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Impacts of Climate Change on Chocolate and Cocoa Production

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Abstract: The demand for chocolate and cocoa products in the international markets are larger than supply due to certain constraints that affect its production. Among the recent and pressing challenges that have been neglected as a factor in cocoa production is climate change. Climate change which is characterized by drought, flood and high temperature has a negative significant impacts on cocoa and chocolate production in Sub-Saharan Africa. This research examines the impacts of climate change on chocolate and cocoa production using a case study of Nigerian cocoa farmers in the South West Region of the country. The research used descriptive survey type in addition to review work on the topic. The research instrument used was a structured questionnaire administered by trained interviewers a total number of 300 respondents were selected for interview during the growing season between 2016-2017 growing season .The result shows that 90% of the respondents experienced risk on their farms caused by an increase in temperature which has a greater impact on chocolate and cocoa production. Also, 90% experienced risk on their farms caused by change in rainfall pattern, furthermore, 90% experienced erosion on their farms caused by heavy precipitation during the previous year, 80% experienced risk caused by drought which lead to reduction in the yield from their farms , moreover, 40% reported flood incidence on their farms that claimed a loss of 10% of harvested crops that year. Therefore, it is highly recommended that modern adaptation and mitigation strategies should be introduced to farmers particularly, insurance of farms and weather update by agricultural extensions in the area while technological intervention through automation process should be introduced by engineering units and construction of dams to control excess water and make them available for production during drought season.

Key words: Cocoa production, climate change, impacts, chocolate, food security, agriculture

INTRODUCTION

Cocoa production and chocolate has long suffered a setback due to climate change International Cocoa Organization, Anonymous (2019), Bunn *et al.* (2017). Cocoa (*Theobroma cacao*) can be defined as a tree that produces cocoa beans in a pod that is developed from flowers. Cocoa pods when matured are harvested from tree when they changed colour from green to yellow, purple or red depending on the variety. The harvested beans from the pods fermented and dried by sun or other mechanical devices are use to make chocolate and other cocoa products such as cocoa solids, cocoa liquor and cocoa butter. Chocolate can be defined as sweet brown food extracted from roasted and grounded cocoa beans. It can be in liquid, paste or block type which can be used as flavor when combined with other food (Anonymous, 2019). There are different types of chocolate based on variety which have identified as milk chocolate, white chocolate and brown chocolate. Chocolate has been globally accepted and consumed by divers tribe of the nations. The records of chocolate consumption of recent in kilogrammes has shown that almost all the nations of the world consumed chocolate and other produce from cocoa beans.

The statistic records shows the estimate per capita consumption of chocolate worldwide by different country in 2017. This reveals Switzerland as the highest consumer of chocolate per capita with an average of 8.8 kg consumed per person. Ihttps://www.statista.com/statistics /819288/worldwide-chocolate-consumption-by-country.

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The economic importance and demand of cocoa and chocolate in the international market: Cocoa production was a major source of Foreign exchange in Nigeria before the discovery of petroleum and has remained a relevant source of income in the agriculture sector till now. Akande cited by Oladosu and Yekinni (2008) reported that 154,275 tonnes of cocoa were exported in 1993 at the rate of ₦ 926 per tonne which led to a Foreign exchange earnings of about 72 million naira to the Nigeria economy. Recently, US cocoa imports from Nigeria have been trending upwards and imports of cocoa products from Nigeria were estimated at $40 million.

Income from cocoa also play a significant role in reducing poverty among the rural dwellers as cocoa contributes about 70-100% of the annual household income of smallholder cocoa farmers. Moreover, reports from many researchers revealed that consumption of cocoa products have health implications. Cocoa beverages, like chocolate and other products prevent heart disease, helps the circulatory system to function well, prevent diabetes, serves as cough suppressant, prevent diarrhea, act as strong antioxidants in food systems, improves blood flow, decreases blood pressure and increase libido in man (Schuier *et al*., 2005; Usmani *et al*., 2005; DeNoon and Daniel, 2008; Selmi *et al*., 2008; Keen *et al*., 2005; Haley and Victoria, 2010; Crozier *et al*., 2011; Anonymous, 2011).

