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# PERCEPTION MATTERS: EXPLORING CLIMATE VARIABILITY, MITIGATION AND THE EFFECT ON COCOA PRODUCTIVITY IN ADANSI BROFOYEDRU, GHANA

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**Abstract**

*In a rapidly changing climate, understanding the dynamics of cocoa farming and its vulnerability to climate variability is of paramount importance. By recognizing the power of perception and the complex interplay between climate factors and farming practices, we unlock novel pathways to build resilience among cocoa farmers. This innovative study aims to explore farmers' perceptions of various climate change issues. Using a quantitative approach, data were collected from a sample of 400 cocoa farmers. The analysis reveals four dimensions of perceptions: (1) the most influential climatic variable was rainfall, (2) the most adopted mitigation intervention practiced by the farmers was pest control, (3) mitigation interventions affects cocoa productivity and (4) high cost of inputs constraints their use of the interventions. Identifying rainfall as the most influential climatic variable highlights the need for targeted interventions where policymakers focus on water management and irrigation systems to help farmers adapt to changing rainfall patterns.*

**Keywords:** *Climate variability, cocoa, farmers, mitigation, perception.*
**JEL Code:** *Q54*

## 1. Introduction

Climate is an essential factor in agriculture. The climate defines the boundaries for agricultural practices in any given region or ecological zone across the world. IPCC (2007) defines climate as the long-term weather patterns observed in a specific location, typically spanning 30 years. According to Kyere (2018), climate change denotes modifications in the long-term weather patterns that take place over time, which can arise from either natural variability or human activities. Buxton et al. (2020) defined climate change as any notable departure or divergence from the average or normal state of weather conditions or variability that persists for many years, typically spanning decades or more.

Climate variability which includes changes in temperature, relative humidity, rainfall and sunshine directly affect crops development processes (Sarr, 2012). This is supported by Owoeye and Sekumade (2016) who also observed that temperature, rainfall, humidity, and sunshine, can also influence the production of cocoa. Masson-Delmotte et al. (2018) indicated that climate change manifests in precipitation quantities, rise in temperatures, alterations in weather patterns and occurrences of extreme events such as floods, fires, heat waves, and droughts can be observed.

According to Masson-Delmotte et al. (2018), the temperature in Africa is increasing at a rate that exceeds the global average and is expected to endure over time. Buxton et al. (2020) asserted climate change as the worst environmental, social and economic threats facing agricultural sector across the globe. Impact of these changes occur on resources including natural ecosystems, agricultural systems, water resources, and human societies (Ullah et al., 2018). Agriculture in Ghana is still rainfed, leading to unpredictable rainfall patterns, frequent extended dry periods, sudden floods, and shortened rainy seasons rendering an area vulnerable to the effects of climate variability and change (Mireku, 2017).

According to Agbongiarhuoyi et al. (2013), *Theobroma cacao* (Cocoa) has been the least resilient crop to climate change. On the average, cocoa thrives best within the temperature range of 18 $^{0}$C to 32 $^{0}$C, with an average rainfall range of 1500 millimeters to 2000 millimeters annually (Mireku, 2017). This suggest that an increase or decrease in temperature or rainfall of the expected range would negatively affect cocoa productivity. In effect, the studies by Ehiakpor et al. *(*2016) revealed that alterations in climate conditions have resulted in a decrease in crop yields while Pilo et al. (2016) reported that the productivity of rain-fed crops in certain developing countries is projected to halve by 2020 and beyond.

In order to explain perceptions in the context of climate variability mitigation and its effects on cocoa productivity, the study adopted two theories: theory of Change and Ricardian theory. The theory of change approach is a process used in project planning, implementation, and evaluation which determines which structure is used to visualise the connections and interactions between the project goals and the early and intermediate changes (Pringle & Adelle, 2019). It emphasizes the presuppositions that form the basis of the process of transformation, which starts from executing specific interventions and actions and culminates in the desired results. The theory of change is a valuable tool for developing and implementing effective climate mitigation strategies; (1) it promotes contextual analysis, it connects diverse projects, its purpose is to iterate, flexible and enables projects to adapt to alterations in the social, political, and natural environment (Pringle & Adelle, 2019; Bours et al., 2014). These indicators in the approach are essential in the execution of efforts to reduce the effects of climate change interventions. The Ricardian theory is applied to evaluate how climate change affects the efficiency of agriculture (Ofori-Boateng & Insah, 2014). The assumptions of the theory are that there are no expenses associated with adapting to changes in climate, such as the cost of acquiring land or the cost of inputs, which fully captures the climate's value in a particular area (Huda, 2015). This implies that farmers make profits based on exogenous conditions like temperature and rainfall. The farmer therefore selects the inputs which is the mitigation strategies that would best help increase his profit (Edet et al., 2018).

