

# Climate Change Perspective and Adaptation Among Local Farmers in Sokoto State, Nigeria

A. Galadima\*    A.M. Lawal  
Centre for Research, Federal University, PMB 1001, Gusau, Nigeria

## Abstract

Perspectives of farmers on climate change and the strategy they employed in handling its impacts in five local governments of Sokoto state was studied. The study employed a Rapid Rural Appraisal technique to interview the farmers on key parameters such as awareness, mitigation and adaptation strategies and the sources of information on climate change. The study interviewed 300 farmers in each of the five local governments and concluded that while the respondents are aware of the climate change and its effects, the techniques employed for the mitigation of its effects are crude with adaptation strategies likely to be more effective.

**Keywords:** Climate change; perception; adaptation; mitigation; strategy.

## 1.0 Introduction

Climate change is the change normally attributed either directly or indirectly to human activities that alter the composition of the global atmosphere. Together with natural climate variability, these alterations and/or changes are observed over comparable time periods (1). It is one of the most serious environmental and human threats that hindered or undermined the achievement of Millennium Development Goals (MDGs) and is considered also a hindrance to the attainment of Sustainable Development Goals (SDGs) as well as the international communities' efforts to reduce extreme poverty (2). It is considered, therefore, as a significant threat to development in the 21st century. Climate change is, potentially, a threat to all natural systems, human development and survival socially, politically and economically (2, 3). Various anthropogenic activities (burning of coal, oil, and natural gas), in addition to deforestation and various agricultural and industrial practices, play major roles in altering the composition of the atmosphere and contributing to climate change which, according to IPCC (4) have led to increased atmospheric concentrations of a number of greenhouse gases (such as carbon dioxide, methane, etc).

Literature has also reported the impacts of climate change on agriculture and natural resources management in countries of Africa, Asia and Latin America (4). However, there is an emerging consensus that developing countries, of which Nigeria is one, are more vulnerable to the projected impacts of climate change. This is because of the predominance of rain-fed agriculture in their economies, the scarcity of capital for adaptation measures, their warmer baseline climates and their heightened exposure to extreme events and low adaptive capacities (2, 3).

Anthropogenic activities have tended to worsen climate change, exacerbate its impacts on agriculture and livelihoods in some states in Nigeria. For example, the Niger Delta region is reported, according to Efe (5) to have about 123 gas flaring sites making Nigeria one of the highest emitters of greenhouse gases in the world. This agreed with another study by the World Bank (6) which revealed that Nigeria accounts for roughly one-sixth of worldwide gas flaring. Similar studies in other parts of Nigeria, (7) linked the effects of these activities on health and agricultural productivity, and people's perceptions and attitudes toward these activities, hence which were attributed to the growing impacts of climate change. It is noteworthy that the studies reported that farmers in those states and communities, knowingly or unknowingly are adapting to the changing climatic conditions using their traditional knowledge, innovations and practices (9, 10). Despite all these, it does appear that the level of awareness of farmers in most of the states on climate change and its impacts leaves much to be desired. As a result, the need for more awareness rising among stakeholders about the phenomenon cannot be over-emphasized.

Studies considered Nigeria as one of the most vulnerable countries to climate change and its effects globally (11). The risks are related to a number of factors such as a densely-populated low-lying coastline, which is home to a high concentration of industry and infrastructure important for GDP (9, 11). The north of the country, which forms part of the Sahel, is at risk of further drought and desertification. The country's economy is largely dependent on climate-sensitive resources, with agriculture, forestry and fishing sectors employing up to 70% of the workforce (12). General food insecurity issues and serious social tensions look more likely influenced by the effects of climate change, including increased migration linked to growing environmental stress in some areas (9).

Flooding, water shortages and an increased disease burden will have associated social disruption, with risks of a downward spiral of environmental degradation, weakening of the economy and social conflict. Moreover, the problem of urbanization and urban poverty which is very complex and multidimensional in Nigeria is one of the factors that contributes to vulnerability of rural and urban populations equally, and the problem is worst

when urbanization occurs in coastal zones and cities that are vulnerable to flooding and related hazards.

Climate models developed by global climate monitoring bodies (such as IPCC) in the recent times suggest that climate in Africa will generally become more variable, with high levels of uncertainty regarding climate projections especially in the Africa Sahel zone. Temperatures in West Africa, and particularly the Sahel, have increased more sharply than the global trend, and the average predicted rise in temperature between 1980/99 and 2080/99 is between 3°C and 4°C, which is more than 1.5 times the average global trend (11).

