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RURAL FARMERS' PERCEPTION OF CLIMATE CHANGE IN CENTRAL AGRICULTURAL ZONE OF DELTA STATE, NIGERIA

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ABSTRACT

Farmer perception of their environment is a factor of climate change. Adaptation to climate change requires farmers to realize that the climate has changed and they must identify useful adaptations and implement them. This study analyzed the perception of climate change among rural farmers in central agricultural zone of Delta State, Nigeria. Climate change studies often assume certain adaptations and minimal examination of how, when, why, and conditions under which adaptations usually take place in any economic and social systems. The study was conducted by survey method on 131 respondents using structured interview schedule and questionnaire. Data were analyzed with descriptive statistics and linear regression model to test that education, gender, and farming experience influenced farmers' perception of climate change. The results showed that the farmers were aware of climate change. The identified causes of climate change were ranging from intensified agriculture, population explosion, increased use of fossil fuel, loss of indigenous know practice to gas flaring. The effects of climate change on crops and livestocks were also identified by the rural farmers. Many of the farmers adapted to climate change by planting trees, carrying out soil conservation practice, changing planting dates, using different crop varieties, installing fans in livestock pens, and applying irrigation. Almost half of them did not adapt to climate change. The linear regression analysis revealed that education, gender, and farming experience influenced farmers' perception of climate change. The major barriers to adaptation to climate change included lack of information, lack of money, and inadequate land.

[***Keywords***: Rural farmers, perception, climate change, adaptation, mitigation, Nigeria]

INTRODUCTION

Rural is an area of settlement in which half or more than half of the adult population is engaged in farming (Ekong 2003). People living in the rural settlement are regarded as rural dwellers who are mostly farmers. The rural farmers are known to be in direct contact with element of nature in their physical and biological environment. The physical environment consists of to as all physio-graphic factors like soil inorganic elements, natural forces such as wind, radiation, and gravity, insects, parasites, wild plants, and animals. Rural farmers are directly exposed to these elements which affect their lives in one way or the other.

In psychology and the cognitive sciences, perception is the process of attaining awareness or understanding of sensory information. According to Wikipedia dictionary, the word perception comes from the Latin word "percepio" meaning receiving, collecting, and action of taking possession apprehension with the mind or senso.What one perceives is a result of interplays between past experience of ones culture and interpretation given to the perceived. If what is being perceived does not have support in any of the above mentioned perceptional bases, it cannot be said to be perceptible.

Man views his environment from the way he feels about it in his interactions with it. Depending on how he perceives and interprets the environment, he reacts to secure his comfort and future. Man so values his security that he would not want to compromise it easily in his interaction with his social, physical and biological environments. The same way man is expected to react according to the way he perceives and interprets climate change.

According to Umar *et al*. (2008), climate change refers to change occurring in the climate during a period of time which can range from decades to centuries. They further stressed that the changes are noted to be caused by natural and human activities. It is now obvious that human existence is under serious threat as the consequences of his own activities. This phenomenon has become a serious concern for everyone in the world over as it has turned out to be a pandemic that everyone and every creature is vulnerable.

Iheanacho and Abdullahi (2006) stated that food is a basic need for sustenance of life which has to be provided to maintain good health and optimal performance. In view of these, it must be available in adequate quality and quantity (Umar *et al*. 2008). But, food security is not only concerned with the availability of food, but also related to accessibility procurement and intake of adequate quality and quantity by individuals, households or communities.

Adetunji *et al*. (2005) stated that agricultural production is still depending on weather and climate despite the impressive advances in recorded and accounted agricultural technology and accumulated wealth of knowledge and agricultural system. It is obvious that climate change has impact on agriculture. The climate conditions prevailing within the top soil and atmosphere where crops and livestock are raised influence the growth and performance of crops and livestock (Ayoade 2002). The macro- and microfauna and flora are not left out. The production of food lies in the hands of rural farmers among whom we find a bulk of the farmers we have. They manage the natural resources needed for their livelihood and sustenance. This implies that they and their activities are directly affected by factors of climate in one way or the other. According to LEISA (2008), while climate change is a global phenomenon, those living in rural areas in the tropics would face greater risk.

The rains these days are unpredictable. The world's average temperature has increased since the last century and it is expected to rise by 2050AD (Shah and Ameta 2008). This is leading to rising sea surface and drastic changes in rainfall patterns, affecting the production potential of rural areas. Meanwhile LEISA (2008) argued that the dominant trends in agriculture and the global economy are going entirely against the principles underlying the sustainable agriculture. In this larger context, sustainable small-scale farming family is a small, increasingly threatened oasis of diversity in a huge ecological desert (Bayomi 2008). According to FAO (2009), farmers in Ethiopia and Uganda observed that there were marked increases in temperature and rainfall for the past five years. The same observation was made by Bryan *et al.* (2009) through their study in Ethiopia and South Africa.

