Journal of Research in Forestry, Wildlife & Environment Vol. 10(4) December, 2018
http://www.ajol.info/index.php/jrfwe
jfewr ©2018 - jfewr Publications
E-mail: jfewr@yahoo.com
ISBN: 2141 – 1778
Awe et al., 2018

ANALYSIS OF THE DETERMINANTS OF RURAL HOUSEHOLDS' ADAPTATION TO CLIMATE CHANGE IN IBARAPA AREA OF OYO STATE, NIGERIA

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ABSTRACT

It is a common belief that rural farmers' livelihoods are susceptible to climate change. Literature has even suggested that locally driven adaptations are critical complementary strategies that can be targeted to reduce the negative effects of climate change in the short-term. This study examined the determinants of rural households' adaptation to climate change in Ibarapa Area of Oyo State, Nigeria. The paper also assessed farmers' perceived effects of climate change on their livelihood and the strategies adopted by households to adapt to the effects of climate change, as well as the constraints to their adaptation to climate change. One hundred and twenty copies of questionnaire were administered to household heads out of which only one hundred and eighteen copies were found analysable and used for the study. The results showed that there were several effects of climate change perceived by the farmers. These include poor crop yields, which is the most noticeable effect by farmers. Others are a loss of livestock, environmental degradation, and even psychological trauma. The regression results revealed that several socioeconomic variables significantly influenced rural households' decision to adapt to climate change. Some of these variables were farmers' access to weather information, access to credit facilities, farming experience, household size. Some of the challenges rural households encountered in their bid to adapt to climate change were also identified. These were unpredictability of weather, high costs of farm inputs, lack of access to water during dry season and lack of access to timely weather information. It is therefore recommended that government through its agency, Nigerian Meteorological Agency, should provide timely weather information to farmers to help them plan their farming activities. In addition, irrigation facilities should be made available to farmers in the study area so that they can engage in dry season farming and make farm produce available all-year round. This will help boost food security status of farmers and by extension, the entire country.

Keywords: Climate Change, Adaptation strategies, Ibarapa, Mitigation, Rural Households

INTRODUCTION

Climate change is a global phenomenon that results in global warming, droughts, flooding and depletion of natural resources (Adger *et al.*2003; Parry *et al.*2004; Naqvi and Sejian2011). A study by Nelson *et al.* (2009) indicated that climate change is expected to bring about significant yield losses between 3 and 30 % and extinction of land plants and animal species between 15 and 37 % by 2050 unless remedial measures are taken into consideration. Developing countries are highly vulnerable to climate change since their economy predominantly relies on rain-fed Agriculture that totally depends on natural factors. Traditional farming systems practiced, which have the low technological capacity, cannot help to adapt and mitigate drastic climate change (Tubiello2012).

Rural sector in Africa, according to Senadza (2012) and Ndhleve *et al.* (2012), is that of a region driven by Agriculture and several natural resource-based non-farm and off-farm livelihood activities. Against this background, in response to climate change, rural communities have managed to align their livelihood strategies in variously available livelihood portfolios, hoping to spread and minimize the risk associated with climate change.

The vast majority of Nigerians live in rural areas and the large proportion of these people depend

upon natural resources for their livelihoods, and they are engaged in rain-fed subsistence Agriculture. Therefore, household food security is largely influenced by some factors including rainfall patterns, land degradation, climate change, population density, low levels of rural investment and the global market (WFP, 2011). The harsh seasonal variations in rainfall and temperature that have come as a result of climate change expose farmers, mostly those in rural areas, to intense risks and this, in turn, has a major bearing on the production outcome. Considering the fact that larger proportion of the local population in Nigeria operates under rain-fed agriculture, rainfall and temperature variations have severe implications on production and food security.

The high rainfall variability, unreliability, and uncertainty have prompted farming communities to engage in measures to adapt to dynamic climatic, environmental and weather conditions. Nhemachena and Hassan (2008), postulate that adaptation is important in helping communities mitigate and cope with the changes associated with climate variations. On the other hand, the speed of current climate change is greatly feared to exceed the limits of adaptation in many parts of the world (Adger and Vincent, 2005). This could be greatly so in larger parts of developing countries, particular among rural poor farmers who have limited capacities to adapt to climate variations.