Cocoa production is declining in developing countries. One critical factor that has been a major concern to cocoa famers is the increase in temperature accompanied by a decrease in rainfall (IPCC, 2014). Truly, Shahbandeh (2021) reported Ghana’s cocoa production has declined from 2016 (969000tons), 2017 (905000 tons), 2018 (812000 tons), 2019 (800000 tons) to 2020 (850000 tons). It is clear that over the last five years, production has decreased since 2016 to 2019 with little upwards adjustment in 2020. This prompt one to ask a question; what is happening in the cocoa production in Ghana? In spite of government intervention to the industry, cocoa productivity is still facing a decline.

The extant literature abounds with various studies on climate change. For instance, Buxton (2020) conducted a study on climate change responses of cocoa farmers in Ghana and showed that farmers' coping strategies to address the impacts of climate change include soil fertility and soil water management practices, behavioural adjustment on spraying, fertilizer application, weed control, pruning and technological and institutional. Farmers who understand climate change adhere to the climate change mitigation interventions. Codjoe et al. (2013) aimed at finding the possible coping strategies implemented by farmers and strategies to enhance these coping mechanisms. The findings showed that farmers depend on God's plan for agriculture and usage of heavy machines. Falola and Fakayode (2014) found that general effects of climate change on farming activities were excessive rainfall, less rainfall, irregular rainfall pattern and delay onset of rainfall, high temperature, drought and changes in the amount of sunlight received over a given period of time. The variation of climate change cause pest and disease attack, late maturity, decreased weight or tainted cocoa bean with impurities.

Ameyaw et al. (2018) conducted a study on knowledge and perception of small-scale cocoa farmers in Ghana regarding the possible effects of climate change on cocoa cultivation. It was revealed that farmers' perceptions of climate change were diverse. Farmers also accepted the importance of trees in maintaining cocoa farms. It was also noted that cultural practices in cocoa farming is linked to cocoa productivity. Kosoe and Ahmed (2022) recently conducted research on climate change adaptation strategies of cocoa farmers and found that the key adaptation strategies for the farmers include changing planting date, planting advanced cocoa cultivars and engaging in tree plantation. Edet et al. (2018) carried out a study to assess the potential economic impacts of climate change on cocoa-producing states in the southwestern state of Nigeria using Ricardain analytical procedure. Results of the study revealed that there were variations in farmers' income as a result of temperature and rainfall differences. The study affirmed that climate and non-climatic variables such as area, producers' price, yield and technology accounts for 98% of the variation in net revenue per hectare of cocoa production. The finding also revealed that climate change account for economic losses.

This current study explores farmers' perceptions of various aspects of climate change. The focus of this study on perceptions highlights the role of subjective interpretations and understandings of climate change variability among cocoa farmers. This has theoretical implications for understanding how perceptions shape decision-making processes and subsequent actions related to climate change mitigation and adaptation strategies. Specifically, it looks at 1) farmers' perception of climate change variability 2) farmers' perception of various mitigation interventions 3) farmers' perception of the effects of climate change mitigation interventions on the productivity of cocoa and 4) farmers' perception of the constraints faced in practicing the climate change mitigation interventions.

## 2. Methodology

Research design is the blueprint for conducting the study or the conceptual structure within which research is conducted (Kelle et al., 2019). For a careful consideration of the research objectives, the quantitative research design (survey) was adopted. The choice of the design was considered suitable because it helped the researcher to obtain adequate data from respondents to enrich the findings of the study.

The research was conducted in Adansi Asokwa Cocoa District, which is situated in the southern region of Ashanti. The capital town of the district is Adansi Asokwa. According to Ghana Statistical Service (2012), 55% of the active male population and 45% of the active female population are involved in farming. There are 13 operational areas related to cocoa extension services.

