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AN ASSESSMENT OF THE LEVEL OF AWARENESS OF CLIMATE CHANGE AND VARIABILITY AMONG RURAL FARMERS IN TARABA STATE, NIGERIA

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ABSTRACT

Previous studies on climate change in Taraba State concentrated on the evidence of climate change in the state, awareness of climate change among students of tertiary institutions in the state and farmers perception and adaptation to climate change in northern Taraba. There is need to have a state wide research that examines climate change awareness and perception among rural farmers in Taraba State. This will greatly reduce the failures in measures to develop a state wide effective monitoring, adaptation and mitigation measures to climate change in the study state. Questionnaires were used to solicit for information from the famers in twelve LGAs of the state. The question ranges from the farmers knowledge of climate change, and how this has affected them over the years. The farmers were asked what they think about the trend of rainfall variables such as total rainfall, onset, cessation, length of rainy season and changes in temperature in the last 10 – 20 years in their area. The farmers were also asked what they think about the trend of incidence of flooding and dry spell in their areas and how this has affected them. Despite the farmers' awareness and adaptation to climate change in the state, lack of information and capital hinders them from getting the necessary resources and technologies that facilitate adapting to climate change.

Keywords: Assessment, Adaptation, Climate change, Farmers, Perception, Rural.

Contribution/ Originality

This study provides recent information on the level of awareness of climate change and variability among rural farmers in Taraba state and current adaption measures employed by the farmers. This will help policy makers to integrate the local knowledge into scientific knowledge in fashioning out effective and sustainable policies on climate change adaptation.

1. INTRODUCTION

Climate change is perhaps the greatest challenge facing our planet today (Adebayo and Oruonye, 2013). Some of these challenges manifest themselves in the form of drought, flooding and inundation of coastal lands, low agricultural productivity, alteration of surface and ground water and devastation of ecosystems among others. On the whole, the impact of climate change on agricultural production depend on the balance of these impacts (Fischer *et al.*, 2002). Althoughfood production may be adversely affected by climate change, crops that are least able to cope will have to bear the additional adverse impacts. It has been observed that Africa is one of

the most vulnerable regions to the effect of global climate change due to her low human adaptive capacity to anticipated increases in extreme events resulting from widespread poverty, heavy reliance on rain fed agriculture, lack of economic and technological resources, insufficient safety nets and educational progress (Bako, 2013). The results of several studies carried out in different parts of Africa's shows that agriculture will be negatively affected by climate change (Pearce *et al*., 1996; McCarthy *et al*., 2001; Dinar *et al*., 2008). This is because many African countries economies depend largely on weather sensitive agricultural production systems.

Studies by McClean *et al*. (2005) shows that habitat changes has already led to shifts in species ranges and changes in plant diversity including indigenous foods and plant-based medicines. Other studies has equally shown that about 11% of arable land could be affected by climate change many in developing countries, including a reduction of cereal production in up to 65 countries and about 16% of agricultural GDP (Food and Agricultural Organization (FAO), 2005). Looking at the Nigerian situation where about 2/3 of the population depend on rain-fed agriculture and fishing activities for their foods and livelihoods the problem become worsened as a result of the high population pressures of 140 million people surviving on the physical environment through various activities within an area of 923,000 square kilometers (Nigerian Environmental Study Team (NEST), 2004; Intergovernmental Panel on Climate Change (IPCC), 2007).

It has been observed that climate change and agriculture are both interrelated processes, as they take place on a global scale (Parry *et al*., 2007). Hence, increasing temperature of the earth (global warming) is projected to have significant impacts on conditions affecting agriculture, including precipitation and glacial run-off (McCarthy *et al*., 2001; Funk *et al*., 2008). Climate change impacts on agriculture include biological effect on crop yield, the resulting impact on prices, production, consumption and the impact on per capital calorie consumption and malnutrition (Adebayo, 2012). These determine the carrying capacity of the biosphere to produce enough food for the human population and domesticated animals (Kemausuor *et al*., 2011).

Several studies have shown that temperature is rising and rainfall frequency and intensity is fluctuating (Mendelsohn *et al*., 2000; Ozor and Cynthia, 2010); (Paavola, 2006). The world average temperature rise has been given as 0.91^{o}C (Dube and Phiri, 2013). Available meteorological data in the country shows evidence of increasing air temperatures since about 1920s (NEST, 2003). For example, Anuforom (2010)and Odjugo (2010) observed that within 105 years, temperatures increased by 1.2^{o}C and 2^{o}C in the coastal cities of Niger Delta and northern extreme of Nigeria respectively. Mohammed *et al*. (2013) observed that in Adamawa State of Nigeria, climatic data (temperature and rainfall) analysis over the past 25 years (1980 - 2005) shows that temperature has increased by 0.3^{o}C and rainfall fluctuated over the years (Adebayo, 2010; Sawa and Adebayo, 2010; Audu, 2013). In Taraba state, evidence of climate change includes delayed onset date of rains, increase in number of dry days during the raining season and increase in maximum temperature (Adebayo, 2012; Adebayo and Oruonye, 2012a; 2012b; Adebayo and Oruonye, 2013). This leads to warmer seasons, increased frequency and intensity of weather extreme events such as drought, decline in rainfall amount by about 15-20%, increased incidence

