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Evaluating Rural Farmers Knowledge, Perception, and Adaptation Strategies on Climate Change in Ghana: A case study of the Wa West District, Ghana

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Abstract

Climate change is a phenomenon that has received significant international attention over the past years due to its profound negative effects on community livelihood especially in developing countries like Ghana where rain-fed agriculture is the main source of employment and livelihood for the majority of the population. Various studies have shown that knowledge and perceptions of people on climate change can have a significant influence on their adaptation and mitigation options, it is vital for researchers to, therefore, undertake regular assessments to gather concrete information on climatic trends and its impact so as to prescribe the best mitigative remedies. This work, therefore, evaluates the perceptions of farmers, their level of knowledge on climate change and the various strategies they employ in Wa West District of the Upper West region of Ghana. Based on findings from this study, a fervent recommendation for the building of resilience interventions in the study area that will target farmers especially women with low adaptive capacity to help boost their capacity in dealing with climate change was proposed.

Keywords: *Adaptation strategies, Barriers, Climate Change, Knowledge, Rural farmers.*

1. Introduction

Climate change is one of the greatest challenges currently facing humanity in all aspects of society at risk due to increasing temperature and rainfall fluctuation. It is expected that Africa's agricultural production will be greatly affected by climate change, considering the fact that, agriculture is the main livelihood source for many people, particularly the rural poor, who rely heavily on rainfall [17]. Destructive flooding, crop failure, increasing livestock death and total reduction of land productivity are among the numerous challenges of climate change, which carries the potential to render farmers vulnerable [18]. Floods, drought and frequent bushfires which are a common impact of climate change is equally prevalent in the Northern regions of Ghana of which Upper West region is a part [20-13] “The observed rise in minimum temperature in the northern savannah ecological zones of Ghana was estimated at 3.7% over the period between 1960 and 2010. Over the same period, a decrease of 120 mm in annual mean precipitation was also observed in the Guinea Savannah ecological zone in which the Northern Region is located"[24] The region is said to be one of the highly vulnerable regions to climate change in Ghana, both ecologically and socially, and the vulnerability is intensified by other biophysical and human-related issues such as deforestation, overgrazing and human-induced bushfires [49-51] As such, rural farmers in the region whose livelihoods depend on rainfall are projected to face daring socio-economic impact due to climatic changes [5-26] These horrid impacts will further worsen if effective measures are not immediately taken into consideration [8] This is because agriculture- a major pillar to Ghana’s economy, contributing about 66.2% to GDP and generating about 30–40 % of the country’s foreign exchange earnings through related agricultural manufacturing can have a much greater negative impact on the entire economic viability of Ghana. [41-29-22]
Adaptation is therefore seen as one sustainable means of addressing the phenomena. As defined by Intergovernmental Panel on Climate Change [32] adaptation refers to “all adjustments or moderation in natural or human systems in response to actual or expected climate change as well as taking advantage of new or arising opportunities”. The United Nations Framework Convention on Climate Change [54] further present adaptation as a process through which societies make themselves better able to cope with an uncertain future by taking appropriate measures and making right adjustments to minimize the adverse effects of climate change. Although there has been attention over the last few decades to control climate change with the prescription of many adaptation strategies for farmers, these measures are expected to be only effective if they are based on the perceptions of the farmers who are directly affected in the society and the various adaptation strategies they are employing in their localities [28] Thus, it is essential to assemble the opinions and perception of the public

especially rural communities in formulating effective climate change policies since public perceptions will likely influence the success of strategies to solve the problem [6].

