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Climate Change Adaptation Measures among Rural Farmers in Igabi Local Government Area of Kaduna State, Nigeria

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ABSTRACT

The study examined climate change adaptation strategies among rural farmers in Igabi Local Government Area of Kaduna State, Nigeria. Primary data were generated through the use of questionnaire. A total of one hundred and fifty (150) farmers were purposively selected in the study area. The results were analysed using descriptive statistics. The result showed that the majority of the respondent are male with the active age of 31-50 and are married. Educational level of the respondents showed that 46% have at least secondary education. Based on membership in organization the distribution of the respondent showed that 79% are both farmers association and religious group. The study revealed majority of the farmers are aware of climate change through sources of information like radio and extension workers. The majority of the respondents agreed climate change has brought about increased in the cost of production in Igabi Local government area of Kaduna State. The findings from adaptation strategy show that 64% adopted planting of trees, cover crops and planting of resistance varieties of crops as a strategies to adapt to climate change. It was concluded that farmers in the area observed elements of climate change. The study therefore, recommends that there should be more emphasis on dissemination of climate change information through the mass media, extension agents, policy makers and researchers to try and get farmers to effectively adapt to climate change and manage the farm resources judiciously.

Keywords: *Climate Change, Adaptation Measures, Rural areas, Farmers*

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INTRODUCTION

Climate change is an environmental life-threatening factor to economic development and sustainability. Natural climate cycle and human activities have contributed to an increase in the accumulation of heat-trapping "greenhouse" gases in the atmosphere thereby contributing to increase in temperature in the global climate (global warming) (UNFCCC, 2007). Global warming causes unpredictable and extreme weather events impact and increasingly affect crop growth, availability of soil water, forest fires, soil erosion, droughts, floods, sea level rises with prevalent infection of diseases and pest infestations (Adejuwon, 2004; Zoellick and Robert 2009). These environ mental problems result to low and unpredictable crop yields, which invariably make farmers more vulnerable, especially in Africa (Ziervogel *et al*., 2006; UNFCCC, 2007).

Desertification, uncontrolled grazing, livestock migration, poaching/settlement within protected areas, bushfires and deforestation also posed threats to the environments. All these adversely affected agriculture and food supply, fresh water resources, natural ecosystems, biodiversity and human health, threatening human development and their social, political and economic survival (Zoellick and Robert, 2009). The growing problem of climatic change impacts is global and the developing countries, especially Africa will be mostly affected. This is because, African economy is pre-dominantly agrarian rain-fed, fundamentally dependent on the vagaries of weather, due to inability to cope as a result of poverty and low technological development, hence low level of cropping capabilities by the farmers (Ziervogel *et al.*, 2006; Jagtap 2007; Nwafor 2007; Onyenechere 2010). It is projected that crop yield in Africa may fall by 10-20% by 2050 or even up to 50% due to climate change (Jones and Thornton, 2002).

The environmental consequences of global warming are impacting negatively on livelihoods employment and sustainable economies of local peoples. Agriculture is a major victim of climate impacts. The situation becomes more critical because agriculture contributes significantly to employment, livelihoods sustenance and poverty reduction in developing countries, including Nigeria. The effects of Climate Variability could

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manifest in declining agricultural productivity and competitiveness, greater risks to human health systems, prospects of increased unemployment, worsened poverty, diminished food security and conflicts of resource use. Daily life comprises a set of activities in space and time during which physical hazard, social relations and individual choice become integrated as patterns of vulnerability. These patterns are guided by the socio-economic and personal characteristics of people involved. The effect of gender, age, income, physical disability, religion, ethnicity as well as class may play a role in affecting livelihood, in addition to poverty, class or social-economic status (Wisner, Blaikie, Cannon and Davis, 2003).

Adaptation may be seen as those measures that enable the natural systems and communities to adjust or cope with the adverse effects of climate variability (Achike and Okpara, 2012). IPCC (2001) defines adaptation as an adjustment in ecological, social and economic systems in response to observed or expected changes in climatic stimuli, and their effects and impacts in order to alleviate adverse impacts of change, or take advantage of new opportunities. Thus, adaptation is considered to involve both building of adaptive or coping capacity to increase the ability of individuals, groups, communities or organizations to adjust to changes, in implementing adaptive decisions that is transforming that capacity or ability to action (Adger, 1999). It therefore includes a wide range of measures and strategies that would increase the resilience of the environment and the ability of vulnerable individuals and communities to cope with the possible adverse effects of climate variability (Yanda, 2010). In the agricultural sector, adaptation incorporates changes in agricultural management practices in response to changes in climatic conditions (Nhemachena and Hassan, 2007).

Adaptation does not occur without influence from other factors such as socio-economic, cultural, political, geographical, ecological and institutional, which shape the human and environment interactions (Eriksen and Brown, 2011). The extent of sustainable adaptation depends on the adaptive capacity, knowledge, skills, robustness of livelihoods and alternatives, resources and institutions accessible to enable undertaking effective adaptation (IPCC, 2007a,b). The adaptive capacity is influenced by factors such as knowledge about climate change, assets, access to

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appropriate technology, institutions, policies and perceptions inter alia (Adger, Huq, Brown, Conway and Hulme 2003; IFAD, 2008). Smithers and Smit (1997) contend that environmental perceptions are among key elements influencing adoption of adaptation strategies. Actions that follow perceptions of climate change are informed by different process such as perception of risk associated with climate change, resource endowments. Cultural values, institutional and political environment and there is no guarantee that having perceptions that climate change has or is occurring would prompt effective adaptation responses (Weber, 2010).