of dry spell (Adebayo, 1998; Anuforom, 2010; Mohammed *et al*., 2013). The problems of flood, high temperature and incidences of pests and diseases have also aggravated the famers' loss which consequently increases the incidence of poverty and malnutrition in the state (Adebayo, 2012). It clear from the above discussion that climate change will have a strong impact on Nigeria, particularly in the areas of agriculture; land use, energy, biodiversity, health and water resources. Nigeria, like all the countries of Sub-Saharan Africa, is highly vulnerable to the impacts of Climate Change (NEST, 2003; Intergovernmental Panel on Climate Change (IPCC), 2007). In the last few decades, the scientific evidence of climate change has become more prominent than ever before (Bako, 2013). According to Bako, the awareness of climate change has spread at an unprecedented pace and it is now accepted as a major threat to human survival and sustainable development. The increased adverse impact of climate change is expected on the environment, human health, food security, economic activities, natural resources and physical infrastructure.

There is a growing consensus in the scientific literature that over the coming decades, higher temperature and changing precipitation levels caused by climate change will depress crop yields in many countries (Orindi *et al*., 2006; Stige *et al*., 2006). This is particularly crucial in low-income countries, where adaptive capacity is perceived to be low (Intergovernmental Panel on Climate Change (IPCC), 2007). Hulme *et al*. (2000) estimated that by 2100, Nigeria and other West African countries are likely to have agricultural losses of up to 4% of GDP due to climate change. Other scholars have also observed that countries that depend on rainfed agriculture could experience decline agricultural yield of up to 50% between 2000 to 2020, due to increasing impact of climate change (Intergovernmental Panel on Climate Change (IPCC), 2007; Oxfam, 2007)and (Ifeanyi-obi *et al*., 2012).

Recent food crises in countries such as Nigeria are reminders of the continuing vulnerability of the region to the vicissitudes of climatic conditions (Apata *et al*., 2009). The devastating effects of recent flooding and the various drought incidence of the twentieth century have clearly demonstrated the vulnerability of the region. The situation is further worsened by the weak institutional capacity, limited engagement in environmental and adaptation issues, and a lack of validation of local knowledge in the region (Adams *et al*., 1988; Royal, 2005; Building Nigeria's Response to Climate Change (BNRCC), 2008; SPORE, 2008). At the national level, the link between flood and crop production is widely known. However, little evidence is available on how climate change affects farmers' adaptation strategies at the local level and the subsequent crop yield in the study area. This knowledge gap is very important if success in the designing of effective adaptation strategies to cope with the potential impacts of climate change must be achieved. This makes it imperative that effort should be made to gain as much information as possible, and learn the positions of rural farmers and their needs, about what they know about climate change, in order to offer adaptation practices that meet these needs. Thus, for many poor countries that are highly vulnerable to the effects of climate change, understanding farmers' responses to climatic variation is crucial in designing appropriate coping strategies to climate change. This better understanding of how farmers' perceive climate change, ongoing adaptation measures, and the factors influencing the decision to adapt farming practices is highly needed to

design policies and programmes that are aimed at promoting successful adaptation of the agricultural sector (Bryan *et al*., 2009). Thus, for the farmers to adapt effectively to climate change impact, they must have correct perceptions about the present climate change pattern and possible future trends. This demonstrate the imperativeness of the knowledge of how interacting climatic factors will affect crop productivity and soil and water resources to the success of effective adaptation. Thus assessing local farmer's perception and adaptation strategies for reducing the vulnerability of communities to climate change in the state will be of great importance in dealing with the inevitable impact of climate change in the study area. This study therefore assesses the perception of climate change by rural farmers and some of the prominent climate change adaptation strategies employed by farmers in the state.

