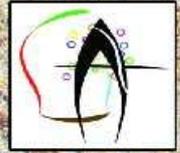CODESRIA

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L'Afrique et les défis du XXIème siècle
Africa and the Challenges of the Twenty First Century
A África e os desafios do Século XXI
إفريقيا وتحديات القرن الواحد والعشرين

Farmers Perception and Adaptation to
Climate Change: Evidence from Ghana

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Introduction

The issue of climate change has gained increased attention in recent times due to the perceived negative repercussions it has on a range of activities chiefly agriculture. Recent climate patterns across the globe have had negative impacts on a number of countries such as Japan, United States of America, and Ghana among several other countries. These events are ample evidence of what climate change is capable of doing if attempts are not made to mitigate and adapt to its impacts. For instance, Dai et al., (2004) andTrenberth et al., (2007) point out that many Third World countries have already experienced extreme weather events in terms of floods, droughts, heat waves and tropical cyclones that are more frequent and intense than previous experiences and the resulting impacts point to the consequences on the environment, production systems, and livelihoods from future climate variability and change.

Before proceeding any further, it is instructive to shed light on what we mean by climate change in order to put things in the right perspective. The Intergovernmental Panel on Climate Change (IPCC) (2007) defines climate change as a change in the state of the climate that can be identified (e.g. using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer. It refers to any change in climate over time, whether due to natural variability or as a result of human activity.

Agriculture contributes about 35% of Ghana's GDP, generates about 30-40% of the foreign exchange earnings, and employs about 55% of the population (Ghana Fact Sheet, 2010). It is envisaged that climate change will pose a serious threat to the environment, agricultural production and food security of most developing countries including Ghana. In particular, rural farmers, whose livelihoods depend on the use of natural resources, are likely to bear the brunt of adverse consequences. This is largely because most developing countries experience high poverty incidence and as a result are incapable to adapt to climate change. However, the extent of climate change impact on agriculture can be ameliorated by the perception and level of adaptation of farmers. Studies have shown that African perception and understanding of climate change are poor. For instance, Taderera (2010) reported that South Africans awareness of climate change was literally interpreted as "changing weather" and this may influence the extent of adaptation. Adaptation is widely recognized as a vital component of any policy response to climate change. It is a way of reducing vulnerability, increasing resilience,

moderating the risk of climate impacts on lives and livelihoods, and taking advantage of opportunities posed by actual or expected climate change.

The way farmers perceive climate change is important for their choice of adaptation and hence their willingness to pay for climate change mitigation action. Perceptions are however influenced by other factors. Gbetibouo (2009) observed that fertile soil and access to water for irrigation decrease the likelihood that farmers will perceive climate change. However, education, experience, access to extension services increases the likelihood that farmers perceive climate change.

Much as perceptions and adaptations to climate change are important, it is however instructive to note that very few studies have examined farmers' perceptions and adaptation and the consequent effect on the willingness to pay for climate change mitigation policy action in the Ghanaian context. This study therefore considers how farmers perceive and adapt to climate change and their willingness to pay for climate change mitigation policy.

In investigating this research problem, the following objectives would be pursued.

1. examine the socioeconomic characteristics of the farmers
2. analyze their level of awareness of climate change
3. analyze farmers perception of climate change
4. examine the various choice of adaptation measures among the farmers
5. identify the barriers to adaptation among the farmers
6. analyze the socio-economic determinants of farmers willingness to pay for climate change mitigation policy.

Review of Related Literature

In response to perceived long-term changes in climate, farm households implemented a number of adaptation measures to reduce the vulnerability of climate change impacts. Analysis of the impacts of climate change and adaptation on food production in Ethiopia by Yesuf et al., (2008) revealed changing crop variety, soil and water conservation, water harvesting, planting of trees and changing planting and harvesting periods as the choice of adaptation measures by the farmers. Among these methods of adaptation, planting trees was the dominant measure adopted by most of the farmers. However, about 42% of the farmers did not use any adaptation method for climate change impacts. Using two separate models to examine the factors influencing farmers' decision to adapt to perceived climate changes, Yesuf et al. (2008)

confirmed that household wealth represented by farm and nonfarm income and livestock ownership, increases the likelihood of climate change awareness and adaptation. Deressa (2008) identified age of household head, wealth, information on climate change, social capital and agro ecological settings as having significant impact on the perception of farmers to climate change. Farmers in areas with higher annual mean temperature over the period of survey were more likely to adapt to climate change.

Numerous factors have been identified as barriers to adaptation: lack of information on choice of adaptation option, lack of financial resources, shortage of land, poor potential for irrigation and labour constraints (Deressa et al., 2008). However, lack of information on choice of adaptation option was the major barrier to adaptation. Madison (2006) and Nhemachena and Hassan (2008) showed that access to information through extension increases the chance of adapting to climate change.

Climate mitigation strategies must be seen as a collective concern for sustainability of agricultural production and livelihoods of many people especially those in developing countries. Consequently, individual willingness to contribute to climate issues is vital in such endeavour. As a result some studies have analyzed the willingness to pay for climate change mitigation policy using different models. The impact of uncertainty associated with climate change on individual decisions regarding support for climate change policy was first examined by Cameron (2005). That study used a Bayesian information updating model in a single bounded contingent valuation framework to estimate individual option price for future climate change using a convenience sample of college students. Empirical results revealed a quadratic relationship between expected future temperature changes and individual support for climate change policy. Thus, the respondents were willing to pay more with increased expected future temperature change but the amount increased at a decreasing rate.

Maddison (2006) reviewed studies on adoption of new technologies and identified farm size, tenure status, education, access to extension services, access to market and credit availability as the major determinants of speed of adoption in Africa. Minimizing the impacts of climate change requires perception and adaptation. Farmer's ability to perceive climate change is a key precondition for their choice of adaptation. Maddison (2006) further revealed that adaptation to

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climate change requires that farmers must first perceive that the climate has changed, then identify useful adaptations and implement necessary adaptation responses.