Climate change has been recognized as having potentially severe impacts on livelihood and development (Mengestu,2011). Empirical studies have shown that high temperatures have resulted in reduced crop yield in developing countries (Stephens, 1996; and Stutley, 2010). In recent times, the increasing incidence of droughts, late rains, floods, decreasing annual precipitation and increasing temperatures in Nigeria has become a major concern. In view of this, farmers need to use adaptation practices in order to cope with the effects of climate change. Studies have shown that without adaptation to climate change, farmers will become more vulnerable and Agricultural production will be severely affected (Smit and Skinner, 2002). Adaptation lessens adverse effects and takes advantage of the benefits of changes in climate variables. Earlier studies show that irrigation, improved crop varieties, crop diversification, farm diversification, change of planting dates and income-generating activities are among the adaptation practices most frequently deployed by farmers (Maddison, 2006; Uddin *et al*., 2014).

Previous studies have also reported that farmers' adaptation to climate change is determined by factors such as education, age, farming experience, gender, access to extension, credit, markets, farm income and farm size (Deressa*et al.*, 2011; Gbetibouo, 2009; Nhemachena and Hassan, 2007). This notwithstanding, current investigations on adaptation to climate change are being conducted-ed, but on a continental and regional scale and need to be downscaled to accommodate realities at the farmer or household level. This study, therefore, was set out to determine the influence of some socioeconomic attributes such as household size, gender, education, farm size, access to credit, and membership to farmer-based organizations on adaptation to climate change at the farmer or household level. In view of this, the aim of this study was to assess household's perception about observed changes in climate over the past decade, examine households perceived effects of climate change in the study area, identify the adaptation practices adopted by farmers in the study area and also determine factors which influence farmers' adaptation to climate change as well as identify the constraints to farmers' adaptation to climate change.

MATERIALS AND METHOD

Study Area

This study was conducted in Ibarapa Area of Oyo State. Ibarapa people are a Yoruba people located in the South-western part of Oyo State (Abimbola,2006) The name of the group is derived from a local cultivar of the melon plant, known locally as *Egusi Ibara*, which was historically acknowledged by neighbouring peoples such as the Egbas, Ibadan and Oyos to be extensively cultivated in the area. The Ibarapa area falls within latitudes 70.15' N and 70.55' N and longitudes 30E and 30.30' E. It is located approximately 100 Km north of the coast of Lagos, and about 95 Km west of the Oyo state capital and the neighbouring city of Ibadan. They border Yorubas of Onko extraction to the North (Iwajowa, Kajola, and Iseyin LGAs) and Yorubas of Oyo extraction to the East (Ibadan). The Yewas or Egbados to the West, and the Egbas to the South (*https://en.wikipedia.org/wiki/Ibarapa_people*).The area is approximately 2,496 km² in geographical size and consists mostly of rolling savannah with forests situated along the southern border and in

isolated patches along river courses such as the Ogun. The natural vegetation was originally rainforest but that has been mostly transformed into derived type savannah as a result of several centuries of slash & burn Agricultural practices (Abimbola, 2006). Most of the land lies at elevations ranging between 120 and 200 meters above sea level, but rocky inselbergs and outcrops can be seen rising to 340 meters (approx 1,115 ft).Ibarapa land is traditionally made up of 7 principal towns known as the *IbarapaMeje* (Ibarapa Seven), and their surrounding villages and farmsteads. These towns include Igangan, Eruwa, Aiyete, Tapa, Idere, Igbo-Ora, and Lanlate. Tapa and Aiyete are in Ibarapa North Local Government Area, Igangan, Idere, and Igbo-Ora are in Ibarapa Central, while Lanlate and Eruwa are located in Ibarapa East Local Government. The three local governments were created by the federal government of Nigeria authorities in 1996 when Ibarapa East was carved out from the old Ibarapa Local Government while Ibarapa Central and North were carved out of the former Ifeloju Local Government Area.

Method of Data Collection

Two of the three LGAs were randomly selected. These were Ibarapa East and Ibarapa Central LGAs of the State. Ibarapa East consists of two main towns, namely Eruwa and Lanlate, with the headquarters in Eruwa. This local government has an area of 838Km^2 and a population of 118226 as at the 2006 census. Ibarapa Central, on the other hand, hasIgangan, Idere, and Igbo Ora as its main towns, with the headquarters in Igbo Ora. It has an area of 440Km^2 and a population of 102,979 as at 2006 census. The two main towns in Ibarapa East were selected while two out of the three towns in Ibarapa Central were randomly selected and in all, four towns were selected for the study. These were Eruwa, Lanlate, Idere, and Igboora. Structured questionnaire and focus group discussions (FGDs) were used to elicit information from the respondents from all the selected towns in the two LGAs. Thirty (30) copies of the structured questionnaire were randomly administered to farmers in each of the selected towns and a total of one hundred and twenty (120) copies were administered in all, out of which only one hundred and eighteen (118) were found analysable. The FGDs was conducted to further buttress and provide additional information to that supplied by the individual household head during the interview.

