

Farmers' Perceptions about Climate Change in the Upper East Region of Ghana

Abdul-Razak Zakaria, University of Tsukuba, Japan
Kenichi Matsui, University of Tsukuba, Japan

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Abstract

This paper assesses smallholder rice farmers' perceptions about climate change in the Upper East Region of Ghana. We used a pretested questionnaire to understand farmers' perceptions about climate change hazards from fifteen communities in the eastern corridor of the region. We also used ten-year observed climate data (2005-2014) to corroborate farmers' perceptions about climate change. Results from field survey shows that more than 60% of the respondents experienced increasing temperature, decreasing rainfall and changing planting time. The Mann-Kendall trend and Sen's slope test revealed a decreasing rainfall and increasing temperature trend. Farmers' perceived changing planting time is explained by a high coefficient of variation of 28%. The respondents demonstrated high level of awareness, knowledge and understanding about climate change hazards. We argue that farmers' perceptions and experiences about climate hazards can be used where climate data is not available. They can also supplement the recorded climate data.

Keywords: Climate change, farmers' perceptions, rainfall and temperature pattern

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1. Introduction

Scholars have growingly recognized the importance of local farmers' climate observation in better understanding climate change. The IPCC regional report, for example, highlights shows its increasing recognition of local farmers' observations about climate change as supplement to the scientifically recorded climate data (IPCC, 2014). A growing number of studies have been published regarding farmers' self-assessment of risk associated with climate change hazards as a key in improving climate change adaptation (Niang et al., 2014; Ayanlade et al., 2017; IPCC, 2014). This paper aims to better understand the extent to which the perceptions of smallholder rice farmers about climate change hazards can be reliable in the Upper East Region of Ghana. In doing so, we interviewed farmers and corroborated their observation with the recorded weather information. We also tried to find out if education background can be a factor to influence farmers' ability to accurately observe weather conditions. In the discussion below, we first introduce our study area, the Bawku zone, in the Upper East Region. Then we explain our methodology and results of our survey and analysis.

2. Study area

The study area we chose is called the Bawku zone. In 2010, it had the total population of 441,828 people. It is predominantly agricultural region. In 2010 Bawku East district (Bawku Municipality) was most urbanized within the zone with 63% of the population lived in urban areas and about 50% engaged in agriculture. In other districts of the zone, more than 80% of the population engaged in agriculture. In rural areas, nearly all households (98%) were engaged in crop farming (Ghana Statistical Service, 2014).

The Bawku zone has a unimodal rainfall pattern. The mean annual rainfall ranges from 950 mm to 1100 mm. The maximum day temperature can reach as high as 42°C in February and March with night temperatures as low as 18°C. The wet season usually extends from May to October. Rice farming is one of main crops in this region during the wet season. It mainly is rain-fed. Irrigated farming practiced near Tono and Veve dams. The average farm size is estimated at 1.3 hectares with the average yield of 1.8 t/ha. This yield is lower than the national average, which is 2 t/ha. Farmers here use simple implements such as hoe, cutlass, bullock ploughs and sickle (Kranjac-Berisavljevic et al., 2003).

3. Methodology

3.1 Sampling

In order to assess farmers' perceptions for our survey, we selected five districts from the thirteen administrative districts in the Region. These districts are Bawku East, Bawku West, Binduri, Garu-Tempene and Pusiga. The selected districts have similar characteristics in terms of the climate, soil type, farming system, culture, language and the crops grown (Ghana Statistical Service, 2014). Three communities were selected in each district. The simple random sampling procedure was used in selecting ten farmers from each community. In total, 150 farmers were surveyed.

A preliminary research was carried out to make sure that we clearly communicate with the respondents through the questionnaire. The lead author also spent 10 years in this Region as an agricultural extension officer for the Ministry of Food and Agriculture. We used his work experience in designing the questionnaire, and better interpreting the results.

3.2 Data

We conducted a field survey between July and August 2016. The first part of the questionnaire was designed to gather data on socio-demographic characteristics such as farmers' age, gender, education level, and years of experience in rice farming. The second part of the questionnaire aimed to understand rice farmers' perceptions about long-term temperature and rainfall pattern and changes in the past ten years (2005-2014). Then, we gathered observed rainfall and temperature data from 2005 to 2014 in the study area from the Manga Savanna Agricultural Research Institute (SARI-Manga). This data was analyzed to corroborate with farmers' perceptions about climate change.

4. Results and Discussion

4.1 Socio-demographic characteristics of the respondents

Table 1 shows the socio-demographic characteristics of the respondents in the study area. Regarding age, 87% of the respondents were within 20-59 years of age. Males consisted of 64%. This male dominance was partly because men tend to represent households in answering questionnaires or other requests from outsiders. In our preliminary field survey and Zakaria's working experience in this area, women were dominant in rice farming. In terms of education, more than 80% of the respondents had no formal education or non-formal education. Almost 70% of the respondents had more than 11 years of rice farming experience.

Table 1 Socio-demographic characteristics

Social characteristics	Category	Frequency (%)
Age	20-29	10 (7%)
	30-39	33 (22%)
	40-49	59 (39%)
	50-59	28 (19%)
	60 & above	20 (13%)
Gender	Female	54 (36%)
	Male	96 (64%)
Education	Junior high	15 (10%)
	Senior high	4 (3%)
	Tertiary	7 (5%)
	Non-formal	3 (2%)
	No education	121 (80%)
Years of rice farming experience	1- 10	47 (31%)
	11- 20	59 (39%)

21- 30	30 (20%)
31- 40	9 (6%)
41-50	4 (3%)
51- 60+	1 (1%)

4.2 Farmers' perceptions about climate change

To understand farmers' perceptions about climate change, the respondents were asked about long-term changes in temperature and rainfall patterns in the past ten years (2005-2014). More than 60% of the respondents stated that temperature and drought events have increased, whereas rainfall has decreased. Due to these changes, they had changed planting time (Table 2). The most pronounced effects were decreasing rainfall (84%) and changing planting time (82%) (Figure 1). Climate change is likely having a significant impact on the livelihood of smallholder rice farmers in all five districts of the Bawku zone as 98% of the respondents perceived declining rice yields.