The estimated projections are for sea level rise of 0.1 m and 0.2 m by 2020 and 2050 respectively, and a temperature increase of 0.4 to 1°C over the same periods. Sea level rise of 1m could result in loss of 75% of the Niger Delta. It is noteworthy that the high scenario is based on more recent scientific findings, but still remains relatively conservative, indicating the risk that potential impacts could be significantly worse, particularly given new evidence indicating that global warming is accelerating. According to a recent World Bank study, continued growth in emissions could result in a global sea level rise of 1 – 3 metres this century (4, 11).

Recent analysis by the Nigerian Meteorological Agency (NIMET) points to a trend of late onset of the rainy season, with most regions of the country experiencing a below-average length of rainy season (4, 11). Climate projections indicated that mean annual rainfall will be lower in the north of the country and higher than normal in the coastal belt, with lower dry season contributions to annual totals in all belts. Water logging could become more severe in the south and south-east. Increased rainfall variability would result in more frequent floods and droughts and larger runs of wet and dry years (14-21). Flash floods as a result of increased rainfall intensity will become more prevalent. Sea level rise leading to submergence of lowlands along the coast would result in much of the land currently used for agriculture being lost, with resultant socio-economic and socio-cultural problems. This could result in mass migration out of submerged agricultural areas which would likely be accompanied by substantial losses of income and increased unemployment. Increased migration is already being observed into the centre of the country from the north, as land degradation is worsened by climatic effects, leading to increased deforestation in the central areas. Dust storms (which are partly due to changes in land use such as grazing and deforestation) in the some parts of the Sahel have also increased, particularly between the 1950s and 1980s (13-21).

### *1.1 Research Objectives*

In Sokoto State, agriculture is highly dependent on rain as irrigation practice is very low. The changes in the rainfall pattern have greatly affected vegetation and agriculture. There is almost complete absence of primary forests. Uncontrolled logging, agricultural activities, acid rain, urbanization and mining activities contribute to loss of vegetation. All these have contributed to climate change, the impacts of which are already being felt in the states with food insecurity, increasing risk of disease and the rising costs of extreme weather damage. The main aim of the paper is therefore to study the climate change perspective and adaptation among local farmers in Sokoto state, Nigeria.

## **2.0 Materials and Methods**

### *2.1 Description of the Study Area*

Sokoto is located between 13<sup>00</sup>5'N, 05<sup>0</sup>15'E and 13.083<sup>0</sup>N, 5.250<sup>0</sup>E in the north-western part of Nigeria and shares border with Zamfara to the East and Kebbi to the west. A typical geographical map of the state is illustrated as Figure 1. The local governments for the study were carefully selected so as to obtain representative data for the state.

Majority of the inhabitants are local farmers that mainly cultivate food crops such as sorghum, millet, rice, maize and cassava to a lesser quantity. The rainy season in the area usually begins in April and ends in November. However, in the recent times the period changes to May and October. During the 1980s and 1990s heavy rainfall with flood episodes have been observed in the areas, but the gravity of the rainfall has seriously declined with the period of dry season increasing occasionally.

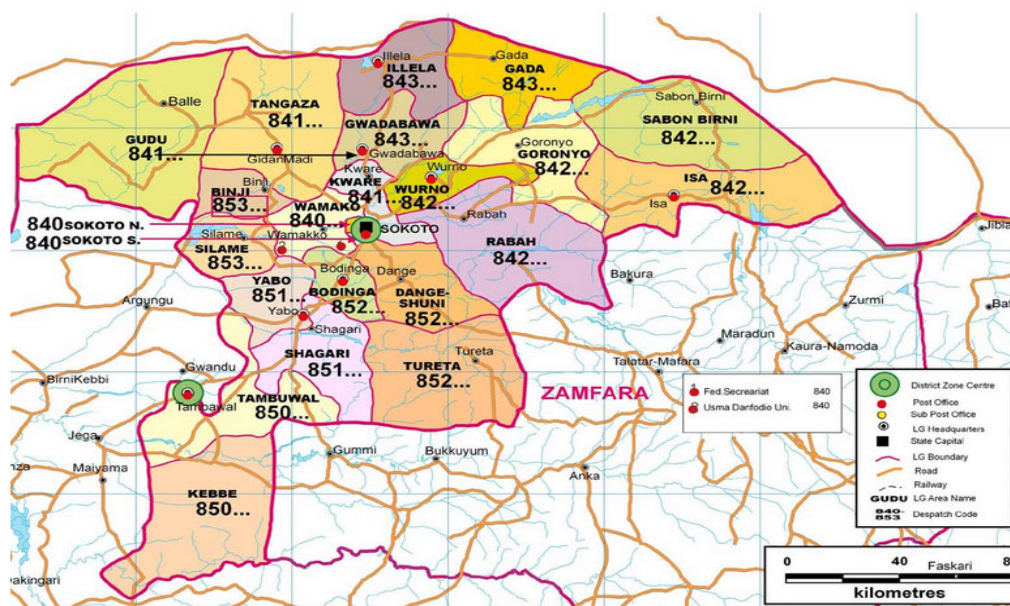


Figure 1. Geographical map of Sokoto state showing the study areas.