Akter and Bennett (2009) analyzed the determinants of households' willingness to pay for Carbon Pollution Reduction Scheme (CPRS) in Australia. The willingness to pay for climate change mitigation was found to be significantly reduced by the uncertainty associated with the expectations of future temperature increases. Furthermore, the willingness to pay for Carbon Pollution Reduction Scheme was found to be negatively affected by respondents' lack of confidence in the CPRS being effective in slowing down climate change.

Analysis of the perception and willingness of graduate students to pay for gas tax (Viscusi&Zeckhauser, 2001) revealed that a major factor that may influence willingness to pay, holding risk estimates constant, is whether a respondent feels scientific uncertainty motivates a more aggressive or less aggressive approach to climate change policy. Han et al. (2010) estimated the willingness to pay for environmental conservation by tourists in China, using a contingent valuation method. The results indicated that willingness to pay increases with income, education level, and age.

Bamidele et al. (2010) analyzed the factors affecting farmers' ability to pay for irrigation facilities in Nigeria. Empirical results from the logistic regression analysis of the paper revealed age of the farmers, education level acquired, farm household income and the size of farmers' household as the major factors explaining farmers' ability and willingness to pay for irrigation scheme.

Methodology

Description of Study Areas

The study centered on Dunkwa in the Shama Ahanta East Municipality and Bawku Municipality of Ghana. These districts are well known farming areas contributing significantly to the food basket of Ghana. Dunkwa lies in Shama in the Western part of Ghana and its geographical coordinates are 5^0 7' 0" North and 1^0 37' 0" West. It has an estimated population of over 1500 and the main occupation in the area is farming.

The Bawku Municipality on the other hand is one of the nine districts/municipalities in the Upper East Region of Ghana. The district is bordered Burkina Faso to the north and Togo to the east. Kusasi, Mamprusi, Bissa and Mossi are the main ethnic groups living in Bawku District. To the south, the municipality is bordered by the Garu-Tempane District and to the west by Bawku West District (Zebilla). It lies between latitude 11^0 and 11^0 15^1 North of the Equator and longitude 1^0 30 ^{1} and 0 ^{0} West of the Greenwich Meridian. The administrative capital town Bawku town is about 880km (550miles) from Accra the national capital and notably a vibrant commercial business centre, connecting economic activities between other West African states such as Togo, Burkina, Niger and Mali. The Bawku Municipality has a total land area of about 1215.05square kilometers and an estimated population of 216,271 at an annual growth rate of 3% with an average of 7 persons per household (2000 census). Agriculture is the dominant occupation in the district with tomatoes, soya beans and onions being some of the main crops cultivated. The average annual rainfall of the municipality is 700mm, with peak rainfall in August.

Sampling and sample size

The target population was farmers in Dunkwa and Bawku. A random sampling technique was used to select 193 farmers in Dunkwa and Bawku. An interview schedule was the main tool of data collection while descriptive statistics and logistic regression analysis were the main analytical techniques. Data was analyzed using the Statistical Product and Service Solution (SPSS) and Stata.

Model Specification

The basic model of the logit estimation is as follows:

$$P_i = \Pr ob(Y_i = 1) = \frac{1}{1+e^{-(\beta_o+\beta_1 X_{1i}+.......\beta_k X_{ki})}}$$

$$= \frac{e^{(\beta_o+\beta_1 X_{1i}+.......\beta_k X_{ki})}}{1+e^{-(\beta_o+\beta_1 X_{1i}+.......\beta_k X_{ki})}} \quad \text{……………………… (1)}$$

Similarly,

$$P_i = \Pr ob(Y_i = 0) = 1 - \Pr ob(Y_i = 1)$$

$$= \frac{1}{1+e^{(\beta_o + \beta_1 X_{1i} + \dots \beta_k X_{ki})}} \quad \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots(2)$$

Dividing (1) by (2) we get

$$\frac{\Pr ob(Y_i = 1)}{\Pr ob(Y_i = 0)} = \frac{P_i}{1 - P_i} = e^{(\beta_o + \beta_1 X_{1i} + \dots \beta_k X_{ki})} \quad \dots\dots\dots\dots\dots\dots\dots\dots\dots(3)$$

Where P_i is the probability that Y takes the value 1 and then $(1-P_i)$ is the probability that Y is 0 and e the exponential constant.

This research uses information criteria as technique for providing the basis for model selection. Most commonly used information criteria such as Akaike Information Criteria (AIC) is employed. The idea of AIC (Akaike, 1973) is to select the model that minimises the negative likelihood penalised by the number of parameters as specified in equation (4).

$$AIC = -2 \log(L) + 2p \qquad\qquad\qquad (4)$$

Where L refers to the likelihood under the fitted model and p is the number of parameters in the model. Specifically, AIC is aimed at finding the best approximating model to the unknown true data generating process and its applications draws from (Akaike, 1973; Bozdogan, 1987; Zucchini, 2000).

Socioeconomic characteristics of farmers in Dunkwa and Bawku

The socioeconomic characteristics of the farmers in Dunkwa were investigated and the results are presented accordingly. Results revealed cereal, vegetables and root/tubers as the types of crops grown by the farmers in the area. However, majority (73.5%) were cereal farmers. Results also revealed that 79.6% of the farmers were males whilst 20.4% were females. The average age of the farmers was 44.92 years with 37.8% in the age range of 34-41 years; 20.4% were between 42-49 years; 14.3% were between 58-65 years. Only 5.1% of the farmers were in the age range of 66-73 years. 10.2% of the farmers interviewed had obtained senior high school education; 48% had obtained junior high school education; 35.7% had obtained basic education; only 6.1% had no formal education. The average annual income of the farmers was GH¢1403.0612 with 48%

earning between GH¢100-GH¢1000; 33.7% between GH¢1100-GH¢2000; 10.2% between GH¢2100-GH¢3000; only 8.2% of the farmers had annual income between GH¢3100-GH¢5000. Given the relatively low annual farming incomes of the farmers, their adaptation and willingness to pay for mitigation policy may be low. The distribution of years of farming experience revealed an average of 17.816 years of farming with 33.7% having between 1-10 years of experience; 32.7% having between 11-20 years of experience; 23.5% having between 21-30 years of farming experience; and 10.2% having between 31-40 years of farming experience. The average household size of the farmers was about 7 persons with 88.8% having a household size between 4-9 persons; 8.2% having between 10-15 persons; only 1% had a household size between 21-25 persons. However, the distribution of farm size revealed an average of 4.306 acres with majority of the farmers (69.4%) having between 1-4 acres of farmland; 16.3% having between 5-9 acres; 9.2% between 10-14 acres: only 5.1% had between 15-19 acres of farmland.