The detrimental effect of climate change on cocoa production: Research tackle cocoa has perceived the shortcoming of cocoa tree to ecological change. It is represented that cocoa is outstandingly unprotected to drought. The precipitation dispersal configuration is bi-measured from April to July and September to November. There is a short dry period from July to August in the midst of which the relative stickiness is still high with over cast atmosphere conditions. There is a basic dry season from November to February-March. The four to a half year of dry atmosphere results in soil water lack and since, water framework isn't a bit of the developing system, cocoa seedling mortality is high in the midst of the establishment organize. In bearing plants, the nearness of the short dry season in the midst of essential gather case filling can impact bean measure, if it is satisfactorily outrageous. In adult plantings, water insufficiencies result in lower yields and a development in the element of mirid (capsid) harm.

Photosynthetic rate of the yield lessens if the photosynthetic contraption is displayed to light powers outperforming 60% of full sunshine while deferred prologue to high light powers hurts the photosynthetic segment of the leaves. Moreover, low light powers smother sprout age with light measurements under 1800 h year-1 having a broad demoralizing effect on creation. This exhibits the essentialness of appropriate sunshine for most outrageous blooming which give most noteworthy yield.

Cocoa must be beneficially developed under temperatures changing between 30-32°C mean greatest and 18-21°C mean least and total least of 10°C. Temperature has been identified with light use productivity with temperatures beneath 24°C decreasingly affecting the light immersed photosynthesis rate. It was accounted for that black unit sickness which is the most damaging of various infections which assault the creating or maturing cocoa case is controlled by atmosphere and climate condition. This illness is increasingly widespread in clammy circumstances and is most damaging in years when the short dry time frame from July to August is wet. This sickness has a ruinous control over the natural products (Anim-Kwapong and Frimpong, 2005). Mirids (capsids) are sucking creepy crawlies that make cocoa hard to build up. On develop cocoa, capsid harm can cause tree passing. The creepy crawlies are typically most dynamic and ruinous from September to March, especially when dampness deficiency is serious. They are supported by high light power and dampness in the cocoa smaller scale condition.

Cocoa is exceedingly helpless to dry spell and touchy to precipitation appropriation. Noteworthy connections between's cocoa yield and precipitation over shifting interim earlier gather of cocoa cases have been accounted by Omonona and Akintunde (2009) and Oyekale and Oladele (2012). Cocoa seedling mortality is encouraged by prolonged dry season (drought), short dry season affects pod filling which will affect the bean size. Prolonged wet season, windy or cloudy days and rains slow down drying and processing of cocoa seeds thereby reducing the market value of the bean and increase the cost of processing. During dry season, livestock or wild animals contaminated the bean. Moreover, the study conducted by researchers at University of Cambridge on the effects of climate change on cocoa production in Brazil show that drought causes high mortality of cocoa tree, reduction in cocoa yield and infection of diseases (Gateau-Rey *et al*., 2018) However, some researchers have carried out resesrch on the effects of climate change on cocoa production in Nigeria, but what was recorded was not actually take into cognizant the effects on the cocoa producers, that is the farmers who are the stakeholders on the farm. Therefore, there is a need to carry out the survey on the impacts of the climatic elements on the cocoa farmers livelihood, cocoa tree, cocoa beans and sustainability of cocoa production in order to ensure that the goal of ensuring food security

which was highlighted by United Nation in 2016 as zero hunger by 2030 should be realized. It was on this premise that this research stand with the objective of examining the physical, economical and social impacts of climate change on cocoa production and chocolate as a whole and the ways by which sustainable development goals can be attainable.

