



**Adaptation Strategies to Climate Change among Grain Farmers in Goronyo Local Government Area of Sokoto State**

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**Abstract**

*This paper examined the adaptation strategies to climate change among grain (millet, sorghum and maize) farmers in Goronyo Local Government Area of Sokoto State. Daily rainfall and temperature data for 30 years (1981-2010) were sourced from the Sokoto Rima Basin Development Authority's Rainfall Reading Office, Goronyo. The data received was augmented with data collected for Sokoto from the Nigerian Meteorological Services (NIMET), Oshodi, Lagos. These data were used to derive the rainfall characteristics of Goronyo such as the onset, cessation, length of rainy season, annual rainfall, mean maximum and mean minimum temperature, which are very crucial in plant growth and development. 382 grain farmers were sampled. Open ended questions were used to ask farmers of their favourite crops. The sampled grain farmers were also asked whether they had perceived long-term changes in rainfall and temperature and about the adaptations they had made as a response to whatever changes they had noticed. The farmers' perceptions to climate change are in line with climatic data records. The characterisation of the climate of the study area showed an increasing trend in the onset and cessation dates. The study revealed an upward trend in length of the rainy season. To cope with the changing climate, grain farmers in the study area adopted some adaptive measures. The main adaptation strategies of grain farmers in Goronyo are: crop rotation, use of improved seed varieties, shifting cultivation, intensification of irrigation, use of organic and inorganic manure among others. The study concludes that the climatic characteristics of the study area affect grain production and that adaptation strategies have significant contribution on grain production in the study area. The study therefore advocates that grain farmers should adopt viable adaptive strategies to climate change so as to maximize the available land and the climatic condition that favours their cultivation.*

**Keywords:** Adaptation strategies; Agriculture; Climate Change; Grain farmers; Goronyo.

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## 1.0 INTRODUCTION

Global climate has been warming at an unprecedented rate since the past 1000 years (IPCC, 2001). This phenomenon is therefore inevitably altering the character of local and regional weather around the world. IPCC (2007) Fourth Assessment Report (AR4) gave the most acceptable definition of climate change, which states that “climate change is a change in the state of the climate that can be identified (e.g. by using statistical tests) by changes in the mean and/or the variability of its properties, which persists for an extended period typically decades or longer”. Climate change, in the most general sense –encompasses all forms of climatic inconstancy (that is, any differences between the “long-term” statistics of the

meteorological elements calculated for different periods but relating to the same area), regardless of their statistical nature or physical cause (Maunder, 1994). Climate change implies a new mean climatic state or climatic normal (Ayoade, 2003). Adaptation is necessary in the short and longer term to address impacts resulting from the warming that would occur even for the lowest stabilization scenarios. Thus, this paper focuses at finding out how climate change affects agriculture and the various adaptation strategies used by grain farmers to cope with the effects of climate change in Goronyo Local Government area of Sokoto State, Nigeria.

## 1.2 MEANING OF ADAPTATION

The IPCC (2007) defines adaptation as the “adjustment in natural or human systems to a new or changing environment”. It is the adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities. Adaptation to climate change is a process through which people reduce the adverse effects of climate on their health and well-being and take advantage of opportunities

that the environment provides (Saka, 2008). Similarly, Mitchell and Tanner (2006) defined adaptation as “an understanding of how individuals, groups and natural systems can be prepared for and respond to changes in climate or their environment.” According to them, “it is crucial to reducing vulnerability to climate change”. Responding to climate change falls into two broad classes of action, mitigation and adaptation.

## 1.3 AGRICULTURE AND CLIMATE CHANGE

Agriculture is perhaps the most sensitive to climate change related issues of all human economic activities. Changes in the world’s climate will bring major shifts in food production. In spite of recent technological and scientific development, weather remains a key variable in agricultural production. Weather and climate affect agriculture and determine the adequacy of food supplies. Climate determines whether or not rainfed agriculture will be successfully cultivated in a given area. All stages of agricultural production from land clearing and preparation, through crop growth and management to harvesting, storage,

transportation, and marketing of agricultural products are subject to the influence of weather and climate. Weather and climate act both as a resource and a constraint to agricultural production. The resource value of weather has to be optimized while the hazards posed by weather have to be managed (Ayoade, 2002). It is common knowledge that farmers in Sub-Saharan Africa, including Nigeria are struggling to cope with the current climate variability (Chakeredza *et al* 2009).

