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INDIGENOUS UNDERSTANDING OF CLIMATE CHANGE, IMPACTS AND COPING STRATEGIES IN A RURAL SETTING OF KWARA STATE, NIGERIA

ABSTRACT. The issue of climate change is so critical to the extent that it affects about seventy five percent of Nigerians' livelihoods. Climate related events such as floods, rainstorms, increasing temperature and droughts among others have been on the increase in the last few years. These have been attributed to both natural and human causes. This study examines the determinants of local people's understanding of climate change, impacts and coping strategies in some selected rural communities of Kwara State, Nigeria with a view to comparing their knowledge with scientific knowledge. Eight rural communities were randomly selected from the State within the area representing more than 80% of the total local district areas. Since rural dwellers engage more in primary activities than any other activities, therefore, respondents were selected from farming, hunting and fishing activities. Participatory Rural Appraisal method with emphasis on group discussion technique and observatory technique were employed to collect data from the participants. Climatic data for two climatic normals were collected from the period 1957 to 1986 and 1987to 2016. Descriptive and inferential tools were used to achieve the stated objectives. The results revealed that local people have their own knowledge of the understanding of the climate change and findings revealed further that the farmers and other primary producers in the studied communities were indeed experiencing climate change variability and impacts. Result of the socioeconomic and demographic characteristics showed that the average age of respondents was 41.2 years, 80.64% were married, majority, (61.27%) had farming has their main occupation and mean years of experience of respondents was 24.5 years on farm and in the management of environmental resources. The multiple regression result revealed that gender, primary activities, age, local knowledge, coping strategies were found to increase the understanding of climate change of respondents. Focus Group Discussion showed that the respondents were very much aware of the climate change and there exist early warning mechanisms which they put in place against the future weather events. They have different local coping techniques to mitigate the possible impact. It was therefore recommended that more awareness be created to ensure that people realize the consequences of climate change and integrate the local knowledge with the formal strategies.

KEY WORDS: Climate Change, Indigenous, Adaptation, Livelihood, Rural Areas

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INTRODUCTION

Climate is defined as average weather condition of an area over a long period of time usually between 30 to 35years. It is usually a typical weather observed over a long period of time in a particular location. Whenever there is a shift in the normal climate or the variation in the earth's global/regional climate lasting over time ranging from decades to millions of years, it is referred as climate change. Climate change is a global phenomenon, although it affects African countries more than any other country because of high dependency on the natural systems and limited capacity to control or adapt to the changes in climate. Climate change has been defined by different organizations in various ways. For instance, the World Meteorological Organisation (WMO) and Intergovernmental Panel on Climate Change IPCC (2001) refer to climate change as statistically significant variation in either the mean state of the climate or its variability, persisting for an extended period. Indigenous groups are projected to be among the communities most heavily affected by climate change (Parrotta and Agnoletti 2012).

The United Nations Framework Convention on Climate Change (UNFCCC 2013) put it as direct or indirect human activities that alter the composition of the global atmosphere. The most acceptable definition of climate change was given by IPCC (2007) Fourth Assessment Report (AR4) as a change in the state of the climate that can be identified (e g. using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period typically decades or longer. The Fifth Assessment Report (ARS) is now the most inclusive assessment of scientific knowledge on climate changes since 2007. It emphasized the much greater prominence on assessing the socio-economic change and its implications for sustainable development (IPCC 2014). Thus the core focus of this current IPCC fifth assessment is characterizing knowledge about vulnerability, the characteristics and interactions that make some events devastating while others pass with little notice.

Tologbonse et al. (2010) reported that the rate of sickness/infection increases as a result of climate change; this in turn reduces family income. Essop (2009) opined that minor changes to rainfall pattern, increased severity of droughts and floods threaten food security. According to the WHO (2003) climate change is caused by internal variability within the climate system together with natural and anthropogenic factors. Theoretically, climate change may be due to changes in astronomical, extraterrestrial and terrestrial factors. It is a well known fact that global warming contributes to environmental, social and economic threats in the world. Past studies (Buba 2004; DeWeerdt 2007; Odjugo 2007, Anselm and Taofeeq 2010) over decades have revealed that anthropogenic activities like urbanization, population explosion, deforestation, industrialization and the release of greenhouse gases contribute highly to the depletion of the ozone layer and its associated global warming, climate variability and change. Indeed climate change started very long ago when man started clearing forest for agriculture. This makes green house gases to be trapped within the atmosphere and this changes the climate and alters weather patterns. Global warming results in climate change and affect every facet of life. It affects health, agriculture (farming, fishing and livestock)

transportation, settlement and water resources just to mention a few. The impact of climate change is global but the impact is mainly felt by the developing countries most especially Africa due to their low level of coping capabilities (Nwafor 2007).

