EXTENT OF CLIMATE CHANGE ADAPTATION BY COCOA FARMERS IN THE ASSIN NORTH DISTRICT OF GHANA

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ABSTRACT

Despite its immense contribution to global economic development and particularly that of Ghana, cocoa production apparently faces numerous challenges including climate change. Whereas empirical literature exists on the perception of farmers on climate change, its effects and adaptation measures used by farmers, there is no evidence on the extent to which cocoa farmers have adapted to climate change. This study therefore, explored the extent to which cocoa farmers in the Assin North District have adapted to climate change. It was found that adaptation strategies adopted by cocoa farmers in the study area include; shade tree management, pruning, improved varieties, mulching, hand pollination, diversification, and avoidance of weedicides. However, extent of climate change adaptation was found to be at low to moderate level. The findings suggest need to intensify education on climate change impact on cocoa production and why the need to adapt at high levels to lessen its effects.

KEYWORDS

Cocoa production, Cocoa farmers, Climate changeAdaptation

1. INTRODUCTION

The cocoa industry contributes significantly to the Ghanaian economy, as it employs approximately 800,000 farm families and generates over $2 billion annually through the foreign exchange of export crops[1]. The country's cocoa production is recognized in the developing world as one of the most modelled commodities and valuables that drive economic growth and poverty alleviation [2], [3]. Despite its immense contribution to global economic development and particularly that of Ghana, cocoa production faces numerous challenges including climate change [4]. Cocoa requires favourable climatic conditions at every phase of its production [5]. Cocoa yield is more highly impacted by precipitation than any climate variable, making the crop vulnerable to the scarcity of soil water [5]. Cocoa-producing regions are anticipated to become increasingly vulnerable to adverse weather conditions as the changing climate advances. According to Okoffo et al.[6], floods and prolonged dry spells are projected to have the greatest influence on cocoa production and food security of households. Other potential climate risks to cocoa production include disruption of seasonal patterns, inconsistent rainfall, rising temperatures, and droughts [7]. Furthermore, climate change tends to enhance the spread of cocoa diseases such as swollen shoot and black pod, thereby altering the resistance of the crop to diseases and pest infestation. Others[5], [8]also noted increased in dieback of cocoa trees, diseases and pest infestation, stunted growth and decreased yield.

1.1. Problem Statement

The Intergovernmental Panel on Climate Change[9] defines adaptation as the interventions that minimizes the adverse effects of climate change while taking advantage of potential new opportunities. Given the significance of cocoa to the economic development of Ghana, it is important to focus attention on adaptation strategies to lessen the impact of climate change on cocoa production. For smallholder cocoa farmers in Ghana who experience poverty and economic vulnerability[10], adaptation is identified as an important strategy that can lessen their vulnerability to climate risks and enhance livelihood security [4], [11].

In their study to assess the determinants of smallholder cocoa farmers' adoption of agronomic practices for climate change adaptation in Ghana, Yiridomoh et al. [12] noted that farmers' decision to adopt soil conservation, pruning/shade management and planting improved varieties are determined by a number of mixed factors including access to extension services, access to credit, access to agricultural land and farming experience. Similarly, Anning et al.[8] found that adaptation measures adopted by cocoa farmers in the Adansi West District of Ghana was influenced by gender, age, education and farming experience among other socioeconomic variables. Earlier studies by Denkyirah et al. [13]reported factors such as gender marital status, educational level, household size, engagement in other economic activities and income from cocoa influence cocoa farmers' choice of adaptation strategies in the Berekum Municipality of the Brong Ahafo Region of Ghana.

Over the years several studies were carried out to determine the perception of farmers on climate change. Others also focused on adaptation strategies used by farmers to mitigate the effect of climate change on cocoa production as well as factors influencing adoption of these adaptation measures. Whereas empirical literature exists on the perception of farmers on climate change, its effect, adaptation measures and factors influencing adoption of adaptation strategies, there is little or no evidence on the extent to which cocoa farmers are adapting to climate change in Ghana and whether the level of adaptation is sufficient enough to mitigate the effect of climate change on cocoa production in the long run. This study therefore explored the extent to which farmers in Assin North District have adapted to climate change on their cocoa farms. The author of this study conceptualises that if cocoa farmers adapt to climate change by adopting recommended practices as shown in Figure 1, this would lessen climate change impact on cocoa production, hence sustainability of the cocoa industry in Ghana.