2. MATERIAL AND METHODS

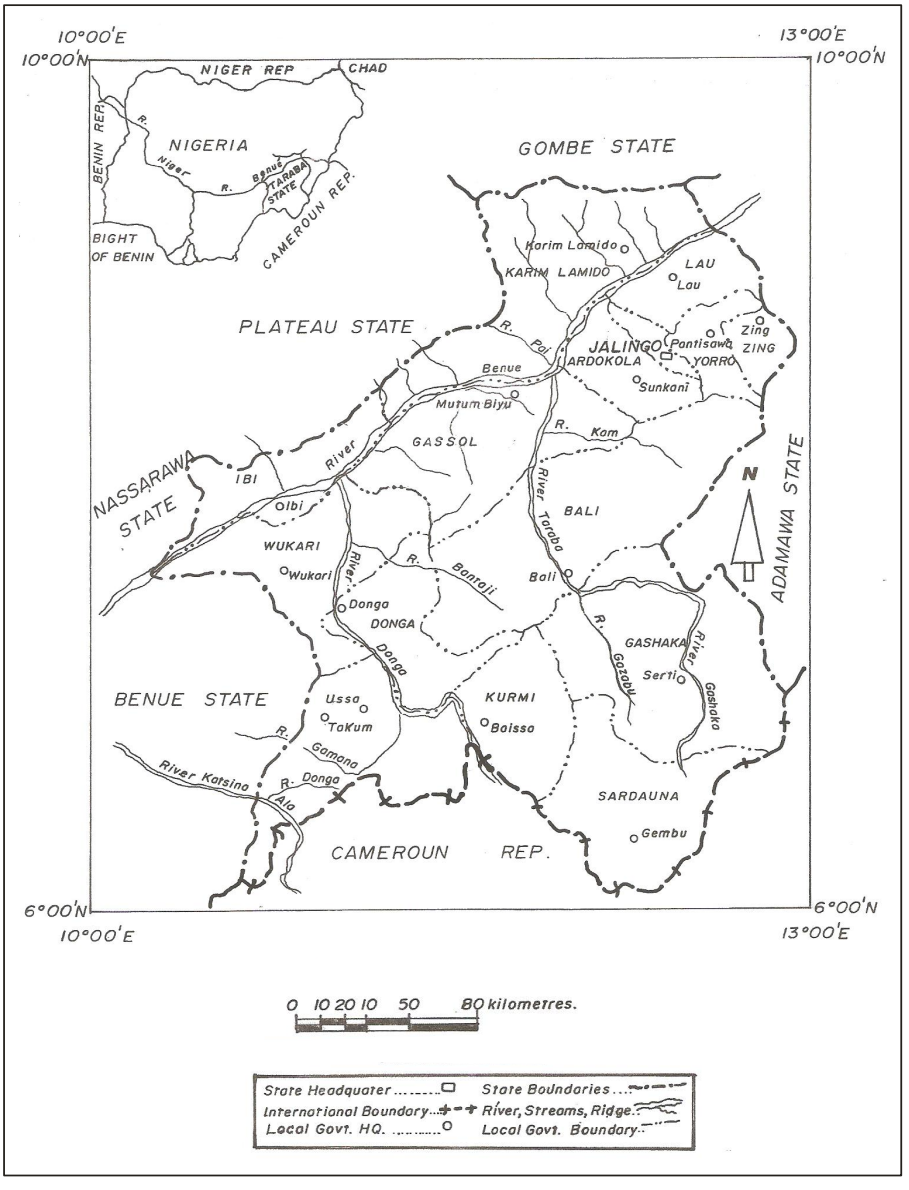
2.1. Study Area

Taraba State is located at the north eastern part of Nigeria. It lies between latitude 6° 30' and 8° 30' north of the equator and between longitude 9° 00' and 12° 00' east of the Greenwich meridian. The state shares boundaries with Bauchi and Gombe states in the north, Adamawa state in the east, and the Cameroon Republic in the south. The state is bounded along its western side by Plateau, Nassarawa and Benue states (Fig. 1). The state has a land area of 60,291km^2 with a population of about 2.5 million people (projected from the 2006 National Population Census). It is divided into sixteen Local Government Areas (LGAs) and three senatorial districts (Taraba north, central and south).

Taraba State is regarded as Nature's Gift to the Nation because of its abundant natural resource endowment. The state is well endowed with abundant solid mineral resources, surface water resources, arable and grazing land. Agriculture is the major occupation of the people of Taraba State, particularly the rural dwellers. The state is blessed with climate and vegetation types that cut across the country, ranging from a more humid climate and forest vegetation in the south to a more seasonal wet and dry climate and savanna vegetation in the north. These favour the growth of tree crops such as palm oil, banana/plantain, orange etc. Root crops in the state include cassava, potato and yam, while cereals include maize, rice, millet, sorghum and guinea corn. Cash crops produced in the state include coffee, tea and groundnuts. In addition, cattle, sheep and goats are reared in large numbers, especially on the Mambilla Plateau, and along the Benue and Taraba river valleys (Oruonye and Abbas, 2011). Communities living on the banks of River Benue, River Taraba, River Donga and Ibi (on the bank of River Benue) engage in fishing activities all year round. The state is also a tourist haven in the country. The famous Mambilla plateau with its beautiful landscape characterized by valleys and waterfalls and its lush green vegetation makes the state a potential pace-setter in the field of tourism in the country. The Gashaka-Gumti National Park located at the foot of the Mambilla plateau is another major outstanding tourist landmark in the state. It is not only the largest of the eight National Parks in the country, but it is the most diverse in terms of species in the whole of West Africa, harbouring such rare animals like the colobus monkey and warthogs, including buffalo, roam antelope,

chimpanzee, hippopotamus, hyena, giant forest hog, lion and leopard (Oruonye, 2011). Taraba State is one of the Nigerian states with the most diverse ethnic groups comprising over 80 ethnic groups.