#### 1.4 EVIDENCE OF CLIMATE CHANGE IN NIGERIA

The most significant changes are with respect to temperature and temperature related parameters. A further support of the evidence of climate change in Nigeria by Odjugo (2005; 2009) is the increase in rainfall amount in the coastal areas since the 1970s, and a constant decline in rainfall amount and duration in the continental interior of the semi-arid region of Nigeria. The increasing rainfall in the coastal cities may have partly be responsible for the increasing floods devastating the coastal cities of Warri, Lagos, Port Harcourt and Calabar as observed by (Ogundebi, 2004; Ikhile 2007; Nwafor, 2007; Umoh, 2007; Odjugo, 2010). The increasing temperature and decreasing rainfall in the semi-arid region of Northern Nigeria-Sokoto, Katsina, Kano, Nguru and Maiduguri may have resulted in the increasing evapotranspiration, drought and desertification in the region as reported by

(Odjugo and Ikhuoria 2003; Adefolalu, 2007). Constant loss of forest cover and biodiversity in Nigeria is linked to global warming and climate change (NEST, 2003; Ayuba *et al.*, 2007).

The Sahara desert is observed to be expanding to all directions trying to engulf the Sahellian region of Africa with annual expansion of 1-10 km (Odjugo and Ikhuoria, 2003; Yaqub. 2007). Odjugo and Ikhuoria (2003) also observe that Nigeria north of 12<sup>0</sup>N is under severe threat of desert encroachment and sand dunes are now common features of desertification in states like Yobe, Borno, Sokoto, Jigawa and Katsina. The migrating sand dunes have buried large expanse of arable lands, thus reducing viable agricultural lands and crops' production.

#### 1.5 ADAPTATION STRATEGIES

Adaptation strategies or measures vary depending on many factors. Adaptation strategies can be classified based on the timing, goal and motive of their implementation. Accordingly, adaptation can include reactive or anticipatory actions, or can be planned or autonomous (IPCC, 2007). There are two main types of adaptation to climate change, Reactive or anticipatory adaptation and planned or autonomous adaptation. Reactive adaptation is our immediate response to climate change. Reactive adaptation occurs after the initial impacts of climate change become evident. This type of adaptation is often used to regain stability. It is sometimes not the best response when our past understanding does not correspond to current environmental and socio-economic conditions.

There is a need to understand what types and forms of adaptation are possible, feasible and likely; who would be involved in their implementation; and what is required to

facilitate or encourage their development or adoption. A necessary first step in addressing these concerns is the identification and characterization of adaptation options in agriculture (Brklacich *et al.*, 1997). Effective adaptation strategies and actions should aim to secure well-being in the face of climate variability. In pursuing this aim, climate adaptation should focus on support for the decision-making and capacity building processes that shape social learning, technology transfer, innovation and development pathways. Adaptation is most relevant when it influences decisions that exist irrespective of climate change, but which have longer-term consequences (Stainforth *et al.*, 2007). A key component of climate adaptation involves building resilience, where resilience is the capacity of a system to tolerate disturbance without collapsing into a qualitatively different state that is controlled by a different set of processes: a resilient system can withstand shocks and rebuild itself when necessary.

Over sixty per cent of Africans remain directly dependent on agriculture and natural resources for their well-being (FAO, 2003). Agriculture is highly dependent on climate

variability, which is why the threat of climate change is particularly urgent in Africa (Boko *et al*, 2007).

## 2 METHODOLOGY OF THE STUDY

### 2.1 Study Area

Goronyo is a local government area (LGA) in Sokoto state, Nigeria. It is located along Latitude 13° 27'11" North and Longitude 05° 40'35". Its headquarters is at Goronyo, on the bank of the Sokoto River. It has an area of 1,704km<sup>2</sup>. Goronyo is in the dry Sahel, surrounded by sandy savanna and isolated hills. With an annual average temperature of 28.3°C, Goronyo, on the whole is a very hot area. However, maximum daytime temperatures are for most of the year generally under 40°C and the dryness makes the heat bearable. The hottest months are

February to April when daytime temperatures can exceed 45°C. The rainy season is from June to October. The annual rainfall is between 500mm in the north and 800mm to the south. The area's lifeline for growing crops is the floodplains of the Goronyo dam system which are covered with rich alluvial soil, Sani (2005). Goronyo is essentially an agricultural area with traditional mode of production predominating with more than 90 percent of the population engaged in subsistence farming. The main crops produced in the LGA are millet, guinea corn, maize, rice, beans etc.