From Bawku, the demographic characteristics are presented below. Of the respondents interviewed, males dominated with a percentage of 82.1 while the remaining 17.9 were females. 23.2% of the respondents interviewed were between the ages of 24-30 years; 45.3% were between 31-40 years; 21.1% were between 41-50 years, 8.4% were between 51-60 years and 2.1% were between 61-70years. Of the respondents 64.2% were heads of their families while the remaining 35.8% were not. Though educational levels of the respondents ranged from no formal education to the tertiary levels, the number of years spent at these levels differed with the respondents. 23.2% of the respondents had no formal education; 12.6% had obtained basic education; 12.6% had obtained middle/JHS education, 17.9% had obtained O'level/SHS education and 33.7% had obtained education up to the tertiary level. 41.1% of the respondents had household size between1-5, 43.2% had between 6-10, 12.6% had between 11-15, 2.1% had between 16-20 and 1.1% had between 21-25.

With regard to their farming experience, 20.0% had 3-10years of farming experience, 47.4% had 11-20years, 20% had 21-30years, 7.4% had 31-40years and 5.3% had 41-50years experience. Of the respondents interviewed, majority constituting 55.8% had farmland size between 1-5 acres, 36.8% had farmland size of 6-10acres, 3.2% had farmland size between 11-15 acres, 3.2% had farmland size between 16-20 acres and 1.1% had farmland size between 21-25. 64.2% of the respondents had other income generating activity while 35.8% only source of income was

farming usually done on subsistence level. Majority constituting 56.8% of the respondents interviewed earned annual income between GH¢800-GH¢2000, 18.9% earned between GH¢2100-GH¢3000, 12.6% earned between GH¢3100-GH¢4000, 7.4 % earned between GH¢ 4100-GH¢5000, 2.1% earned between GH¢5100-GH¢6000 and 2.1% earned between GH¢6100-GH¢7000.

From the socioeconomic characteristics of farmers in Dunkwa and Bawku, it can be seen the agriculture is predominately engaged in by male in Ghana no matter one finds himself in the southern or northern regions. Majority of the farmers sampled from the two areas had some form of education. More the two-thirds of the farmers had more than a decade years of experience in farming. Again, majority of the farmers had small farm lands to work on in both areas. Even though the general income accrued from agriculture in the country is generally low, the study reveals that those in the northern region have relatively high incomes than their southern counterparts.

**Figure 1: Perception of climate change (Bawku)**
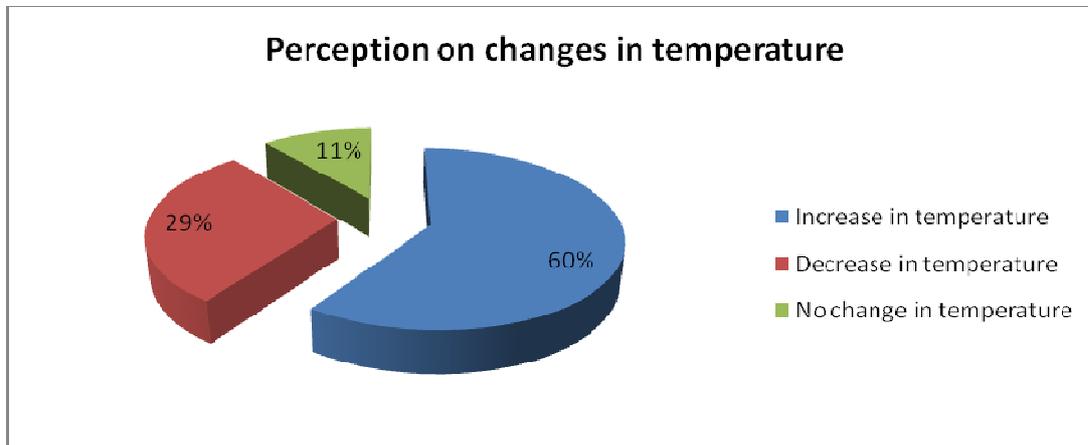
Note: **IT**=Increase in Temperature **DT**=Decrease in Temperature **NCT** = No Change in Temperature

When asked about the perception of changes in temperature, majority constituting 60% of the total respondents perceived an increase in temperature. 29% of the respondents indicated a decrease in temperature while the remaining 11% of the respondents went contrary to this opinion i.e. perceived no change in temperature.

Farmers' Perception on temperature changes in Dunkwa

About 49% of the farmers perceived increases in temperature whilst 33% of the farmers perceived a decrease in temperature. However, 18% of the farmers did not perceived any change in temperature.

Figure 2: Farmers' perception on temperature changes in Dunkwa
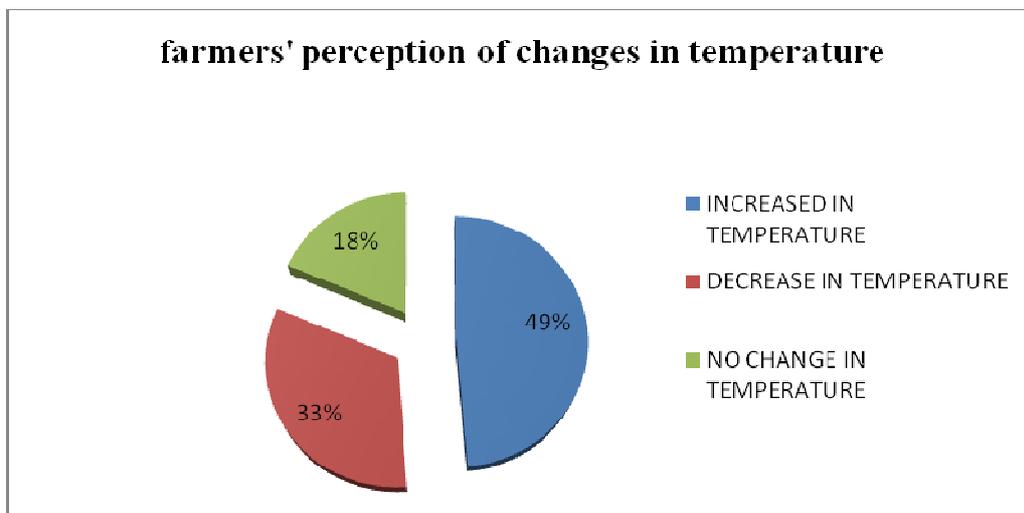
Perception of changes in rainfall in Bawku

