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Adoption of Climate Change Adaptation Strategies by Smallholder Farmers in the East Mamprusi Municipality of the Northern Region of Ghana

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ABSTRACT

The purpose of the study was to determine the differences in perceptions about changes due to climate change by sex as well as identify the adaptation strategies used by the farmers in the east Mamprusi district of the northern region of Ghana. Survey design was used in this study. Two hundred and fifty (250) respondents were selected for the study using a simple random sampling. A semi-structured interview guide was the main instrument used for the study. Means and standard deviations were the tools used to analyze the data. The results show that generally there are no differences in perception about climate change between male and female respondents. The study indicated that the following adaptation strategies have been adopted by farmers in response to climate change/variability: planting crops late, use of fertilizer and pesticides, use of soil and water conservation practices, mixed farming and mixed cropping. It was recommended that there is the need to introduce drought resistant crop varieties that are capable of adapting to the changing environmental conditions to the farmers and also encourage them to adopt these varieties as a way of reducing the adverse effects of climate change on agriculture in the area.

KEYWORDS: Climate change, Adaptation, Drought, Rainfall, Temperature

Introduction

Climate change and variability and related crop yield variability in Northern region is a feature that has been prevalent for centuries. The fact that the study area falls within the tropical sub-humid region projects this phenomenon. The mean annual rainfall amounts in the study area is between 1000 mm to 1500 mm. Rainfall comes between June and October. The rainfall is, however, irregular with dry spells during the rainfall season. The peak rainfall occurs in July and September. The rainy season is followed by a prolonged dry season with the peak occurring between March and April with adverse impact on agriculture and food security of smallholder farmers (GSS, 2010).

Temperatures are generally high throughout the year, ranging from a mean minimum of about 27.4^{o}C to a mean maximum of about 35^{o}C. The hottest part of the year is between March and May when the rainy season is about to begin. Temperatures during this period could go up to about 42^{o}C during the day and as low as about 12^{o}Cat night.

According to World Bank (2009) agricultural production constitutes the mainstay of Ghana's economy, accounting for 32% of GDP in 2009 and employing 55% of the economically active work force of the population. Ghana's agriculture, however, is predominantly rainfed, which exposes it to the effects of present climate variability and climate change. Duffuor (2012) revealed that the agricultural sector contributed 31.8 percent to the country's Gross Domestic Product (GDP) in 2011 and 21.3% of the GDP in 2013 and provides the largest employment among all the sectors. Despite its high contribution to the overall economy, this sector has been facing many challenges with climate-related extreme events like drought and floods being the major ones.

The challenges notwithstanding, agriculture remains a major principal sector in Ghana's economy. Al-Hassan and Diao (2007) reported that over 60 percent of the population in Ghana depends on Agriculture for their livelihood, particularly Northern Ghana where majority of the population is in agriculture. Hence, agricultural productivity growth is essential for the economic success of Ghana's rural households and the economy as a whole. The susceptibility of Ghana's agriculture to climate makes a closer look at climate very important.

According to Isaac (2014) climate is defined as the average weather condition of a place which includes patterns of

temperature, precipitation, humidity, wind and seasons. This average weather condition experienced over a given area is over a long period of time usually ranging from decades to millions of years. Compared to climate, weather is a short-term phenomenon, which describes the atmosphere, daily temperature, pressure, humidity, wind speed, and precipitation (IPCC, 2007). To the farmer two aspects of climate are critical since they impact production. These are climate variability and climate change.

Fussel and Klein (2006) defined climate variability as the variations in the mean state and other statistics such as occurrence of extremes of the climate on all temporal and spatial scales beyond that of individual weather events. Obeng (2014) refers climate variability to the observed year-to-year differences in values of specific climate variables within an averaging period (typically 30 years). According to IPCC (2007) climate change is any long term significant change in the "average weather condition" that a given region experience. Also IPCC (2005) simply refers to climate change as increase or decrease in the average precipitation caused by land use changes and the anthropogenic increase in the concentrations of greenhouse gases, particularly carbon dioxide (CO_2) in the earth's atmosphere.