### 2.2 Types of Data

Climatic data used in this study are daily rainfall and temperature records of Goronyo (1981-2010), and Goronyo's grain farmers' perception and adaptation to climate change. The grain farmers' perception helped to know the sensitivity of farmers to the changing climate and their adaptive strategies to climate change. The daily rainfall and

temperature records for the stated period were obtained from the Sokoto Rima Basin Development Authority, rainfall reading office, Goronyo, and Nigerian Meteorological Services (NIMET), Oshodi, Lagos. While farmers' perception and adaptation strategies to climate change were obtained by means of structured questionnaire.

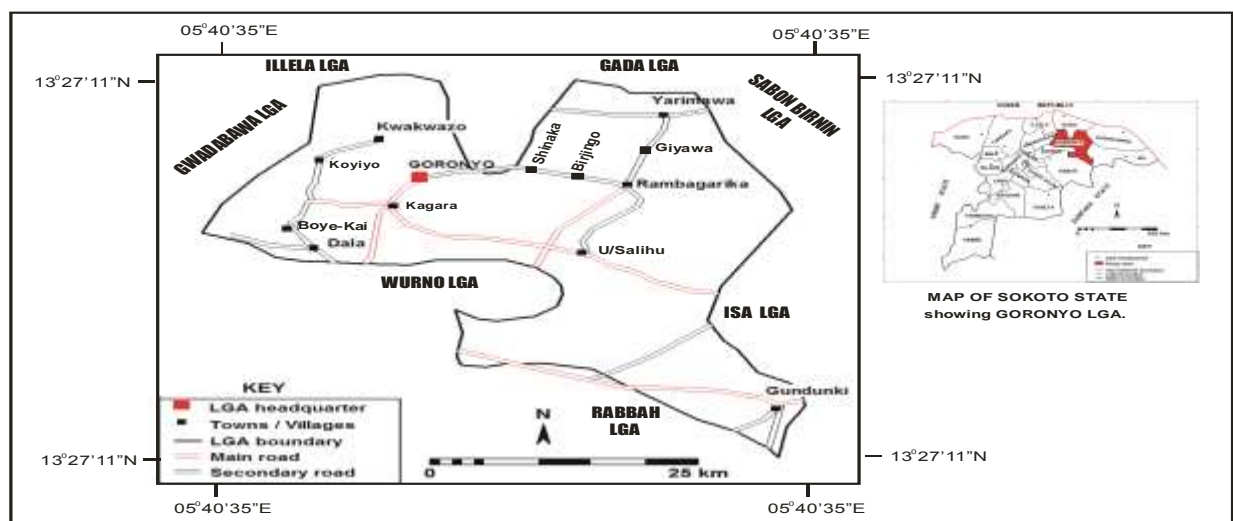


FIG. 3.1: GORONYO LGA SHOWING TOWNS / VILLAGES  
Source: Modified from Administrative Map of Sokoto State, 2008

Figure 1. Map of Goronyo Local Government Area.

### 2.3 Sampling Technique

Purposeful sampling technique was used to determine the respondents after which simple random sampling was used to administer the questionnaire among the eleven wards of the LGA. Purposeful sampling, according to Bernard (2002) “is the deliberate choice of an informant due to the quality the informant possesses.” The three hundred and eighty five (385) questionnaires were shared proportional to the population of each ward, but due to the non-availability of population figures for each ward from the 1991 and 2006 census results, the questionnaire was distributed equally among the eleven (11) wards, with 35 questionnaires in each ward. For the purpose of administering the questionnaire, grain farmers above thirty (30)

years of age and who must have lived at least twenty (20) years within the study area were identified through the “Sarkin Noma” (Head of the Farmers) and the village Heads. This was done by asking the farmers of their age and how long they have lived in the area. Thereafter the questionnaire was issued. The reason for this decision was that those within the age bracket have the information needed about climate change. The researcher was assisted by field assistants.

To present the various agricultural adaptive strategies used by the farmers to cope with climate change, percentage analysis was used. The data was summarized and presented in tables, charts, percentages.

## 3.0 RESULTS AND DISCUSSION

### 3.1 Onset of the Rains in Goronyo

The linear trend and trend line equation for

the onset dates of the rainy season in the study area are shown in Fig. 2 below.