Of the farmers interviewed, 24% perceived an increase in rainfall. Up to 49% of the total respondents perceived decrease in rainfall. Although 16% of the total respondents perceived no changes in rainfall, up to 11% went contrary to this view since they perceived irregular rainfall pattern

**Figure 3: Perception of changes in rainfall in Bawku**
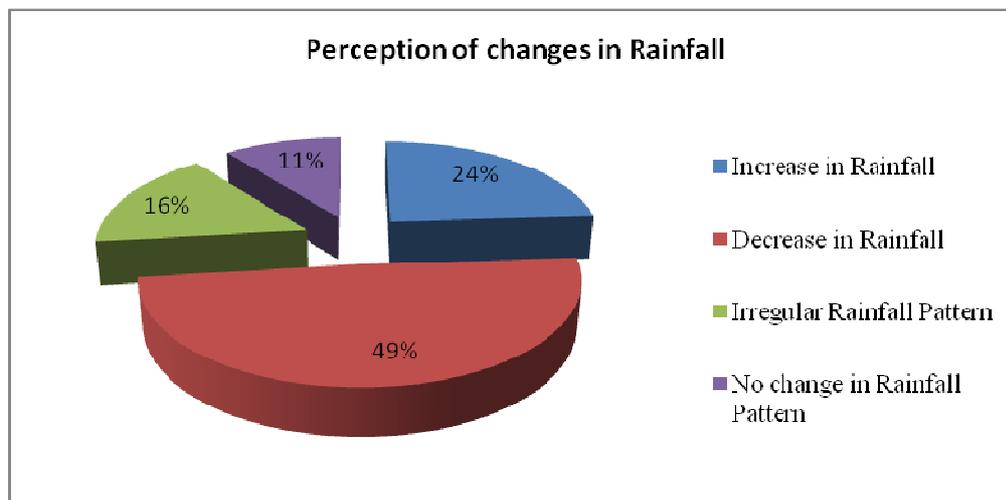
Note:IR = Increasing Rainfall **DR** = Decreasing Rainfall **IRP** = Irregular Rainfall Pattern
NCRP = No Change in Rainfall Pattern

Farmers' Perception on Changes in Rainfall Pattern in Dunkwa

The distribution of the perception of the farmers concerning changes in rainfall pattern revealed that 22% perceived an increase in precipitation; 37% perceived a decrease in precipitation; 30% perceived an irregular rainfall pattern. Despite higher perception of the farmers interviewed on changes in rainfall pattern, 11% of the farmers interviewed did not see any change in rainfall pattern.

Figure 4: farmers' perception of rainfall pattern in Dunkwa
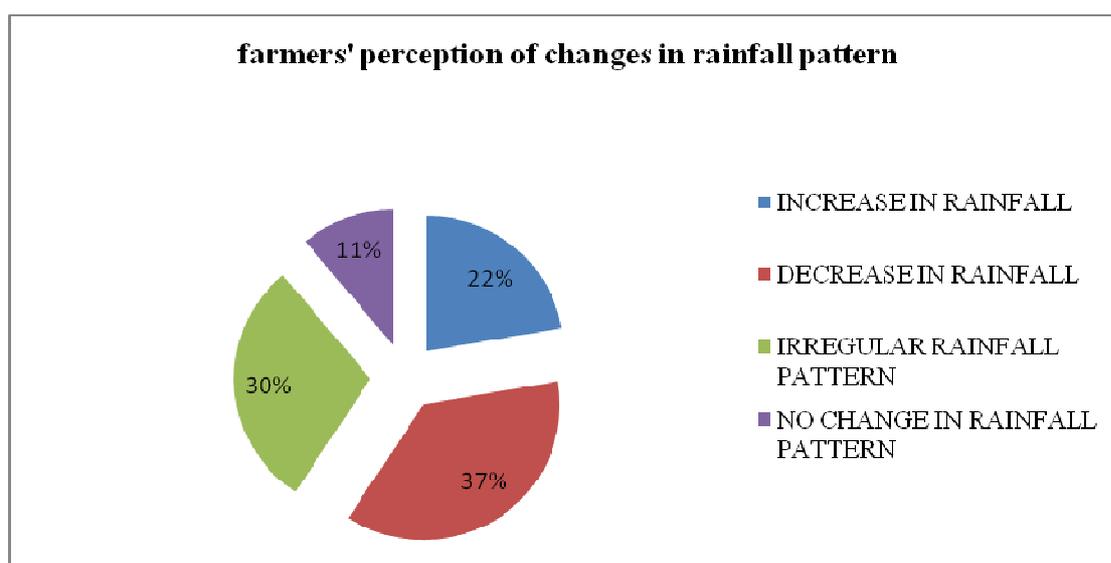
Choice of adaptation methods in Bawku

When asked if these farmers had some adaptation methods due to the perceived changes in climate, majority forming 87.4% of the total population had adapted methods while the remaining 12.6% had not. Changing planting dates, soil conservation and using different crop varieties were the major methods. The other methods included planting trees, prayers, irrigation with water harvesting being the least method adapted despite its numerous benefits.