Fig-1. Map of the study area (Taraba state)



2.2. Data Collection

The data used for this study were obtained from a survey of farmers in twelve LGAs of the three senatorial districts of the state. The data were obtained during the 2012 and 2013 cropping season. In the selection of farmers, a multistage sampling technique was adopted. The first stage involved the delimitation of the state into zones. For convenience, the political zonation was

adopted which gives 3 senatorial zones - Taraba north, central and southern Taraba zones. The second stage involves the selection of the local government areas. All the five LGAs in the Northern senatorial districts were purposively selected because of their close proximity to Jalingo, the state capital. In the two other senatorial districts, 3 LGAs were also purposively selected based on convenience and financial constraints. These were Sardauna, Bali and Gassol LGAs (Taraba Central) and Wukari, Ibi and Takum/Ussa LGAs (Southern Taraba). Twelve LGAs were sampled out of the sixteen LGAs of the state. The third stage is the selection of settlements from the LGAs. In each LGA, 60 questionnaires were administered and 3 settlements were purposively selected. A total of 49 settlements were selected and administered with questionnaires.

The last stage involves the selection of farmers from the chosen settlements in the LGAs. In each of the selected settlement, 20 questionnaires were randomly administered. 248 local farmers were selected from 31 settlements in the six LGAs of northern Taraba State and 360 local farmers were selected from 18 villages of six LGAs in central and southern Taraba state. About 608 structured questionnaires were administered in the 3 senatorial districts of the state. Field assistants were engaged to collect the data from field for the survey. Data were collected using a pre-tested, well structured questionnaire on socio-economic characteristics of the respondents, level of awareness of climate change, methods of adaptation, problems of adaptation and factors influencing adaptation techniques.

3. RESULT OF THE FINDINGS

The demographic data shows that 70.4% of the respondents are male and 29.6% are female as shown in Table 1. The demographic data also shows that 24.8% are within the ages of 20 - 30 years, 34.9% were between 31-40years, 25.5% between 41 -50 years and 14.8% are between the ages above 51years. The result of the findings also shows that 60.8% of the respondents are married, 27.5% are single, while 5.3% are divorcee and 6.4% are widow.

Table-1. Demographic characteristics of respondents

GENDER		
Gender	**Frequency**	**Percentage (%)**
Male	428	70.4
Female	180	29.6
Total	608	100
AGE		
20 - 30yrs	151	24.8
31 – 40yrs	212	34.9
41 – 50yrs	155	25.5
51yrs and above	90	14.8
Total	608	100
Marital Status		
Married	370	60.8
Single	167	27.5
Divorcee	32	5.3

Widow	39	28.0
Total	608	100
Education		
No formal education	151	24.8
Primary education	125	20.6
Secondary education	162	26.6
Tertiary education	170	28.0
Total	608	100
Years of Farming		
0 – 10years	429	70.6
11 – 20years	109	17.9
21 – 30years	70	11.5
Total	248	100

Source: Fieldwork, 2013.

The findings of the study also shows that 89.8% of the respondents were aware of changes in climate conditions in recent years, while 10.2% are not aware of any changes in climate. This corroborated the findings of Ishaya and Abaje (2008), Adebayo and Oruonye (2012a; 2012b) and (Egbe *et al*., 2014) which shows a high level of climate change awareness among local farmers in Kaduna, northern Taraba and Cross River area of northern Nigeria. When the respondents (local farmers) were asked if they know the causes of the change in climate conditions in recent years, 47.4 percent of them responded in affirmative, while 52.6 percent claimed that they don't know. Also, when the farmers were asked if the changes in climate condition in recent years has affected their farming activities, 89.5 percent responded in affirmative while 10.5 percent of respond to the contrary. The respondents stated that some of the changes in climate conditions that they have observed in recent years include low rainfall, excess rainfall, late onset of rainfall, early cessation of rainfall, flooding and extreme high temperature.

When the farmers were asked how low rainfall has affected them, their response ranges from reduced crop yield (87.8%) to reduce water for livestock (8.9%) as shown in Table 2.

Table-2. How low rainfall affects farmers in the study area

S/No	How low rainfall affect you	Frequency	Percentage
1	Reduced crop yield	534	87.8
2	Reduced water for livestock	54	8.9
3	Reduced grass or biomass for livestock	20	3.3
4	Total	608	100

Sources: Fieldwork 2013

On the other hand, when the farmers were asked how too much or excess rainfall affects them, their response ranges from destruction of farmlands by flood (79.1%) to submergence of houses by flood (10.5%) as shown in Table 3. This corroborated the findings of Oruonye (2012a; 2012b) and Oruonye and Adebayo (2013) which shows an increasing cases of flood disaster in the study area with worse flood in 2005 and 2012 in which over 5000 farmlands were destroyed.

Table-3. How too much rainfall affects farmers in the study area

S/No	How too much rainfall affect farmers	Frequency	Percentage
1	Destruction of farmland by flood	481	79.1
2	Submergence of houses by flood	64	10.5
3	Death of livestock	58	9.6
4	No response	05	0.8
5	Total	608	100

Sources: Fieldwork 2013

When the farmers were further asked how extreme high temperature affect them, their response ranges from wilting of crops (42.6%) to spoilage of farm produce (39.8%) as shown in Table 4. Yam which is a common crop in this zone is susceptible to spoilage with high temperature. Research findings also suggest that increase in temperature can lead to increase in pest development and fecundity and frequency of outbreaks of insect pest and diseases that affects crops and livestock (SPORE, 2008). Thus, the increasing temperature in the study area has a tendency of affecting yam production in the study area, with implication on food security.