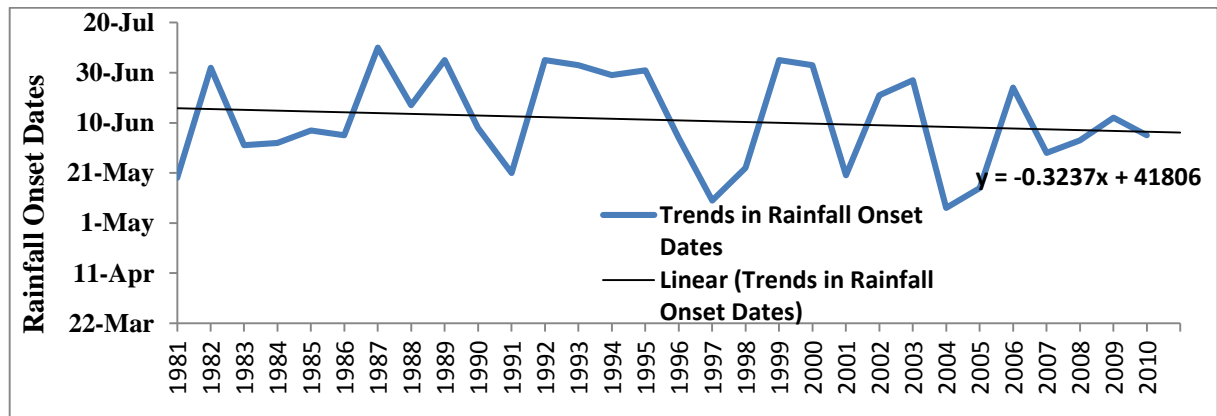


Figure 2. Trends in Rainfall Onset Dates in Goronyo, Source: Field survey, August 2012.

Figure 2 clearly indicates an increasing trend in the onset dates (that is, the rains are now coming early). The earliest onset date of rain in the study area within the 30 years of study as shown in fig. 2 is 7<sup>th</sup> May, (2004), while the late onset date within the 30 years of study is 10<sup>th</sup> July (1987). The mean onset dates is 25<sup>th</sup> May. According to Ati (2002), “in the Sudan Savanna the start of the rains is seldom abrupt but it is usually preceded by a

succession of isolated showers of uncertain intensity with intermittent dry periods of varying durations. These may be false starts followed by prolonged dry spells whose duration may last for two or more weeks. This condition dries out the topsoil and prevents the germinating or emergent plants, leading to repeated and late planting, which usually results in low yield or complete crop failure.

### 3.2 Cessation Dates

The cessation dates, otherwise known as the end of the growing season for the study area are shown in Figure 3.

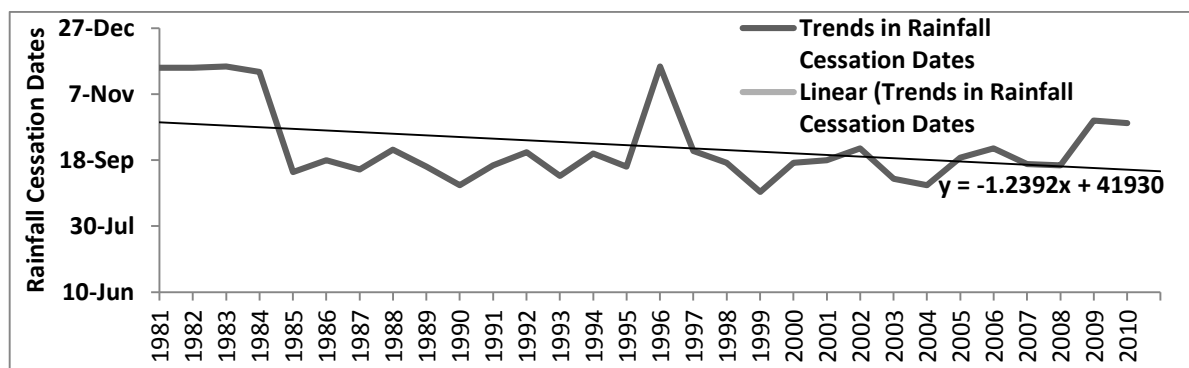


Figure 3. Trends in Rainfall Cessation Dates at Goronyo (1981 – 2010). Source: Field survey, August 2012.

The earliest cessation date in Goronyo occurred on 25<sup>th</sup> August (1999), while the latest cessation date occurred (twice within the thirty years of study) on 28<sup>th</sup> November (1983). The average cessation date of rainfall in Goronyo within the thirty years of study is 30<sup>th</sup> September. Cessation dates in the study area within the thirty years of study occur between 25<sup>th</sup> August and 28<sup>th</sup> November. These periods of anomalies, that is early

cessation and prolonged cessation may affect the production of grains in the study area.