### 2.2 Research Methodology

About 300 farmers across five (5) local government areas of Sokoto state were interviewed by issuing out questionnaires. The selection of interviewees was done using a multistage random sampling technique. Rapid Rural Appraisal involving transect-walks, identification and inspection of farmlands was used to encourage the respondents to describe their relationships with their natural resources, particularly the indigenous adaptive measures.

The interview schedule was divided into five (5) sections (A-E). Sections B-E, however, had more relevance to the main aim of the research. Section B determined rural households' climate change awareness. Respondents were asked to indicate the extent to which variables such as high/low rainfall, floods, food insecurity and hunger, extinction of animal and planting species, desertification etc represented their level of climate change awareness. Section E looked at the effective indigenous, emerging technologies and innovations adopted by the farmers to mitigate the negative effects of climate change in their neighbourhoods.

### 3.0 Results and Discussion

Nearly all the farmers interviewed in the five local governments were involved in subsistence (with only 1% in Illela local government engaged in commercial) farming. This observation is explained by the fact that most of the respondents are married (again, Illela with 65% has the lowest percentage of married respondents) and explained, partly, why the major farming practice is subsistence. Another explanation may be as a result of poor yield which shifted the focus of the farmers to self-preservation rather than commercial adventure.

The results of strategies employed by the various respondents to mitigate and adapt to climate change effects are presented below:

**Table 1:** Showed the results (in percentage) of climate change awareness level by the respondents.

	LOCAL GOVERNMENT				
	Isa	Dange	Bodinga	Illela	Yabo
Excellent:	03	-	10	08	-
Very Good:	10	08	-	10	05
Good:	15	10	05	15	20
Fair:	20	15	15	22	10
Poor:	52	67	70	45	65
<b>Total</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>

#### 3.1 Awareness to Climate Change

Clearly, most of the farmers, as presented in table 1, have no idea or adequate awareness of climate change or its effects on their environment, economy and farming practices. This was explained by the fact that with only 10%, Bodinga local government has the highest percentage of respondents having excellent awareness of climate change while Yabo and Dange (both 0%) have the least. Interestingly, also, Bodinga has the highest percentage

of respondents (70%) with poor awareness on climate change and its effects. It was closely followed by Dange and Yabo with 67% and 65% respectively. Illela, with 8% having excellent awareness has the least number of respondents with poor knowledge/awareness (45%). There is perhaps an international dimension to this as Illela shares borders with Niger Republic which for long have been affected by desertification. It can be seen that a significant percentage of the farmers in these local governments have no or little knowledge of modern farming practices which are designed to accommodate the effects of changes in climate.

Poor knowledge of climate change awareness is a clear indication that there is either a lack of coherent policy plan by the state and federal governments or the agencies responsible are not up to the task.

### 3.2 Source of Information on Climate Change

For most of the respondents, especially in Yabo and Dange (with 81% and 75% respectively), radio and television provided them with most adequate information about climate change. Isa local government with only 50% (the lowest percentage) of the respondents getting most of their information about climate change and its effects from radio and television still represents the highest source of information about climate change although some respondents from the local government (25%) source their information from farming co-operatives and other local organisations. This suggests that the local government has an organised farming community. Isa is followed closely by Illela with 21% of the respondents sourcing their information from co-operatives. This followed a familiar trend, both Isa and Illela share borders with Niger republic whose farmers for long have been battling the effects of climate change. Dange and Yabo (10% each) have the lowest respondents who sourced their information from the farming co-operatives and other organisations in their localities.

The most technology savvy respondents whose source of information comes from the internet come from Illela (10%) while Bodinga and Yabo (3%) have the least. This indicates that, while the world is turning into a global village, farmers in these local governments and, by extension state, do not embrace technology as a means of combating climate change.

Results indicated that there are no extension workers in the local governments and where there are, they were either inadequate or not properly trained or both. This is because most of the respondents reported not having been engaged by the extension workers in their local governments and therefore this category of people contribute less than mass media (radio/television) and/or community and farming co-operatives in providing awareness on climate change, its effects, mitigation and/or adaptation strategies. Isa and Bodinga, with 20% and 19% respectively, have the highest number of respondents whose information about climate change comes from extension workers with Yabo local government having the least (6%).