Table-4. How extreme high temperature affects farmers in the study area

S/No	How extreme high temperature affect farmers	Frequency	Percentage
1	Wilting of crops	259	42.6
2	Spoilage of farm produce	242	39.8
3	Death of livestock	101	16.6
4	No response	06	1.0
5	Total	608	100

Sources: Fieldwork 2013

3.1. Climate Change Adaptation

When the farmers were asked if they have been making any effort to adopt or adjust to climate change regarding their farm operation, 59.4 percent of the respondents respond in affirmative while 40.6 percent insist that they have not been making any effort. In terms of accessibility to adequate information on how to adapt to climate change, 34 percent of the respondents believed that they do have access to adequate information while 66 percent claimed that they do not have access to adequate information on how to adapt to the problem of climate change. When the respondents were asked what major challenges can hinder or limit their adaptation efforts in the present circumstance, the respondent response ranges from information accessibility (49.7%), appropriate technology (29.9%), necessary inputs (7.2%) and required labour for adaptation measures (13.2%) as shown in Table 5. Ishaya and Abaje (2008) reported similar findings in their study in Kaduna State and Onyeneke and Madukwe (2010) in south east rainforest zone of Nigeria.

Table-5. Constraint to farmers' adaptation effort in the study area

S/No	Constraints to farmers adaptation effort	Frequency	Percentage
1	Information	302	49.7
2	Appropriate technology	182	29.9
3	Necessary inputs	44	7.2
4	Required labour for adaptation measures	80	13.2
5	Total	608	100

Sources: Fieldwork 2013

On the most suitable adaptation measures applicable or relevant to the farmer's immediate environment, the respondent's response ranges from altering of planting season (28.5%), use of different tillage system (17.8%), use of tolerant seed variety (10.5%), planting early maturing variety (31.2%) and crop diversification/mixing (12%) as shown in Table 6.

Table-6. Adaptation measures suitable or relevant in the study area?

S/No	Adaptation measures suitable in your area	Frequency	Percentage
1	Altering the planting schedule (date of planting) of crops	173	28.5
2	Using different tillage system	108	17.8
3	Using tolerant seed variety	64	10.5
4	Planting early maturing varieties	190	31.2
5	Crop diversification/mixing	73	12.0
6	Total	608	100

Sources: Fieldwork 2013

3.2. Farmers Assessment of Climatic Variables

Part of the questionnaire of the study requires the farmers to make their assessment of some climatic variables in the state. Thus, when the farmers were asked to assess the temperature conditions of their areas in the last 10 – 20 years, 59.4 percent of the respondents believed that the temperature has been increasing, while 20.7 percent claimed that it has been decreasing, 9.2 percent insist that there have been no change and 10.7 percent claimed that they don't know whether the temperature has been increasing or decreasing as shown in Table 7. The farmers assessment of increasing temperature agreed with experts report on temperature trend in other parts of northern Nigeria (Adebayo, 2010; Umar, 2011).

When the farmers were asked to assess the annual rainfall total in the last 10 – 20 years in their locality, 27.8 percent claimed that rainfall is increasing, while 52.6 percent claimed that rainfall is increasing, 9.7 percent insist that there were no changes and 9.9 percent claimed that they don't know whether the rainfall is increasing or decreasing in their area (Table 7). The farmer's opinion of decreasing rainfall corroborated the previous research findings on general decline in annual rainfall in many parts of Nigeria (Odjugo, 2010; Umar, 2011) . On the length and frequency of dry spells during the growing season, 52.6 percent of the farmers claimed that the length and frequency of dry spells is increasing in the study area, while 26.5 percent claimed that it is reducing, 5.9 percent insist that there were no changes and 3.6 percent claimed that they

don't know (Table 7). This observation of increasing length and frequency of dry spells by the local farmers in the area is in line with the findings of Sawa and Adebayo (2010) which observed that dry spells during the growing season are on the increase in the Sudano sahelian zone of northern Nigeria.

The study also required the farmers to assess the situation of onset of rain/beginning of planting season now in the study area. Thus, 65.1 percent of the farmers claimed that there is delay, while 25.4 percent of the respondents claimed that the onset of rain/planting season is much more early, 5.9 percent insist that there have been no changes in the onset of rain/beginning of planting season and 3.6 percent of the respondents claimed that they don't know if the onset is early or delayed. Similarly, the farmer's observation of delayed onset of rain/beginning of planting season has been confirmed by expert's findings in northern Nigeria e.g. Adebayo (1998) and Sawa and Adebayo (2010). The local farmer's assessment of cessation or end of the rains presented in Table 10 shows that 29.9 percent of the respondents believed that cessation of rainfall in the study area are delayed, while 57.7 percent claimed that the rainfall ends earlier than usual, 8.1 percent insist that there were no changes in rainfall cessation in the study area and 4.3 percent claimed that they don't know whether there are changes or not.