It has been established that climate variability and change has tremendous impacts on agricultural production and productivity especially in developing societies. Unfortunately, the extent of this change and the adaptation capacity in African agriculture has not been well determined to guide adaptation, policy and development efforts. Nigeria is one of the developing countries of Africa that is greatly affected by climate change perhaps as a result of high dependency on natural resources which are susceptible to the impact of climate change. Nigeria alone emits 35 million tons of carbon dioxide (CO^2) and 12million tons of methane (CH^4) which has a high warming potential than CO^2 (Watts 2001). Poor communities who rely mostly on the land and natural resources for their food and livelihood but less equipped to cope with natural disasters and weather variations bear these impacts most (Yocogan-Diano and Kashiwazaki 2009).Whenever there is an event of climate change, natural resources are usually affected; hence communities have to look for antidotes to cushion the effect of this event on their livelihood. For instance, farmers, fishermen, transporters and other people affected have to seek for coping and adaptation strategies.

Over the years, reports from rural parts of Nigeria on the impact of climate change so much that one wonders whether rural people do not even have their own ways of understanding the causes, impact and strategies for coping with climate change. According to Mabogunje (2018), the best way to mitigate the impact of climate change is through effective understanding, knowledge and awareness creation. It is anticipated that climate variability and change in sub-Saharan Africa will have overwhelming impacts on agriculture and land use, ecosystem and biodiversity, human settlements, diseases and health and water resources. With respect to agriculture and land use, climate change will likely elicit a significant change in agricultural production both in terms of the quantum of products as well as the location or area of production. For example, the change is expected to lead, among other things, to a shift in rainfall belts. Rural agriculture is largely rain-fed in Nigeria; this is expected to be accompanied by a shift in the traditional areas of production of certain crops with all the possible negative effects that this may bring to the rural people. This study was therefore prompted by the careful assessment and evaluation of the works done on the climate change and indigenous knowledge which have not lucidly torched on its local people understanding, experience and coping mechanism among others. This will be critically subjected to an intensive research towards awareness creation and information dissemination among the rural and urban households using indigenous knowledge.

Based on the clarifications and discussions in the forgone, this study seeks to answer the following research questions: what are the determinants of the indigenous understanding of climate change? What are the local impacts and coping strategies of indigenous people? How can local knowledge be compared with scientific knowledge? The objectives of the study include to: asses the socioeconomic and demographic characteristics of the respondents; identify the determinants of local people's understanding of climate change; examine the indigenous ways of coping with the impact of climate variability and change; and compare respondents' knowledge with scientific knowledge.

STUDY AREA

The study area is Kwara State and is located between latitudes 8° and 10°04^{1}N and longitudes 2°45^{1}E and 6o121E (Fig. 1). The state occupies an area of 36,825km^2 and shares boundaries with Niger State in the North, Kogi and Ekiti States at the East, Osun and Oyo States in the South and an international boundary with the Republic

of Benin in the West. The State has sixteen Local Government Areas. Kwara State falls under the tropical climate with a distinct dry and rainy season. The dry season is about four months from November to February and sometimes times it may extend to early March. The rainy season on the average lasts for nine months between March and October or sometimes early November with a mean annual rainfall of 1,000 to 1,500 mm. The study area is located in the transitional zone between the deciduous woodland of the south and the dry savannah of north of Nigeria. The natural vegetation consists broadly of rainforest and wooded savannah with sprouts of tall grasses. The relief of Kwara State ranges between 60 metres and 680 metres above mean sea level. The hinterland is undulating with the highest hills found mostly in Ifelodun, Irepodun and Ilorin West Local Government Areas. The State is well drained by several major rivers such as Rivers Niger, Moshi, Teshi, Awon, Oshin, Oyi and Moro in the Central area and; Ebba and Oyi in the eastern part of the state (Oriola 2004).

The 2006 population census by National Population Commission put the population of Kwara State at 2,371,089 people with 1,229,581males and 1,150,508 females. When compared with the 1991 census which put the state's population at 1,150,712 people, of which 773,234 were males and 775,230, were females, there is a great increase in the population indicating rapid population growth (NPC 2006). The mainstay of the economy of the state is agriculture. More than 90 percent of the state's rural populations who form the bulk of the state's total population are engaged in farming. Food crops grown include maize, yam, guinea corn, sorghum, cassava and sweet potato among others.

MATERIALS AND METHODS

Types of Data and Instrument of Data Collection

Both primary and secondary sources of data were employed for this study. A combination of methodologies including surveys, open-ended interviews (Questionnaire) and focus group discussion (FGD) were used to explore the respondents' understanding of climate change issues using their indigenous knowledge, experience, marital status, years of education, occupation among others. Copies of questionnaire were administered on respondents. This method offers opportunities for open-ended responses since the motive of this research is not only to examine individual indigenous perceptions but also community positions on some of the issues, a method which brings members together. These methods were used by Gbadegesin (2000), Jegede (2005), Ife (2003), Buwaly (2004) and Tijani (2007) among other studies on natural resources management and climate change mitigations and adaptation strategies. Key informants included elders and personnel from government establishments in the local communities.