Sustainable development goals, climate change and cocoa production: Sustainable Development Goals (SDGs) are call for action by all countries in order to sustain and promote prosperity while at same time protecting the planet. These goals have targets of reducing poverty to zero, eliminating hunger, ensuring good health and well being, ensuring quality education, gender equality, availability of clean water and proper sanitation to all. Moreover, it focuses on provision of avoidable and clean energy, decent worked and economic growth, industry innovation and infrastructure, reducing inequalities, establishing sustainable cities and communities, ensuring responsible consumption and production. Furthermore, its objectives include climate action, provision of comfortable life below water and on land, establishing peace, justice and strong institute and partnerships for the goals. All these goals are expected to be realized by the year 2030, https://www.un.org/sustainabledevelophttps://www.un.org/sustainabledevelopment/

Therefore, this research study intends to fill the knowledge gap about the impacts of climate change on chocolate and cocoa production in Sub Saharan Africa. According to United Nation Framework Convention on Climate Change. Latin America, Asia and African are among the four zones with highest impacts of climate in the world. A recent report by the United Nations Office for disaster risk reduction had stated that extreme weather events affected about 60 million people in 2018 alone, upsetting every part of the globe. Therefore, it is important to identify regional impacts on food security and welfare of the most vulnerable citizen in the Africa country. Farmers in Africa cannot be compared with farmers in the developed country because they are the most vulnerable citizen because Africa depends solely on rain fed agriculture. In order to evaluate the impacts of climate change on cocoa production in Africa a case study of cocoa farmers survey from South West Nigeria was used in the study.

MATERIALS AND METHODS

The research adopted a descriptive survey type. The population consists of 3,000 registered cocoa farmers in South-West, Nigeria. A four-stage purposive and stratified sampling technique was used to select 10% of the population registered swith governmental organization, agricultural development programme. This selection cuts across three selected states from six states in the region making 50% of the geo-political zone of South West Nigeria. The reason why the area was choosing was because the area is known for their major contribution to cocoa production in Nigeria. The area selected were: Ondo, Osun and Ekiti States in South-West, Nigeria. The instruments used were interview schedule and structured questionnaire which was used to elicit the data. The questionnaire was validated by experts from Landmark University. The socio economic data of the respondent which may affect their perception of climate change was collected together with the data on awareness of farmers about climate change impacts. But our focus is on the impact of climate change on cocoa production. The impacts were rated with mean to three levels: high, medium and low impacts. Data collected were analyzed using descriptive and inferential statistics such as Pearson product moment correlation and t-test at 0.05 level of significance.

RESULTS AND DISCUSSION

This study also revealed the level of awareness about climate change impacts among the respondents. Results revealed (Fig. 1) that the majority 90% of respondents were aware of the changing climate in the study area while the remaining 10% were unaware of any change. The farmers claimed that they experienced the impacts on their farm and more, so, their interaction with development agency such as Cocoa Research Institute of Nigeria, extension agents, social groups such as cooperative society and farmers unions has increased their awareness. More importantly radio and television, broadcasting has helped them to response to the challenges of climate change.

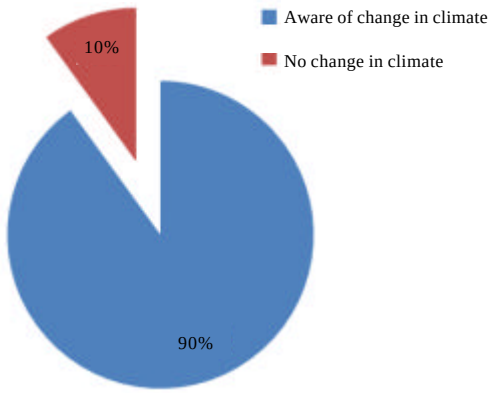

Fig. 1: Respondent's awareness of level of climate change impact (Author Field Survey in 2018)

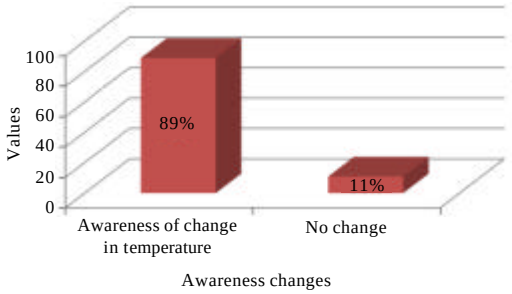

Fig. 2: Respondents awareness change in temperature (Author Field Survey in 2018)

This underscores the importance of interpersonal communication in creating awareness of climate change impacts and creating appropriate technology. This outcome shows that cocoa ranchers in the examination region are bit by bit getting to be mindful of environmental change. This would assist ranchers with adapting to environmental change alleviation measures and help make mindfulness among individual ranchers. The outcome demonstrates that cocoa ranchers are very much aware of environmental change. Mertz *et al*. (2009), and Fosu-Mensah *et al*. (2012) revealed comparative outcomes on Rancher's familiarity with environmental change.