Figure 5: Choice of adaptation methods in Bawku
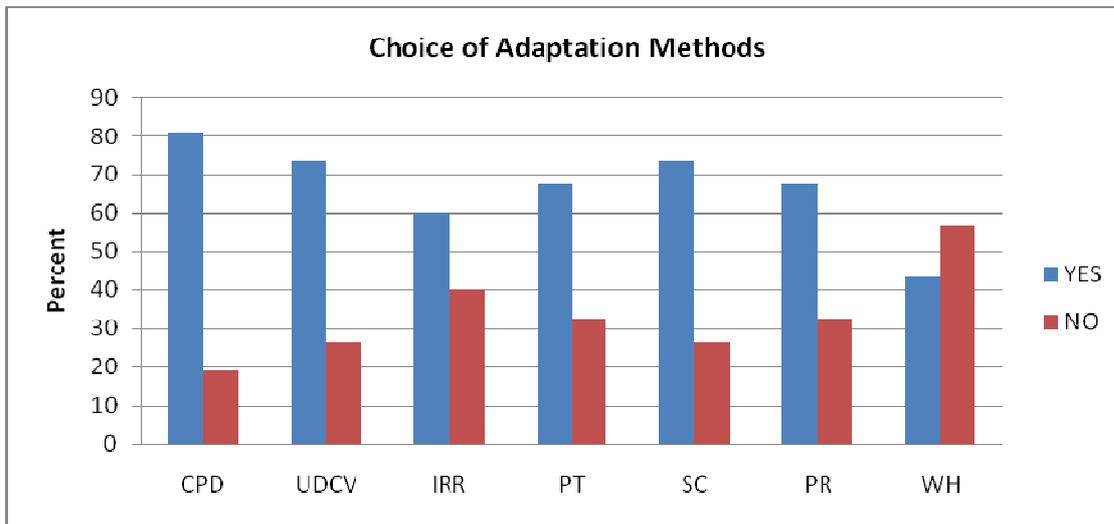
Note: CPD = Changing Planting Dates   **IRR** = Irrigation   **UDCV =** Using Different Crop Varieties   **PT** = Planting Trees   **PR** = Prayers SC = Soil Conservation   **WH**= Water Harvesting

From the figure 5 above, 81.1% of the respondents interviewed adapted changing planting dates while 18.9% did not. 73.7% of the respondents adapted using different crop varieties while the remaining did not. With irrigation as an adaptation method, 60% of the respondents used it while the remaining 40% did not. 67.4% of the respondents adapted to planting trees while the others did not. Most respondents (73.7%) adapted to soil conservation during changes in climate while the remaining did not. Prayers surprisingly gained popularity as an adaptation method with 67.4% of the respondents using it while the remaining 32.6% did not see its benefits. Water harvesting on the contrary had a lower percentage of adaptation (43.2) while the majority 56.8% did not employ it as an adaptation strategy.

Choice of Climate Change Adaptation Measures in Dunkwa

 Attempts were made to find out whether the farmers used some climate change adaptation measures and subsequently the types and reasons for their choice of adaptation. Of the farmers interviewed, 60.2% used some form of climate change adaptation options whilst 39.8% did not use adaptation measures. Changing planting dates, using different crop varieties, tree planting, irrigation practices, soil conservation, water harvesting and prayers were the main adaptation measures used by the farmers. Of the farmers interviewed, 92.9% used changing planting dates as their method of adaptation whilst 7.1% do not use this method. 93.9% of the farmers used different crop varieties to reduce climate change impacts whilst 6.1% have never used this measure before. 73.5% of the farmers use water harvesting as an adaptation measure whilst 26.5% do not use this method.

With regard to irrigation and tree planting, 23.5% of the farmers interviewed use irrigation to adapt to climate impacts whilst 76.5% do not use this method; 33.7% of the farmers use tree planting as an adaptation measure whilst 66.3% do not use this measure. Soil conservation was used by 30.6% of the farmers interviewed to adapt to climate change impacts. However, 74.5% of the farmers use prayers as a measure of adaptation. The figure 7 depicts the distribution of various measures of adaptation used by farmers in Shama in the Western Region of Ghana.

When asked why they preferred their choice of adaptation over the other options, 67.8% indicated that their choice of adaptation was most economical or less costly to use; 16.9% said their choice of adaptation improved the fertility of the land and prevented erosion; 10.2% said their choice was environmentally friendly; only 5.1% said their choice leads to early maturity of crops.