In this study, the population involved all farmers engaged in cocoa farming in the Adansi Brofoyedru Cocoa District in the Ashanti Region of Ghana. In order to obtain findings that would fairly give understanding of the topic under study, a sample size from a total population size of 16,000 cocoa farmers, 390 cocoa famers were selected for this study using Yamane (1967) formula for sample size determination. Purposive sampling technique was used to select four operational areas and then a quota sample given to each study area based on their population. However, convenient sampling technique was used to select the respondents from each operational area. Following Yamane (1967) formula of determine sample size, this is how the sample size was generated Yamane (1967) formula was used to determine the sample size

$$\boldsymbol{n} = \frac{\boldsymbol{N}}{\mathbf{1}+\boldsymbol{N}\,(\boldsymbol{e^2})}$$

n – the sample size

N – the population size

e – the margin of error (acceptable sampling error), for this study 95 % confidence level, thus P value = 0.05 was assumed.

$$n = \frac{16000}{1 + 16000\ (0{,}05^2\ )}$$

N = 390.1

The researcher relied on both primary and secondary sources of data for this study. The main source of primary data for this research was obtained through a questionnaire administered to the selected participants. In contrast, the secondary source of data for this study was the documented information obtained from Cocoa Health and Extension Division farmer data. After a careful review of the literature and consultation with some experts, the questionnaire was considered appropriate for the collection of data to answer the research questions in this study.

Data from the survey was coded and keyed into SPSS for the statistical analysis. Prior to conducting any analysis, the data underwent a cleaning process to eliminate errors that may have arisen from coding, recording, missing data, or outliers. By performing this data cleaning step, the researcher was able to ensure the accuracy and quality of the data. Descriptive statistics such as percentages, frequencies, mean and standard deviation were used to analyse the descriptive data. A Likert scale with three options – [Agree (3), Not Sure (2), and Disagree (1)] and [Always (3), Sometimes [2], and Never [3] were used to score the perception statements. Inferential statistics such as the one sample t test was subsequently used to find out the difference between the sample mean and the population mean of the results. According to Sekaran and Bougie (2016), a one-sample t-test is a statistical hypothesis test used to determine if the mean of a single sample significantly differs from a specified population mean. It is appropriate when there is a single group of participants or observations and want to compare their mean value to a known or hypothesised population mean. It assesses whether there is enough evidence to reject the null hypothesis that the sample mean is equal to the population mean. The test compares the difference between the sample mean and the population mean to the variability or standard error of the sample mean.

## 3. Results and Discussion

### 3.1 Background of Respondents

The data indicate that there is a higher representation of male respondents (73%) compared to female respondents (27%) (see Table 1). This gender imbalance suggests the need for gender-sensitive approaches in addressing climate change interventions and their perceptions. Recognising the gender dynamics in agriculture and ensuring equitable participation and access to resources can contribute to more inclusive and effective climate change strategies in the cocoa farming sector.

Concerning the age of the respondents, 4.5% (18) respondents were between 20-30 years, 21.5% (86) respondents were between 31-40 years, 25.0% (100) respondents were between the age of 41-50 years, 31.0 % (124) were also within the range of 51-60 years while 18.0 % (72) of the respondents were within the age of 60 years and above (see Table 1). This provides insights into the generational perspectives and experiences related to climate change interventions. Understanding the age demographics can help identify variations in knowledge, attitudes, and adaptation practices among different age groups.

**Table 1. Demographic Characteristics of Respondents**

| **Demographic Variables** | **Frequency** | **Percent** |
|---|---|---|
| **Sex** | | |
| Male | 292 | 75.0 |
| Female | 108 | 27.0 |
| **Age** | | |
| Below 30 years | 18 | 4.5 |
| 31-40 years | 86 | 21.5 |
| 41-50 years | 100 | 25.0 |
| 51- 60 years | 124 | 31.0 |
| 60 years and above | 72 | 18.0 |
| **Level of Education** | | |
| No formal education | 52 | 13.0 |
| Primary | 52 | 13.0 |
| Junior High school | 72 | 18.0 |
| Middle school | 48 | 12.0 |
| Senior High School | 120 | 30.0 |
| Tertiary | 56 | 14.0 |
| **Level of Farmers' Experience** | | |
| 1-10 years | 146 | 36.5 |
| 11-20 years | 155 | 38.8 |
| 21-30 years | 79 | 19.8 |
| 31-40 years | 8 | 2.0 |
| 41-50 years | 12 | 3.0 |
| **Size of Farm Plot** | | |
| 1-5 acres | 168 | 42.0 |
| 6-10 acres | 173 | 43.2 |
| 11-15 acres | 59 | 14.8 |
| **Number of Plots** | | |
| 1-2 plots | 269 | 67.3 |
| 3-4 plots | 131 | 32.8 |