Agriculture will continue to suffer the negative economic and ecological consequences of the larger world around it. Climate change is already being felt and its effects are expected to continue and to increase and rural communities are increasingly vulnerable to climate induced hazards (Gurung and Bhandari 2008).

Farmer perception of the their environment is a factor of climate change. Adaptation to climate change requires that farmers must first notice that the climate has changed and then identify useful adaptations and implement them (Maddison 2006). There are many cultural adaptations that have been suggested in various literatures. These include crop diversification and uttering the timing of operations, income diversification, development and promotion of new crop varieties, and improvement of water management techniques (Smith and Lenhart 1996; Mendelsohn 2001; Smit and Skinner 2002; Kurukulariya and Rosenthal 2003; Deressa *et al*. 2009). According to Winarto *et al*. (2008), farmers have always responded to climate change with respect to their choice of crops, crop varieties, planting, and other cultural measures. According to Gbetibouo (2009), most of these adaptation options represent possible or potential adaptation measures rather than ones actually adapted. There is actually no evidence that these adaptation options were feasible, realistic, or even likely to occur (Risbey *et al*. 1999). Therefore, climate change studies more often than not assume certain adaptation and minimal scouting on how, when, why, and the conditions under which adaptation actually takes place in any economic and social system. A study of this nature will unveil their perceptions of and response to climate change. The result of this study when released to the Ministry of Agriculture, Agricultural Development Programme (ADP) and Non-Governmental Organizations (NGOs) will be useful as a guide in program formulation and design while planning climate change adaptation program for farmers and other rural dwellers.

The major objective of the study was to analyze farmers' perception of climate change and examine its relationship to socio-economic characteristics of farmers. Specifically the study aimed to ascertain awareness of rural farmers on climate change, determine farmers' perception of the causes of climate change, understand the effect of climate change on crops and livestock as perceived by them, identify the approach to climate change adaptation, and examine implication on food security and extension service delivery. The hipotesis of the study was that the socio-economic characteristic variables such as gender, level of formal education, farming experience and farm size do not affect farmers' perception of climate change.

METHODS

The study was conducted in the central agricultural zone of Delta State demarcated by the Delta State Agricultural Development Programme (DTADP). The study area is sandwiched between the Delta North Agricultural Zone and Delta South Agricultural Zone to the southern part of the Delta State. It consists of 11 local government areas (Isoko North, Isoko South, Ughelli North, Ughelli South, Ethiope East, Ethiope West, Udu, Patani, Sapele, Uvwie and Okpe LGAs respectively) which also form the agricultural extension blocks. The study was started in September 2008 and concluded in November 2009.

People in the area cultivated both tree and arable crops. The tree crops farmed included oil palm, rubber, citrus, pear and to a little extend cocoa, while the arable crops common in the study area were cassava, maize, yam, vegetables, cocoyam, plantain and banana. The people here are predominantly farmers and they farm on small scale.

Multistage sampling technique was used for this study. Out of the 11 agricultural extension blocks in the study area, five blocks were selected and from the five selected extension blocks, three extension cells were selected randomly from each, summing to fifteen extension cells for the study. Again ten farmers were randomly selected from each of the extension cells making a total of 150 respondents for the study. This study was conducted for 6 months from March to August 2009.

The data were collected from the respondents using structured interview schedule, since most of the farmers are not formally educated. Out of 150 copies of structured interview schedule and questionnaire sent out, only 131 were returned. The data collected were subjected to descriptive statistical analysis such as frequently counts, percentage and mean derived from four-point Likert's type scale as the following: 4 = strongly agree, 3 = agree, 2 = disagree, and 1 = strongly disagree.

The Likert's scale was done by asking some positive questions like are afternoons hotter these days? To which the responses were rated according to their perceptions and the cut-off mean score was determined by adding the ratings up (4 + 3 + 2 + 1 = 10) and dividing the sum by 4 to give 2.5 as the cut-off mean score. For each statement, the total score was divided by the number of respondents, for instance a statement like "hotter afternoons are experienced these days" may have responses of strongly agree (*f* = 65); agree (*f* = 26); disagree (*f* = 28) and strongly disagree (*f* = 12). It will now be worked as 65 x 4 = 260, 26 x 3 = 78, 28 x 2 = 56 and 12 x 1 = 12. Then 260 + 78 + 56 + 12 = 406. The sum was devided by the total *f* thus, 406 / 131 = 3.09. In this case, 3.09 is the mean score which is greater than the cut-off mean score of 2.50. The ranking was done according to the mean values, with the one with the highest mean ranking '1'.