Figure 6: Climate change adaptation measures in Dunkwa
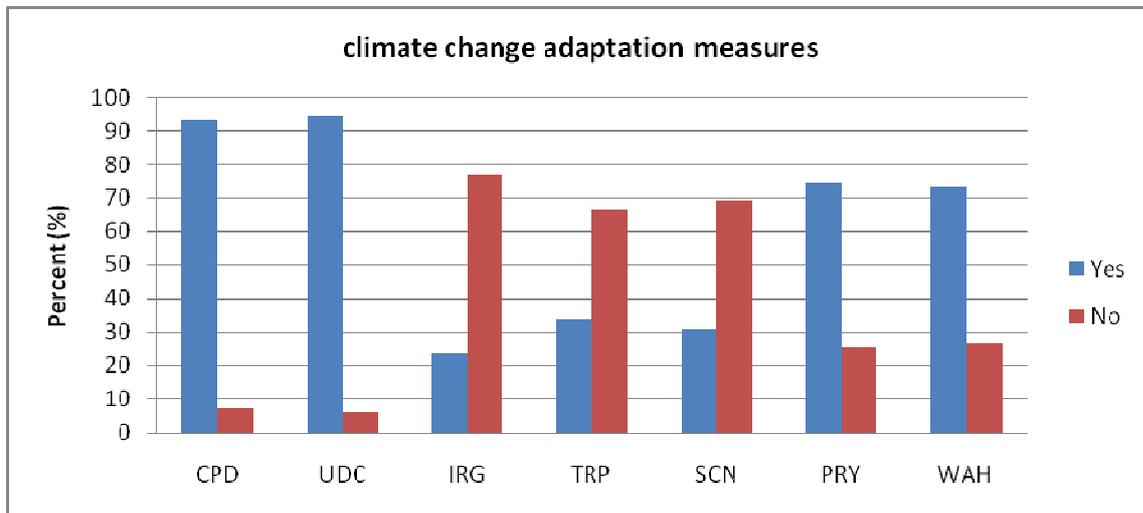
Note:**CPD=** Changing Planting Dates, **UDC=** Use of different Crop varieties, **IRG=** Irrigation Practices, **TRP=** Tree Planting, **SCN=** Soil Conservation, **PRY=** Prayers, **WAH=** Water Harvesting
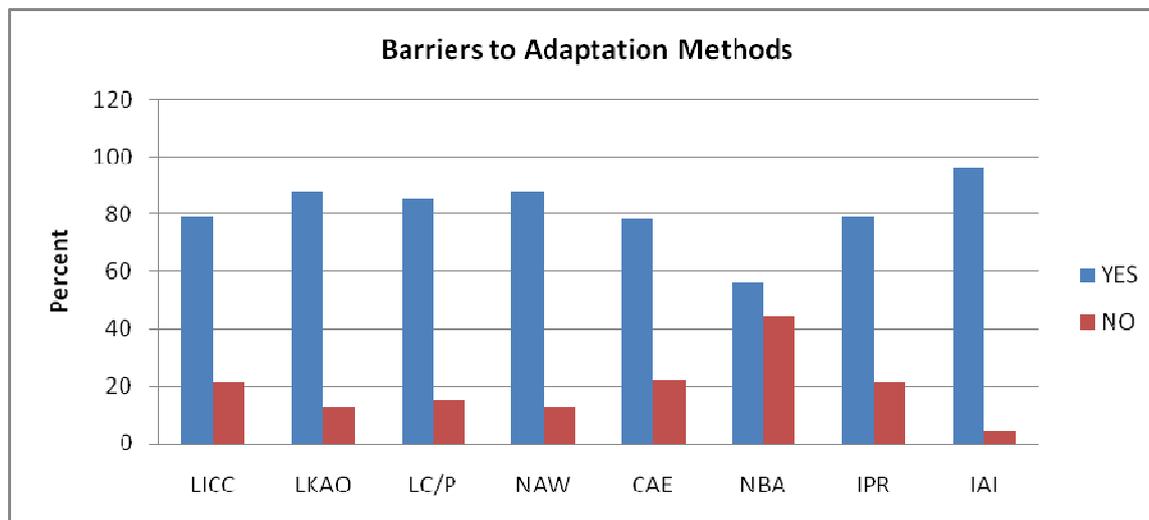
Barriers to adaptation methods

With regards to barriers to adaptation methods, insufficient access to inputs, lack of knowledge about adaptation options and no access to water dominated the response. Other constraints included expensivechanges, insecure property rights, lack of credits and lack of information about climate change.

From figure 7, 78.9% of the respondents perceived lack of information about climate change to be a barrier to adaptation while 21.1% went contrary to this opinion. 87.4% of the respondents attributed lack of knowledge about adaptation options to be a barrier to adaptation methods while 12.6% did not.

While 85.3% of the respondents interviewed attributed lack of credit and poverty as a barrier to adaptation method, the remaining 14.7% did not perceive so. Majority (87.4%) indicated no access to water as an important barrier to adaptation method while the remaining 12.6% did not perceive so. 77.9% of the respondents affirmed changes are expensive while 22.1% perceived otherwise.

Figure 7: Barriers to adaptation methods in Bawku

Note: **LICC** =Lack of Information about climate Change **LKAO** = Lack of Knowledge about Adaptation Options **LC/P** = Lack of Credit/Poverty **NAW**= No access to Water **CAE** = Changes are Expensive **NBA** = No Barriers to Adaptation **IPR** = Insecure Property Right **IAI**= Insufficient Access to Inputs

When asked if there were no barriers to adaptation, 55.8% representing more than half of the total respondents indicated the affirmative while the remaining 44.2% perceived barriers. 78% of the respondents perceived insecure property right as a barrier while 21.1% did not. Most (95.8%) attributed insufficient access to inputs as a major barrier to adaptation methods while only 4.2% of the total respondents (95) did not perceive so.

**Barriers to Adaptation Strategies in Dunkwa**

Barriers preventing farmers from adapting to climate change was investigated. Results as shown in the figure 8 identified lack of information on climate change impacts and adaptation options; lack of knowledge about adaptation measures; lack of access to credit; no access to water, high cost of adaptation; insecure property rights and insufficient access to inputs as the major barriers inhibiting their ability to adapt to climate change impacts.

With regard to lack of information, 77.6% of the farmers identified this as the main barrier to effective adaptation to climate change; whilst 22.4% did not think so. 71.4% of the farmers identified lack of knowledge regarding adaptation measures whilst only 28.6% were aware of

adaptation options. 93.9% of the farmers interviewed indicated that access to credit was very low and this had constrained many of them from effective adaptation of climate impacts.

No access to water for irrigation and other farming activities was identified by 41.8% of the farmers as a barrier to adaptation; however, 58.2% did not see access to water as a problem. Cost involved in adapting to climate change impacts was identified by 82.7% of the farmers as the reason explaining their poor adaptation ability whilst 17.3% disagreed. Insecure property rights over land constrainted about 87.8% of the farmers from using any adaptation measure. About 91.8% of the farmers indicated that inadequate access to inputs was a barrier to adaptation. This was attributed to lack of access to credit as well as the expensive nature of adaptation measures.