Method of Data Analysis

Both inferential and descriptive statistics were used to analyse the data collected. Percentages, frequencies, and means were used to describe farmers' perceptions of the observed effects of climate change and the perceived barriers to their use of adaptation practices. This study, therefore, applied weighted average index (WAI) analysis to rank the effects of climate change on crop performance, environment, households' socio-economy, and psychological trauma. Respondents were asked to score their perceived effects of climate change based on a three-point Likert scale (i.e in terms of 'high (3)', 'moderate (2)' and 'low' (1)). The WAI was then estimated using the formula given below

$$\text{WAI}=\frac{F3W3+F2W2+F1W1}{F3+F2+F1} \quad \text{---------- 1}$$

$$\text{WAI}=\frac{\sum FiWi}{\sum Fi} \quad \text{---------- 2}$$

Where:

F = frequency; W = weight of each scale; i= weight (3 = high occurrence; 2 = moderate occurrence and 1= low occurrence)

Logistic Regression was used to determine factors influencing rural households' adaptation to climate change. The dependent variable in this study is whether a household has 'adapted' or 'not adapted' any adaptation practices to climate change. Based on reconnaissance survey, review of literature and field observations, the adaptation practices identified included improved crop varieties (drought-tolerant and early maturinG crops), crop diversification (mixed cropping and crop rotation), farm diversification (mulching, composting, ridging and terracing), change in planting date, income generating activities, irrigation practice (dry season gardening) and agroforestry. Adaptation is the dependent dummy variable. To determine the dummy, a value of '1' was assigned to those households that had adopted at least one of the adaptation options and '0' for those that had not adopted. Independent variables included gender, education, farming experience, household size, farm size, household income, access to credit, and access to weather information, age membership of

farmer-based organizations (FBOs), market access and extension services

This study used the functional form of the logistic regression model, presented by Agresti (1996). In this model, the dependent variable becomes the natural logarithm of the odds when a positive choice is made, as expressed in equation1:

$\ln\{Px/(1- Px)\} = b_0+ b_1X_{1i}+ b_2X_{2i}+\ldots.+ b_kX_k$ ---3

Where: P_x= probability of adaption; $(1-P_x)$ = probability of non-adaption; i = i_{th} observation in the sample; b_1, b_2… b_k= regression coefficients of the explanatory variables; X_1, X_2……. X_k= explanatory variables; b_0= constant term.

The explicit expression of equation (1) is given as:

$\ln Y = b_0 + b_1X_1 + b_2X_2 + \ldots+b_{12}X_{12}$ ---------- 4

Where Y = Probability of adopting an adaptation practice (1, if yes, 0 if otherwise)

X_1 = Gender of respondent

X_2 = Educational status of respondent (1, if educated, o if otherwise)

X_3 = Access to weather information (1, if yes, 0 if no)

X_4 = Household size of respondent

X_5 = Access to credit facilities (1, if yes, 0 if no)

X_6 = Monthly household income (in naira)

X_7 = Membership of farmer-based organization (1, if yes, 0 if no)

X_8 = Access to market (1, if yes, 0 if no)

X_9 = Farming Experience (in years)

X_{10} = Age of respondent (in years)

X_{11} = Farm size (in hectares)

X_{12} = Access to extension services (1, if yes, 0 if no)

RESULTS

Findings from the study showed that 28.02 % of respondents perceived an increase in temperature while 24.16 % noticed excessive drought over the past 10 years. About fourteen percent (13.88%) of the respondents claimed there was a rise in the incidence of flooding resulting from excessive rainfall over the past ten years in the study area (Table 1). Slightly above twenty percent (20.05%) of the farmers perceived a decline in rainfall pattern over the past 10 years (Table 1).