Although there is an emerging trend of studies on climate change adaptation especially in Ghana [44-50-11] there is still a gap especially in understanding and identifying community-based impediments to successful adaptation measures. [11] posits that evidence of climate adaptation is fraught with unclarity. As a result, effective adaptation strategy policies are difficult to be formulated by relevant authorities from the local to national level. In this regard, an understanding of current effects and response to climate change in Upper West region specifically Wa West District will help decision-makers to map up strategic approaches in dealing with the phenomenon. It will also help in future studies on the effects and responses to climate change and in identifying effective adaptation strategies [4]. The broad aim of this paper is to provide a platform of summary on perception and adaptation strategies being mapped up by the farmers in Wa West District in the Upper West region of Ghana who are facing the consequences of climate change as a result of their heavy reliance on a single and already modified rainy season [11]. The specific objectives of the study are to study the trend in climate education, identify the various responsive strategies that smallholder farmers have adopted to cope with the effects of changing climate as well as constraints to the various adopted measures and approaches. It is hoped that the study will contribute to existing literature on climate change response practices undertaken in Ghana especially in the northern parts of the country and that researchers would find the work useful for further research

2. Research Design and Methods

2.1 Study Area

The Wa West District is one of the eleven (11) districts in the Upper West Region of Ghana with Wechiau as the regional capital. The Wa West district was carved out of the Wa Municipality and made an autonomous district by L.I 1746. It is located in the Guinea Savannah ecological zone of Ghana which is largely characterized by a stretch of lowland and grassland. This study examines two communities in the Wa West District, which is located in the western part of the Upper West Region of Ghana, approximately between longitudes 40ºN and 45ºN and Latitudes 9ºW and 32ºW [29-57]

The district shares boundaries with Sawla-Tuna-Karlba District to the South, Wa Municipal to the East Nadowli District to the North and to the West with Ivory Coast. [57]. The entire district is characterized by a prolonged dry season between November, March and April. Frequent bushfires, prolonged dry season and drought are common climate change impact on the region and district [20-13] with annual mean temperature ranging between 22.4 to 33.9 degrees [2] Wa West District was selected in accordance with [29] which reveals that about 63% of the population in the district live in rural areas; 85.5% of households depend on agriculture as the main economic activity, 99.1% of the farming households depend on rain-fed agriculture. The population of Wa West District, according to the 2010 Population and Housing Census, is 81,348 representing 11.6 per cent of Upper West Region's total population. Males constitute 49.5 per cent and females represent 50.5 per cent. The district is entirely rural. The sex ratio of the district is 97.8. The population of the district is youthful (45.5%) depicting a broad base population pyramid which tapers off with a small number of elderly persons (5.8%). As high as 91.6 per cent of households in the district are, engage in agriculture. [57] Majority of households in the district (97.2%) are involved in crop farming. Poultry (chicken) is the dominant form of animal rearing in the district constituting 33.4 per cent [41]

2.2 Methodology

A mixture of participatory methods was used in collecting data. This included field survey, focus group discussions and informant interviews. This was to allow the farmers to share their knowledge and to spell out various approaches being adopted in their farms. Information relating to climate, location and size of the study area were gleaned from the District Meteorological Service and the District Assembly. Wechiau, the district capital and Poyentanga, a key commercial town were purposively chosen from among the various communities under Wa West District of the Upper West Region because studies have identified them as being vulnerable to climate change impacts [50] The study was also limited at the two communities due to resource and time constraints. The target groups used in this survey were fifty (50) farmers randomly selected from each of the towns. This made a total sample size of 100 respondents. Additionally, four focus groups were held. Each focus group was attended by 8 to 12 farmers, consisting of men and women and traditional leaders in the locality. Six key informants were also interviewed on the premise of their knowledge on the subject matter

Figure 1.1: Map of the West District (Source: Ghana Statistical Service (2014).

The data collected through semi-structured interviews had 6 themes revolving around: (1) socioeconomic characteristics including educational levels; (2) Existing knowledge on climate change, (3) farmers' sources of information about climate change (4) farmers' perception on causes of climate change (5) Various adaptation strategies (6) Farmers' constraints in adapting to climate changes. The questions relating to the general climate change perception were open-ended, while the specific questions related to climate change effects and causes were organized with options to tick optional answer. Although all the questions were set in English, the local language (Wala) was also use as a communication medium during data collection, especially with the farmers. The objectives of the individual survey were to collect the information needed for in-depth analysis of the research questions, whereas the ones of the focus group were to verify the information obtained during the individual surveys [20]