The hypothesis was subjected to analysis using linear regression model. The hypothesis states that the socioeconomic characteristics of respondents such as gender, farm size, level of formal educational attainment and farming experience do not affect farmers' perception of climate change, and it is expected that these variables will affect their perception. The implicit form of the model for the regression analysis was given below:

$$Y = f(X_1, X_2, X_3, X_4, U)$$

Where Y = perception (total Likert's type scale of each respondent)
X_1 = gender (male = 1, female = 0)
X_2 = education (number of years of schooling)
X_3 = farming experience (years)
X_4 = farm size (ha)
U = error term

RESULTS AND DISCUSSION

Socio-Economic Characteristics of Respondents

Table 1 shows that most (60.31%) of the farmers were females, while 39.69% were males. This is because women are more involved in arable crop cultivation than the men in the study area. According to the prevailing culture, women dominate in arable crop production while the men concentrate on permanent crops and livestock farming. Most (77.07%) of the arable crop farmers were in the age of 36 to above 50 years. The mean age of the respondents was 39 years. This implies that most of them are young and energetic and that the young adults are not much involved in arable farming. Majority (46.56%) of the farmers were married, while 35.11% were widowed, 15.26% were single and 3.05% were divorced. Most of them as implied by the data had responsibility and this is expected to reflect on their farming activities (their level of seriousness with farming). The divorcees were few because the rate of divorce in the study area was low as divorce is not encourage because of the shame attached to it.

Most (30.53%) of the farmers had primary education, while 18.32% of them had secondary education, 18.32% had tertiary education and 6.10% had adult education. This implies that most of the respondents have one form of formal education or the other. This is expected to influence their perception of climate change. Most (30.53%) of the farmers had 11-15 years of farming experience, while 25.19% had 16-20 years, 22.90% had more than 20 years, 15.26% had 6-10 years, and 6.10% had 1-5 years of farming experience. The mean years of farming experience was 15 years. This implies that most of them have many years of farming experience and have interacted much with the climate in relation to their farming activities. Con-

Table 1. Socio-economic characteristics of respondent farmers in Delta State, Nigeria, 2008-2009 (n = 131).

Variable	Percentage	Mean
Gender		
Male	36.69	
Female	60.31	
Age (years)		
20-25	4.68	
26-30	6.87	
31-35	11.45	
36-40	16.16	39.0
41-45	19.08	
46-50	25.19	
> 50	16.77	
Marital status		
Single	15.26	
Married	46.56	
Divorced	3.05	
Widowed	35.11	
Level of education		
No formal education	26.71	
Adult education	6.10	
Primary education	30.53	15.0
Secondary education	18.32	
Tertiary education	18.32	
Farming experience (years)		
1-5	6.10	
6-10	15.26	
11-15	30.53	15.0
16-20	25.19	
> 20	22.90	
Size of farm (ha)		
0.5-1.0	14.50	
1.5-2.0	33.58	
2.5-3.0	30.53	3.5
3.5-4.0	18.32	
4.5-5.0	3.05	
> 5.0	0.00	

sidering this fact, they have good knowledge of climatic factors as they relate to their farming operations. Majority (33.58%) of the farmers had farms of 1.5-2.0 ha and others (30.53%) had 2.5-3.0 ha, 18.32% had 3.5-4.0 ha, 14.50% had 0.5-1.0 ha and 3.05% had 4.5-5.0 ha of farm land. The mean farm size was 3.5 ha. This implies that the farmers are small-medium holder farmers and they still depend on the use of energy sapping crude implements.

Farmers' Perception of Change in Climate Factors

Table 2 shows that the farmers observed that afternoons were hotter, the onset of wet season was delayed, dry season had become shorter, incidences of flood increased, and rainfall had become erratic. This implies the shorter wet season and increased temperature. It means that the farmers recognized the changes in climate factors. This finding is congruent with Gurung and Bhandari (2008) who also discovered that the people in Chituen village in Nepal experienced hotter summer, shortening winter, drought, floods and erratic pattern of rainfall. Bryan *et al*. (2009) in their study in Ethiopia and South Africa observed increased temperature and decreased rainfall. Vedwan and Rhoades (2001), Hageback *et al*. (2005), Maddison (2006), and Gbetibouo (2009) reported that farmers perceived long term changes in temperature and decrease in precipitation. Gbetibouo (2009) also observed that farmers' perceptions appear to be in accordance with the statistical record in the Limpopo River Basin which was his study area. Mertz *et al*. (2009) discovered that farmers in Senegal are aware of climate change in his earlier study.