The United Nations Framework Convention on Climate Change (UNFCCC 1992; cited in Blessing et al. 2010) refers to climate change as a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods. Climate change affects the survival of man, especially those whose livelihoods depend so much on rainfed agriculture (Obeng, 2014). Lobell et al. (2008) reported that the Africa continent is the most vulnerable in terms of climate change effects on agricultural production The vulnerability of African to climate change is due to the very low coping and adaptive capacity on the continent (Nellemann et al., 2009). Climate change is inflicting hash and extreme environmental conditions on smallholder farmers by reducing the poor household's options, particularly in the agriculture sector (Brown and Crawford, 2008).

Two key elements of climate that are critical to agriculture are rainfall and temperature. How variable these elements are, with respect to agricultural production, has a lot of implications for crop production. According to Van der Geest (2004:14) unreliable rainfall can be defined as a situation of insufficient rainfall or excess rainfall which can trigger food and livelihood stress when vulnerable people are affected. Rainfall variability refers to the differences in rainfall from place to place (spatial variability), the differences in rainfall between years (inter-annual variability) and differences in rainfall distribution within the same year (intra-annual variability). For agricultural production the total amount of rainfall might not matter much as its distribution over the period of the rainfall (Obeng; 2014).

Ministry of Environment, Science and Technology (MEST, 2012) reported that there has been rise in temperatures across the various ecological zones in Ghana whereas rainfall patterns are becoming less predictable and recent increases in floods along the river banks also threaten settlements. The 2007 floods in the northern sector of the country demonstrated how climate change undermines development investments, with three hundred and seventeen thousand (317,000) people affected, one thousand kilometers of roads destroyed, two hundred and ten (210) schools and forty five (45) health facilities damaged, and six hundred and thirty (630) drinking water facilities damaged. Thousands of people were displaced leading to the death of more than thirty (30) people, and resulting in direct emergency funding of around US$ 25 million.

There have been frequent rainfall variability, droughts, floods, and increased temperatures and reduction in soil moisture and crop yields in northern Ghana (Obeng, 2014). The coping strategies adopted by smallholder farmers in the past to survive the changes in climate have increasingly become unworkable because of increases in intensity of the climate change impacts. Therefore, smallholder farmers have resorted to adaptation strategies to help them survive these impacts. The perceived effects of climate variability on agricultural production have been a subject of intense discussion among smallholder farmers, and other stakeholders in recent times in the study area. The extreme weather conditions such as rising temperature and erratic rainfall have led to substantial decline in agricultural productivity and rising food insecurity in the area.

Statement of the Problem

Climate change impacts are felt in agricultural production, health, biodiversity, and socio- economic conditions, and affect people and the environment in general. It is predicted to worsen the incidence of drought and flood and several people will become vulnerable (Blessing et al., 2011). Climate change is perhaps the most serious environmental threat to the fight against hunger, malnutrition, disease and poverty in Africa, essentially because of its impact on agricultural productivity (Ozor et al., 2010).

The impacts of climate change are being felt by both the rich and poor, and in the East Mamprusi District for instance, more than half of the district population is thought to be prone to the effects of climate change due to their over dependence on rain fed agriculture. It is anticipated that adverse impacts of climate change on the agricultural sector will exacerbate the incidence of food insecurity in the district which is likely to be severe among the farmers since their livelihoods depend on the agricultural sector. Although the farmers have made some efforts to adapt to and reduce climate change effects, the efforts are still minimal,

especially when compare with the impending impact. This has necessitated the need to investigate the adaptive strategies used by farmers in the East Mamprusi District of Northern Region of Ghana.

Purpose of the Study

The purpose of the study was to determine the differences in perceptions about changes due to climate change by sex as well as identify the adaptation strategies used by the farmers in the east Mamprusi district of the northern region of Ghana.

Research Questions

(1) What are the differences in perceptions about climate change by sex?
(2) What are the adaptation strategies used by the farmers in the study area?

Methodology

Survey design was used in this study. The target population for this study was mainly farmers selected from the five area councils in the study area. They comprised male and female farmers in East Mamprusi district of Northern region of Ghana. Multistage sampling technique was used to select the respondents. Firstly the District was divided into five based on the geographical location of the Area Councils thus: Gambaga, Nalerigu, Langbinsi, Sakogu, and Gbintiri Area councils. A Community Base Organisation (PARED) operating in the study area had formed some farmer groups. The researcher used these farmers groups as the study population since there were no other records of small holder farmers in the study area. Each of the 5 area councils has 15 farmer groups consisting of 10 farmers per each group making a total of 750 farmers. Secondly, using Krejcie and Morgan (1970:603) table for sample size determination as a guide, two hundred and fifty (250) respondents were selected for the study using a simple random sampling.

