



## The Effect of Farmers' Socioeconomic Characteristics on Adoption of Adaptation Measures to Climate Change in Northern Zone of Sokoto State Agricultural Development Project

<sup>1</sup>G. A. Ubandoma, <sup>1</sup>B. F. Umar, <sup>1</sup>B. Z. Abubakar and <sup>2</sup>S. D. Abubakar

<sup>1</sup>Department of Agricultural Extension and Rural Development, Usmanu Danfodiyo University, Sokoto, Nigeria

<sup>2</sup>Department of Geography, Usmanu Danfodiyo University, Sokoto, Nigeria

Corresponding author: [ubandomagarba@yahoo.com](mailto:ubandomagarba@yahoo.com) 07060619690

### Abstract

*The study assessed the effect of farmers' socioeconomic characteristics on adoption of adaptation measures to climate change in the northern zone of Sokoto State Agricultural Development Project. Five out of the twelve Local Government Areas in the zone were purposively selected using multistage random sampling techniques. Two hundred and forty respondents were randomly selected for the study from the list of registered farmers in Sokoto State Agricultural Development Project (SADP). Primary data were collected with the aid of a structured questionnaire. Data obtained was analyzed using descriptive statistics and regression analysis. Result showed that all of the respondents were male and married with a mean age of 34 years. Majority (65%) had no formal education. The mean household size was 6 persons, mean farm size was 2.7ha, mean farming experience was 14 years and mean annual income was N21,500. Majority (95.52 %) of the respondents' source of information on climate change was through friends. Regression analysis indicated that annual income, farm size and farming experience were found to be positive and significantly related with adoption of adaptation measures to climate change. Improved education is one of the important socio-economic factors in the overall capital accumulation and investment in agricultural enterprises. Government should encouraged formal education through literacy programme and provides adequate extension support services.*

**Keywords:** Farmers; Climate Change; Adaptation Measures; Adoption and Agricultural Development Project.

### Introduction

Anon (2009) defined climate change as the long term significant environmental changes in the average weather that a given region experiences. Average weather includes temperature, precipitation, wind, humidity, evaporation, pressure and solar radiation. It involves changes in the variability or average state of the atmosphere over durations ranging from decades to millions of years. These environmental changes include higher temperatures and altered precipitation patterns, increased frequency and magnitude of extreme weather events, such as droughts, floods and storms. These have short and long term socio-economic and political consequences including food insecurity, migration, conflicts over resources, damage to farms and increased spread of endemic water and vector-borne diseases (IPCC, 2007). Climate change is perhaps the most serious environmental threat facing mankind world-wide. It affects crop production in several ways, one of which is its direct impact on food production. Climate change, which is attributable to natural climate cycle and human activities, has adversely affected agricultural productivity in Africa (Ziervogel *et al.*, 2006). As the planet gets warmer, rainfall patterns shift, and extreme events such as droughts, floods, and forest fires become more frequent (Zoellick, 2009). This results in poor and unpredictable crop yields, thereby making farmers more vulnerable, particularly in Africa (UNFCCC, 2007). Farmers, who constitute the bulk of the poor in Africa, face prospects of tragic crop failures, reduced agricultural productivity, increased hunger, malnutrition and diseases (Zoellick, 2009). It is projected that crop yields in Africa may fall by 10-20% by 2050 or even up

to 50% due to climate change (Jones and Thornton, 2002). This is particularly because African agriculture is predominantly rain-fed and hence fundamentally dependent on the vagaries of weather. Unfortunately, just as climate change is negatively affecting crops productivity, the steady increasing human population has led to a rise in the demand for food which caused more land to be put under agricultural cultivation (Explore (2005). As the people of Africa strive to overcome poverty and to advance economic growth, this phenomenon threatens to deepen vulnerabilities, erode hard-won gains and seriously undermine prospects for development (Zoellick, 2009). In Nigeria, higher temperatures, long droughts, increasing frequent and violent storms are predicted to exacerbate the current challenges faced by agricultural production system. Already, the climate change rate is gradually exceeding the adaptive capacity of a broad range of crops and forage varieties. Thus, in a long-run, agriculture and agricultural practices will have to adapt to changes to ensure food security for human survival. There is therefore the need for concerted study on the effect of farmers' socioeconomic characteristics on the adoption of adaptation measures to climate change. Other specific objectives of the study are to:

1. Describe the socioeconomic characteristics of the farmers.
2. Determine the adaptation measures to climate change adopted by the farmers.
3. Identify the farmers' sources of information on climate change adaptation measures
4. Find out the constraints to adoption of climate change adaptation measures by the farmers.

### **Research hypothesis**

H<sub>0</sub>: there is no significant relationship between farmers' socioeconomic characteristics and the Adaptation measures adopted by the farmers.

### **Materials and Methods**

#### **Study Area**

The study was carried out in the Northern zone of Sokoto State Agricultural Development Project. Sokoto State falls within the Sudan Savannah ecological zone and is located between longitude 11° to east and latitude 4° to 6° north. The study area is bordered to the north with Niger Republic, and Zamfara State to the east with a total land mass of 28,232,375sq kilometers ( Sokoto State Desk Diary,2013). Sokoto State has a population of 3.6 million people (National Population Commission, 2006).

The effects of climate change will be more pronounced in communities in the zone because of its poor climatic conditions, drought and subsequent long period of dry spells in the raining season compared to the western zone of the State (Illiya *et al.*, 2009). The area experiences a long dry from October to May and short raining from June to September seasons. The dry season consists of a cold dry spell harmattan (Singh and Babaji, 1989). The rainfall in the area is erratic in nature and small in quantity with an annual falls ranging between 500mm to 1,300mm. The average annual temperatures of 28.3°C (87.9°F) was recorded (Rode, 2009). However, the highest monthly temperature is about 43°C in April while the lowest mean monthly temperature occurs during the harmattan period when the temperature could be as low as 15°C. In terms of vegetation, the area falls within Sudan savannah zone and the climate is semi-arid. This is open tsetse fly free grassland suitable for the cultivation of grain crops and animal husbandry (Sokoto State government website).

#### **Sample population/Sampling frame**

The arable crop farmers in the Northern operational zone of the State Agricultural Development

Project purposively constituted the sample frame for the study (400 farmers).

### **Sampling procedure and sample size**

A multistage sampling technique was used to select 240 farmers to arrive at the sample size for the study. In the first stage, the five frontlines (ie local government areas at boundary with other country) Local Government Areas namely: Gada, Illela, Isa, Sabon-birni and Tangaza in the zone were purposively selected to constitute the blocks. Purposively means that the selection was done with purpose. The purpose was to determine the magnitude of the occurrence of climate change in those selected local government areas. Because it was assumed that the effects of climate change will be more pronounced in those communities in the zone due to poor climatic conditions, drought, subsequent long period of dry spells in the raining season and closeness to the boundary with Niger and Cameroon republics respectively; known for their harsh environmental conditions. In the second stage, eight circles were selected from each of the selected blocks to make a total of forty circles for the study. In the final stage, six farmers were selected randomly from each of the selected circles to make a total of 240 respondents for the study. In each of the selected circles, a list of registered farmers was obtained from the village extension agents (VEAs). The list obtained was used to randomly select the farmers.

### **Data collection**

Both primary and secondary data were used for the study. Primary data were collected using a structured questionnaire administered by the researcher and secondary data were obtained from textbooks, journals, internet, magazines and other literatures relevant to the study.

### **Data analysis**

Descriptive (Frequency, Percentage and Mean) and inferential (Regression analysis) statistics were used to analyze the data obtained. Regression analysis was used to determine the relationship between the farmers' socioeconomic characteristics and the adaptation measures adopted. The objectives were analyzed using descriptive statistics.

