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Farmers' Perception and Adaptation to Climate Change; A Case Study of Sekyedumase District in Ghana

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Introduction

Climate change is expected to have serious environmental, economic, and social impacts on Ghana, particularly on rural farmers whose livelihoods depend largely on rainfall.
Agriculture, primarily small-scale, is the backbone of Ghana's economy with the sub-humid zone being one of the major food producing zones. 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). Despite its high contribution to the overall economy, this sector is challenged by many factors of which climate-related disasters like drought and floods (most often in northern Ghana), are the major ones. In recent years, adaptation to climate change has become a major concern to farmers, researchers and policy markers alike. Vulnerability and adaptation strategies are seen to be linked to poverty reduction measures (Halsnæs and Trærup, 2009). Bryant et al. (2000) report that adaptation in agriculture is how perception of climate change is translated into agricultural decision-making process. A review of studies on adoption of new technologies identified farm size, tenure status, education, access to extension services, access to market and credit availability as the major determinants of the speed of adoption in Africa (Maddison 2006). To enhance policy towards tackling the challenges that climate change poses to farmers, it is important to have knowledge of farmers' perception on climate change, potential adaptation measures, and factors affecting adaptation to climate change. The Sekyedumase district of Ashanti region which lies in sub-humid Ghana is one of the major food production areas of the country. To continue high food production in this region, farmers would have to adapt to climate change. There is however, little knowledge whether farmers perceive climate change and have adopted adaptation measures. Hence, this paper seeks to explore farmers' perception and adaptation to climate change and investigate the factors and barriers affecting the adaptation process.

Methodology

A household survey was conducted in February and October 2009 where 180 farmers were randomly sampled from four farming communities in the Sekyedumase district (latitude 7°22'N and longitude 1°21'W) of the Ashanti region in Ghana. Structured and unstructured questionnaires were used to investigate whether farmers had noticed long-term changes in temperature, rainfall, and vegetation cover over the past 20 years. Questions about adaptation and the barriers to adaptation were also posed. The dependent variables in this study are perception and adaptation while the explanatory variables includes: household characteristics (the level of

education, age, and gender of the head of the household), years of faming experience, farm size, access to markets, access to agricultural extension services, access to credit / loan, land tenure and soil fertility.

For statistical analysis, the logit model was employed due to the nature of the decision variable; whether farmers perceived climate change and have adapted or otherwise. For such a dichotomous outcome, the logit model is the most appropriate analysis tool. The logistic model considers the relationship between a binary dependent variable and a set of independent variables, whether binary or continuous. The logistic model for '*k*' independent variables ($x_i, x_2, x_3 \cdots, x_k$) is given by

$$Logit\ P(x) = \alpha + \sum_{i=1}^{k} \beta_i x_i$$

Exp (β_i) indicates the odds ratio for a person having characteristics *i* versus not having *i*, while β_i is the regression coefficient, and α is a constant.

Results

Perception of changes in temperature

Figure 1 shows that 91.1 % of farmers interviewed perceived a long-term change in temperature. Almost 88 %, representing 158 farmers out of 180 interviewed, perceived an increase in temperature, while only 3.3 % were contrary to this opinion. A total of 8.9 gave other responses.

As to the causes of perceived rise in temperature, about 63.3 % of the farmers attributed it to deforestation, 18.9 % to bush burning, 3.3 % to increased population, and 8.9% to other factors. A 5.6 % respondents could not give any reason for the perceived change in temperature.
To verify farmers perceived long-term change in temperature, the historical mean annual temperature data in Ejura from 1972 to 2008 (36 years), with omission of 2003, were analysed. The data shows a slight increasing trend in temperature especially from 1999 to 2008 (Figure 2).