A semi-structured interview guide was the main instrument used for the study. The instrument consisted of close-ended and open-ended questions that allowed the respondents to freely express their opinions. The perceptions of farmers were measured using a 5-point Likert scale. The scale was rated as follows: ***Strongly Agree (SA) = 1, Agree (A) = 2, Somewhat Agree (SWA) = 3, Disagree (D) = 4 and Strongly Disagree (SD) = 5.*** The interview was supplemented with focus group discussions (FGD). Checklists were used to conduct the FGDs. The researcher held ten (10) focus group discussions during the data collection which provided more insight into the determinants of adoption of climate change adaptation strategies by smallholder farmers. A combination of qualitative and quantitative data was gathered for the data analysis.

Data Analysis Procedure

Research question 1 sought to determine the perceptions of respondents about climate change by sex and was answered using means and standard deviation. Research question 2 sought to identify the adaptation strategies pursued by the farmers and this was answered using means and standard deviation.

Results/Discussion

Research question 1 sought to determine the perceptions of respondents about climate change by sex. The respondents were asked to indicate the extent to which they perceived changes in suggested climate events they are experiencing in their area on a five point Likert-type scale. The results are presented in table 1.

Table 1: Perceptions of respondents about climate change by sex (n=250)

Perceived change	Male		Female	
	Mean	SD	Mean	SD
Decreasing rainfall amount	2.44	1.17	2.42	1.05
Onset of rainfall shifting	1.98	.76	2.09	.76
Rainy season starts late than normal	1.74	.72	1.74	.75
Planting date of crops changing	1.93	.78	1.96	.68
Crops are planted late now	1.56	.69	1.68	.84
Increased seasonal flooding	2.34	.95	2.47	.87
Increasing temperatures	1.74	.56	1.72	.61
Increased pest and disease attack on crops and animals	1.79	.80	1.76	.79
Increased cropping diversity	2.61	1.07	2.58	1.04
Increased seasonal drought	1.95	.92	2.01	.96
Mean of Means	**2.00**	**0.84**	**2.04**	**0.84**

Source: Field survey (2015)
Scale: 1 = Strongly Agree (SA); 2 = Agree (A) 3 = Somewhat Agree (SA) 4 = Disagree (D); 5 = Strongly Disagree (SD)

The results show that generally there are no differences in perception about climate change between male and female respondents. This is seen from the mean of means values for males (2.00, SD = 0.84) and females (2.04, SD = 0.84). A mean of 2 corresponds to the "Agree" response category. This implies that both sexes agree that there have been

changes in climate in the area. For the individual statements the perceptive means range from 1.56 (Crops are planted late now) to 2.61 (Increased cropping diversity) for males with SD also ranging from 0.56 to 1.17 and from 1.68 (Crops are planted late now) to 2.58 (Increased cropping diversity) with SD ranging from 0.61 to 1.05 for females. With the exception of increased cropping diversity which scored mean values of 2.61 and 2.58 for males and females respectively which are approximately to 3.00 and correspond to "Somewhat Agree" on the scale, all the remaining statements recorded mean values of approximately 2.00 which correspond to "Agree" on the scale. This reinforces the fact that generally the respondents hold the perception that there have changes in climate in the area. It is important to note that all the perceptive statements point in the direction of worsening climate and the agreement of the respondents with these statements imply that there is the need to put in place measures that will not only help to stem the tide with respect to the worsening situation but also improve the situation. The findings from the FGDs on the perceptions about changes due to climate were not quite different from the individual farmer views. The results have confirmed that temperature had increased while rainfall had reduced in recent times in the study area.

Research question 2

Research question 2 sought to identify the adaptation strategies pursued by the farmers in response to climate change and the result is presented on table 2.