Sampling Technique and Procedure

Respondents from which data were collected were sampled through the use of multistage sampling. The first sampling stage was the purposive selection of eight LGAs Patigi, Irepodun, Oyun, Asa, Ifelodun, Ilorin South, Kaiama, and Oke Ero (Fig.1). This selection was informed by the fact that these are the rural areas where farming production other primary activities are prevalent. The second stage was the purposive selection of eight rural communities from eight local government areas (Table 1) within the state representing 50% of the sixteen (16) local government areas of the state while this was followed by random sampling of 50 respondents who are engaged in primary activities for their livelihood than any other activities. Therefore, respondents were selected from farming, hunting and fishing activities. A total of 400 respondents were sampled and 346 respondents were used for the final analysis while 29 were rejected as a result of bias data supply and general mutilation of questionnaire arising from rainfall and weather related effects while 25 were not returned. However, the data used in this study was collected over a duration of three months (June, July, August) 2016 when rainfall was regular and steady. To select the target respondents, a systematic sampling was employed and in this case, every 8th

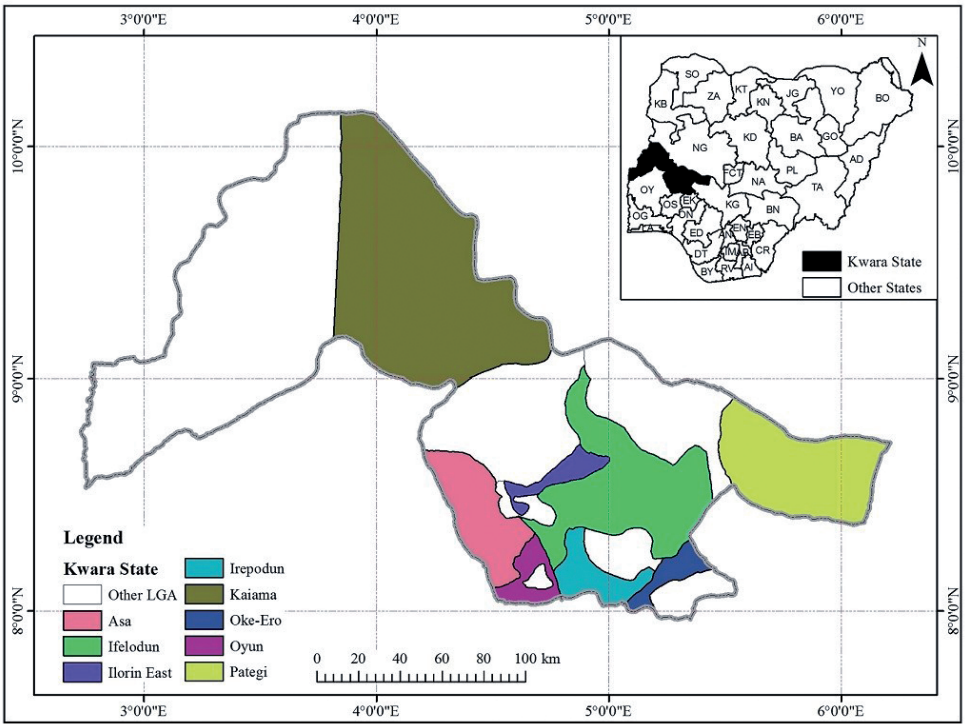

Fig. 1. Map of Kwara State, Nigeria showing the sampled Local Government Areas (Kwara State Ministry of Lands 2017)

building was selected and a farmer or hunter or fisherman was selected until a total of fifty respondents were selected per community.

Data Analytical Technique

Descriptive and Inferential statistics were used in analyzing data employed in the study. Objectives one, three and four were analyzed using descriptive statistics such as tables, percentages, mean, charts and line graph. Objective two was analyzed using multiple regression model. The use of the model was because of its amenability to finding the cause effect relationship of the dependent and independent variables. The implicit form of the model is stated as follows:

$$Y = f(X, X_2, X_3 ..... X_n,)$$

Where Y is the % of respondents with clear indigenous understanding of climate change

The explicit form of the equation is expressed thus:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + ... + \beta_n X_n e_1$$

Where: $ß_5$=parameters to be estimated; Q= % of respondents with understanding of climate change(in %); X_1= Experience (in years);X_2 = Sex (Female=1;otherwise = 0); X_3= Primary occupation (Farming=1;otherwise= 0); X_4 = Season (Rainy =1, Dry = 0); X_5 = % of respondents with knowledge of early warning (Head of household with knowledge=1 otherwise =0); X_6 = application of indigenous knowledge (weather forecasting=1 vulnerability assessment and implementation of adaptation strategies =0) However, four functional forms of the OLS regression model were fitted to the data when the lead equation was selected based on the following criteria:

a) the magnitude of the co-efficient of multiple determination (R^2) and the adjusted co-efficient of multiple determination;

b) the sign of the parameter estimated as predetermined by a *priori expectation*;

c) the significance of the variables modeled at the three conventional levels of 1%, 5%, and 10 %, respectively.

The functional forms tested were: linear, exponential, double-leg, and semi-log (see Table 1).