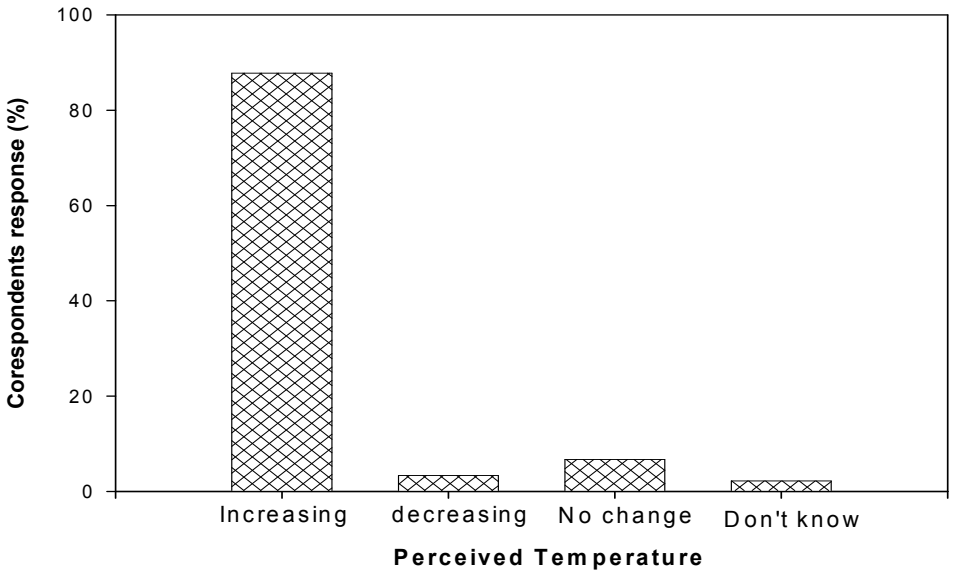

Figure 1: Farmers perception of change in temperature (%) during the past 20 years in the Ashanti region of Ghana.

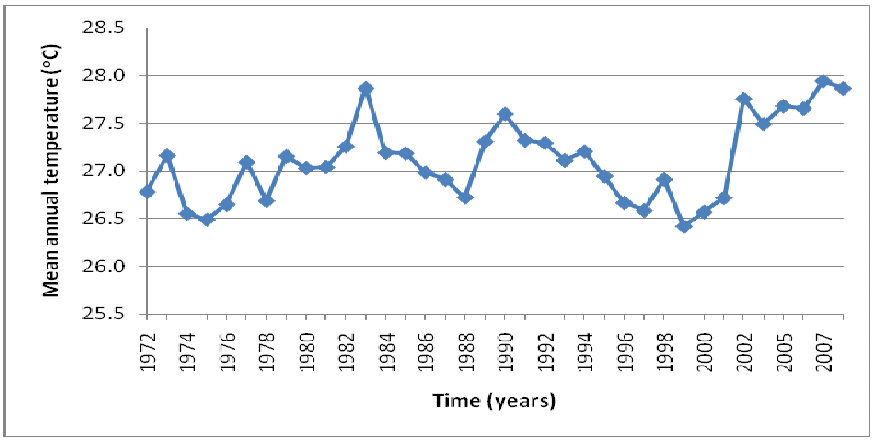

Figure 2: Historical mean annual temperature in Sekyedumase district in Ghana.

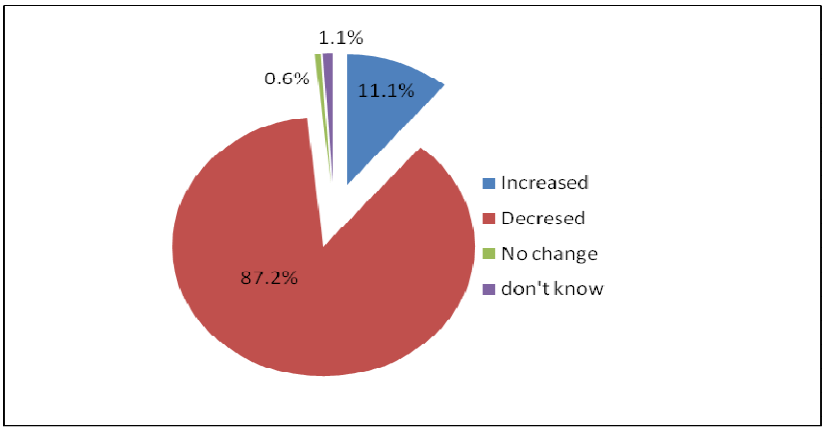

Figure 3: Farmers perception of changes in precipitation (%) in the sekyeredumase district in Ghana.