### **Study variables**

The major variables in this study are farmers' socioeconomic characteristics, climate change adaptation measures, sources of information on climate change adaptation measures and the constraints to the adoption of adaptation measures. Data were collected on socioeconomic characteristics and climate change adaptation measures.

### **Climate Change Adaptation Measures:**

This was determine as :(1) Using early maturing crops (2) Planting more than one crop (3) Early planting (4) Using resistance Crop varieties (5) Using crop rotation (6) Using irrigation (7) Change crop intensity (8) Crop diversification (9) Diversifying from farming to non-farming activities (10) Adjusting the timing of farm operations (11) Soil conservation techniques (12) Recycling or storing water (13) Varying the sowing/planting dates (14) Using cover crops (15) Reduced tillage practices (16) Migration ( Mark *et al*, 2008: Hassan and Nhemachena 2008; Brussel, 2009).

### **Sources of Information on Climate Change Adaptation Measures**

Farmers' sources of information were determined as follows: Friends, Relatives, Radio, Television, Print media and Extension Agents.

### **Constraints to Adoption of Adaptation Measures by the Farmers**

This was determined using the following: Lack of information, Inadequate operating capital, Shortage of labour, Farm size, Land tenure, Illiteracy, Poor access to extension services and Inadequate market.

### **Operationalization of the study variables**

$$Y = a + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + b_7X_7 + b_8X_8 + b_9X_9 + U$$

Where; Y = Adoption (adaptation measures adopted),

X<sub>1</sub> = Age of the farmer (years), X<sub>2</sub> = Sex (dummy 1= male, 2= female), X<sub>3</sub> = Marital status (dummy 1= single, 2= married), X<sub>4</sub> = Household size (number), X<sub>5</sub> = Educational status (number of years spent in formal school), X<sub>6</sub> = Annual income (naira), X<sub>7</sub> = Occupation (dummy 1= part-time farming, 2= full-time farming), X<sub>8</sub> = Farm size (hectares), X<sub>9</sub> = Farming experience (years), a = constant, b<sub>1</sub>-b<sub>9</sub> = Regression coefficients of the variables and U = Unexplained variables (Olayemi, 1998).

## **Results and Discussion**

### **Socio-economic Characteristics**

Table 1 show the distribution of respondents according to their socio-economic characteristics. The results show that the respondents were within the age range of 25, 35 and 42 years respectively with a mean of 34 years. This further shows that the respondents were at the middle or active productive age group. At this age, the respondents tend to withstand stress and harsh climatic condition in various farming activities. Musa (2010) asserted that physical labour productivities of farmers depend on their socio-economic characteristics namely: age, sex and health status of the individual. The entire respondents were male. Farming is a laborious activity that could be handled more effectively by men. This implies that men dominate women in terms of farming activities in the study area. This is in line with findings of FAO (2009), which reported that men participated fully in farming activities whereas women engaged mostly in processing and selling of farm products. As indicated in Table 1, 100% of the respondents were married. This connotes that marriage is highly valued in the study area. Married people are more involved in farming activities and more aware about climate change in order to adopt adaptation measures. These findings supported the view of Olorunfemi (2009) that most of the arable crop farmers are married. Findings in Table 1 further revealed that 30.0% of the respondents had a household size in range of 5-7 persons while 25.8% had 8-10 persons respectively. It was also found out that mean household size in the study area was 6 persons. Given the poor economic condition of small farmer the use of household members as farm labour is an ideal option. Ogunbameru, *et al.* (2008) found a significant relationship between household size and farm labour. Table 1 indicated that 56% of the respondents had no formal education, 12.0% acquired primary education, 13.8% acquired secondary education and 12.0% acquired tertiary education. Climate change is a natural occurrence and can be easily identified even without being informed or heard but the adoption of right and suitable adaptation measures requires a formal education. The educated farmers adapt modern agricultural practices than the uneducated farmers. Ogunbameru *et al.* (2008) stated that the level of education attained is one of the important socio-economic factors in the overall capital accumulation and investment in agricultural enterprises. Table 1 expressed that (69.2%) of the respondents are full-time farmers while 30.8% are part-time farmers. This shows that farming as an occupation accounts for a greater percentage of the total employment in the area. With the knowledge of climate change awareness occurring naturally year by year and considering farming