3. Results and Discussions

3.1 Educational Background of respondents

According to [12] education is a major key to development through decision-making. Education plays a major role in the development of individuals and the community as a whole. The daily lives of individuals and a community depend much on the educational level be it formal or informal. This could be due to understanding, writing and reading, and interpretation of issues that confront the individual and the community [58-12]. From the field survey, it was revealed that 42.00% of the respondents had no formal education. Nonetheless, the majority of the respondents (58%) had been in school at a point in time. Thus, the rate of illiteracy in the community was quite moderate. This influenced the approach used in interviewing, understanding and interpreting of the questionnaire, because most of the questions had to explain further or in some cases converted to their local language (Walaa) for easy comprehension. Respondents attributed the high school-drop to mainly financial constraints in accessing further education. [29] showed that 65,853 of the total population of Wa West (49.0%) are literate. The findings further re-echo the fact that the education sector is an untapped opportunity to help people adopt since people's adaptive capacities to risk can improve through education [57] Thus, education fundamentally plays a central role in many processes that can speed up social change and climate change

adaptation. The lack of formal education was also traced as a factor to a number of people engaged in farming as it is the only livelihood source due to lack of inadequate requisite skills for formal jobs. This phenomenon indirectly also influences farmers to desire to learn new ways of mitigating and strategizing to combat the impact of climate change. Thus, their adaptive capacity in fully desiring to change farming pattern is affected [6-48]

3.2 Knowledge level of farmers about climate change

Farmers in Wechiau and Poyentanga were aware of climate change and its pattern over time. As many as 86 respondents have adequate knowledge about climate change. Many were able to attribute the change in climate and speedy deforestation to indiscriminate bush burning before farming. The farmers alluded to the fact that there is an increasing temperature and rainfall reduction pattern. Additionally, about 96% of the respondents stated that the decline in food production is because of the changes in climatic conditions. This clearly shows that the farmers are aware of the changes in climatic conditions. This finding in this study is in line with a report by [45] as observed from crop farmers. [45] explains that farmers are 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. [45] further reveals that hot temperatures because of climatic variations lead to the loss of soil fertility such as soil moisture, soil microorganisms, soil nutrients as well as evaporation of underground water. This eventually leads to low yield as was affirmed by most of the respondents from this study. The good level of knowledge regarding climate change can be attributed to the somewhat appreciable level of education of respondents. Nonetheless, 14% of respondents were naïve about factors leading to climate changes.

A review of literatures suggests that farmers' knowledge on climate change is not enough; this assertion was not however explicit in Wechaiu and Poyentanga as most respondents expressed a fair idea about climate change, its resultant effects and localized adaptation measures. [3-32] The appreciable level of knowledge on climate change evidently is attributed to the various roles and activities being played by various NGO's and stakeholders in educating communities in the Upper West Region on climate change issues.

3.3 Perceived causes of Climate Change

Numerous causes are attributed to the climate change [33-34] these causes are categorized under two themes: natural and man-made. From the field survey farmers (13%) asserted that climate change is linked to natural causes whiles the remaining 87% agreed climate change was solely due to human activities, such as charcoal burning, which our study reveals was prevalent in Wa West. A respondent in Poyentanga strongly emphasized that the uncheck menace of Fulani herdsmen was the reason why the gods were angry with the community hence no rain. He said "these fulanis rape our women in the farm, beat people up and disregard all sacred days and vehemently violate all rules in the community. Based on their activities, the gods are not happy and nobody is able to talk because when they meet you in the bush, they can kill you" similar assertion was made in Wechaiu by an elderly farmer who also believed the evil deeds of people was a contributing factor for the poor downpour of rainfall. However, this assertion as made could not be widely confirmed by other farmers in Wechiau but rather the core blame was on various human activities such as cutting down of trees for charcoal primarily by the women in the various communities. This underlying attribute of human activities as the primary cause of climate change adds credence to [33] findings which say that several greenhouse gases are responsible for global warming with human emitting them in different ways. Most come from the combustion of fossil fuels in cars, factories and electricity production. The gas responsible for the most warming includes carbon dioxide, methane and nitrous oxide as well as the loss of forests that would otherwise store CO2 [22-58]