Table 1. Explanation of variables and a priori Expectation with Respect to Dependent Variable (Proportion of people with indigenous knowledge of weather forecasting)

Variables	Description	Explanation on Variables	A priori Expectation
X_1	Experience	(in years)	+
X_2	Sex	(Female=1 Male= 0	+/-
X_3	Primary Occupation	(farming=1,if otherwise =0	+
X_4	Predicting season	(wet=1;Dry= 0)	+
X_5	Households head with knowledge of early forecasting	Household with knowledge=1 otherwise= 0	+
X_6	Application of indigenous knowledge	Weather forecasting=1 otherwise =0	+

Source: Authors' Fieldwork/computation, 2016

Table 2. Sampled Communities

S/No	L. G. A	Settlements	No. of Sampled Respondents
1.	Patigi	Patigi	50
2.	Oyun	Ijagbo	50
3.	Asa	Afon	50
4.	Ifelodun	Oro-Ago	50
5.	Oke-Ero	Iloffa	50
6.	Irepodun	Iludun-Oro	50
7.	Kaiama	Kaiama	50.
8.	Ilorin East	Pepele	50
	Total	8	400

Source: NPC (2006) & Authors' Fieldwork, 2016

RESULTS AND DISCUSSION

Socioeconomic and Demographic Characteristics of Respondents

The socioeconomic characteristics of respondents are given in Table 3.The age distribution revealed that households with indigenous knowledge of forecasting and climate variability were highest (39.60%) in the category of 41-50 and this was followed closely by the age category of 31-40 and above 60 years with 19.08% and 19.08% respectively while the average age stood at about 41.2 years. The distribution of respondents based on gender indicated that the males were more than females with 58.09 and 41.91 percent respectively. It could be inferred from this result that males are into farming with better understanding of indigenous weather variability and forecasting. Marital status of respondents showed that overwhelming majority (80.64%) were married. The implication of this is that married respondents are more mature and have more responsibilities which may in turn affect their understanding of environmental factors than unmarried respondents. The household size shows that respondents in the range (5-8) were highest with 54.05% while the lowest 20.23% fell within the range (>8) with a mean household size of 7 members. It could be implied from this result that most of the households in the area are large due to the rural nature and primary activities they engaged in. Primary occupation of respondents revealed that 61.27% had farming has their main occupation. It could be inferred that farming is a traditional occupation which is practiced from time immemorial with vast local knowledge of the preparatory seasons and harvesting period.

Table 3. Distribution of Socioeconomic and Demographic Characteristics of Respondents

Variable	Frequency	Percentage	Mean
Age (years)			
<30	42	12.13	
31-40	66	19.08	
41-50	137	39.60	41.2years
51-60	35	10.11	
>60	66	19.08	
Gender			
Male	201	58.09	
Female	145	41.91	
Educational Level			
No formal Education	105	30.35	
Attempted Primary	32	9.25	
Primary	80	23.12	
Attempted Secondary	25	7.23	
Secondary	69	19.94	
Tertiary	35	10.11	
Marital Status			
Single	17	4.91	
Married	279	80.64	
Widowed	34	9.83	
Divorced/Separated	16	4.62	
Household size			
<5	89	25.72	
5-8	187	54.05	7 members
>8	70	20.23	
Primary Occupation			
Farming	212	61.27	
Trading	60	17.34	
Hunting	43	12.43	
Civil servant	31	8.96	
Experience in years			
<10	27	7.80	
11-20	189	54.63	
21-30	77	22.25	24.5years
>30	53	15.32	
Total	346	100	

Source: Authors' Fieldwork, 2016

Years of experience of respondents revealed that the highest 11-20 years (54.63%) with an average experience of 24.5 years. It could be inferred from this result that most of the farmers and other primary producers had good significant number of years in predicting weather and general understanding of climate change which, by implication, remains a veritable means of local people adaptation to weather variability.

Determinants of the Local People's Understanding of Climate Change

The OLS multiple regression on the determinants of the local people 's understanding of weather variability by respondents reveals that the coefficient of multiple determinations (R^2) showed that 46.78% of dependent variable was accounted for by the modeled independent variables. The F-value (9.38) which was found very significant at 1 percent level suggesting that the model used is fit and appropriate for the analysis.
The selected functional form showed that experience, primary occupation, gender and sex with 0.0017, 0.30074, 0.0876 and 0.0238 respectively were found to be very significant with signs of interest. It could be implied from this result that, the more the experience of the household head over the years in farming and other primary activities, the better their abilities to understand and construct their own ways of looking at the changing average weather condition in relation to their environment. Their indigenous observation processes were cautiously crafted around variability in climate, adapting modes of survival, coping strategies and obtaining sustenance from the environment. The fact that more of male respondents devoted more time to farming; hunting and other primary activities which are dominant in the rural areas enhanced the respondents understanding of the weather variability and climate change in general.

Outcome of Focus Group Discussion on Indigenous Ways of Controlling the Impact of Climate Change

With the assistance of some indigenes who served as research assistants, key individual informants were identified and interviewed in each of the eight communities (8). The informants were mostly elderly people and community leaders who are considered knowledgeable and experienced enough to speak on the issue at stake. The communities visited include Patigi, Ijagbo, Oro-Ago, Iloffa, Iludun-Oro, Kaiama, Pepele and Afon.

The economic survival of these rural communities predominantly depends on farming and harvesting of natural resources in their natural environment. Other economic activities the people engage in include hunting, artisan, fishing, and mining of building materials such as sand, clay, stones, gravels etc. Some of the measures adopted by the local people in Kwara State to understand the climate change scenarios as an overview of findings include bush fallowing methods of farming, which means that the typical rural farmer in Kwara State had already known the need to allow the land to observe a period of rest due to unstable climate variability. Through the practice of land fallow, it prevents soil impoverishment, escalating erosion, flooding and destruction.