**Figure 8: Barriers to Adaption strategies**
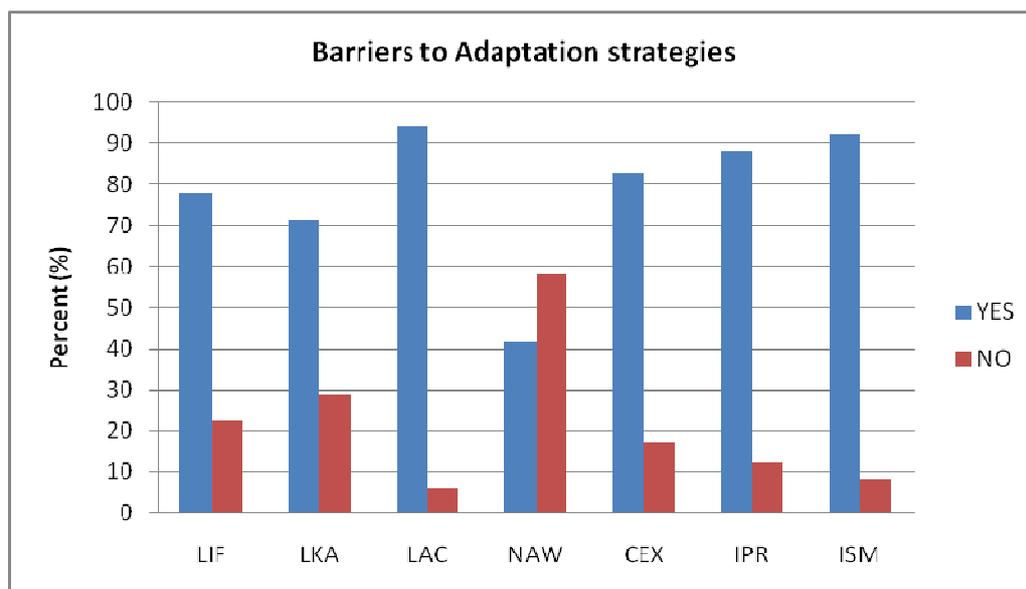
Note: LIC= Lack of Information on Adaptation options, **LKA=** Lack of Knowledge on Adaptation options, **LAC=** Lack of Access to Credit, **NAW=** No Access to Water, **CEX=** Changes are Expensive, **IPR=** Insecure Property Rights, **ISM=** Insufficient access to Inputs

Willingness-to-pay for climate change mitigation policies in Bawku

Of the respondents interviewed 71.6% were willing to pay for climate change mitigating policies while 28.4% of them despite the associated benefits of these policies were unwilling to pay. From figure 9, the respondents were willing to pay for four mitigating policies at a total amount

of GH¢ 5073. Out of the total respondents, 32% were willing to pay GH¢1618 for massive tree planting (MTPE), 27% were willing to pay GH¢ 1351for provision of irrigation facilities to farmers (PIFF), 22% were willing to pay GH¢ 1117 for training volunteers to guard against unauthorized cutting of trees and 19% were willing to pay GH¢ 987 for organizing annual education programme for the farmers (OEP).

Figure 9: Willingness-to-pay for climate change policies in Bawku
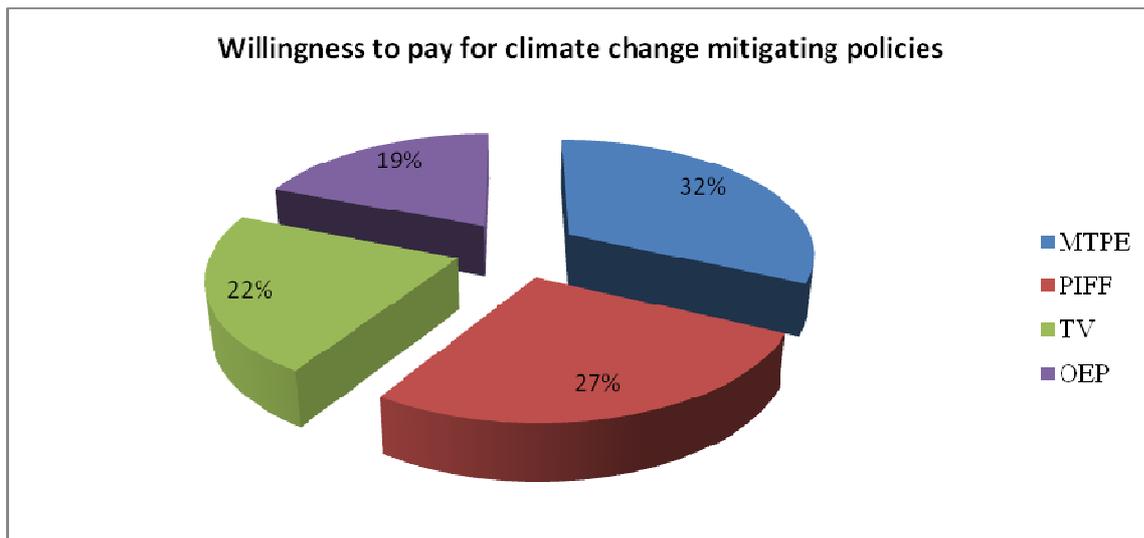
Willingness to Pay for Climate Change Mitigation Policy in Dunkwa

Climate change mitigation policies are necessary if the long term agricultural productivity, food security and the growing needs of increasing population growth are not to be compromised. As a result, the farmers were asked if they were willing to pay for climate change mitigation policies.

Of the farmers interviewed, 55.1% were willing to pay for mitigation policy whilst 44.9% were not. The study identified massive tree planting exercise, provision of irrigation facilities to farmers, training of volunteers to guard against unauthorized cutting of trees and organization of education programmes on climate change as strategies for mitigation action.

Figure 10 below shows the distribution of the farmers' willingness to pay for these climates mitigation policies. From the figure, it is obvious that farmers willingness to pay for tree

planting exercise was high (35.68%); followed by provision of irrigation facilities to farmers constituting about 30% of the farmers. About 17% of the farmers interviewed were willing to pay for training of volunteers whilst about 17% were willing to pay for climate change education programmes.