3.4 Climatic Adaptation and Mitigation Strategies

Climate change adaptation depends on how farmers perceive it. The perception of risk associated with climate change and agriculture motivates farmers in their choice of adoption [30] During the field survey, it was realized that farmers were abreast with changes in temperature, rainfall and seasonal variability over the last 10 years. Most of these farmers were, as a result, diversifying their livelihood strategies from farming to non-farming activities. This confirms [19] finding that most members of farmer households search for new occupation in nearby urban centres as salesmen and security guards whilst a few with capital open up businesses like provision stores, mobile money and repair outlets in the community. Interview analysis stress on the fact, that adaptation investment in the form of irrigation facilities, fertilizer and seedlings for large farm sizes was expensive [1] The

larger the farm size, the more expensive it is for the farmers to implement adaptive mechanism as against smaller farms [15]

3.4 Table 1. Climate Adaptation and Mitigation Strategies

Contraints to adaptation	**Strategies**	**Type of Adaptation and Term**	**Frequency**
Unpredictability of weather	Changing the timing of planting	Long term and on field	26
	Planting drought-tolerant crops.	Long term and on field	
	Planting early maturing varieties of crops	Long term and on field	
	Irrigation	Long term and on field	
	Reduce farm size		
Limited access to agricultural markets	Change in crop type	Short team and on field	9
		Short term and on field	
High Cost of farm inputs	Diversification of livelihoods activities.	Short term and Off field	19
	Reliance on family and friends for funds	Short term and off field	
Poor soil fertility	crops diversification.	Long term and on field	27
	Reduction in farm size.	Short term and on field	
	Mix cropping	Short term and on field	

Authors Survey,2017

Farmers indicated that various strategies and adaptation measures are used in mitigating and minuting the impact of changing climatic conditions. Growing of crop varieties with pesticide application, the practice of mixed cropping, reducing farm size and changing of planting season was the common long-term and short-term strategies farmers were aligning to. Majority of the respondent was being compelled to also reduce the size of land they cultivate due to fear of losses this invariably has to deepen the poverty situation of the farmers in Wa West whose only source of livelihood is farming [56] There were farmers who have also adopted mixed cropping as a safeguard approach towards crop lost ***"Now, I do plant beans under the maize so that even if the maize is not coming the maize can supplement for. I also use part of the land for millet"-*** a farmer asserted.

Another farmer recounted that ***"from 12 acres in 2015 to 7 acres in 2016. In 2017 this year, I farmed only 4 acres. If you do big farming, you still don't get the expected bags of maize and it's because the rain is not coming since the conditions are not good for the crops"***

The use of crop varieties or improved seedlings is also common practice by local farmers as an adaptation and coping measure [5] The farmers who uses the mixed approach of crop variety and pesticides admit that without it, they will experience low harvest [36] From focus group discussion with farmers, it came to light that farmers have an appreciable knowledge of the importance of mixed cropping. They mentioned advantages such as a safeguard to crop failing, reducing of erosion, slowing down the spread of diseases and increasing of yield in good season. In essence, all respondents with an appreciable level of knowledge about climate change had developed an adaption strategy. This is in contract to [25] who asserts that only a few farmers develop adaptation mechanism despite their knowledge on causes and effect of climate change. It cannot be ruled out however that the socio-economic and high educational levels better position farmers to develop sustainable adaptation strategies.

3.5 Barriers to adaptation

The farmers raised concerns about how unpredictable weather conditions were, especially for those closers to water bodies, they expressed worry over the quick rate at which water dries up. The farmers sounded hapless and were only restoring to prayers with hope for rainfall. As of September, when this study was conducted there were still no rains as expected normally between June-July, this phenomenon that was certainly going to trigger massive crop failure and food shortage. Such weather unpredictability makes it difficult for farmers to plan ahead. 32% of farmers also attributed high cost of farm inputs mainly fertilizer, tractor services and seedlings as a primary reason why they are not able to fully adopt as they wish. Limited access to agricultural extension officers (14%), and poor soil fertility (19%) were also high-ranking constraints to adaptation. Farmers claim of high cost of farm inputs is similar to findings reported in Southern Africa where smallholder farmers are unable to meet the transaction cost of adaptation measures due to lack of credit facilities [21] This also affirms the assertion that, barriers, especially in Africa that impedes farmers ability to adapt to climate changes, are numerous [14]. [35] also report that institutional factors, irregularity of extension services are among the most prevalent. All of these were confirmed by the responses given by the farmers.