**Source:** Field Study (2022), *N = 400*

The respondents possess different kinds of professional qualifications which range from 'no formal education' to tertiary level. About 13 % (52) of the respondents possess both no formal education and primary education each. A total number of 18.0% (72) respondents have completed JHS, 12.0% (48) respondents were middle school certificate holders, 30.0% (120)

respondents were Senior High Certificate holders with 14.0% (56) being tertiary certificate holders. This diversity may influence the adoption and understanding of climate change interventions and their perceptions. It emphasizes the importance of considering different levels of education and tailoring communication strategies accordingly when disseminating information and implementing climate change mitigation practices.

It was found out that, 36.5% (146) respondents were having farming experience of 1 to 10 years, 38.8% (155) were having 11 to 20 years of farming experiences, 19.8% (79) were having 21-30 years farming experience, 2.0% (8) were also having 31 to 40 years and 3.0% (12) respondents were having a great experience of 41-50 years in farming (see Table 1). The distribution of respondents' farming experience provides insights into the level of expertise and practical knowledge available within the sample. Farmers with longer farming experience (e.g., 41-50 years) may possess valuable traditional knowledge and practices that can contribute to discussions on climate change adaptation and mitigation. Conversely, newer farmers (e.g., 1-10 years of experience) may benefit from targeted capacity-building initiatives to enhance their understanding and adoption of climate-smart agricultural practices.

Out of 400 respondents, 42.0 % (168) were operating 1 (one) to 5 (five) acres of plot farm, 43.3% (173) respondents were having 6-10 acres of farm, 14.8% (59) respondents were also having 11 to 15 acres of farm (see Table 1). The distribution of respondents' land size reflects the range of farm sizes within the study area. This information can be valuable in understanding the scale of agricultural operations and its potential implications for climate change interventions. It can inform policymakers and stakeholders about the needs and challenges faced by farmers operating on different scales, such as access to resources, financial support, and technical assistance.

The result also shows that out of 400 respondents, 67.3 % (269) respondents were operating with 1 (one) to 2 (two) different farms of cocoa, 32.8 % (131) were also operating with 3 (three) to 4 (four) different farms of cocoa (see Table 1). The distribution of respondents operating multiple cocoa farms indicates the prevalence of diversified farming practices within the study area. This finding suggests that farmers may have different experiences and challenges in managing multiple farms. Understanding the dynamics and implications of operating multiple farms can help tailor support mechanisms, extension services, and training programmes to address the specific needs of farmers engaged in such practices.

### 3.2 Farmers' Experience of Climate Variability

The respondents were requested to show their experience (most) of the various climate change variability issues. According to the survey conducted, it was found that among the respondents, 43.5% (n = 174) indicated rainfall as the most influential climate change variable, 29.25% (n = 117) mentioned temperature, 19.5% (n = 78) highlighted drought, 7.75% (n = 31) identified flooding, and 2.0% (n = 10) indicated humidity. The findings indicate that while multiple climatic factors were identified by the farmers, the most influential variables they experienced were rainfall and temperature (see Table 2). Recognising that rainfall and temperature are the most influential climate change variables allows policymakers and agricultural stakeholders to prioritise and develop targeted adaptation strategies. Efforts can be directed towards enhancing water management practices, such as irrigation systems or rainwater harvesting, to mitigate the impacts of changing rainfall patterns. Additionally, promoting the use of climate-resilient crop varieties that can withstand temperature fluctuations can help farmers adapt to changing temperature conditions. The changes in climatic events such as temperature and rainfall significantly affect the yield of crops. The temperature increase is found to reduce the yield, while the precipitation increase is likely to offset or reduce the impact of increasing temperature (Adams et al., 1998). Along with temperature and rainfall, other factors that affect agricultural yields include humidity and wind speed. Without taking these factors into account, it is possible to overestimate the cost of climate change (Zhang et al., 2017).