Table1: Rural Households Perception about Changes in Climatic Variables

Variables	*Frequency	Percentage
Increase in temperature	109	28.02
Excessive rainfall	54	13.88
Inadequate rainfall	78	20.05
Excessive drought	94	24.16
Flooding	54	13.88

*Multiple responses

Field Survey (2017)

The highest-ranking perceived effect of climate change was poor crop yield which has a WAI value of 2.68, with loss of livestock and socioeconomic challenges coming second, having a WAI value of 2.42 each. According to the perception of the respondents, environmental degradation and psychological trauma were ranked 4th and 5th with WAI values of 2.07 and 2.04 respectively. (Table 2).

Table 2: Households' Perceived Effects of Climate Change

Effect	High	Moderate	Low	WAI	Rank
Poor crop yield	88	22	08	2.68	1st
Loss of livestock	70	28	20	2.42	2nd
Environmental degradation	45	36	37	2.07	4th
Socio-economic challenges	70	28	20	2.42	2nd
Psychological trauma	40	43	35	2.04	5th

About ninety percent (89.83 %) of farmers who have perceived climate change claimed to have used one form of adaptation practice or the other. Slightly above sixty percent (60.38%) of these people claimed they used crop diversification measures to combat climate change, while 17.92% change the planting date, 10.38% engaged in the use of improved crop varieties and5.66% each engaged in farm diversification measures as well as income generating activities to ameliorate the impacts of climate change on their farming activities as depicted in Table 3

Table3: Adaptation Practices Used by Farmers in the Study Area (N=106)

Adaptation Practices	Frequency	Percentage
Crop diversification	64	60.38
Change in planting date	19	17.92
Use of improved crop variety	11	10.38
Farm diversification	06	5.66
Income generating activities	06	5.66

Source: Field Survey, 2017

Results of the logistic regression model for the determinants of adaptation to climate change are presented in Table 4. The results show that gender, educational status, access to weather information, household size, access to credit facilities, household's monthly income and farm size were significant at 5% level of significance.

Table 4: Logistic regression Results of Factors Influencing Farmers Decision in Adopting Adaptation Practices

Variable	Coefficient	Sig.	Odd Ratio
GDR	3.035	0.032*	20.801
EDU	0.565	0.004*	1.759
ACWI	2.467	0.010*	11.787
HHS	2.286	0.021*	9.836
ACCF	0.226	0.001*	1.254
MHI	2.917	0.003*	18.486
MFBO	1.237	0.091	3.445
ACM	1.576	0.101	4.836
FE	3.065	0.056	21.434
FS	-0.577	0.024*	1.781
ACES	1.336	0.098	

***Significant at 5%*

Table 5 depicts the results of farmers' perceived constraints to their use of adaptation practices The results revealed that unpredictability of weather(30.2%), high cost of farm input (22.1%), lack of access to timely weather information(20.4%) and lack of access to water (18.3%) are the most important barriers to farmers effective use of adaptation measures, while limited access to extension services(1.2%) and limited access to agricultural markets(1.5%) were considered to be less important barriers.

Table 5: Constraints to Farmers' Use of Adaptation Practices

Constraints	Percentage
Limited access to agricultural markets	1.5
Unpredictability of weather	30.2
Lack of access to credit facilities	3.3
Limited access to extension services	1.2
High cost of farm inputs	22.1
Poor soil fertility	3.0
Lack of access to water	18.3
Lack of access to timely weather information	20.4

DISCUSSION

Findings from the study imply that all the respondents agreed that there has been observed change in climate over the past decade. From the focus group discussions, it was discovered that farmers attributed the perceived trend of rising in temperature to irregular and declining rainfall pattern. Other factors the respondents attributed to the cause of the excessive drought being experienced include indiscriminate felling of trees and setting of bushes on fire, causing the depletion of the ozone layer and the resultant heat being experienced. This finding corroborates previous studies by Ndamani and Watanabe (2016), Fosuh-Mensah *et al*. (2012); Apata, (2011); Mertz *et al*., (2009) which showed that most farmers and households have perceived long-term changes in climate variables. Farmers also perceived the effects of climate change on Agriculture in terms of poor or low crop yield, loss of livestock, environmental degradation, socio-economic challenges and psychological trauma.

From the focus group discussion, farmers claimed that socioeconomic challenges of climate change included migration in search of the alternative source of livelihood, indebtedness, shortage of food supply and low or loss of household incomes. They identified some of the psychological effects it has on them as stress, depression, and insomnia. This may not be unconnected with their inability to pay back farm resources borrowed from colleague farmers and relatives or loans from bank or cooperatives in the event of a climate-related crop failure and this can cause psychological trauma. Furthermore, low or loss of income, as well as food insecurity, can also lead to depression, sicknesses and even deaths in farm households. This further corroborates the work by Ndamani and Watanabe (2016) on the determinants of farmers' adaptation to climate change in Ghana.