Table 2. Perception of climate change by farmers in Delta State, Nigeria, 2008-2009 (n = 131).

Perception	Mean	Rank
Hotter afternoon	4.21	1
Shorter dry season	3.81	3
Erratic rainfall	3.70	5
Increasing incidence of flood	3.80	4
Delay in onset of wet season	3.90	2

Cut-off score = 3.0 (> 3.0 = important observation, < 3.0 = not important observation).

Farmers' Perception of Causes of Climate Change

The farmers perceived intensified agriculture, population explosion, use of chemical fertilizer, deforestation, soil degradation and erosion, increased use of fossil fuel, loss of indigenous knowledge practice and gas flaring as being causes of climate change (Table 3). This implies that the most important factor in terms of vulnerability is the fact that in many areas in the tropics, like the study area, agroecosystems have dramatically deteriorated in recent decades. LEISA (2008) further argued that this is mainly due to change in land use patterns in intensified agriculture coupled with deforestation, soil degradation and erosion. Deforestation and erosion result in consider-able quantities of carbon dioxide being released into the atmosphere, a total complemented by the produc-tion and use of fertilizer.

Table 3. Causes of climate changes as perceived by farmers in Delta State, Nigeria, 2008-2009 (n = 131).

Cause	Mean	Rank
Intensified agriculture	3.96	2
Population explosion	3.21	7
Use of chemical fertilizer	3.86	4
Deforestation	3.67	6
Soil degradation and erosion	4.33	1
Increased use of fossil fuel	3.81	5
Loss of indigenous knowledge practice	3.12	8
Gas flaring	3.92	3

Cut-off score = 3.0 (> 3.0 = important cause, < 3.0 = not important cause).

Effects of Climate Change on Crops and Livestock

The farmers' perception of the effects of climate change included changes in timing and length of growing season, reduced crop yield, increased pest and disease out break, stunted growth of crops, decreased feed intake by livestock, reduced growth rate of livestock, reduced egg production, inadequate pasture, and reduced birth rate and size (Table 4). These effects of climate cannot seriously threat to agriculture as a result of rising temperatures, changes in rainfall patterns or increased drought. Shah and Ameta (2008) agued that this is directly linked to reduced soil productivity and high incidence of pests and diseases. This is also directly linked to reduced performance of livestock. These effects have serious implications for food security for the study area, especially the rural communities which also rely on agriculture to meet their subsistence needs. These findings support Mertz *et al*. (2009) who observed that farmers attribute these challenges aforementioned to climate.

Adaptation Strategies of Farmers in Central Agricultural Zone of Delta State, Nigeria

The results indicated that many (39.69%) of the farmers have not adapted to climate change (Table 5). Those who adapted to climate change conducted various adaptation strategies such as planting trees, applying soil conservation, changing planting dates, cooling livestock pens with fans, using heat tolerant species, irrigation and using different crop varieties. Planting trees as an adaptation strategy could be attributed to lower expense and the ease with which farmers access trees seeds and seedlings; considering the vegetable belt (rainforest belt) of which the study area is located. Likewise, applying soil conservation practice as adaptation method to climate change is associated with lower expense and ease of farmers' access to the required inputs. Most of these adaptation measures indicated by farmers in central agricultural zone of Delta State, Nigeria are in consonance with the findings of Bradshaw *et al*. (2004), Maddison (2006), Nhemachena and Hassan (2007), Hassan and Nhemachena (2008), Kurukulariya and Mendelsohn (2008), Deressa *et al*. (2009) in their various studies.

The farmers generally gave many reasons for the failure to adapt to climate change, namely lack of information, lack of money, inadequate labor supply, inadequate land and poor potential for irrigation (Table 6). This is congruent with Deressa *et al.* (2009) who got similar results in his study in Mile Basin of Ethiopia.

Table 4. Farmers' perception of the effects of climate change in Delta State, Nigeria, 2008-2009 (n = 131).

Effects	Mean	Rank
Changes in timing and length of growing season for crops	4.01	5
Reduction in crop yield	4.45	1
Increased pest and disease out break	3.89	7
Stunted growth rate of livestock	4.21	3
Decreased feed intake by livestock	4.15	4
Reduced growth rate of livestock	4.00	6
Reduced egg production	4.32	2
Inadequate quantity of pasture	3.03	9
Reduced birth rate and size	3.35	8

Cut-off score = > 3.0 = important effect; < 3.0 = unimportant effect.