Sporadically, the dredging of streams and rivers is organised and executed on communal basis. This exercise is common in rural communities of Kwara state to ensure the longevity of the water bodies as their own indigenous approach to adaptation and mitigation measures to climate change situation. This according to them will enhance the flow of such water bodies as these methods will also prevents siltation and eutrophication. In showing their understanding of the traditional ecological knowledge of weather variability, the local people encourage the protection and preservation of vegetal resources in their areas. Generally, the communities preserve their sacred groves, ritual crops, food crops and economic trees now more than ever

before. Usually, people are forbidden from tampering with any forest designated 'sacred'. Many of these communities still have rich repositories of certain rare species of flora and fauna. The practices are still being sustained to protect their water, land and vegetal cover from unwanted weather challenges. There are also traditional laws against indiscriminate grazing by domestic animals which are in existence in many communities in Kwara State.

Similarly, pastoral farmers in the northern part of the state particularly in Patigi, Kaiama and other communities in the central parts of the state were able to respond to variability through stock reduction and dipping. Insufficient rain period also affected off-farm work opportunities adversely. Farmers have been coping by providing supplemental feed to the livestock. All farms surveyed reported climate-related heat stress to livestock, livestock water shortages related to rainfall pattern especially in the northern senatorial district of Kwara State covering Kaiama and Patigi communities.

There are other efforts by the indigenes to cope with changing pattern of weather events especially uncertainty in the timing of agricultural activities as a direct result of late starts of the wet rainfall season and increased frequency of dry spells during the season. These include changes in ground preparation and harvesting times; wind erosion prevention measures (retaining bushed strips in lands, or planting of wind breaks, which reduced loss of food crops due to wind; and traditional water conservation measures.

The local people have also understood that the unusual early rains that are not sustained, erratic rainfall pattern, delay in the onset of rain, long period of dry season, less rainfall, long period of harmattan and higher temperature, heavy winds, drought and decreasing soil moisture have been on the increase. Thunderstorm, heat waves, desertification and loss of forest resources have shown no change, while floods, heavy rainfall and escalating soil erosion have been decreasing with early rain. This was also the same trend for pests, diseases, weeds and signals of land degradation such as declining soil fertility and drying up of streams/rivers such are the cases with other parts of Nigeria in the face of varying climate. In adjusting to weather variability pattern, the farmers in these communities employed cropping mixture. For example, they usually substitute early millet for sorghum and they also plant cassava and quick maturing cowpea.

The most common indigenous technologies that have been continually adapted and applied by these farming communities include; multiple cropping to diversify production; early or late planting; mulching to retain soil moisture, texture and fertility; terrace building to prevent soil erosion; use of fertilizers; and prayers for God's intervention among others. Although most indigenous technologies have been considered effective in coping with climate variability in the past, it remains unclear on how effective they will be in the light of further warming as it is presently being experienced.

Indigenous people are not only keen observers of climate changes but are also actively trying to adapt to the changing conditions. In some instances, people can draw on already existing mechanisms for coping with short-term adverse climatic conditions such as droughts or flooding. Some of these responses may be traditionally included in their normal subsistence activities, while others may be acute responses, used only in case of critical weather condition. Accordingly, for the development process, indigenous knowledge is of particular relevance for local farmers have developed several adaptation measures that have enabled them reduce their vulnerability to climate variability and extremes. This assertion was equally supported by Ajibade and Sholemi (2003) that an important step in reducing the vulnerability of a climatic hazard is the development of an early warning system for the prediction or forecast of the event. The local people have developed intricate system of gathering, predicting, interpreting and decision-making in

relation to weather events. However, it was recommended that the most effective and sustainable indigenous technologies used by the farming communities could be incubated with a view to up scaling and out scaling them in other areas so as to enhance adaptation to climate change and variability.

Comparison of indigenous Understanding with Regional Climate Changes

Analysis of climate variability based on the available two climatic normals, the first, 1957 to 1986 and 1987 to 2016. Three climatic variables were considered, the minimum temperature, maximum temperature and rainfall for the period. The first climatic normal (1957-1986) indicates in Table 4 that the mean minimum temperature is 21.1oC whereas the second normal (1987-2016) was 22.1°C. The implication of this is an increase of 1oC is a climatic variation and change in the climate of the State. There is a clear variation in the climate of the area. Similarly, the mean maximum temperature for the two normal as indicated in the table, is 32.1oC for the period 1957-1986 and 33.2°C, though the variation may be insignificant but there exist variability. The precipitation mean values show a shift in the climate from the period 1957-1986 with mean rainfall 111.54mm and the period 1987-2016 with the mean rainfall of 100.34 mm. This implies a state or regional climate getting drier due to the reduction in the amount of rainfall. Fig. 2, 3 and 4 show the trends of humidity, rainfall and temperature over a period of forty (40) years. The analysis shows there is real climate change in the area as observed and understood by the local people.

