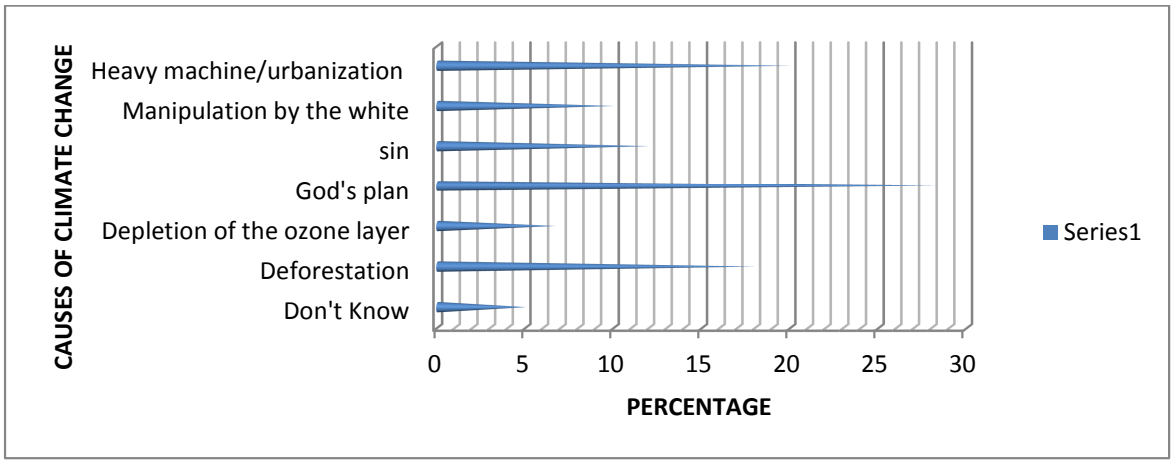


FIG 2: PERCEPTION OF FARMERS ON HUMAN ACTIVITIES THAT CAUSES CLIMATE CHANGE

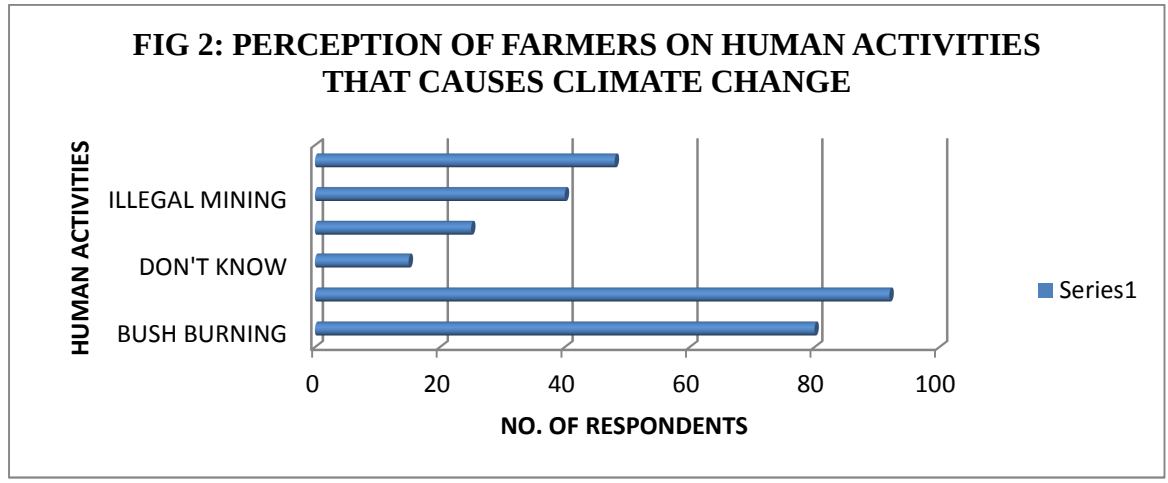


FIG 3: FARMERS PERCEPTION ON RELATIVE IMPORTANCE OF WEATHER VARIABLES TO COCOA PRODUCTION

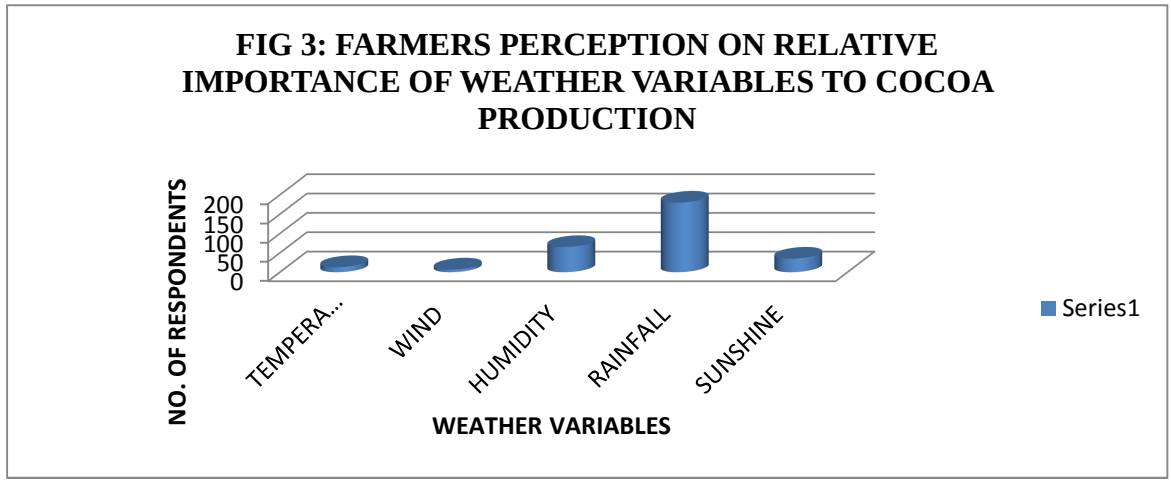