### 3.3 Length of Rainy Season

The linear trend and trend line equation for the length of rainy season is shown in figure 4. From this figure, it is observed that the trend line for the length of rainy season is increasing.

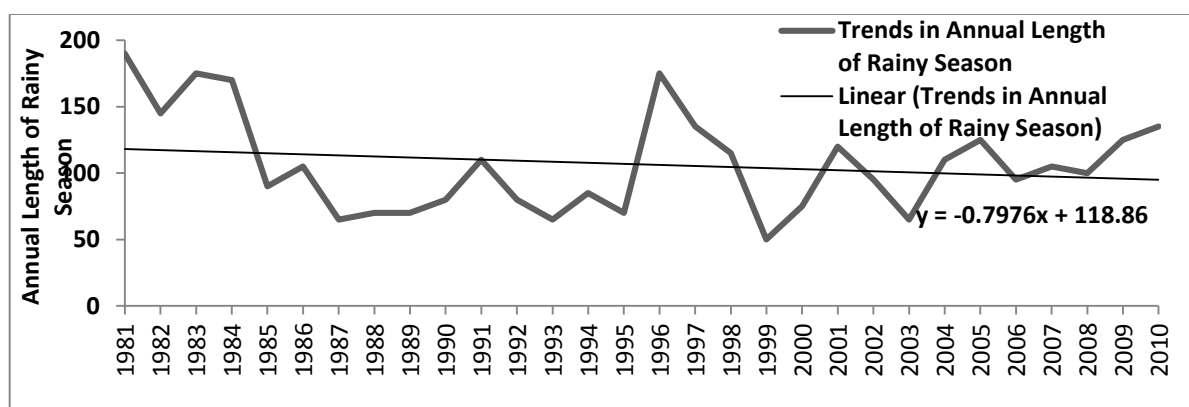


Figure 4. Trend in Length of Rainy Season at Goronyo (1981 – 2010). Source: Field survey, August 2012.

The linear trend line equation for the length of rainy season is  $y = -0.797x + 118.8$ . This negative trend line equation further indicates that the length of the rainy season is on the decrease in Goronyo. The highest length of rainy season within the thirty years of study

was recorded in 1981 (190 days out of the 365 days of that year), while the shortest length of rainy season was recorded in 1999, with 50 days. The mean length of rainy season (days) is 107 days.

### 3.4 Annual Rainfall

The trends in fig. 5 show an increasing annual rainfall amount. The best fit trend line equation is  $y = 5.506x + 441.8$ . The positive equation implies that annual rainfall is on the increase. The highest rainfall was recorded in 1994 (905.2mm), while 1984 had the least

rainfall (263.4mm). The mean annual rainfall during the period of the study is 531.8mm. This amount is lower than the minimum required for the cultivation of sorghum and maize in the study area. Millet requires the minimum of 300mm of rainfall, sorghum 400-600 and maize 500-750mm.

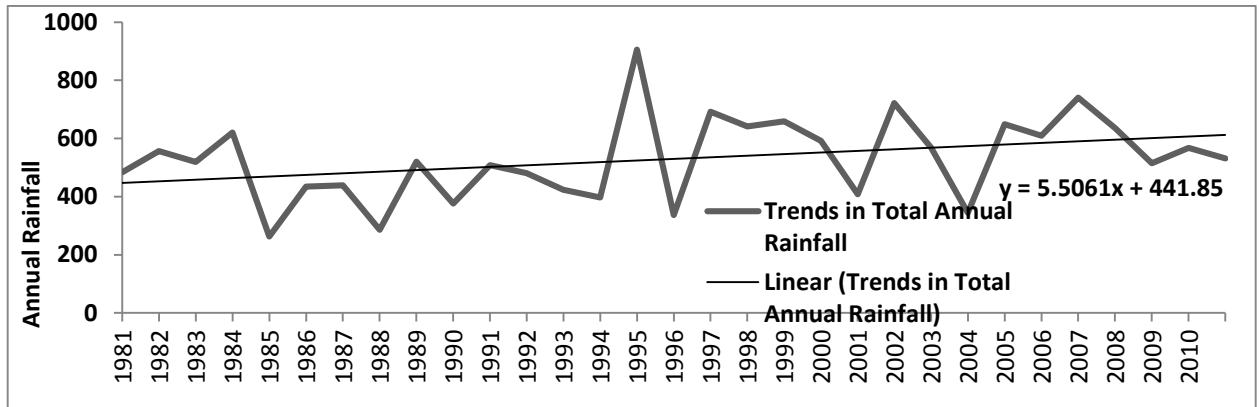


Fig. 5: Trends in Total Annual Rainfall (mm) at Goronyo (1981 – 2010). Source: Field survey, August 2012.