Awareness of temperature change: The 89% of the respondents were aware that there was an increase in temperature while the remaining 11% were not aware of any incident of increase in temperature (Fig. 2). This implies that some farmers perceived high temperature while some farmers did not. As it was ealier mentioned that cocoa production required optimum temperature of 30-32°C increase temperature lead to mortality of seedlings, destruction of pods etc. And this has great effects on yield and quality of chocolate produced.

Change in rainfall awareness impact: The 90% of the respondent were aware that there was a change in the rainfall pattern while the remaining 10% were not aware of any change in the rainfall (Fig. 3) this has great impacts on chocolate and cocoa production because unpredicted rainfall pattern can cause reduction in yield of cocoa and also caused devastating effects on cocoa bean which may result to spoilage of beans and which will drastically affects the production rate of chocolate to feed 9 billion people by 2050. This call for the appropriate intervention by the government and stakeholder in given assistance to cocoa farmers by providing a mechanical and solar energy to assist farmer in the area of production and processing.

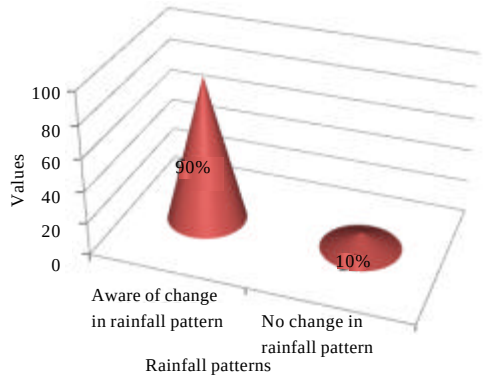

Fig. 3: Respondent's awareness of level of change in rainfall pattern over years (Author Field Survey in 2018)

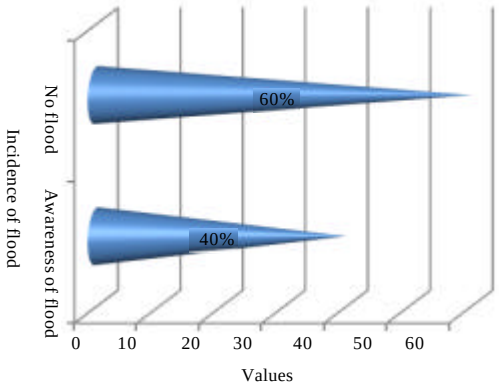

Fig. 4: Respondent awareness of incidence of flood in the study area (Author Field Survey in 2018)

Incidence of flood: The 40% of the respondent were aware that there was a incident of flood as result of heavy rainfall pattern while the remaining 60% were not aware of any incident of flood as result of heavy rainfall pattern (Fig. 4). This implies that some area witness flood while some area did not. This call for the attention of civil and mechanical engineers to assist farmers in building flood proof houses and good drainage system as a means of adaptation to climate change. Also, a dam can be constructed to harvest the water for the purpose of irrigation during the drying seasons.

Incidence of erosion at the farmer's farm: The 90% of the respondents were aware that there was a incident of erosion as result of heavy rainfall pattern while the remaining 10% were not aware of any incident of erosion as result of heavy rainfall pattern (Fig. 5). This implies that some area witness farm erosion while some area did not. Erosion can be defined as the washing away of topsoil which is the major source of nutrient to the cocoa tree.