FIG 4: WEATHER VARIABLES VERSUS BLACKPOD INCIDENCE

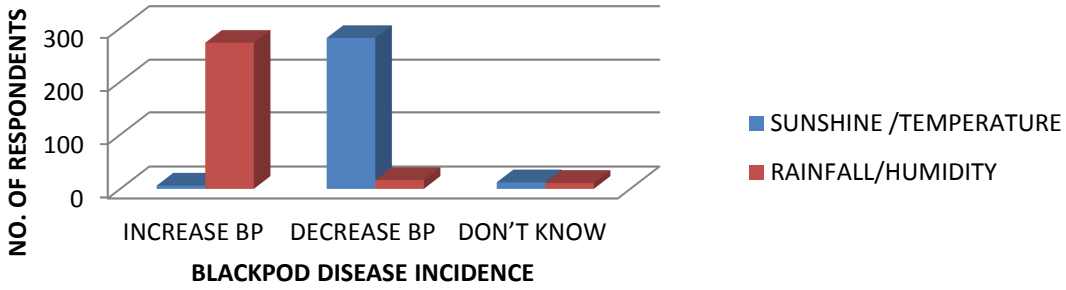


FIG 5: DISTRIBUTION OF RESPONDENTS BY SHADE MANAGEMENT STRATEGY

FIG 6: SHADE MANAGEMENT STRATEGIES

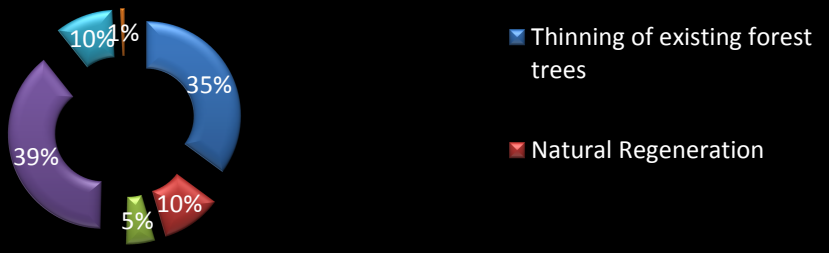
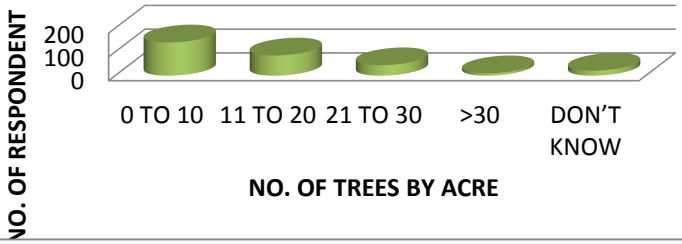