Suggested Rural Communities Adaptation Strategies

A variety of frameworks have been developed for the assessment of climate change impacts, vulnerability, and adaptation. This paper adopted the adaptation-based approaches which examined the adaptive capacity and adaptation measures required to improve the resilience or robustness of the selected rural communities in Kwara State, Nigeria who have been exposed to vagaries of the impacts of climate change.

The climate variability occurring in the study area undermines agricultural productivity and development. It is imperative that non-governmental

Table 4. Mean Values of Rainfall, Maximum Temperature and Mean Temperature

Period/ Normal	Rainfall/Precipitation mm	Maximum Temperature °C	Minimum Temperature °C
1957-1986	111.54	32.1	21.1
1987-2016	100.34	33.2	22.1

Source: Authors Computation, 2018

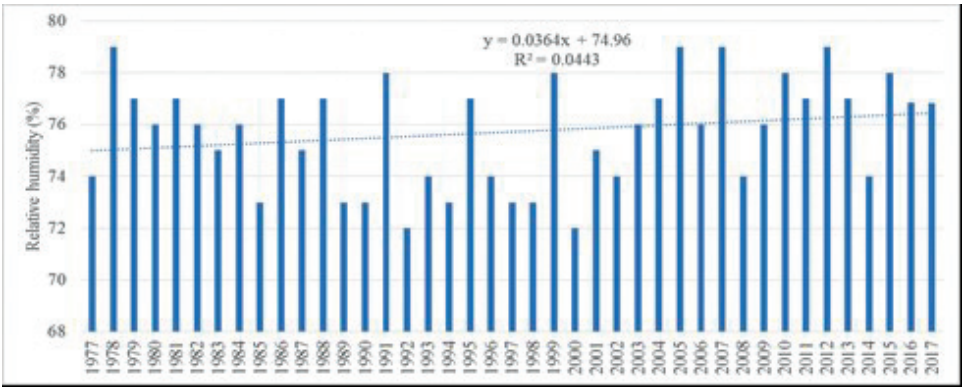

Fig. 2. Trend of Humidity over the period 1957-2017

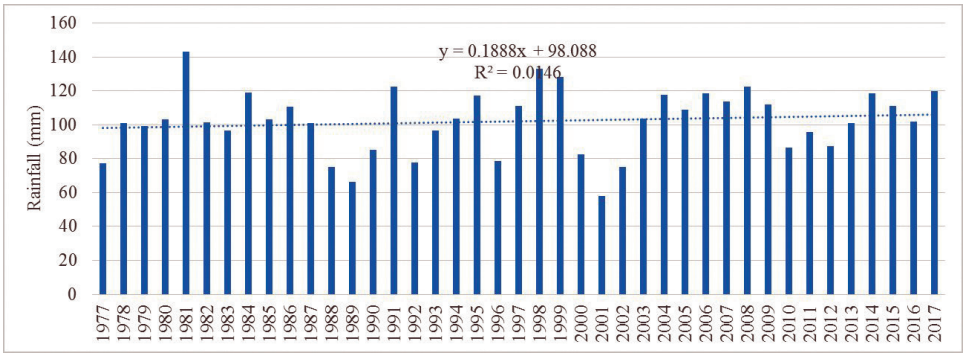

Fig. 3. Trend of Rainfall over the period 1957-2017

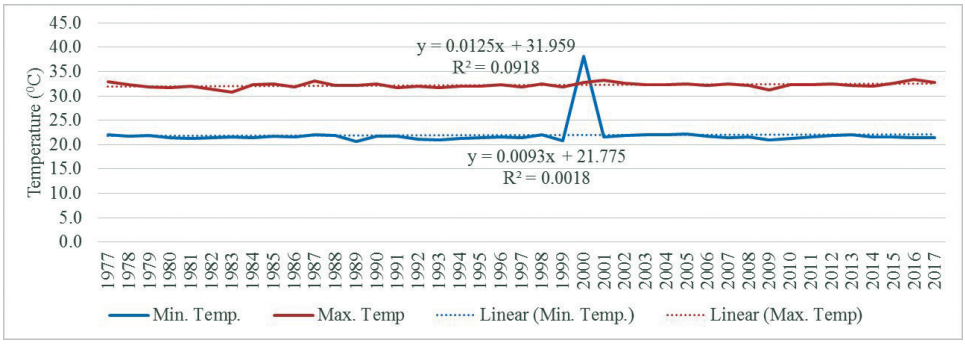

Fig. 4. Trend of Temperature over the period 1957-2017

organizations and government play a role in developing the capacity and strategies to help both men and women adapt to climate change. However, with the preparations and discussion around REDD+ (Reducing Emissions from Deforestation and Forest Degradation in developing countries, and the role of conservation, sustainable management of forests, and enhancement of forest carbon stocks in developing countries) both in Nigeria and globally to mitigate the impact of climate change. Also, the capacity building for forest personnel in this area is important, especially now that there are concerted efforts on climate-smart landscapes for integration of mitigation and adaptation, capacity-building and collaboration among all government and international agencies involved with natural resources.