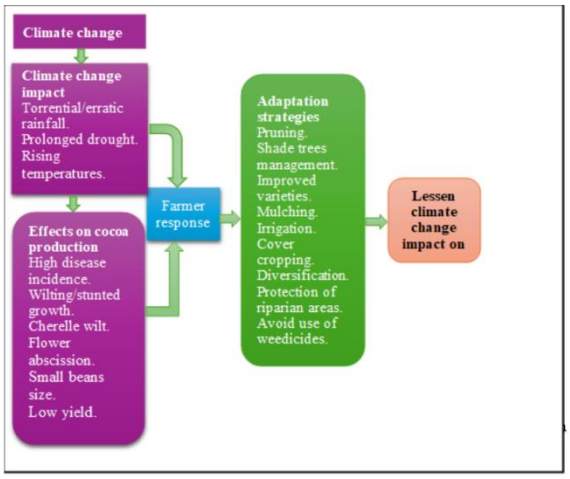

Figure 1. Conceptual framework

Source: Author's own conceptualization, 2024

1.2. Research Questions

To achieve the above broad objective, the following research questions guided the study;

1. What are the climate change adaptation measures used by cocoa farmers in the Assin North District of Ghana?
2. What is the extent of climate change adaptation by cocoa farmers in the Assin North District of Ghana?

Source: Author's own conceptualization.

2. METHODOLOGY

This section describes the study area, data collection, unit of analysis and analytical techniques used to make meaning out of the data collected.

2.1. Study Area

This survey was carried out in the Assin North District of Ghana. The district is situated between Longitudes 10 05' East and 10 25' West and Latitudes 60 05' North and 60 4' South. It was carved out from the defunct Assin North Municipal Assembly in 2017 and was inaugurated on 15th March, 2018 by the Legistlative Instrument LI 2338. It is bounded to the North by the Adansi South District in the Ashanti Region, to the south by the Assin Fosu Municipal, to the East by Birim South District in the Eastern Region, and to the West by Twifu Ati-Morkwa District. The district covers a land area of about 750 sq km and comprises of about 260 settlements including; AssinBereku as capital, Assin Akonfudi, AssinPraso, AssinKushea among others. The population of the district according to the 2021 population and housing census stands at 80,539 with 40,469 males and 40,070 females. Agriculture is the main economic activity in the district, employing 74.4 percent of the economically active population. The district produces agricultural products such as cocoa, rice, oil palm, cassava, maize, plantain, cocoyam and variety of vegetables. Besides crops, livestock rearing is also a major agricultural activity in the district with animals like cattle, sheep, pigs, goats, fish farming and poultry produced on commercial scale.

2.2. Data Collection

Multistage sampling procedure was used to select the sample size for the survey. Sampling procedure involved first sampling 15 communities out from 260 communities. In each selected community, 10 farmers were randomly selected to participate in the study giving a sample size of 150 farmers. The questionnaire for the survey was programmed using Google Forms. Data collected was stored in Excel and imported into SPSS Version 26 for analysis.

2.3. Units of Analysis

The section briefly describes how the variables of interest were gauged on the field during data collection.

2.3.1. Research question 1

Data was collected by observing selected cocoa farms, listing and taking count of agronomic practices adopted by farmers to minimise climate change impact. A check list of climate smart

agricultural practices including; pruning, shade tree management, use of improved varieties, cover cropping, mulching, irrigation, artificial hand pollination, diversification, protection of riparian areas, avoidance of use of weedicides were listed for enumerators to select which ones were applicable.

2.3.2. Research Question 2

Extent of each climate change adaptation strategy was measured on a four-point Likert scale, where 0 = none adoption, 1 = low, 2 = moderate and 3 = high. The assigning of 0, 1, 2, or 3 was gauged from a technical point of view by experienced technical staff of Cocoa Health and Extension Division of Ghana Cocoa Board.

2.4. Data Analysis

Descriptive statistics, mainly frequency tables were used to make meaning out from the data collected using SPSS Version 26.

3. RESULTS AND DISCUSSION

This section discusses results obtained from analysis of data collected for this survey. The findings are discussed in the following sub-sections.

3.1. Demographic of Respondents

A total of 150 cocoa farmers were randomly selected to participate in this survey. This number comprised of 41 females and 109 males. Respondents were aged between 31 to 79 years with average age of 52 years(Table 1), implying we have few youths involved in cocoa farming in the study area.