When the farmers were asked to assess the incidence of flood in the study area in the last 10 – 20 years, the response ranges from increasing flood incidence (42.7%), decreasing flood incidence (25.6%), no change (18.3%) and 8.9% claimed that they don't know whether the incidence of flood is increasing or decreasing in the study area. Farmers observation of increasing incidence of flooding in the study area corroborated the findings of (Oruonye, 2012a; 2012b; 2012c) and Oruonye and Adebayo (2013).

Table-7. Local farmer's assessment of climatic condition in the last 10 – 20 years in Taraba State.

S/No.	Assessment of Temperature	Frequency	Percentage
1	Increasing	361	59.4
2	Decreasing	126	20.7
3	No change	56	9.2
4	I don't know	65	10.7
5	Total	608	100
S/No.	Assessment of annual rainfall	Frequency	Percentage
1	Increasing	169	27.8
2	Decreasing	320	52.6
3	No change	59	9.7
4	I don't know	60	9.9
5	Total	608	100
S/No	Respondents assessment of dry spells	Frequency	Percentage
1	Increasing	320	52.6
2	Decreasing	161	26.5
3	No change	60	9.9
4	I don't know	67	11
5	Total	608	100
S/No.	Situation of onset of rainfall	Frequency	Percentage
1	Delayed	396	65.1
2	Early	154	25.4

3	No change	36	5.9
4	I don't know	22	3.6
5	Total	608	100
S/No.	Opinion on cessation of rains	Frequency	Percentage
1	Delayed	182	29.9
2	Early	351	57.7
3	No change	49	8.1
4	I don't know	26	4.3
5	Total	608	100
S/No.	Assessment of incidence of flood	Frequency	Percentage
1	Increasing	287	47.2
2	Decreasing	156	25.6
3	No change	111	18.3
4	I don't know	54	8.9
5	Total	608	100

Source: Fieldwork 2013

4. CONCLUSION

This study has examined the perception of climate change among rural farmers in Taraba State and implication on food security. The findings of the study show that about 90 percent of the farmers are aware of the changes in climate but 50 percent do not know the causes of climate change. Analysis of the farmers' level of awareness of the effects of climate change using the Likert's scale show that the most important aspect of climate change that the local farmers are aware of, include increasing incidence of flood in the study area, the environment becoming drier, and increasing incidence of dry spell. On the other hand, the perceived effect of climate change on the local farmers were on crop and animal production, increase in cost of food crops, decline in water resources and fuel wood scarcity. The results of this study shows that the farmers assessment of climatic variables in the state agreed with experts findings in other parts of northern Nigeria and scientific analysis of data collected in the area. Despite the farmers' awareness and adaptation to climate change in the state, lack of information and capital hinders them from getting the necessary resources and technologies that facilitate adapting to climate change. With persistent changes in the environment, the farmers are having difficulty to properly time their planting because of the changing climatic patterns, a situation that makes it imperative for experts to trace the new trends and come up with conclusive recommendations on when to plant.

5. RECOMMENDATIONS

1. Part of the problem with climate change is the incidence of pest and diseases, particularly during dry spells. This is further exacerbated by the fact that farmers are often poorer and rarely have access to safe and effective pesticides, robust varieties of plants/seeds and adequate irrigation facilities. The government can do well by assisting the farmers with these necessary inputs at subsidized rate.

2. It is important that government make issues of climate change adaptation top of its political agenda. Policies of reducing poverty and ensuring food security need to include climate change strategies. A detailed analysis of the risks and possible solutions could assist in finding appropriate adaptation strategies and play an important role in achieving food security and fighting poverty.

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REFERENCES

Adams, R.M., J.D. Glyer, B.A. McCarl and D.J. Dudek, 1988. The implications of global change for Western agriculture. West J Agric Econ., 13(2): 348–356.

Adebayo, A.A., 1998. The incidence in of dry spells during the growing season in Yola. In: J.E. Ukpong (Ed.) Geography and the Nigerian environment. Nigerian Geographical Association. pp: 258 – 264.

Adebayo, A.A., 2010. Climate: Resource and resilience to agriculture. 8th Inaugural Lecture of Federal University of Technology, Yola, Adamawa State, Nigeria.

Adebayo, A.A., 2012. Evidence of climate change in Taraba State: A preliminary report. A Paper Presented at the faculty of Science Seminar Series, Held at the Lecture Hall on 13th September, 2012.Taraba State University, Jalingo, Nigeria.

Adebayo, A.A. and E.D. Oruonye, 2012a. An investigation of local farmers assessment of climate change in Northern Taraba State, Nigeria. Proceedings of the Conference of the Nigerian Meteorological Society (NMetS), Held at the University of Benin, Benin City, Edo State, Nigeria, 5h – 9th November, 2012. pp: 75.

Adebayo, A.A. and E.D. Oruonye, 2012b. An assessment of the level of farmers. Awareness and adaptation to climate change in Northern Taraba State, Nigeria. Proceedings of Climate Change and ICT Conference Held at Osun State University Okuku campus, Osun State,Nigeria 27th – 28th November, 2012. pp: 13-22.