**Table 2. Farmers' Experience of Climate Variability**

| Climatic Variables | Frequency | Percent |
|---|---|---|
| Humidity | 10 | 2.0 |
| Flooding | 31 | 7.75 |
| Drought | 68 | 17.5 |
| Temperature | 117 | 29.25 |
| Rainfall | 174 | 43.5 |
| Total | 400 | 100.0 |

**Source:** Field Study (2022), *N = 400*

In determining the patterns of rainfall and temperature patterns over the last decade, Table 3 reveals that majority of the respondents (80.8%) representing 323 famers indicated that rainfall level has decreased while 18.3% of the respondents indicated that rainfall has increased with 1.0 % (4) indicated no change in rainfall level. Concerning temperature level, 3.0 % (12) indicated 'no change', 88.5% (354) indicated that temperature level has increased while 8.5% (34) believed that temperature level has decreased. The results show that rainfall level is decreasing while temperature level keeps on increasing. Owoeye and Sekumade (2016) also confirmed that rainfall and temperature are the most influential climatic variables farmers experience most.

**Table 3. Rainfall and Temperature Level over the Past 10 Years**

| Climate Change Variable | No change | Increasing | Decreasing |
|---|---|---|---|
| Rainfall | 1.0% (4) | 18.3% (73) | 80.8% (323) |
| Temperature | 3.0% (12) | 88.5% (354) | 8.5% (34) |

**Source:** Field Study (2022), *N = 400*

### 3.3 Mitigation Interventions Practiced by Cocoa Famers

From Table 4, the eleven mitigating interventions of climate change obtained mean scores that ranged from 1.32 to 2.79. Five agronomic activities were considered to be practiced always by the cocoa farmers as mitigation interventions towards climate change: pest control (Mean=2.79), weed management (Mean=2.69), mulching/cover cropping (Mean=2.68), use of improved seeds/seedlings (Mean=2.51), and disease control (Mean=2.50). The following agronomic activities were sometimes practiced by the cocoa farmers: fertiliser application (Mean=2.28), mixed cropping (Mean=2.26), lining and pegging (Mean=2.17), irrigation (Mean=1.75) and pruning (Mean=1.53). Agroforestry was never practiced by the cocoa farmers (Mean=1.32). Overall mean of frequency of practice of mitigation interventions was 2.23. This suggest that farmers sometimes practiced the mitigating interventions of the climate change. The practice of agronomic activities as mitigating intervention of climate change was adopted in Ghana since 2014 (Seidu, 2018; Abbam et al., 2018). It was adopted for its effectiveness in mitigating the effects of climate change on crop production (Pelling, 2011). The present results agree with Agbongiarhuoyi et al. (2013) and Hutchins et al. (2015) that mitigation interventions of climate change are in different forms including farm rehabilitations, agroforestry, shade management, practicing of mulching, soil management, diversification of varieties, mixed cropping, livestock farming, the use of different crop varieties, varied harvesting dates, and the mixing of less productive drought-resistant varieties with high water-sensitive crops.

**Table 4. Mitigation Interventions Practiced by Cocoa Farmers**

| **Interventions** | **Mean** | **Std. Deviation** |
|---|---|---|
| Pest control | 2.79 | 0.405 |
| Weed management | 2.69 | 0.508 |
| Mulching / cover cropping | 2.68 | 0.505 |
| Use of improved seeds/seedlings | 2.51 | 0.573 |
| Disease control | 2.50 | 0.623 |
| Fertilizer application | 2.28 | 0.671 |
| Mixed cropping | 2.26 | 0.592 |
| lining and pegging | 2.17 | 0.703 |
| Irrigation | 1.75 | 0.780 |
| Pruning | 1.53 | 0.754 |
| Agroforestry | 1.32 | 0.536 |
| Overall mean | 2.23 | 0.600 |