**Table 2:** Showed the sources of information (in percentage) about climate change and its effects.

<b>LOCAL GOVERNMENT</b>					
<b>Source</b>	<b>Isa</b>	<b>Dange</b>	<b>Bodinga</b>	<b>Illela</b>	<b>Yabo</b>
Extension workers:	20	09	19	09	06
Friends:	-	-	-	-	-
Cooperatives:	25	10	15	21	10
Radio/TV:	50	75	63	60	81
Internal:	05	06	03	10	03
Politicians:	-	-	-	-	-
<b>Total</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>

### 3.3 Adaptive Measures

In the absence of modern technologies for climate change adaptation, the local farmers, with the help of the information they get from predominantly mass media (radio and television) sources, they were able to devise ways that help them in adapting to climate change effects. The use of crop varieties that are well acclimatized to the climate as adaptive measure is the most widely used technique. Respondents from Illela local government (60%) practice this strategy most and were closely followed by Bodinga and Dange local governments with 51% and 50% of the respondents having reported using the same technique with respondents from Yabo and Isa local governments (45% and 40%) utilizing this technique the least. Apart from the use of acclimatized crop varieties, respondents in Isa local government showed more preference (20%) to mixed farming practice. They were closely followed by respondents from Bodinga and Yabo (with 12% and 10% respectively). Dange (with 5% each of mixed farming strategy alongside Illela) preferred planting pest resistant crops with 15% of its respondents engaging in the practice. This was only second to respondents from Bodinga (17%) while Illela (8%) and Yabo (5%) are not so keen on this strategy.

About 20% of respondents from Yabo and Dange local governments prefer the use of cover cropping as a strategy to adapt to the effects of climate change. Also, Isa and Bodinga, with 15% of respondents each, significantly engage in this practice. However, in Illela local government only 12% respondents are engaged in this practice. Interestingly, only 20% of the respondents from Yabo local government (the highest) engage in the

practice of using crops with short harvesting period while Bodinga has the least respondents (5%) who engage in similar practice. Isa, Illela and Dange have 15%, 15% and 10% respondents engaging in this strategy respectively.

**Table 3:** Showed the strategies (in percentage) employed by the respondents in adapting to climate change.

**LOCAL GOVERNMENT**

Strategy	Isa	Dange	Bodinga	Illela	Yabo
Planting Cover Crops	15	20	15	12	20
Planting Pest Resistance Crops	10	15	17	08	05
Mixed Farming Practice	20	05	12	05	10
Use of crop Varieties that are well acclimatized:	40	50	51	60	45
Use of Crops that are harvested in short period:	15	10	05	15	20
<b>Total</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>

**3.4 Mitigation Strategies**

In order to mitigate climate change effects, the respondents in the local governments employed basically three practices; Reforestation/afforestation, use of contour bounds around farmlands and draining of wetlands for crops production. About 71% of the respondents from Bodinga local government are engaged in reforestation/afforestation practices for climate change mitigation. These are closely followed by respondents from Yabo, Illela and Isa with 69%, 67% and 65% respectively. Respondents from Dange, with only 48%, practice the technique the least. Perhaps what informed the employment of this technique is the fact that Sokoto is one of the hottest states in Nigeria in addition to being one of the most affected by desertification. There are sustained campaigns in the mass media (which was the principal source of information on climate change in the local governments) about the importance of reforestation/afforestation as a tool for combating climate change.

The use of contours is aimed at combating desertification as well as demarcation of farmlands. It is a practice that is becoming less and less common as indicated by the percentage of respondents engaged in the practice. The highest respondents engaged in this practice come from Dange local government (32%). They are closely followed by respondents from Illela (24%), Isa (20%), Bodinga (19%), and Yabo (13%).

Since the landscapes in these local governments have been largely affected by desertification and erosion, farmlands are often flooded during rainy season. Such wetlands have to be drained, as difficult as that is, to accommodate crop production. Of the respondents, those from Dange (20%) are engaged most in this practice, perhaps due to the landscape and/or terrain. These were followed by respondents from Yabo (18%), Isa (15%), Bodinga (10%) and Illela (9%).

**Table 4:** Showed the strategies (in percentage) employed by the respondents in mitigating the effects of climate change. **LOCAL GOVERNMENT**

Strategy	Isa	Dange	Bodinga	Illela	Yabo
Reforestation/Afforestation:	65	48	71	67	69
Making Contour bounds around farmlands:	20	32	19	24	13
Draining of wetlands for crops production:	15	20	10	09	18
<b>Total</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>

**4.0 Conclusion**

The research established that the respondents are indeed aware of climate change and are familiar with its effects. This moved the respondents to employ basic techniques aimed at mitigating the impacts of climate change. Most of the adaptation strategies employ the use of acclimatized seedlings; cover cropping, mixed farming and using crops with short harvesting period. For mitigation, the respondents utilize reforestation/afforestation and use of contour bounds. Generally, while there is significant awareness, the perception of the respondents on the effect of climate change is poor as there are no programmes in place that will help them understand and device more suitable ways of combating climate change and its effects.

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