Findings from the study revealed that male farmers are more likely to use adaptation measures to combat climate change than female farmers. This finding, therefore, corroborates earlier study by Blackden and Wodon(2006) that in Sub-Saharan Africa, female household heads have lower levels of education, less access to markets and credit and other input and as a result, they are less likely to meet the investment demands of climate change adaptation. In addition, Rohr (2007) inferred that women are less able to diversify income sources and adapt to climate change because of other domestic responsibilities and less control of financial resources.

The study also showed that education was positive and significantly related to farmers' decision to adapt to climate change. In other words, educated farmers are twice more likely to use adaptation measures than farmers without education. This agrees with the work of Ndamani and Watanabe (2016) that education plays a significant role in farmers' adaptation to climate change and farmers with higher levels of education are more likely to use improved technologies in order to adapt to climate change. This is particularly so because educated farmers are more knowledgeable due to their ability to access information pertaining to climate change and adaptation options. The results further showed that farmers with increased access to information are more likely to adapt to climate change than those without access to information. This implies that farmers with access to timely weather information and other extension services are more likely to adapt to climatic change.

Furthermore, findings indicated that the likelihood of adaptation to climate change was higher with large household size than with small households,

corroborating the studies by Ndamani and Watanabe (2016) as well as Oyekale and Oladele (2012) that the visible tendency of larger households to adapt to climate change is probably due to their higher endowment of labour. In addition, the results showed that the likelihood of adaptation to climate change increases with increased access to credit facilities. Household income was also positively related to adaptation. This result is in consonance with the findings of Ndamani and Watanabe (2016) and Gbetibuou (2009) that showed that wealthier farmers are more likely to use adaptation practices in response to climate change than poor farmers.

Results of the study also revealed a positive but not significant relationship between membership to farmer-based organization (FBOs) and adaptation to climatic change. This is consistent with earlier research findings in Ghana, Nepal and Bangladesh that showed that farmers belonging to cooperative organizations have greater tendencies of using adaptation practices owing to their capacity to share information, discuss problems facing them with one another, share ideas and take common decisions (Ndamani and Watanabe, 2015; Tiwari *et al*., 2014; Uddin *et al*., 2014). The results further indicated that access to market has a positive and significant relationship with farmers' adaptation measures taken to combat climate change.

In addition, farming experience has a positive and significant relationship with adaptation to climate change. This implies that farmers with years of farming have probably experienced varying changes in climate and are probably better positioned to know how to adapt to climatic variation and which adaptation strategy is suitable for them. Furthermore, the estimated results showed that the probability of adaptation is higher with small farm sizes and lower with large farm sizes. This may not be unconnected with the fact that investment in adaptation measures (i.e. irrigation facilities, improved seeds, and fertilizer) for large farm size rural farmer could be expensive and beyond the reach of rural poor farmers.

Finally, findings from the study reveal that lack of access to weather information and water inadequacy were the major constraints to farmers' effective use of adaptation practices in the study area. This therefore has impacted negatively on their yields.

CONCLUSION AND RECOMMENDATION

This study was carried out to determine factors that influence farmers' adaptation to climate change. These include household income, access to information, education, household size credit and markets, and membership of farmers-based organizations. The study further identified some of the constraints militating against farmers' effective use of adaptation strategies or measures to combat variation in climate. Some of the identified constraints were the unpredictability of weather, the high cost of farm input, lack of access to timely weather information and limited access to water resources which the farmers perceived as the most important constraints to adaptation.

In view of this, it is therefore recommended that governments at all levels as well as development partners and non-governmental organizations should mainstream the determining factors of adaptation and barriers to adaptation into climate change-related policies, projects and programs to help farmers, especially rural farmers combat the scourge of climate change. This could also be achieved through the provision of timely weather information to farmers through the Nigerian Meteorological Agency (NiMet) as well as the formation and prioritization of farmer-based organizations to help farmers improve theirs in-formation sharing and decision-making processes. In addition, irrigation facilities should also be made available to farmers in the study area, the same way it has been provided to their counterparts in the northern part of the country so that they can engage in dry season farming and make farm produce available all-year-round. This will help boost the food security status of farmers. Farmers should also be provided with agricultural credit facilities so that they can meet the financial demands of adaptation.

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