These attest to the fact why only 11 farmers out of the 382 sampled grain farmers in Goronyo cultivate sorghum and 18 farmers cultivate maize in the study area (Goronyo dam favours the cultivation of maize through

irrigation system). Under this condition, farmers in Goronyo would have to implore several adaptive strategies to cope with the inconsistency in rainfall pattern.

### 3.5 MAJOR ADAPTATION STRATEGIES TO CLIMATE CHANGE BY FARMERS

It is no doubt that adaptation strategies can reduce the impacts of climate change and increase benefits. As shown in Figure 6, crop rotation, mixed cropping, use of improved seed varieties, shifting cultivation, access to

water for irrigation, use of organic and inorganic fertilizer, access to credit loan are the major adaptation strategies to climate change adopted by farmers in Goronyo as presented in Figure 6.

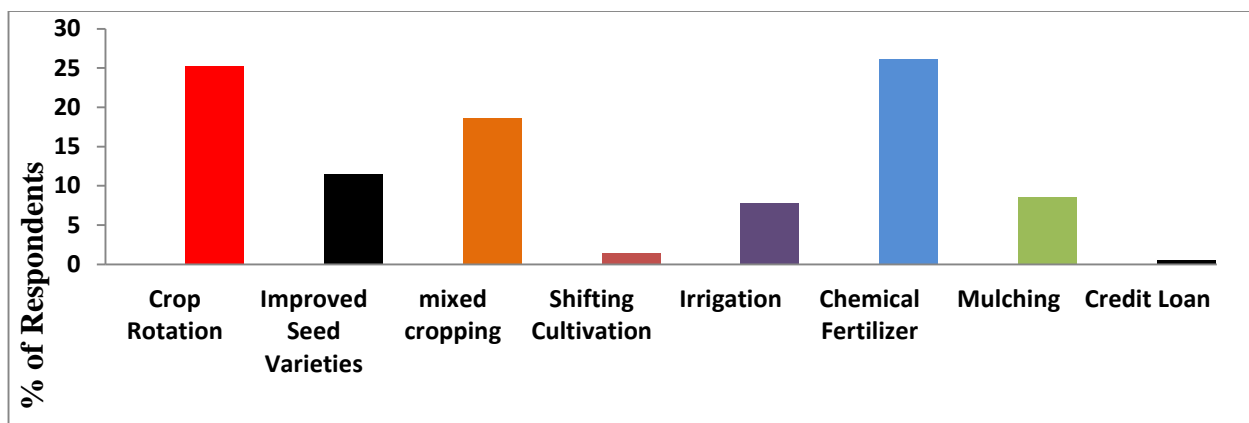


Figure 5. Farmers' Strategies to Adapting to Climate Change in Grain Production. Source: Field survey, August 2012.

As strategies to adapting to climate change in grain production, 25.2% practice crop rotation; 18.6% practice mixed cropping; 15.5 percent uses improved seed varieties; 1.5 percent use shifting cultivation; 7.8 percent use irrigation/fadama farming; 32.2% use chemical fertilizer (chemical fertilizer helps to improve crop yield); 3 percent use

mulching with crop residue and animal dung; 0.2 percent use credit loan as a means of diversification of the economy for livelihood and only 0.5 percent stated that no adaptation method is best fit.

### 3.6 OTHER ADAPTATION STRATEGIES TO CLIMATE CHANGE

On other strategies to cope with climate change, sixty four percent ticked early planting of seed; fourteen percent ticked late planting of seed; seventeen percent ticked

early weeding to reduce weed competition for nutrient; one percent ticked the use of improved seed and four percent ticked others adaptive strategies not listed in the options.

Table 2: Other Strategies to Cope with Climate Change in Goronyo .

S/N	Other Strategies	Number of Respondents	Percentage (%)
a)	Early planting of seed	247	64
b)	Late planting of seed	56	14
c)	Early weeding to reduce weed competition for nutrients	68	17
d)	Use of improved seed	04	01
e)	Others	17	04
	Total	382	100

Source: Field survey, August 2012.