Table 5. Farmers' adaptation strategies to climate change in Delta State, Nigeria, 2008-2009 (n = 131).

Variable	Percentage
No adaptation	39.69
Planting trees	21.37
Applying soil conservation	15.26
Changing planting dates	6.10
Cooling livestock pens	1.52
Using heat tolerant species	3.05
Irrigation	5.34
Using different crop varieties	7.63

Table 6. Barriers to adaptation to climate change by farmers in Delta State, Nigeria, 2008-2009 (n = 131).

Variable	Percentage
Lack of information	38.93
Lack of money	22.90
Inadequate of labor	9.92
Inadequate of land	17.55
Poor potential for irrigation	10.68

Factors Affecting Farmers' Perception of Climate Change

Table 7 reveals on R^2 value of 0.684 for the farmers. This simply implies that 68% of the variations in the perception of the farmers were explained by the independent variables included in the linear regression model. The F-ratio was also good statistically, which attests to the fact that the model fits the data. Gender, level of education, and farming experience were statistically significant and positively correlated with perception of climate change, while correlation of farm size was not significant. These results grossly agree with an earlier expectation that the variables will positively affect farmers' perception of climate change. Therefore, the nul hypothesis is rejected. These imply that increase in these variables will lead to enhance the perception of climate change among the farmers. This is congruent with a priori expression.

Gender of household head

The result implies that the male headed households better appreciated climate change. This is to say that male headed households were more likely to appreciate climate change.

Level of Education

Education of the household heads increased the possibility of better appreciation of climate change. The level of education of the household heads enhanced their perception of climate change. This implies that a unit increase in the number of years of schooling would lead to about 1% increase in the probability of appreciation of climate change. Education is out of the salient variables that enhances ones perception of climate change. But according to Gbetibouo (2009), educated farmers are more likely to see that rainfall does have a significant trend of long-term changes.

Table 7. Factors affecting farmers' perception of climate change in Delta State, Nigeria, 2008-2009 (n = 131).

Socio-economic characteristic	Coefficient	t-value	Level of significance
Constant	83.104	22.053*	0.000
X_1 Gender	5.119	3.062*	0.002
X_2 Level of education	0.147	1.862*	0.065
X_3 Farming experience	0.196	2.085*	0.003
X_4 Farm size	0.591	0.556	0.532

* = significant at 5% level. F-ratio = 14.43, F-table = 2.65, R^2 = 0.684.

Farming Experience

Farming experience of household head which also translates to the age influenced perception of climate change. An increase in the farming experience of household head resulted in better understanding of the climate, thus, a better appreciation of climate change with experience, farmers are more likely to perceive change in temperature (Gbetibouo 2009).

CONCLUSION AND IMPLICATION

Farmers' perception of climate change in the study area was in line with findings of other researchers around the world. Farmers were able to recognize that temperatures have increased and precipitation has dwindled. However, most of them have not used any adaptation strategies as a result of some barriers which included lack of information, lack of money, inadequate land, inadequate labor supply, and poor potential for irrigation.

In the midst of the aforementioned barriers, crop and livestock production for food security is adversely affected as also indicated by the farmers. If most of these farmers continue to operate without adaptation to climate change, there will be food shortage and therefore insecurity would be inevitable. This demands government policies to favor farmers, to enhance their adaptive capacity to climate change.

Government policies should enable farmers have access to extension services adequately as a lack of information has been indicated as a barrier to adaptation. The public extension service needs to train and employ qualified citizens to fill the extension need gap. Information is a very critical variable in farming operations and therefore, cannot be overlooked.

Such policies should also ensure that farmers through extension services have access to affordable credit to enhance their ability and flexibility to adapt to climate change. For the fact that access to water for irrigation increases the resilience of farmers to climate variability, irrigation investment should be considered to allow farmers increased water control to counteract adverse impacts to climate variability and change. Review of land use decree of 1978 is required to increase farmers' access to land, especially the new emerging farmers who are not as experienced to have relevant skills and adequate information.

Extension services should carry out massive campaign on tree planting and educate the masses on the effect of deforestation as it contributes to climate change. Reforestation of our depleted forests and other lands will help to bring back the situation to normal. Therefore, Central Agricultural Zone where a lot of depletion and a lot of gas flaring is taking place should be highly considered in such policy formulation.

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