Consequently, while direct activities linked to climate change adaptation were reduced in the rural communities studied, the presence and intensity of membership in rural local institutions including development agencies represent a strength that can be built upon for future action. For instance, research in Kenya demonstrated that local institutions reduce local vulnerabilities and increase livelihood security in areas experiencing climate variability. However, there is urgent need for Local or Community Forest institutions to provide position for enhancing adaptive capacity. Their presence may provide a point of contact for foreign and international institutions, which is of value to those communities where they are located. The links that local NGOs and international institutions have with indigenous rural communities can therefore facilitate the exchange of knowledge, but this should go beyond raising awareness to more focused climate adaptation interventions for the people. Finally, in the rural communities of Nigeria, as exemplified in this study, planning for climate change adaptation needs to promote the capacity of diverse local institutions and improve the relationships between local and national-level adaptation planning as suggested by Agrawal et al. (2012) and IPCC (2014).

SUMMARY AND RECOMMENDATIONS

This study in attempting to investigate the indigenous understanding of climate change in Kwara State revealed that the average age of the local people with understanding was 41.2 years. Furthermore, majority married (80.64%) and moreover farming was found to be the occupation of 61.27% while the mean years of experience by respondents of their knowledge of environment was 24.5 years. Exponential year function was the lead equation for multiple regression model, experience ($p<0.001$),gender ($p<0.001$), primary occupation ($p<0.005$) and application of indigenous knowledge ($p<0.005$) were found to increase the understanding of variability of climate in the respective of 0.0017,0.3076,0.0876, and 0.0236.The foregoing also highlights the fact that certain cultural values, norms and practices are effective tools to understanding the climate variability conditions, warning systems and indigenous adaptation strategies. (Ajibade and Sholemi 2003; Hens 2006; Okorie et al. 2006; Ghorbani et al. 2013; Msoffe 2013; Risiro et al. 2013; Tamuno 2014; Uluocha 2015; Idumal et al. 2016). The paper identified indigenous indicators that are employed by local communities such as plants phenology, arthropods' activities, birds' migratory pattern, and the condition of clouds among others. Evidently, local knowledge of preserving and conserving environmental resources have been largely ignored and abandoned. The study therefore recommends:

i. awareness should be created further to inform the rural people on climate variability and adaptation and mitigation realization advantage;

ii. there is need to integrate the indigenous and formal methods to recognize some of our traditional methods of early weather warning systems, predicting weather events and environmental protection in general through gradual documentation. Obviously, people in the rural areas will be more favourably disposed to embracing policies that took their local knowledge, interest and rights into consideration rather than, the ones that contain outlandish pronouncements and provisions.

iii. for low potential areas that are highly vulnerable to climate change, significant investments will be needed to maintain agricultural production and the general community livelihoods. Achieving the above would need increased understanding of climate change and socio-economic dynamics of particular locations which will aid the pursuit of longer term policies on adaptation; and

iv. indigenous knowledge and practices should be integrated into formal climate change mitigation and adaptation strategies for continuous process of innovation.

REFERENCES

Ajibade L. and Shokemi O. (2003). Indigenous approaches to weather forecasting in Asa LGA, Kwara State, Nigeria. Indilinga African Journal Indigenous Knowledge System 2, pp. 37–44.

Agrawal A. and Perin N. (2018). Climate Adaptation, Local Institutions and Rural Livelihood. I&RI Working paper W081-6; International Forest Resources and Institutions program (FRI) School of Natural Resources and Environment, University of Michigan, Ann Arbot, MI, USA.

Agrawal A., Perrin N., Chhatre A., Benson C. and Kononen S. (2012). Climate policy processes, local institutions, and adaptation actions: mechanisms of translation and influence. WIREs Climate Change, 3(6), pp. 565-579. doi: http://dx.doi.org/10.1002/wcc.203.

Anselm A. and Taofeeq A. (2010). Challenges of Agricultural Adaptation to Climate Change in Nigeria: a Synthesis from the Literature. Field Actions Science Reports [Online] Vol. 4 | 2010, http://factsreports.revues.org/index678.html. (Accessed 20 Dec. 2010).

Ayoade J. (2004). Introduction to Climatology for the Tropics. Spectrum Books Limited, Ibadan pp 258.

Buba A. (2004). Climate change and water problems in Chad Republic. Journal of Arid Environment, 3(2), pp. 42-50.

Buwaly S. (2004). Critical Analysis of Community-Based Wildlife Resource Management in Southern Africa: Case study from Zambia. www.cbnim.ne. (Accessed 14 Jun. 2011).

DeWeerdt S. (2007). Climate change coming home: Global warming effect on populations. World Watch, www.ccsenet.org/enrr Environment and Natural Resources Research, 3(1), pp. 6-13.

Essop T. (2009). Climate Change 'a great issue' My News 24.

Gbadegesin A. (2000). From Degradation to Deforestation: Historical and Gender perspectives on the use of forest- land in South-Western Nigeria. Journal of the Social Science Academy of Nigeria, 12(1), pp. 39-65.

Ghorbani M., Azarniv H., Mebrabi A., Jafari M., Niyebi H. and Seeland K. (2013). The Role of Indigenous Ecological Knowledge in Managing Rangelands Sustainably in Northern Iran. Ecology and Society, 18 (2), pp. 15-25. http://dx.doi.org/10.5751/ES-05414-1800215 (Accessed 19 Feb. 2014).