Farm sizes of participants ranged between 0.21 ha to 12.67 ha, with average farm size of 1.83 ha (see Table 1)which confirm earlier studies which noted majority of cocoa farmers in Ghana have farm sizes less than 2 ha hence referred to as smallholder cocoa farmers.

The ages of cocoa farms were noted to range from 8 to 33 years with mean age of 18 years(Table1). Which means that, majority of cocoa farms are Class B and C according to COCOBOD's classification which is an indication that there are more productive cocoa farms in this district.

Table 1. demographic of respondents

Variable	N	Minimum	Maximum	Mean	Std. Deviation
Age of farmer	150	31	79	51.64	9.846
Farm size (Ha)	150	.21	12.67	1.8256	1.81303
Age of farm	150	8	33	17.67	5.428
Valid N	150				

Source: survey data, 2024.

3.2. Climate Change Adaptation Strategies Used by Cocoa Farmers in the Assin North District

It was largely observed that majority of cocoa farmers in the Assin North District have adapted to climate change by adopting a number of climate smart cocoa practices. These practices include; shade tree management, pruning, use of improved varieties, mulching, diversification, and avoidance of weedicides. Out of the 150 farmers involved in the study only one farmer had irrigation facility installed on his cocoa farm. All farms visited were mature farms with so much mulch material as a result of regular pruning and natural shedding of leaves from cocoa trees and economic shade trees. Majority of farms from which data was collected were not close to any river or stream hence protection of riparian areas was not applicable to the respondents. Also, there were no young farms involved in the survey, so cover cropping was not applicable as well.

3.3. Extent of Climate Change Adaptation by Cocoa Farmers in Assin North District

This section discusses the extent to which cocoa farmers in the study area have adapted to climate change.

3.3.1. Hybrid Cocoa

As can be seen from Table 2 below, a total of 105 respondents representing 70 percent of respondents have adopted the cultivation of improved varieties referred to as hybrid cocoa at varying degrees. The remaining 45 respondents have not adopted hybrid cocoa on their farms. It is important to note that 74 respondents out of those who adopted hybrid cocoa had a mix of old cultivars hereby referred to as mixed cocoa. Only 31 respondents representing 20.7 percent of respondents have cultivated only hybrid cocoa on their farms. We can infer that adoption of hybrid cocoa as planting material as being recommended by technical staff of Ghana Cocoa Board and Community Extension Agents of Licensed Buying Companies is still quite low in the study area.

Table 2. Extent of adoption of hybrid cocoa.

Extent of adoption of hybrid cocoa	Frequency	Percent	Valid Percent	Cumulative Percent
High	31	20.7	20.7	20.7
Low	49	32.7	32.7	53.3
Moderate	25	16.7	16.7	70.0
None	45	30.0	30.0	100.0
Total	150	100.0	100.0	

Source: Survey data, 2024.

3.3.2. Extent of Shade Tree Management

The survey noted a number of economic shade trees on all cocoa farms visited. However, only 13.3 percent of respondents had adequate number of economic shade trees per hectare of cocoa farm as recommended by the Cocoa Health and Extension Division (CHED) of COCOBOD. A sizeable number of respondents i.e., 38.7 percent had low number of economic shade trees per hectare of cocoa farm and 48 percent of the respondents had moderate number of economic shade trees on their cocoa farms(Table 3). On the whole we can say that shade tree management on cocoa farms in the Assin North District is a bit inadequate. Hence resilient towards droughts has

not been built enough to a level that can withstand and help to rapidly bounce back after any adverse impact from prolonged dry spells.

Table 3. Shade tree management

Extent of adaptation	Frequency	Percent	Valid Percent	Cumulative Percent
High	20	13.3	13.3	13.3
Low	58	38.7	38.7	52.0
Moderate	72	48.0	48.0	100.0
Total	150	100.0	100.0	

Source: survey data, 2024.

3.3.3. Extent of Pruning

On the whole majority i.e., 138 farmers representing 92 percent of total respondents did pruning in the 2023/2024 crop season. As shown inTable 4 below, only 12 respondents out of the 150 did not carry out pruning on their cocoa farms in the operational year in question. It is worthy to note that 44 of those who pruned did high level of pruning by adequately removing chupons, low lying, interlocking, adventitious, dead and diseased branches as well as mistletoes. It was also found that an overwhelming majority constituting 62.7 percent of total respondents did low to moderate level of pruning. On these farms there were visible presence of interlocking branches with aerial chupons and mistletoes that were not properly removed. The study found that cocoa farmers in the Assin North District have good reasons to adopt pruning. However, their level of pruning from technical point of view needs some improvement.