as a full-time occupation, the adoption of suitable and right climate change adaptation measures will be possible. In line with this finding, Lawal (2002) noted that farming is still an important sector of the nation's economy that can provide employment. Table 1 further expressed that 37.5% cultivates <1.00ha, 37.1% cultivates 1.00-1.50ha and 10.8% cultivates about 2.00-2.50ha with a mean farm size of 2.7 ha in the study area. The limiting factor to the adoption of adaptation measures to climate change in the area was largely attributed to the fragmentation of the farmlands. The implication of this was that the farmers would not be able to engage in a large scale production or to have access to bigger credit facilities to improve on their level of output. This is in line with the findings of Musa (2010) that most farmers in Nigeria still produce at a subsistence level. Results in Table 1 shows that majority of the respondents (97.9%) acquired the farmland by virtue of inheritance while 2.1% by purchased. Farmlands are acquired by inheritance in the rural area. Farmlands were continuously fragmented and transferred from generations to generations. Farm size is an important factor in farming as it affects not only the crop output but also the level and type of input to use. The implication of this was that there will be no improvements on agricultural output since the farmlands were fragmented continuously; production will remain at subsistence level. According to Musa (2010), farm size is an important determinant in the allocation of resources like basic inputs and labour which will eventually impact on the final output and returns. Results in Table 1 further show that the respondents (27.5%) had farming experience between 17-22 years, (26.3%) had farming experience between 11-16 years and 12.5% of the farmers had more than 22 years farming experience. The mean years of farming experience in the study area was 14 years. Farming experience improves awareness of climate change and adaptation measures. According to Lawal (2002), experiences acquired so far in farming by the farmers have been of tremendous contributions to the sustainability of their farming occupation in view of the prevailing agro-ecological conditions. The Findings in Table 1 revealed that the respondents (56.7%) earned less than N10, 000, (19.6%) earned between N10, 000 - N15, 000 and (12.9%) earned between N16,000-21,000. The annual income of N21, 500 was recorded as the mean in the study area. This could be attributed to the fact that the production is subsistence and mainly for family food security. The sale of farm products is a taboo in the rural areas. The implication of this was that the respondents will find it difficult to cope with the farm expenses and adoption of adaptation measures would be difficult especially those that requires technical know-how. This is in line with the findings of Musa (2010) that most farmers in Nigeria still produce at a subsistence level.

#### **Adaptation measures to climate change adopted.**

Results in Table 2 provide information on the type of climate change adaptation measures adopted by the respondents in the study area. The Table shows that all (100%) the farmers adopted the use of early planting and planting more than one crop respectively. Using cover crops (92.9%) of the farmers and using early maturing crops\_ (35.4%) of the farmers. Growing different type of crops on the same plots or on different plots reduces the risk of complete crop failure since different crops are affected differently by climate change. This research findings supported the view of Hassan (2008) who reported that the adaptation measures farmers perceived as appropriate include: crop diversification, using different crop varieties, varying the planting and harvesting dates, use of irrigation, soil conservation techniques and diversifying from farming to non farming activities

#### **Sources of Information on Climate Change Adaptation Measures**

Table 3 presents the sources of information on climate change to the respondents in the study area.