### 4.0 CONCLUSION

Over the 30 years examined, rainfall is characterized by large inter-annual variability with a substantial decrease in the amount of rainfall in 1984 (263.4mm) and 1987 (285.7mm). The mean annual rainfall is

563.6mm which favours the cultivation of millet than sorghum and maize. In addition, the study also revealed that the length of the rainy season in Goronyo is too short for the effective cultivation of grains without

imploing adaptive strategies. Summarily, the characteristics of rainfall and temperature in the study area are not consistent.

Moreover, it was revealed in the study that millet is the most cultivated grain crop in Goronyo. Millet is the framers' favourite because it yield very well compare to sorghum and maize, it requires little effort and maintenance etc. Millet is better adapted than sorghum and maize to dry, infertile soils, high temperature, low and erratic precipitation and poor water-holding capacity.

## 5.0 RECOMMENDATIONS

Following the findings and conclusions made in the study within the 30 years covered, the following recommendations are made:

Since the annual rainfall totals favours the cultivation of millet, grain farmers should focus more on millet cultivation so as to maximize millet yield.

Since personal observation is the farmers' main source of awareness on climate change, grain farmers in Goronyo should be sensitive and observant to changes in weather and climate indices so as to know when the climate is changing. Grain farmers should be flexible and willing in their decision to adjust

Furthermore, the study revealed that farmers' perceptions of climatic variability are in line with climatic data records. Although farmers are well aware of climatic changes, few seem to take steps to adjust their farming activities. The main adaptation strategies of farmers in Goronyo are Crop rotation (e.g., from maize to millet and sorghum, a more heat-tolerant crop); use of improved seed varieties; shifting cultivation; intensification of irrigation or fadama farming; and use of organic and inorganic manure etc. The study also showed that a decrease in rainfall is likely to push farmers to delay their planting dates.

and identify potentially useful adaptation strategies and implement them.

Government policies should therefore ensure that farmers have access to affordable credit, weather and climate information, improved seed varieties, Extension services, organic and inorganic manure and water for irrigation as they increases the resilience of farmers to climate variability.

Lastly, the Goronyo dam should be developed and opened up for farmers' use as most of the farming activities in the study area is carried out around the Goronyo dam area, mostly maize cultivation.

## 6.0 REFERENCES

- Akpodigaga, P. and Odjugo O. (2010). General Overview of Climate Change Impacts in Nigeria in *Journal of Human Ecology*, vol. 29 Issue 1: pp 47-55. 2010.
- Ati, O. F. (2002): "A Comparison of a Traditional Method with Emperical ones for calculating the onset of the Growing Season in Kano, Kano State, Nigeria. *In the Zaria Geographer*, Vol.15 (1)(2002),80-87.
- Ayoade, J. O. (2002). Introduction to Agroclimatology. Ibadan. Vantage Publishers, pp 201
- Ayoade, J. O. (2003). Climate Change, Vantage Publishers, Ibadan, pp. 45-66.
- Ayuba, H. K, Maryah U. M, and Gwary D. M (2007). Climate Change Impact on Plant Species Composition in six semi-arid rangelands of Northern Nigeria, *Nig. Geogr. J.*, 5(1):35-42.