Table 4. Extent of pruning

Extent of pruning	Frequency	Percent	Valid Percent	Cumulative Percent
High	44	29.3	29.3	29.3
Low	40	26.7	26.7	56.0
Moderate	54	36.0	36.0	92.0
None	12	8.0	8.0	100.0
Total	150	100.0	100.0	

Source: Survey data, 2024.

3.3.4. Extent of Mulching

It is interesting to note that all farms visited had some amount of mulch materials covering the surface of the soil. This is as a result of pruning and shedding of leaves of economic shade trees and the cocoa tress. It was found that 31 respondents have high level of mulch material on their cocoa farms. Whereas majority representing 79.3 percent have low to moderate level of mulching on their farms(see Table 5). It can be deduced that the soils of these farms visited have the potential of retaining water and conserving moisture, improving soil structure and protect against erosion and temperature fluctuations.

Table 5. Extent of mulching

Extent of mulching	Frequency	Percent	Valid Percent	Cumulative Percent
High	31	20.7	20.7	20.7
Low	50	33.3	33.3	54.0
Moderate	69	46.0	46.0	100.0
None	0	0.0	0.0	100.0
Total	150	100.0	100.0	

Source: survey data, 2024.

3.3.5. Extent of Irrigation

From Table 6 below, out of the 150 farmers involved in this survey only one farmer had an irrigation facility installed on his farm. This raises concern about resilient against drought. Should drought condition persist for a little longer than normal, wilting of these cocoa farms will be inevitable in the Assin North District of Ghana.

Table 6. Extent of irrigation.

Level of irrigation	Frequency	Percent	Valid Percent	Cumulative Percent
High	1	.7	.7	.7
Low	0	.0	.0	.7
None	149	99.3	99.3	100.0
Total	150	100.0	100.0	

Source: survey data, 2024.

3.3.6. Extent of Artificial Hand Pollination

This variable was gauged using number of trees pollinated per acre and target number of flowers. Technical Officers of Cocoa Health and Extension Division of COCOBOD in this study relied on secondary data collected during pollination window in the 2023/2024 crop season. It is interesting to note that majority of farmers in this survey adopted artificial hand pollination. However, very few farmers adopted at a high level which could result in yields close to or above national average of 10 bags per acre of cocoa farm. Also, 58.7 percent of the farmers adopted this innovation at low to moderate level. It is important to indicate that a significant number of farmers accounting for 37.3% of total respondents did not adopt artificial hand pollination in the 2023/2024 crop season(refer to Table 7). This implies that quite a large number of flowers might have been lost in the 2023/2024 crop season due to farmers inability to carry out artificial hand pollination.

Table 7. Extent of artificial hand pollination

Extent of adaptation	Frequency	Percent	Valid Percent	Cumulative Percent
High	6	4.0	4.0	4.0
Low	21	14.0	14.0	18.0
Moderate	67	44.7	44.7	62.7
None	56	37.3	37.3	100.0
Total	150	100.0	100.0	

Source: survey data, 2024.

3.3.7. Extent of Avoidance of Weedicides

The study found that 44 percent of the farmers' farm visited are putting in effort to halt the use of weedicides. It was observed that some portions of their farms were weeded using matchets or motorized weed slashers whereas other portions were sprayed with weedicides. This category of farmers mentioned scarcity of labour and the high cost of hiring this labour if available as their main constraint of adopting sustainable weed control methods. Nonetheless, a significant number of farmers in the study area accounting for 24 percent of total respondents have totally avoided the use of weedicides on their cocoa farms. It is worth noting that some farmers in this survey numbering 48 out of 150 farmers' farm visited still use weedicides as the main weed control measure on their cocoa farms as shown in Table 8 below.

Table 8. Extent of voidance of weedicides

Extent of avoidance of weedicides	Frequency	Percent	Valid Percent	Cumulative Percent
High	36	24.0	24.0	24.0
Low	26	17.3	17.3	41.3
Moderate	40	26.7	26.7	68.0
None	48	32.0	32.0	100.0
Total	150	100.0	100.0	

Source: survey data, 2024.