**Source:** Field Study (2022), *N = 400*
Never=1, Sometimes=2, Always=3

Table 5 reveals the one sample t-test that was conducted to find out whether farmers' practice of the mitigation interventions of climate change is significantly different from the population mean (2.0). The outcome suggests that there was no significant statistical difference between the population (2.0) and the test scores of agronomic activities as mitigating interventions for climate change (Mean=2.23; t= 1.516; p= 0.161). Hence, the conclusion is made that the cocoa farmers in the Adansi Brofoyedu Cocoa District do not rely on the mitigation interventions. The implication is that these farmers may not be actively implementing practices or strategies aimed at mitigating the effects of climate change on their cocoa production. By not actively implementing mitigation interventions, cocoa farmers may be more vulnerable to the negative impacts of climate change, such as extreme weather events, changing rainfall patterns, pests, and diseases. These factors can significantly affect cocoa yields, quality, and overall farm productivity. They may have limited capacity to adapt and respond to the challenges posed by climate change. This can hinder their ability to maintain sustainable cocoa production in the long term. They may also face difficulties in ensuring the long-term viability and sustainability of their cocoa production systems.

**Table 5. One Sample t-test for Agronomic Activities Used by Farmers**

| **Mean *(M)*** | **Standard Deviation** | ***(df)*** | ***(t) value*** | **Sig. (2-tailed)** |
|---|---|---|---|---|
| 2.225 | 0.049 | 11 | 1.516 | 0.161 |

**Source:** Field Study (2022), *N = 400*

### 3.4 Perceived Effects of Climate Change Mitigation Interventions on Cocoa Productivity

Farmers are aware that climate change is very sensitive to cocoa (Falola & Fakayode, 2014). Table 6 shows that seven (7) perceived effects of mitigating intervention of climate change. The scores range from 1.92 to 2.43. Out of the seven perceived effects, only one, thus, increase cocoa yield was agreed on by the cocoa farmers. The overall mean of 2.17 shows that generally, the cocoa farmers were neutral about how climate change interventions would impact the productivity of cocoa. In this context, a neutral mean value indicates that, on average, the cocoa farmers neither agreed nor disagreed with the notion that climate change interventions would have a significant impact on cocoa productivity. It suggests that the farmers' perception of the relationship between climate change interventions and cocoa productivity was neither positive nor negative.

**Table 6. Perceived Effect of Mitigation Intervention on Cocoa Productivity**

| **Item** | **Mean** | **Std. Deviation** |
|---|---|---|
| Increase in cocoa yield | 2.53 | 0.574 |
| Increase in income level | 2.29 | 0.520 |
| Reduction in the maturity period of cocoa | 2.23 | 0.620 |
| Decrease in the mortality rate of coca trees | 2.14 | 0.623 |
| Resistance of cocoa to disease | 2.07 | 0.457 |
| Resistance of cocoa to pest | 2.03 | 0.415 |
| High quality of cocoa bean | 1.92 | 0.791 |
| Overall mean | 2.17 | 0.570 |

**Source:** Field Study (2022), *N = 400*

**Table 7. One Sample t-test for Perceived Effects of Mitigation on Cocoa Productivity**

| **Mean *(M)*** | **Standard Deviation** | ***(df)*** | ***(t) value*** | **Sig. (2-tailed)** |
|---|---|---|---|---|
| 2.17 | .017 | 6 | -2.44 | .05 |

**Source:** Field Study (2022), *N = 400*

A one sample t-test was conducted to find the significant difference between population mean (2.0) and the t-test mean (2.17) of the perceived effects of mitigation interventions of climate change with regard to the average mean score as shown in Table 7. The results indicate that there is a statistically significant difference between the population mean (2.0) and the effect of mitigation interventions of climate change test scores (Mean = 2.17; SD = 0.01; t=-2.438; p=0.05). The sample mean of 2.17 indicates that, on average, the participants perceive the effects of mitigation interventions to be higher than the assumed population mean of 2.0. The positive impact of the mitigation interventions confirms what was revealed by Seidu (2018) and Malhi et al. (2021) that the practice of several interventions such as pest and disease control and the introduction of improved seeds have helped to produce quality cocoa beans and boosted farmers' income. The capacity of the farmers to apply agronomic strategies to mitigate climate change effects brings to notice the relevance of the theory of change which emphasises and encourages contextual analysis (Ofori-Boateng, 2012). It is therefore important to agree with Ameyaw et al. (2018) that famers need to change their traditional way of farming practices and adopt the agronomic strategies.