Adebayo, A.A. and E.D. Oruonye, 2013. An assessment of climate change in Taraba State, Nigeria. Nigerian Journal of Tropical Geography, 4(2): 602– 612.

Anuforom, A.C., 2010. Demonstration and assessment of climate change in Nigeria and development of adaptation strategies in the key socio-economic sectors: Meteorological approach. A Paper

Presented at the National Stakeholders Workshop on Developing National Adaptation Strategies and Plan of Action for Nigeria, Held on 22nd March. NIMET.

Apata, T.G., K.D. Samuel and A.O. Adeola, 2009. Analysis of climate change perception and adaptation among arable food crop farmers in South Western Nigeria. Contributed Paper Prepared for Presentation at the International Association of Agricultural Economists' 2009 Conference, Beijing, China.

Audu, E.B., 2013. Gas flaring: A catalyst to global warming in Nigeria. International Journal of Science and Technology, 3(1): 6-10.

Bako, M.M., 2013. Climate change vulnerability assessment in parts of Northern Nigeria. Nigerian Journal of Tropical Geography, 4(2): 449 – 470.

Bryan, E., T.T. Deressa, G.A. Gbetibouo and C. Ringler, 2009. Adaptation to climate change in Ethiopia and South Africa: Options and constraints. Environmental Science and Policy, 12: 413-426. Available from http://dx.doi.org/10.1016/j.envsci.2008.11.002.

Building Nigeria's Response to Climate Change (BNRCC), 2008. Annual workshop of Nigerian environmental study team (NEST): The recent global and local action on climate change, held at hotel Millennium, Abuja, Nigeria. [Accessed 8-9th October, 2008].

Dinar, A., R. Hassan, R. Mendelsohn and J. Benhin, 2008. Climate change and agriculture in Africa: Impact assessment and adaptation strategies. London: Earth Scan.

Dube, T. and K. Phiri, 2013. Rural livelihood under stress: The impact of climate change on livelihoods in South Western Zimbabwe. American International Journal of Contemporary Research, 3(5): 11 – 25.

Egbe, C.A., M.A. Yaro, A.E. Okon and F.E. Bison, 2014. Rural people's perception to climate variability/change in cross River State Nigeria. Journal of Sustainable Development, 7(2): 25 – 36.

Fischer, G., M. Shah and V.H. Van, 2002. Climate change and agricultural vulnerability. International institute for applied systems analysis. Report Prepared under UN Institutional Contract Agreement 1113 for World Summit on Sustainable Development. Laxenburg, Austria.

Food and Agricultural Organization (FAO), 2005. Irrigation in Africa in figures. AQUASTAT Survey – 2005. FAO, Rome.

Funk, C., M. Dettinger, J. Michealson, J. Verdin, M. Brown, M. Barlow and A. Hoell, 2008. Warming of the Indian ocean threatens Eastern and Southern African food security but could be mitigated by agricultural development. Sustainability Science, 105(32): 11081-11086. Available from www.pnas.org.cgi.doi.10.1073.pnas.07081896105.

Hulme, M., R. Doherty, T. Ngara, M. New and D. Lister, 2000. African climate change: 1900-2100. Climate Research, 17(2): 145-168.

Ifeanyi-obi, C.C., U.R. Etuk and O. Jike-wai, 2012. Climate change, effects and adaptation strategies; Implication for agricultural extension system in Nigeria. Greener Journal of Agricultural Sciences, 2(2): 053-060.

Intergovernmental Panel on Climate Change (IPCC), 2007. Climate change 2007: Impacts, adaptation, and vulnerability. Contribution of working group II to the third assessment report of the intergovernmental panel on climate change [Parry, Martin L., Canziani, Osvaldo F., Palutikof,

Jean P., van der Linden, Paul J., and Hanson, Clair E. (eds.)]. Cambridge, United Kingdom: Cambridge University Press. pp: 1000.

Ishaya, S. and I.B. Abaje, 2008. Indigenous people's perception on climate change and adaptation strategies in Jemma LGA of Kaduna state. Journal of Geography and Regional Planning, 1(18): 138-143.

Kemausuor, F., E. Dwamena, A. Bart-Plange and N. Kyei-Baffour, 2011. Farmers perception of climate change in the Ejura – Sekyedumase districts of Ghana. Journal of Agriculture and Biological Science, 6(10): 26.

McCarthy, J., O.F. Canziani, N.A. Leary, D.J. Dokken and C. White, 2001. Climate change 2001: Impacts, adaptation, and vulnerability, contribution of Working Group II to the 3rd Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge.

McClean, C.J., N. Doswald and W. Kuper, 2005. Africa plant diversity and climate change. Annals of the Missouri Botanical Garden, 92(2): 139 -152.

Mendelsohn, R., A. Dinar and D. Arne, 2000. Climate Impact on African agriculture. Climate Change, (45): 583 – 600.