The table shows that information on climate change was dominantly obtained from friends (95.8%) and relatives (93.3%). These findings supported the view of Adamu (2011) that newspapers, magazine, radio and television are generally the expensive media to communicate message to large

Table 1: Distribution of Respondents based on their socioeconomic characteristics (n=240)

Variable	Frequency	Percentage	Mean
<b>Age(years)</b>			
<25	14	5.8	
25-30	71	29.6	
31-36	125	52.1	34
37-42	29	12.1	
>42	1	0.4	
<b>Sex</b>			
Male	240	100.0	
<b>Marital status</b>			
Married	240	100.0	
<b>Household size(persons)</b>			
<2	7	2.9	
2-4	49	20.4	
5-7	72	30.0	6 persons
8-10	62	25.8	
>10	50	20.8	
<b>Educational status</b>			
No formal education	156	56.0	
Primary education	29	12.0	
Secondary education	33	13.8	
Tertiary education	22	9.2	
<b>Occupation</b>			
Part-time farming	74	30.8	
Full-time farming	166	69.2	
<b>Farm size(hectares)</b>			
< 1.00	90	37.5	
1.00-1.50	89	37.1	
2.00-2.50	26	10.8	
3.00-3.50	10	4.2	2.7 hectares
4.00-4.50	3	1.3	
>4.50	22	9.2	
<b>Farm source</b>			
Inherited	235	97.9	
Purchased	5	2.1	
<b>Farming experience(years)</b>			
<5	20	8.3	
5-10	61	25.4	14 years
11-16	63	26.3	
17-22	66	27.5	
>22	30	12.5	
<b>Level of income(N)</b>			
<10,000	136	56.7	
10,000-15,000	47	19.6	
16,000-21,000	31	12.9	
22,000-27,000	14	5.8	N21,500
28,000-33,000	9	3.8	
>33,000	3	1.3	

Source: Field survey (2013).

number of people simultaneously. Improved education and disseminating information are important policy measures for stimulating awareness on adoption of adaptation measures to climate change. Knowledge and information from agricultural research are essential for improving food security. However, useful agricultural knowledge and information must be effectively communicated to farmers (F.A.O., 2009).

**Table 2: Adaptation Measures Adopted (n=240)**

<b>Variables</b>	<b>Frequency</b>	<b>Percentage</b>
Early planting	240	100.0
Planting more than one crop	240	100.0
Using cover crops	223	92.9
Using soil conservation techniques	100	41.7
Using early maturing crop	85	35.4
Using irrigation	74	30.8
Migration	35	14.6
Using resistance crop varieties	22	9.2
Varying the sowing/planting dates	20	8.3
Change crop intensity	15	6.3
Reduced tillage practices	12	5.0
Adjusting the timing of farm operations	11	4.6
Diversifying from farming to non-farming activities	7	2-9
Using crop rotation	6	2.5
Crop diversification	3	1.3

Source: Field survey (2013)

**Table 3: Respondents' Sources of information on Climate Change Adaptation Measures**

<b>Sources of Information</b>	<b>Frequency</b>	<b>Percentage</b>
Friends	230	95.8
Relatives	224	93.3
Radio	161	67.8
Extension Agents	54	22.5
Print media	19	7.9
Television	16	6.7

Source: Field Survey, (2013). \*Multiple responses

### **Constraints to adoption of climate change adaptation measures**

Results in Table 4 provide information on the constraints to adoption of adaptation measures faced by the respondents. The table revealed that majority (97.9%) lack of finance, lack of farm size (96.7%), access to extension services (62.5%) and lack of information on climate change adaptation measures (61.7%). Fund is the sole of any agricultural enterprise. Without fund, adoption of adaptation measures would be difficult especially those that require finance and technical knowhow. Therefore, the respondents kept on operating and producing at subsistence level from generations to generations. These research findings supported the result of study conducted by Centre for Environmental Economics and Policy in Africa (CEEPA), as reported, finance, labour, farm size, tenure status, level of education of the farmers, adequate information

on climate change and access to extension services are the major determinants of speed of adoption of adaptation measures to climate change (Maddison, 2006).