3.3.8. Extent of Diversification

In this study diversification was measured based on whether a farmer had other cash crop farms aside cocoa or rears some livestock for sale. It was found that 75.4 percent of the respondents (Table 9) grow other crops such as oil palm, rice, cassava, maize and vegetables including okro, pepper, tomatoes, garden eggs and rear livestock including poultry, sheep and goats. Only 4 farmers out of this number have diversified at high level, with majority diversifying at low to moderate levels. It is worth noting that a significant number of farmers in this study accounting for 22.7 of total respondents have not invested in any other income generating activities aside cocoa. This raises a lot of concern in that in the unlikely event that cocoa yield is reduced beyond reasonable expectation, income of these farmers will adversely be affected with spiral consequences on household welfare and adoption of GAPs.

Table 9. Extent of diversification

Extent of diversification	Frequency	Percent	Valid Percent	Cumulative Percent
High	4	2.7	2.7	2.7
Low	60	40.0	40.0	42.7
Moderate	52	34.7	34.7	77.3
None	34	22.7	22.7	100.0
Total	150	100.0	100.0	

Source: survey data, 2024.

4. CONCLUSION

It was largely observed that majority of cocoa farmers in the Assin North District have adapted to climate change by adopting a number of climate smart cocoa practices. These practices include; shade tree management, pruning, use of improved varieties, mulching, artificial hand pollination, diversification, and avoidance of weedicides. Out of the 150 farmers involved in the study only one farm farmer had irrigation facility in place.

Only 20.7 percent out of total respondent have planted only hybrid cocoa implying level of adoption of hybrid cocoa as an adaption strategy is quite low in the Assin North District.

Shade tree management in the study is low. Only 13.3 percent of respondents had adequate number of economic shade trees per hectare of cocoa farm as recommended by COCOBOD. Meaning resilient towards drought has not been built to levels that can help cocoa trees withstand prolonged drought conditions.

Majority of the farmerspruned their farms in the 2023/2024 crop season. However, only 44 respondents out of the 150 did high level of pruning by adequately removing chupons, low lying, interlocking, adventitious, dead and diseased branches as well as mistletoes. On other pruned farms there were visible presence of interlocking branches with aerial chupons and mistletoes that were not properly removed. Level of pruning from technical point of view needs some improvement in the study area.

All farms visited had some level of mulch materials covering the surface of the soil. Meaning the soils on these cocoa farms have the potential of retaining water and conserving moisture.

Only one farmer out of the total respondents had an irrigation facility installed on his cocoa farm. In the midst of climate change and in the unlikely event of prolonged drought, cocoa trees are likely to wilt with significant reduction in yields.

The study revealed majority of respondents accounting for 94 respondents adopted artificial hand pollination in the 2023/2024 crop season. However, very few farmers adopted at a high level which could result in yields close to or above national average of 10 bags per acre of cocoa farm.
The survey found that a significant number of cocoa farmers accounting for 32 percent of total respondents used only weedicides as a measure in the control of weeds on their cocoa farms. Only 24 percent of farmers involved in this survey completely discarded the use of weedicides on their cocoa farms. The remaining respondents did applied weedicides on some portions of their farms and also did manual weeding on some portions.

It was found that 75.4 percent of the respondents grow other crops such as oil palm, rice, cassava, maize and vegetables including okro, pepper, tomatoes, garden eggs and rear livestock including poultry, sheep and goats. However, their level of diversification needs some improvement to be able to help generate alternative income should cocoa yields drop significantly.

On the whole it was found that the extent of climate change adaptation by cocoa farmers in the Assin North District is not adequate enough for the resilient needed against climate change impact on cocoa production in the district.

5. RECOMMENDATIONS

Need to intensify education on climate change and its effects on cocoa production and adaptation strategies farmers can adopt to mitigate its effects.Extension officers in the study area should

continue in their relentless effort to convince cocoa farmers to adopt climate smart cocoa practices.

There should be pragmatic effort to increase economic shade trees on cocoa farms. The Cocoa Health and Extension Division in collaboration with Seed Production Division should be resourced to undertake economic shade tree enumeration exercise on all cocoa farms in the district to identify shortfalls and take steps to supply such farms with enough shade trees.
Need to intensify education on harmful effects of weedicides and alternative weed control measures such as use of motorized slashers and matchets.

Need for industry players to take bold steps to invest in irrigation. Irrigation is an expensive investment which cannot be shouldered by smallholder cocoa farmers so,some form of credit facility to support these farmers to install irrigation facility on their cocoa farms.

Cocoa farmers should be encouraged to invest part of their income generated from cocoa farming into other portfolios so they can build resilience in the midst of climate change.

Lastly cocoa farmers in the study area should be encouraged to adopt artificial hand pollination as it is currently the panacea to increasing productivity per hectare of cocoa farm.

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