Mohammed, D., P.V. Kwaghe, U. Bukar and J. Umar, 2013. Economic of adaptation to climate change among crop farmers in Adamawa State, Nigeria. IOSR Journal of Agriculture and Veterinary Science, 5(4): 61 – 66.

NEST, 2003. Climate change in Nigeria: A communication guide. Dev. Com. Nigerian Environmental Society.

Nigerian Environmental Study Team (NEST), 2004. Regional climate modelling and climate scenarios development in support of vulnerability and adaptation studies: Outcome of Regional Climate Modeling Efforts over Nigeria, NEST, Ibadan, Nigeria.

Odjugo, P.A.O., 2010. Regional evidence of climate change in Nigeria. Journal of Geography and Regional Planning, 3(6): 142 – 150.

Onyeneke, R.U. and D.K. Madukwe, 2010. Adaptation measures by crop farmers in the South East rainforest zone of Nigeria to climate change. Science W or ld Journal, 5(1):32-34.

Orindi, V., A. Ochieng, B. Otiende, S. Bhadwal, K. Anantram, S. Nair, V. Kumar and U. Kelkar, 2006. Mapping climate vulnerability and poverty in Africa. In: Thornton, P.K., Jones, P.G., Owiyo, T., Kruska, R.L., Herrero, M., Kristjanson, P., Notenbaert, A., Bekele, N. and Omolo, A. (Eds) Climate change and poverty in Africa. Report to the Department for International Development. Nairobi: ILRI.

Oruonye, E.D., 2011. An assessment of the level of awareness of the effects of climate change among students of tertiary institutions in Jalingo metropolis, Taraba State Nigeria. Journal of Geography and Regional Planning, 4(9): 514-519.

Oruonye, E.D., 2012a. Socio-economic impact assessment of flash flood in Jalingo metropolis, Taraba State, Nigeria. International Journal of Environmental Sciences, 1(3): 135 –140.

Oruonye, E.D., 2012b. The challenges of urban flood disaster management in Nigeria: A case study of Jalingo metropolis, Taraba State Nigeria. Recent Scientific Journal, 3(1): 37 -42.

Oruonye, E.D., 2012c. Assessment of flood risk perception and response in Jalingo metropolis, Taraba State, Nigeria. Proceedings of the Annual Conference of the Nigerian Association of Hydrological Sciences Held at Federal University of Agriculture Abeokuta (FUNAAB). pp: 4- 12.

Oruonye, E.D. and B. Abbas, 2011. The geography of Taraba State, Nigeria. Germany: LAP Publishing Company.

Oruonye, E.D. and A.A. Adebayo, 2013. An assessment of the effects of the 2012 flooding in Taraba State. A Paper Accepted for Presentation at the 5th Annual National Conference Nigerian Association of Hydrological Sciences (NAHS), Scheduled to Hold at University of Nigeria Nsukka.

Oxfam, 2007. Climate alarm report: Climate aarm: Disasters Increase as Climate Change Bites.

Ozor, N. and N. Cynthia, 2010. Difficulties in adapting to climate change by farmers in Enugu State, Nigeria. Journal of Agricultural Extension, 14(2): 106 – 122.

Paavola, J., 2006. Livelihoods, vulnerability and adaptation to climate change in the Morogoro region of Tanzania, Centre for Social and Economic Research on the Global Environment (CSERGE). UK: University of East Anglia, Working Paper. pp: 8-12.

Parry, M.L., O.F. Canziani, J.P. Palutikof, D.L.P.J. Van and C.E. Hanson, 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. Cambridge, U.K. New York, USA: Cambridge University Press.

Pearce, D., W. Cline, A. Achanta, S. Fankhauser, R. Pachauri, R. Tol and P. Vellinga, 1996. The social costs of climate change: greenhouse damage and benefits of control. In: Bruce, J., Lee, H., Haites, E. (eds) Climate change 1995: Economic and social dimensions of climate change. Cambridge: Cambridge University Press.

Royal, S., 2005. Impact of climate change on crops worse than previously thought. Available from http://royalsociety.org/news.asp [Accessed June, 2008].

Sawa, B.A. and A.A. Adebayo, 2010. Spatial and temporal variation in the onset, cessation of length of rainy season in the Sudano-Sahelian region of Northern Nigeria. Paper Presented at the NURS/NAHS Conference, 2010 Held at the University of Lagos, Nigeria.

Spore, 2008. Climate change, spore Special Issue-August, 2008.

Stige, L., J. Stave and K. Chan, 2006. The effect of climate variation on agro-pastoral production in Africa. Proc Natl Acad Sci., 103: 3049–3053.

Umar, A.T., 2011. Climate change in Nigeria: Evidence from meteorological parameters. Paper Presented at 2011 Association of Nigeria Geographers Conference at Usman Danfodio University, Sokoto.

BIBLIOGRAPHY

Adebayo, A.A., 2001. Dry spells and rice yield in Yola, Adamawa State. Environment and Development, 4: 6-9.

Adebayo, A.A., 2002. Agro-climatic information for sustainable agricultural planning in Taraba State. Nigerian Journal of Tropical Agriculture, 4: 121 - 124.