These findings also verify [50] on the fact that, lack of knowledge about other adaptation options, access to water, lack of credit, the high cost of adaptation and insecure property rights are the main climate change adaptation constraints. According to same authors, farmers in constant contacts with extension officers stand the better chance of being aware of climate change conditions and various sustainable adaptation measures. Being able to put in place structures and mechanisms that help in monitoring, informing and observing the planned adaptation of farmers can aid them to maneuver all adaption constraints [53]

3.6 Sources of Information about climate change

Awareness on climate change through either media or observation can help farmers to plan on mitigation strategies especially for those who depend on a rainfed agricultural system [47-32] The lack of adequate and modern equipment at various meteorological service stations across Ghana in general accounts for the limited information farmers have on climate change. Most weather stations in Ghana are not able to produce the right information for farmers to make informed decisions. This hampers timely prediction and rainfall pattern forecast. Hence most farmers rely on past experience and certain weather characteristics to take a decision on when to plant or harvest. [11] It was figured out from various focus group discussion sessions and interviews that information on climate change and best farming practices are seldom passed on radio station. Farmers (46%) in the study area attributed their source of information on climate change to the radio and community education by some NGOs. The rest were in a dearth of information. Although some NGOs are trying to fill the gap by providing farmers with information. It appears very scanty in relation to the number of farmers who need it to stay abreast with climate change updates. ***"I get my update from FarmLine, they call me on my phone to tell me to expect rains or some kind of weather on certain days"-*** a female's respondent revealed.

As stated by [4] information and awareness on climate change could potentially serve as a barrier to successful implementation of adaptation practices. Hence for farmers to have adequate knowledge of climate changes, there

must be intensive education and regular updates, as this can help the farmers better manage and adapt to change [48]

4. The Way forward

Aside, a few farmers who are able to afford resistant seedlings, fertilizer, the majority of farmers only resort to hope and prayers for rain as a strategy with no clear-cut sustainable adaptation measure. Adaptation measures in developing countries is a big challenge, particularly in Ghana, where the majority of people are smallholder farmers with lower adaptive capacity; there is the urgent need therefore for policy-driven incentivized adaptation strategies [40] lead by the government and various Non-Governmental Organizations. Such policy drive should include the revamping of the metrological services and Ministry of Information through the Ministry of Food and Agriculture to deliver up to date information on climate change information. This is very essential for planning and strategizing to meet all changing circumstances. [42-16]. This study also recommends adequate extension services and irrigation facilities to assist farmers to increase their yields which invariably will help sustain their livelihoods in the long run as well as supporting programmes that may include subsidies on fertilizers and credit to purchase other farm inputs like resistant seedlings etc. This can be done by recruiting and training more extension officers in various agricultural fields to meet growing need and demand in the sector. These officers should be spread across various districts in the country with strict supervision from the district assemblies and other stakeholders at the local level. The Ministry of Food and Agriculture, regional and local agriculture officers and Non-governmental organizations should also provide incentives to foster farmer associations that will bring farmers together in forming communication and adaptation strategies as a response to climate change. It is known that farmers learn easily from other progressive farmers; by working and learning together, hence such an approach can be instrumental in boosting adaptation strategies.

5. Conclusion

This study has provided evidence data to support the perceived assertion of climate change and farmers' perception in Upper West Region where farmers are already adapting to climate change. This study has also shown that farmer's capacity to adapt to climate change is based on their level of knowledge, which emanates from their source of information hence a comprehensive and sustainable approach that addresses multiple effects and combines indigenous knowledge and experience with scientific insights is still required to overturn the factors that prevent farmers from mitigating against climate change in Wa West, and Ghana as a whole.

Conflicts of Interest: The authors declare no conflict of interest

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