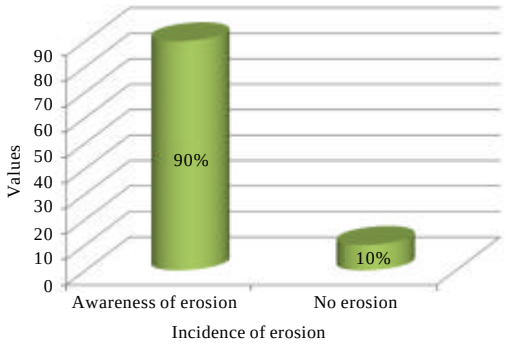

Fig. 5: Respondents awareness of incidence of erosion in the study area (Author Field Survey in 2018)

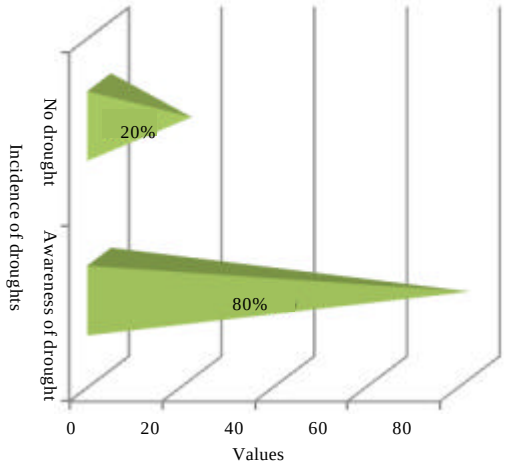

Fig. 6: Respondent awareness of incidence of drought in the study area (Author Field Survey in 2018)

According to Anonymous (2019) erosion can be defined as action that causes surface removal of soil, rock and dissolved material from one location to the other. Erosion can be caused by heavy rainfall and wind. According to Segura *et al*. (2014) water erosion in an area is determined by rainfall runoff erosivity. The research work by Nearing *et al*. (2004) confirmed that intensity of rainfall have a negative impacts on soil and there by reducing productivity. Wind breakers and water drainage system can be constructed by engineers to reduce soil erosion rate which is caused by impacts of climate change. The result has shown that erosion which is as a result of climate change was high in the zone. The consequence is loss of nutrient and low productivity in cocoa production and the ultimate repercussion is poverty. The adaptation strategies used by farmers were application of fertilizers to crop and mulching.

Incidence of drought: The 80% of the respondents were aware that there was a incident of drought as result of prolong dryness while the remaining 20% were not aware of any incident of drought as result of prolong dryness (Fig. 6). This implies that some area witness drought while some area did not. Drought has been reported to have negative impacts on cocoa production as it causes seedling mortality, death of tree, wilting of fruits. premature ripening of fruits etc. (Gateau-Rey *et al*., 2018). The overall impacts on cocoa production is reduction in the output and yield which eventually lead to poor income generation from farming activities, despite of enormous input invested into the system. The overall consequence is increase in poverty level of the cocoa producers. This climatic events call for an intervention on the part of government and non-governmental organization in the cocoa sectors. In order to reduce impacts, additional source of water should be channel into farmers farm by engineers through construction of dams around cocoa farmers farm. More importantly, provision of irrigation system at affordable price to farmers in order to boost the yield from cocoa production.

CONCLUSION

The study concludes that the impact of climate change on chocolate and cocoa production is high with risk experienced as the result shown that 90% of the respondents experienced risk on their farms caused by an increase in temperature which has a greater impact on chocolate and cocoa production. Also, 90% experienced risk on their farms caused by change in rainfall pattern. Furthermore, 90% experienced erosion on their farm caused by heavy precipitation during the previous year, 80% experienced risk caused by drought which caused reduction in the yield from their farms. However, 40% reported flood incidence on their farms that claimed a loss of 10% of harvested crops that year.

RECOMMENDATIONS

Therefore, it is highly recommended that modern adaptation and mitigation strategies should be introduced to farmers, particularly, farm insurance policy and weather update by meteorological stations, drought tolerant varieties of crops and irrigation systems. Moreover, agricultural extensions personnel should communicate the climate smart agriculture to the farmers in the area while technological intervention through automation process should be introduced by engineering units and construction of dams to control excess water and make them available for production during drought season.

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SIGNIFICANCE STATEMENT

This research will provide baseline information to agricultural practitioners, researchers, governmental and non-governmental organization and policy makers in decision making toward reducing the vulnerability levels and impacts of climate change.

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