Table 2: Adaptation strategies used in response to climate change

Strategy	Mean	SD
Household resorted to dry seasons gardening	3.99	.91
Household has resorted to planting of different crops	3.13	1.19
Household now plant crops late	1.97	.84
Household engage in off-farm activities	3.85	1.01
Household now use fertilizer and pesticides on the farm	1.61	.75
Household now resorts to soil and water conservation practices	2.06	.72
Household resort to mixed farming	2.28	1.09
Household resort to mixed cropping	2.31	1.07
Household resort to land rotation	3.25	1.22
Household farm along river banks	3.92	.91
Household resort to planting leguminous trees on farm	3.93	.98
Household resort to planting cash crops **(cotton, tobacco, cashew)**	3.63	1.15
Mean of Means	**2.99**	**0.99**

Source: Field survey, 2015

Scale: 1 = Strongly Agree (SA); 2 = Agree (A) 3 = Somewhat Agree (SA) 4 = Disagree (D) 5 = Strongly Disagree (SD)

The mean of means value of 2.99, approximately 3.0 with an SD = 0.99 as indicated in Table 4.4, corresponds to the "Somewhat Agree" response category on the scale. This means that the respondents are of the perception that to a certain extent they have adopted some adaptation strategies to help them deal with the effects of climate change. The mean values range from 1.61, SD = 0.75 (Household now use fertilizer and pesticides on the farm) to mean value 3.99, SD = 0.91 (Household resort to dry seasons gardening).This implies that households resort to the use of fertilizer and pesticides most and dry season gardening least. A mean value of 3.99 for resort to dry season gardening is approximately 4.00 and is equivalent to "Disagree" on the scale. The resort to the use of fertilizer and pesticides as the most important is not out of place since the farmers have already consented to the fact that climate change has led to increase in pest and disease infestation on crops and animals.

The results further indicate that the following adaptation strategies have been adopted by farmers in response to climate change/variability: planting crops late (1.97, SD = 0.84), use of fertilizer and pesticides (1.61; SD = 0.75), use of soil and water conservation practices (2.06, SD =0.72), mixed farming (2.28, SD =1.09) and mixed cropping (2.31, SD = 1.07). The mean values for all these strategies correspond to the "Agree" response category on the scale. The respondents "Somewhat Agree" with the fact that they plant different crops (3.13, SD = 1.19) and practice land rotation (3.25, SD = 1.22). This means that they resort to these strategies to a lesser extent. All the remaining strategies recorded mean values of approximately 4.00, meaning that they disagree with these statements and therefore do not use these strategies in response to climate change or variability. In percentage terms 41.7% of the adaptation strategies are practised by the respondents while another 41.7% is not practised.

The findings are in line with Temesgen et al, (2008) who reported that farmers employed the following adaptation measures; mixed cropping, tree planting, soil conservation, early and late planting, and use of irrigation to adapt to climate change. Uddin, Bokelmann and Entsminger (2014) also identified crop diversification, crop rotation, cultivating short duration crops, use of drought tolerant varieties, engagement in non-farm activities and soil conservation practices as some of the strategies farmers in Bangladesh have adopted towards climate change adaptation.

Findings

1. The results show that generally there are no differences in perception about climate change between male and female respondents.

2. The results from the study indicate that the following adaptation strategies have been adopted by farmers in response to climate change/ variability: planting crops late, use of fertilizer and pesticides, use of soil and water conservation practices, mixed farming and mixed cropping.

Conclusions

The purpose of the study was to determine the differences in perceptions about changes due to climate change by sex as well as identify the adaptation strategies used by the farmers. It is concluded that the perceptions about changes in the climate of the area do not differ between males and females. Again, adaptation strategies adopted by farmers in response to climate change/variability in the study area include planting crops late, use of fertilizer and pesticides, use of soil and water conservation practices, mixed farming and mixed cropping.

Recommendations

1. There is the need to introduce drought resistant crop varieties that are capable of adapting to the changing environmental conditions to the farmers and also encourage them to adopt these varieties as a way of reducing the adverse effects of climate change on agriculture in the area.
2. The development of or rehabilitation of small scale irrigation schemes by the Ministry of Food and Agriculture and private organizations will go a long way to enhance and diversify farming practices from being rainfall dependent to irrigation that will ensure the availability of water all year round

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