To validate farmers' perceptions that planting time has changed, we calculated and examined ten-year coefficient of variation on recorded annual rainfall from 2005 to 2014. The result was 27.6% (Tables 5). The observed variations in the decadal coefficient of variation mean that annual rainfall in the Bawku zone have varied from the normal by about 28%. Generally, the planting time in this study area starts from May and ends in October (Ghana Statistical Service, 2014).

Having these results, we then tried to find out the extent to which these farmers' perceptions about climate change corresponded with actual observed data in the study area. Results showed that the lowest and highest annual rainfall between 2005 and 2014 are 671 mm and 1562 mm, respectively. The Mann-Kendall's p-value of 0.048 (Table 3) and the Sen's slope value of -44.5 signifies a decreasing trend in annual rainfall in the Bawku zone. This finding suggests that rainfall had varied and decreased by 44.5% in the past ten years. Similarly, the highest and lowest temperature are 37 °C and 20.5 °C, respectively. The Mann-Kendall's p-value for the maximum temperature of 0.251 and that for minimum temperature of 0.917 (Table 4) signifies no trend in the data set. However, the Sen's slope showed maximum temperature increased by 7.8% and that for minimum temperature data decreased by 7.2%.

The results of this study also positively correspond with previous studies on West African sub-regions. These studies reported about increasing temperature and decreasing rainfall (Fosu-Mensah et al., 2012; Zampaligré et al., 2014).

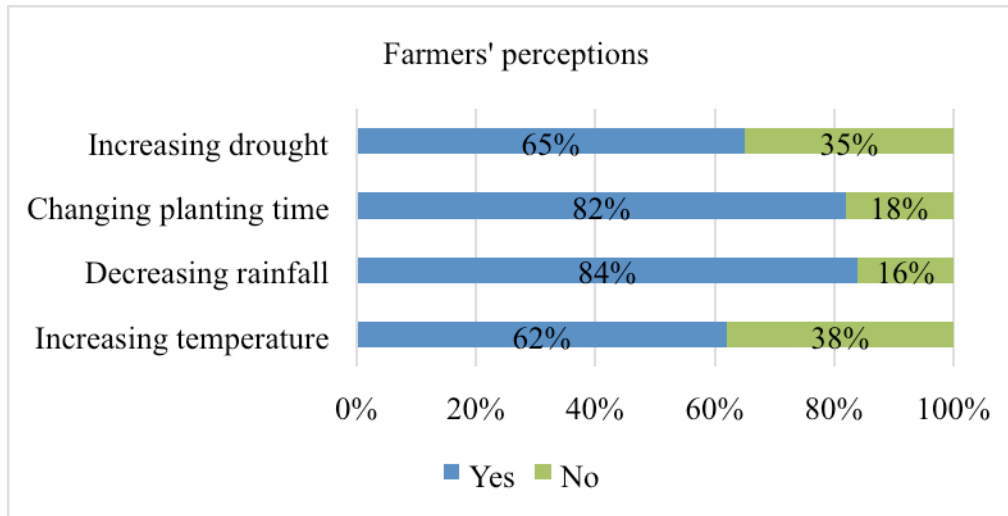


Figure 1 Farmers' perceptions about climate change hazards

Table 2 Chi-squared (p-value) for socio-demographic characteristics and farmers' perceptions

Socio-demographics	Increasing temperature	Decreasing rainfall	Changes in planting time	Increasing drought	Reduced crop yield
Age	0.175 (0.996)	4.695 (0.32)	2.782 (0.595)	4.350 (0.361)	5.773 (0.217)
Gender	2.465 (0.116)	0.028 (0.867)	1.450 (0.228)	5.038 (*0.025)	0.009 (0.923)
Experience	2.916 (0.713)	10.044 (0.74)	5.665 (0.340)	5.212 (0.391)	2.982 (0.703)

χ^2 denotes Chi-squared, df denotes degree of freedom and * denotes p-value

Table 3 Result of Mann-Kendall trend test for annual rainfall

Kendall's tau	-0.556
S	-20.000
Var(S)	92.000
p-value (Two-tailed)	0.048
Alpha	0.05

Table 4 Result of Mann-Kendall trend test for maximum and minimum temperature

Kendall's tau	0.333	Kendall's tau	-0.056
S	12.000	S	-2.000
Var(S)	92.000	Var(S)	92.000
p-value (Two-tailed)	0.251	p-value (Two-tailed)	0.917
Alpha	0.05	alpha	0.05

5. Conclusion

This paper assessed smallholder rice farmers' perceptions about climate change hazards in the Upper East Region of Ghana. Most responding smallholder rice farmers perceived decreasing rainfall, increasing temperature, and reduced crop yields. They had dealt with these changes by adjusting planting time. Our respondents' perceptions positively corresponded with recorded rainfall and temperature trends with a high coefficient of variation.

Although most of the respondents did not have proper scientific education at formal schools, they demonstrated fairly good awareness and knowledge about climate change phenomena. Their awareness can positively facilitate high adoption of appropriate climate change adaptation strategies in the area. Farmers' perceptions can be relied upon to supplement missing or insufficient meteorological data at the local level to inform agricultural policy.

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