Figure 10: Willingness-To-Pay for Climate Change Mitigation Policies (In Percentage) inDunkwa
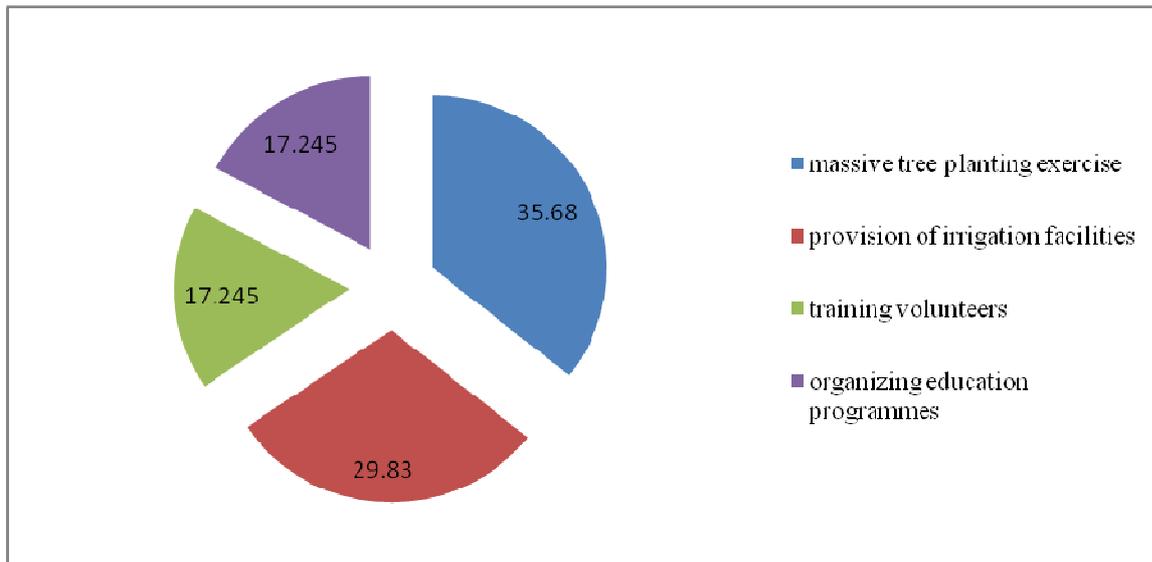

Table 1: The Statistics of Willingness-To-Pay (WTP)

N=61	
Mean	12.3519
Median	9.00000
Std. Deviation	9.60573
Skewness	1.840 (std. error 0.325)
Kurtosis	2.915 (std. error 0.639)

Table 1 shows the summary statistics of the willingness to pay responses of farmers. The mean and median were GHS 12.3519, GHS 9.00 respectively. The median was lower than the mean, indicating that majority of the farmers were willing to pay less than the mean willingness to pay, and that the response distribution was skewed by a limited number of high bidders.

Model Estimation Results of the Logistic Regression Analysis

A logistic regression analysis was employed to analyze the socio-economic factors that influence farmer's willingness to pay for climate change mitigation policy. The Akaike Information Criteria, Akaike (1973) provided the basis for selecting the model that provided the best fit to willingness to pay for climate change mitigation policy.

Table 2: Parameter estimates of the logistic model.

Variables	Coef.	Robust Standard Error	z	P>z
age	-.338	.123	-2.75	0.006***
hhs	.066	.044	1.51	0.132
edu	.073	.031	2.37	0.018**
exp	.003	.001	2.54	0.011**
ofl	1.065	.357	2.99	0.003***
fs	-.013	.044	-0.30	0.766
oinc	.577	.344	1.68	0.094*
cons	6.784	2.838	2.39	0.017**

***1%; ** 5%; * 10%

Note: AGE= Age of respondent, **HHS=** Household size **EDU=** Years of education of respondent, **EXP** = Farming experience in years **OFL=** Own farmland, **FS =** Farm Size **OINC=** Other Income generating activity

The model specification with willingness to pay for climate change mitigation policy as the dependent variable and age, years of education, years of farming experience, owner of farm land, farm size and other income as the covariates provided the best fit with AIC of 244.95.

Empirical results from the logistic regression analysis reveals that age and farm size negatively influence willingness to pay for climate change mitigation policy whilst household size, years of education, years of farming experience, owner of farm land and other income generating activity positively influenced the willingness to pay for climate change mitigation policy. The regression analysis finds age, years of farming experience, owner of farm land, and other income as significant predictors of the probability to pay for climate change mitigation policy.

The parameters of years of farming experience, and other income were significant at 5% and 10% level respectively while age of respondent andowner of farm land were significant at 1%. It should be emphasized that a negative sign of a parameter indicates that high values of the variables tends to decrease the probability of the willingness to pay for climate change mitigation policy. A positive sign implies that high values of the variables will increase the probability of willingness to pay for climate change mitigation policy.

The results of the odds ratio are presented below in table 3.

Table 3: Parameter estimates of the logistic model with odds ratio

Variables	Odds Ratio	Robust Std. Err.z	P>z		
age	.713	.088		-2.75	0.006***
hhs	1.068	.047		1.51	0.132
edu	1.075	.033		2.37	0.018 **
exp	1.003	.001		2.54	0.011**
ofl	2.899	1.034		2.99	0.003***
fs	.987	.043	-0.30	0.766	
oinc	1.781	.613	1.68	0.094*	

***1%; ** 5%; * 10%

Conclusion

Farmers' adaption to climate change is crucial to combating food insecurity and related problems. Against this background, this paper assessed farmers' perception and adaptation to climate change. Specifically, the study investigated farmer perception of changes in temperature and precipitation, choice of adaptation methods, barriers to adaptation and socio-economic determinants of willingness to pay for climate mitigation policies.

Results from the descriptive analysis of farmers interviewed revealed that the farmers were characterized by active labour force, small farm sizes, low income distribution, high farming experience, large household size, and low level of formal education. With regards to farmers' perception and methods of adaptation, majority of the farmers perceived increases in temperature and decreases in rainfall pattern. Farmers' level of adaptation was found to be relatively high with majority of the farmers using changing planting dates, different crop

varieties and soil conservation methods as the major adaptation measures to climate change impacts. However, access to water, high cost of adaptation, lack of knowledge on adaptation, insecure property rights and lack of credits were identified as the major barriers to adaptation. Results revealed high level of willingness to pay for mitigation policies among the farmers. However, majority of the farmers supported massive tree planting exercise.

Logistic regression estimates finds age, years of farming experience, owner of farm land, and other income as significant predictors of the probability to pay for climate change mitigation policy. Implications for policy will be to implement a public education program on climate change adaptation strategies. There is the need for government to embark on massive implementation of mitigation policies since most farmers are willing to pay for these policies. Additional income generating activities should be encouraged among farmers since it is a positive and a significant predictor of their willingness to pay.

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