Hens L. (2006). Indigenous Knowledge and Biodiversity Conservation and Management in Ghana. Journal of Human Ecology, 20(1), pp. 21-30.

Idumal F., Magondo B., Ighodaro U. and Ochondo P. (2016). Climate Change and Food Production in Nigeria: Implication for food Security. Journal of Agricultural Science, 8(2), pp. 74-83.

Intergovernmental Panel on Climate Change (2001). Synthesis Report. Contribution of Working Groups I, II, & III to the Third Assessment report of the Intergovernmental Panel on Climate Change. Geneva: IPCC.

Intergovernmental Panel on Climate Change (2007). Synthesis Report. Contribution of Working Groups I, II, & III to the Fourth Assessment report of the Intergovernmental Panel on Climate Change. Geneva: IPCC.

Intergovernmental Panel on Climate Change (2014). Synthesis Report. Contribution of Working Groups I, II, & III to the Fifth Assessment report of the Intergovernmental Panel on Climate Change. Geneva: IPCC.

Ife U. (2003). "The challenge and imperatives of conservation-with development in Cross River Nationalpark". http//www.earthath.org/europe/limbe/upt-htm/ (Accessed 20 Nov. 2010).

Jegede A. (2005). Analysis of Qualitative Data .In A. Olayinka, V Taiwo, F. Raji-Oyelade, ed. Methodology of Basic and Applied Research, Ibadan: Postgraduate School, University of Ibadan.

Mabogunje A. (2018). Ways to Mitigate Climate Change in Nigeria. Environ News Nigeria. http://www.environewsnigeria.com (Accessed 28 Feb. 2018).

Msoff G. (2013).The Role of Indigenous Knowledge in Environmental Conservation and Climate Change Adaptation and Mitigation in Tanzania http.//www.suanet.actz/cclam/docs/msoffe.pdf (Accessed 10 Mar. 2014).

National Population Commission (2006). National Population Census.NPC, Abuja, Nigeria.

Odjugo P. (2007). The Impact of Climate Change on Water Resources; Global and Regional Analysis. Indonesian Journal of Geography, 39(1), pp. 23-41.

Okorie P., Udofia S., Samuel N. and Effiong I. (2006). Indigenous Knowledge in Environmental Resources Conservation. Journal of Environment and Culture, 3(2), pp. 84-94.

Oriola O. (2004). Effects of Irrigation on Soils of a Sub-Humid Part of Kwara State, Nigeria. Centerpoint: A Journal of Intellectual, Scientific and Cultural Interest University of Ilorin, 12 (1), pp. 52-62.

Parrotta J and Agnoletti M. (2012). Traditional Forest-related Knowledge and Climate Change. In: J. Parrotta, R. Trosper, ed. Traditional forest-related knowledge: Sustaining Communities, Ecosystems and Biocultural diversity. Dordrecht. The Netherlands: Springer, pp. 491–534.

Porbeni C. (2004). The Impacts of Global Warming on high Latitudes and Altitudes. Journal of Arid Environment, 3(2), pp. 75-88.

Risiro J., Tshuma., D. and Basikiti A. (2013). Indigenous Knowledge Systems and Environmental Management: A Case Study of Zaka District, Masvingo Province, Zimbabawe .International Journal of Academic Research in Progressive Education and Development, 2(1), pp. 19-39.

Tamuno T. (2014). Indigenous Knowledge in Geography: a case study of Okolaba, Bayelsa State. Nigeria. Geographical Journal, 9 (2), pp. 163-176.

Tijani N. (2007). Evaluation of Community-based Conservation in Old Oyo National Park. Ph.D Thesis, Department of Geography, Bayero University, Kano, Nigeria.

Tologbonse E., Auta S., Jaliya M., Onu R. and Issa, F. (2010). Farmers 'Perception of the Effects of Climate Change and Coping Strategies in Three Agro-Ecological Zones of Nigeria. Journal of Agricultural Extension, 14(1), pp. 125-136.

Uluocha N. (2015). Indigenous Knowledge and Sustainable Environmental Resources Management: Experiences from South-East Nigeria. Nigeria Geographical Journal, 10 (2), pp. 225-241.

UNFCCC (2013). Reporting and accounting of LULUCF activities under the Kyoto Protocol. United Nations Framework Convention on Climatic Change (UNFCCC), Bonn, Germany. Available at: http://unfccc.int/methods/lulucf/items/4129.php.

World Health Organization (WHO) (2003). Climate Change and Human Health. "Risk and Responses" Geneva, 2003.

Watts M. (2001). "Petro-Violence Community Extraction, and Political Ecology of a Mythic Commodity," In: M Watts and N. Peluso, ed. Violent Environments, Cornell University, Itchaca, pp.189-212.

World Meteorological Organization (WMO) (2017). Climate Change.

Yocogan-Diano V. and Kashiwazaki T. (2009). Rural Women and Climate Change: Challenges and Recommendations. Asia Pacific Conference on Climate Change. Asia Pacific Research Network (APRN) Thailand.

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