FIG 7:SHADE TREE POPULATION IN RESPONDENTS FARMS



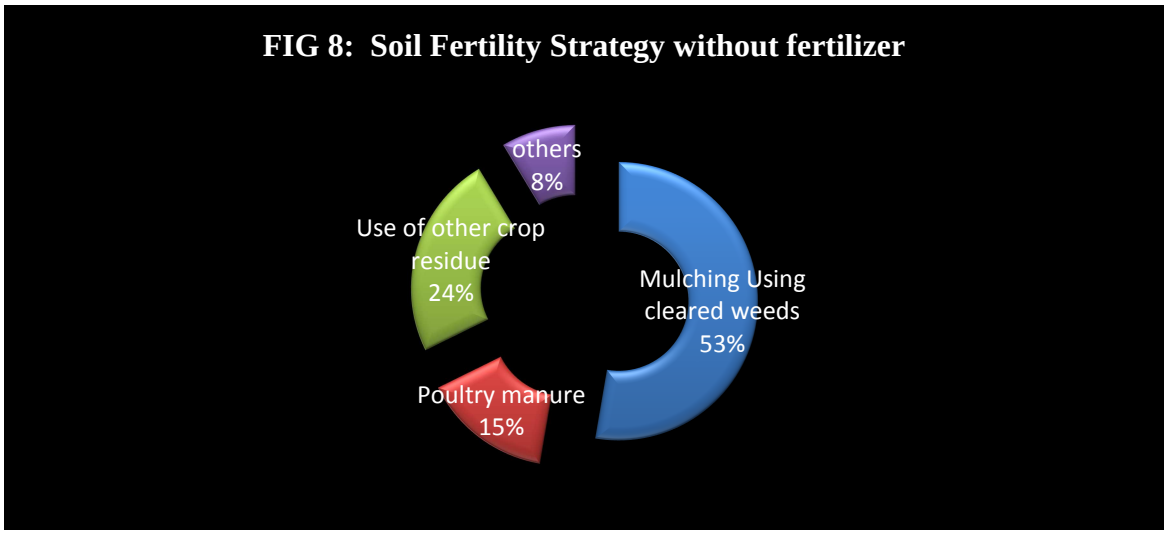
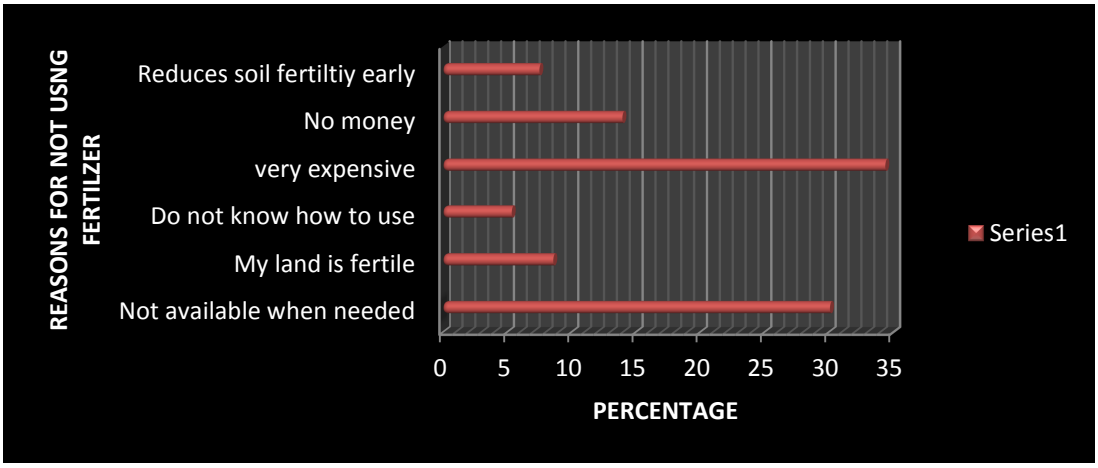
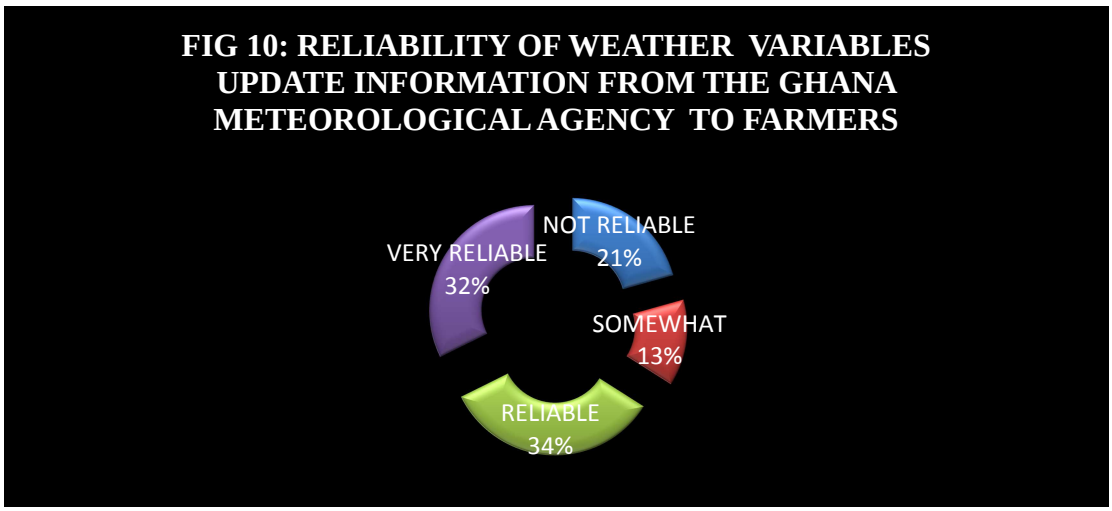