The response of farmers to changes in precipitation was very similar to that of temperature, with the great majority of interviewees (87,2 %) indicating a decreasing trend (Figure 3). Deforestation was perceived as the key cause of declining rainfall.

Adaptation strategies by farmers in the face of increasing temperature

In spite of the perceived increase in temperature by the majority of farmers, only 44.4 % indicated the adoption of some adaptation measures (Table 1). Crop diversification and changing crop planting dates were identified as the major adaptation strategies to a warmer climate. Similarly, about 41 % of farmers appeared to have changed their management in response to declining precipitation, with crop diversification and shifting the planting date being the most important adaptation measure (Table 1). Land tenure, soil fertility level, access to extension services, access to credit and community lived by farmers are the significant determinates to adaption to climate change (Table 2).

Table 1: Adaptations strategies in response to change in temperature and precipitation (%)

Adaptation strategies	Increasing temperature (%)	Decreasing precipitation (%)
Crop diversification	16.7	7.8
Change in crops	7.2	3.9
Reduce farm size	1.1	0
Change in planting date	14.4	18.9
Find off- farm jobs	1.1	0
Plant short season variety	1.1	7.2
No adaptation	55.6	58.9
Others	2.8	3.3
Total	100	100

Table 2: Logistic regression of determinants of adaptation to decreasing precipitation

Adaptation	Coefficients	Std Err	z	P>z	[95 % confidence intervals]	
Age	-0.218	0.278	-0.79	0.432	-0.763	0.326
Gender	0.815	0.441	1.85	0.064	-0.049	1.678
Education level	0.040	0.118	0.34	0.734	-0.192	0.272
Farm size	-0.225	0.181	-1.24	0.213	-0.579	0.129
Land tenure	0.235*	0.119	1.99	0.047	0.003	0.468
Soil fertility	1.020**	0.588	-3.44	0.001	-3.180	-0.874
Access to extension	1.020*	0.397	2.57	0.010	0.242	1.800
Access to credit	2.076**	0.543	3.82	0.000	1.012	3.140
Farming experience	0.137	0.260	0.53	0.599	-3.73	0.646
Ejura	0.907*	0.459	1.98	0.048	0.008	1.807
constant	-1.692	1.098	-1.54	0.123	-3.845	0.461

Note: ** and * are significant levels at 1 and 5%, respectively.

Discussion and Conclusion

The results of this study on the perception of farmers in the Sekyedumase district in Ghana on changes in temperature and rainfall showed that they are well aware of climate change, as more than 80 % of farmers interviewed perceived an increasing temperature and a decreasing precipitation trend.

Although farmers appear to be well aware of climate change, few seem to actively take steps toward adjusting their farming activities. Only about 44 % of farmers have adjusted their farming practices to account for the impacts of increasing temperature and 40 % made adjustments to counteract the decreasing precipitation trend. The main adaptation strategies of farmers identified include change in crop types, planting short season varieties, changing planting dates, and crop diversification. The results of determinants of adaptation strategies suggest that land tenure, soil fertility, and access to extension service and credit are the most significant factors affecting the adaptation capacity of farmers. Land tenure is vital to adaptation as landowners tend to adopt new technologies quickly than tenants, an argument that has justified numerous efforts to reduce tenure insecurity (Lutz et al. 1994; Shultz et al. 1997). Access to credit /loan facilitates adaptation to new technology and climate change as access to cash allows farmers to purchase inputs like seeds of improved varieties and fertilizer. The positive correlation between adaption to climate change and the availability of credit observed in this study is in line with the findings of Gbetibouo **(**2009) and Deressa et al., (2009). Similarly, farmers who perceive that their land is infertile are more likely to adopt management technologies that help in improving land productivity, such as application of inorganic fertilizers. Thus, the lower the fertility of the soil, the higher the likelihood of adaptation.

Government policies should therefore ensure that terms for credit in the banks are flexible to enhance farmers' access to affordable credit, which will increase their ability and flexibility to change crop and soil management strategies in response to climate change. Furthermore, given the inadequate extension services in the region, improving the knowledge and skills of extension service personnel about climate change and adapted management strategies, increasing extension-farmer ratio, and making the extension services more accessible to farmers appear to be the key components of a successful adaptation program.

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