**Table 4: Constraints to Adoption of Adaptation Measures (n=240)**

Constraints	Frequency	Percentage
Finance of finance	235	97.9
Farm size	232	96.7
Shortage of labour	226	94.2
Lack of access to extension service	150	62.5
Lack of information on climate change adaptation measures	148	61.7
Lack of education	126	52.5
Lack of market	22	9.2

Source: Field survey (2013)

### **Effects of Farmers' Socioeconomic Characteristics on the Adoption of Adaptation Measures**

Table 5 shows the  $R^2$  value which measures the variation in the dependent variable(Y) that is explained by the independent variables was 0.44. This means that 44% of the variation in the dependent variable is explained by the independent variables. The F-value which measures the level of significance of all the explanatory variables in the regression model was 2.517 and it was significant at 5%. The significant and positive F-value was an indication that the model was fit and suitable for the data.

The positive relationship between household size and adoption implies that the larger the size of a farmer's household the higher the adaptation measures adopted. This is in agreement with a *priori* expectation. Large household size provides the farmers with access to more family labour which is expected to increase their levels of operations and consequently their adoption level. The coefficient for annual income was found to be positive and significant at 5%. This implies that as the income increases, the adaptation measures adopted would also increase. This finding supports Owolabi (2012), that wealthy farmers have the resources to adopt innovations if they believe it is profitable.

Farming as primary occupation was also found to be positive; the adoption could be as a result of considering farming as their means of livelihood. They adopt the adaptation measures to minimize the effects of climate change on their crops so that they can maximize outputs. This finding supports Hassan and Nhemrehen (2002) that the awareness of climate problems and the potential benefit of taking action are important determinant of adoption of adaptation measures. In the same vein, Illiya *et al.* (2009) states that farmers' good knowledge of their physical environment and cultural peculiarities most probably explain their success. Farm size was also positive and significant at 5%. The positive coefficient of farm size suggests that as farm size increases, adoption would increase. This is because farm size can affect and in turn be affected by other factors influencing adoption. Farm size affect adoption costs, risk perceptions, human capital, credit constraints, labour requirements, tenure arrangement and more (Anselm *et al.*, 2011).The coefficient obtained for farming experience was also found to be positive and significant at 5%. This implies that increase in years of farming experience would increase the level of adoption. This finding supports Anselm *et al.* (2011) who found years of experience significantly associated with adoption of agricultural technologies among farmers of Kama district in Eastern Nigeria. However, the age of the respondents in the study area show positive relationship with adoption.

This implies that age influence the amount of effort put into any economic activity since it is the age group that contributes significantly to human labour in an agrarian community. Adubi (1992) stated that age has a significant influence on decision making process of farmers. The educational status has negative relationship with the number of adaptation measures adopted. This was because people with higher level of education in the study area are usually public servants who may take farming as part-time occupation. These people are less likely to adopt climate change adaptation measures because they have other major source of income. Low level of education was found to be very common among the farmers in Nigeria (Lawal, 2002).

**Table 5: Effects of Farmers' Socioeconomic Characteristics on the Adoption of Adaptation Measures o Climate Change**

Variables	Regression Coefficient	Standard Error	t-value	R <sup>2</sup>	F-value
Constant	6907	0.743	9.295	0.44	2.517**
Age	0.012	0.023	0,505		
Household size	0.012	0.013	0.927		
Educational status	-0.001	0.011	-0.505		
Annual Income	0.07	0.000	2.184**		
Occupation	0.250	0.270	0.928		
Farm size	0.004	0.002	2.411**		
Farming Experience	0.014	0.011	1.318**		

\*\* = Significant at 5%

### Conclusion

Among the farmers' socio-economic characteristics: household size, annual income, occupation, farm size and farming experience played an important role in adoption of climate change adaptation measures. However, annual income, farm size and farming experiences were positive and significantly related to adoption of adaptation measures to climate change.

The positive and significant relationship between the socio-economic variables shows that if those variables are improved, adoption will improve thereby boosting crop output which in turn increases farmers' income and improve their standard of living.

### Recommendations

- i. Government should encourage formal education through literacy programme.
- ii. Government should provide adequate extension support services.
- iii. Farmers should form cooperatives to enhance their accessibility to credit facilities.
- iv. Farmers should be encouraged to form societies to enhance information gathering as well as learning effectively from others.

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