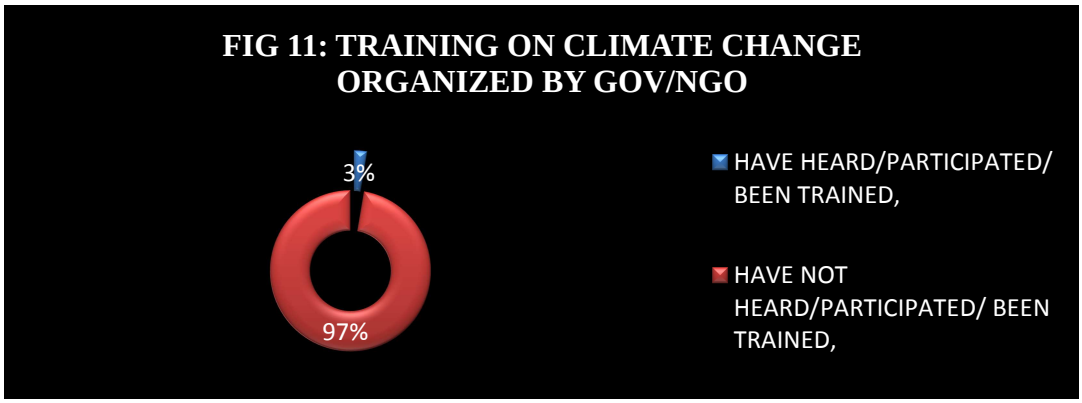


FIG 9: REASONS GIVEN BY RESPONDENT FOR NOT USING FERTILIZER







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