- Bernard, H. R. (2002). *Research Methods in Anthropology Qualitative and Quantitative Methods*. 3<sup>rd</sup> edition, AltaMira press, Walnut Creek, California.
- Boko, M. I. (2007). *Africa in Climate Change 2007: Impacts, Adaptation and Vulnerability*. Contribution of Working Group II to the fourth Assessment Report of the Intergovernmental Panel on Climate Change, M. L. Parry, O. F. Canziani, J. P. Palutikof, P.J. Van der Linden and C.E. Hanson, Eds., Cambridge University Press, Cambridge UK, 433-467.
- Brklacich, M., McNabb, D., Bryant, C. and Dumanski, J. (1996). 'Adaptability of agriculture systems to global climate change: A Renfrew County, Ontario, Canada pilot study', in B. Libery, Q. Chiotti and T. Rickard (eds.), *Agricultural Restructuring and Sustainability: A geographical perspective*, Wallingford, CAB International, pp. 351-364.
- Chakereddza, S., August, B., Aissetou Y., Makungwa S., and Saka D. K. (2009). *Mainstreaming Climate Change into Agricultural Education: Challenges and Perspectives*. Nairobi, Kenya. Published by the World Agroforestry Centre.
- FAO, Food and Agricultural Organisation of the United Nations, (2003). *Responding to Agricultural and Food Insecurity Challenges Mobilising Africa to Implement NEPAD Programmes*. Conference of ministers of agriculture of the African Union, Maputo, Mozambique, 1-2 July, 2003.
- Ikhile, C. I. (2007). *Impacts of Climate Variability and Change on the Hydrology and Water Resources of the Benin-Owena River Basin*, an unpublished Ph.D thesis submitted to the Department of Geography and Regional Planning, University of Benin, Benin City, Nigeria
- IPCC, (2001). *The Report of Working Group II of the Intergovernmental Panel on Climate Change survey for Policy Makers*. Pp 879 – 884.
- IPCC, (2007). *Climate Change 2007: Impacts, Adaptation, and Vulnerability*. Contribution of working Group II to the fourth Assessment report of the Intergovernmental Panel on Climate Change (Parry, Martin L., Canziani, Osvaldo F., Palutikof, Jean P., Vander Linden, Paul J., and Hanson, Clair E. (eds.)) Cambridge University Press, Cambridge, U.K.
- Maunder, W.J. (1994). *Dictionary of Global Climate Change* (2<sup>nd</sup> edn). New York. Chapman and Hall publishers.
- Mitchell, J. and Tanner, T. C (2006). "Climate Change: Mitigation and Adaptation", *Climatic Change* (in press).
- Nigerian Environmental Study/Action Team (NEST). (2003), *Climate change in Nigeria: A communication guide for reporters and educators*, NEST, Ibadan.
- Nwafor, J. C. (2007). *Global climate change: The driver of multiple causes of flood intensity in Sub-Saharan Africa*, paper presented at the International Conference on Climate Change and Economic Sustainability held at Nnamdi Azikiwe University, Enugu, Nigeria, 12-14 June 2007.
- Odjugo, P. A and Ikhuria, A. I. (2003). *The Impacts of Climate Change and Anthropogenic Factors on Desertification in the Semi-arid Region of Nigeria*, *Global Journal of*

- Environmental Science, 2(2): 118-126.
- Odjugo, P. A. (2005). An analysis of Rainfall Pattern in Nigeria, in *Global Journal of Environmental Science*, 4(2): 139-145.
- Ojugo, P. A. (2007). The Impacts of Climate Change on Water Resources; Global and Regional Analysis, *Indonesian journal of Geography*, 39 (1): 23-41.
- Odjugo, P. A. O. (2009). Global and regional analysis of the causes and rate of climate change. Proceeding of the National Conference on Climate Change and Nigerian Environment held at the Department of Geography, University of Nsukka, Nsukka, Nigeria, 29th June – 2nd July, 2009.
- Odjugo, P. A. (2010a). Regional Evidence of Climate Change in Nigeria in *Journal of Geography and Regional Planning*, Vol. 3(6), pp. 142-150, June 2010 Available online at <http://www.academicjournals.org/JGRP>. ISSN 2070-1845© 2010 Academic Journals
- Odjugo, P. A. (2010b). Shift in Crops Production as a means of Adaptation to climate change in the semi-arid region of Nigeria in *Journal of Meteorology and Climate Science* Vol. 8(1), pp. 1-6, June 2010. ISSN: 2006-7003© 2010 Academic Journals
- Ogundebe, A. O. (2004). Socio-economic impacts of Flooding in Lagos state, *Environ. Impact Anal.* 12 (1): 16-30.
- Saka, A, (2008). Global Warming and the Impacts of Climate Change on Vulnerable communities and sectors of economic growth. Paper presented at the 2<sup>nd</sup> ANAFE International Symposium on “Mainstreaming Climate Change into Agricultural and Natural Resources Management Education: Tools, Experiences and Challenges” Held at the Lilongwe, Malawi from the 28<sup>th</sup> July to 1<sup>st</sup> August 2008.
- Sani, M. (2005). The Geographical Study of Sokoto Central Market. An unpublished Msc. Thesis presented in the Department of Geography, Usmanu Danfodio University, Sokoto.
- Stainforth, D. A *et al.* (2007). Issues in the Interpretation of Climate Model Ensembles to Inform Decisions. *Philosophical Transactions of the Royal Society*, 365, pp. 2163-2177.
- Umoh, E. (2007). Flooding Problems in Rivers state, *J. Environ. Sci.* 4(2): 44-60.
- Yaqub, C. N (2007). Desert encroachment in Africa: Extent, causes and impacts. *Journal of Arid Environment*, 4(1): 14-20.