### 3.5 The Constraints Cocoa Famers Face in Practicing the Climate Change Mitigation Interventions

Although, the mitigation interventions saw increase in the cocoa productivity, the cocoa industry still face some challenges in its implementation. In determining the constraints of using the mitigation interventions, respondents were requested to express their level of agreement or disagreement with eleven (11) challenging factors that could affect their practice of mitigation interventions of climate change. An overall mean of 2.51 shows that cocoa farmers agree on the challenges affecting their practice of mitigation interventions. The three most severe challenges are high cost of farm inputs (Mean=2.83), lack of credit facilities (Mean=2.78) and unpredictable weather (Mean=2.60). This finding affirmed Denkyirah et al. (2017) that in Ghana, high cost of input serves as barrier to climate change adaptation measures. Kosoe and Ahmed (2022) also agree that unpredictable weather conditions can be a challenge in the implementation of climate change mitigation interventions. Hutchins et al. (2015) and Seidu (2018) also agree that lack of knowledge, awareness and lack of extension services are major climate change mitigation constraints (see Table 8).

**Table 8. Constraints to Mitigating Interventions of Climate Change**

| **Item** | **Mean** | **Std. Deviation** |
|---|---|---|
| High cost of farm inputs | 2.83 | 0.68 |
| Lack of credit facilities | 2.78 | 0.82 |
| Unpredictable weather | 2.60 | 0.57 |
| Lack of formal education | 2.59 | 0.55 |
| Poor soil fertility | 2.53 | 0.74 |
| Farmers attitudes to change | 2.52 | 0.59 |
| Lack of technological support | 2.30 | 0.70 |
| Lack of knowledge | 2.03 | 0.70 |
| Inadequate and unsustainable government support | 2.50 | 0.62 |
| High of labour | 2.47 | 0.58 |
| Lack of extension services | 2.49 | 0.72 |
| Overall mean | 2.51 | 0.66 |

**Source:** Field Study (2022), N = 400

### 4. Conclusion

This current study explores farmers' perceptions of climate variations, use of mitigation interventions, the effects on cocoa productivity and the constraints cocoa farmers face in the use of the mitigation interventions. The study concludes that rainfall and temperature changes are the most influential climatic variable. The farmers sometimes practiced agronomic activities as mitigating interventions of climate change, with pest control, weed management, and mulching/cover cropping being the most frequently practiced. Generally, the statistical test showed that the farmers do not rely on the mitigation interventions. However, the study also shows that there is statistically significant impact made on the cocoa productivity of farmers if they use the mitigation interventions. Again, the farmers indicated that the mitigation interventions increase cocoa yield. Additionally, the study identified several challenges to the implementation of these interventions, including the high cost of farm inputs, lack of credit facilities, and unpredictable weather.

Following the research objectives and the findings, the following recommendations have been made to the stakeholders of Cocoa Industry to enhance yield and facilitate the adaption of cocoa to climate change. Since most of the agronomic activities of mitigation intervention were on pest and disease control as well as weed management, the Ghanaian government should make a deliberate attempt to enhance their technological infrastructure in agriculture to help farmers use more technology as climate change mitigation intervention strategies. It is recommended that Ministry of Agriculture should intensify the free mass spraying exercise to ensure that all cocoa farms in the country are covered. This will help to increase productivity and improve the livelihoods of cocoa farmers. It is also necessary to augment and intensify education efforts on the adoption of climate change interventions and about the good farm management practices including pruning, the utilisation of improved seeds and seedlings, and the application of chemicals in the farm. It was found that agroforestry was not widely practiced in farming communities. Therefore, the Ghana Cocoa Board, in collaboration with the Ministry of Agriculture, should make an effort to provide hybrid cocoa seeds and shade tree seedlings to farmers as an adaptation strategy, either for free or at a reduced cost. There should be enough trained extension officers to educate the farmers about good farm management and the effect of climate change on agriculture.

The study suggests that climate change mitigation interventions should be designed based on farmers' perceptions and preferences. Practical implications include the development of targeted interventions that address the specific climatic variables perceived as influential by cocoa farmers in Adansi Brofoyedru. This could involve promoting practices such as water management, pest control, and improved crop varieties that align with farmers' perceptions and needs. The findings provide practical insights for policymakers in formulating climate change policies and support mechanisms for cocoa farmers. This includes considering the identified climatic variables and their perceived impact on cocoa productivity. Policymakers can prioritize resource allocation, funding, and infrastructure development to support climate change adaptation and resilience efforts in the cocoa sector.

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