Response to climate change through adaptation however, appears to be weak. It seems that there is a gap between the rate at which climate is changing and the response to reduce its impact through employment of adaptation strategies that ensure sustainable food security by rural farmers of Igabi Local Government. Rural farmers are highly experiencing the impacts of climate change such as late onset and early termination, less amount of precipitation and erratic pattern of time, and extreme climatic shocks like drought and floods, micro level studies at the farm-level on how horticultural smallholder farmer perceive these changes and how they are responding to the effects of a changing climate are limited. As to the best knowledge of the researcher, no earlier study was conducted on the climate change adaptation strategies of horticultural smallholder farmer in this study area. Hence considering this knowledge gap, the study assess the impacts of climate change and adaptation strategies in Igabi L.G.A through the achievement of these objectives: examine the demographic characteristics of farmers in the study area, assess adaptation strategies to the impact of climate change among rural farmers; identify farmer's adaptation measures to the impacts of climate change.

MATERIALS AND METHOD

Study Area

The study was carried out in Igabi Local Government Area (LGA) of Kaduna State. Igabi is one of 23 local government areas in Kaduna State and was created in 1989 out of the Zaria Local Government in Kaduna State, that is located in guinea savannah zone of Nigeria, and covers an area of about

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445,659km with a population of about 430,753 people according to the 2006 census (NPC, 2006). The LGA is made up of three districts namely: Igabi, Rigachukun and Rigasa. The Local Government is dominated by farmers who produce food crops on commercial level, major crops produced are yams, maize guinea corn, beans and sugarcane.

A reconnaissance survey was conducted in the area to observe the impacts of climate change on their farm and adaptation measures adopted by these farmers. This assisted in the construction of the research instrument for data in terms of questions necessary to satisfy the objectives.

The study employed the use of questionnaire to obtain data. The questionnaire contained relevant and well-structured questions aimed at eliciting responses that aid the understanding of the farmers' perception on the impacts of climate change and adaptation strategies to climate change issues in the study area. The questionnaire contained both open and closed ended questions. A total of three major districts make up the study area, and ten villages were randomly selected in each district, to make up thirty village.

The purposive sampling technique was used for the purpose of selecting respondents. This method is characterized by the use of personal judgment and a deliberate attempt to obtain representative sample by including presumable typical areas or groups in the sample (Abiola, 2007). The copies of questionnaire were distributed uniformly among the three (3) districts in the local government. To determine the actual number of questionnaire administered in each district, 150 copies of questionnaire were distributed among the Thirty villages evenly. Each village had 5 copies of questionnaire.

The data collected from this research was subjected to descriptive statistics and inferential statistics. Descriptive statistics was used to analyse the demographic characteristics of respondents and other variables such as age, gender, education, farm land size, years of farming experience, observed impacts of climate change over the years and various adaptation strategies. Descriptive statistical methods employed are tables and percentages pie and bar graphs as well as likert scale to determine the perception of farmers on the impacts of climate change in the study area.

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RESULTS AND DISCUSSION

Demographic Characteristics of the Respondents: The table 1 shows that majority fall within the age range of 31-50 years about 72% with the mean age of 37 years. This group forms the active percentage of farming population in the rural area and believe to have adequate knowledge of the study area, This result concurs with the study of Ikpe (2014) on adaptation strategies to climate change among grain farmers in Goronyo LGA of Sokoto State which showed that people within the age bracket of 31-50 years are active in farming activities in the area. According to Adesina and Forson (1995), age plays a major role in agricultural practices and coping strategies to climate change. It is generally agreed that age negatively influences the decision to adopt new strategies. It may be that older farmers are more risk averse and less likely to be flexible than younger farmers and thus have a lesser likelihood of adopting new technologies. Some scientists say that, age may positively influence the decision to adopt (Mignouna, Manyong, Mutabazi, and Senkondo, 2011). It could also be that older farmers have more experience in farming and are better able to assess the characteristics of the study area and the modern adaptive strategies than younger farmers, and hence a higher probability of adopting the strategies.

Figure 1 shows that 95% of the respondents are males while 5% are females. The result agrees with the findings by Abaje, Sawa and Ati (2014) which shows that the majority of the respondents were males while only 13% were females. This is also in agreement with Ishaya and Abaje (2008); Abraham, Bamidele, Adebola and Kobe (2012) who observed that the agricultural sector and the tedious activities related to climate change adaptation strategies are dominated by males.

Table 1 revealed that 23% of the respondents are single, 64% are married, while 10% are divorced, 2% are widowers and 10% are already separated. This may not be unconnected with the fact that marriage is an important aspect of adulthood in most African societies. Thus, individuals who have attained marriageable ages are left alone to fend for themselves outside the comfort of their parents' care (Bambale, 2014). This result is in line with findings of Abaje *et al*. (2014) that had the majority of the respondents are married.

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The Figure 2 shows the educational level of respondents in the study area; 18% have no formal education, 11% have primary education, followed by secondary education with 17% while 30% and 24 % are with tertiary education and adult education respectively. It could be deduced from the result that the majority of the respondents are educated with at least primary education. This implies that education of the respondents in the study area have direct influence or determinant to their perception to impacts of climate change and adaptation strategy ameliorate the problem of climate change in the study area. Formal education is still high among rural households hence their awareness of contemporary climate change issues may be high as well.

Table 1 shows the result of the farm size with 43% of the respondents having less than 1 hectare of land, 6% have between the range of 1-3 hectares while 27% have between 4-6 hectare and 24% have more than 6 hectare. It can be deduced from the result that the mean land size is 3.6 hectares. This indicates that 51% of respondents have above 4 hectare of land to farm. This implies that the respondents have enough land to farm and have knowledge about climate change and have adopted one or more adaptation strategies to climate change.

The table 1 further shows that 25% of the respondents have less than 2 years farming experience, 43% have between 2-4 years, 26% have between 5-7 years while 2% have between 8-10 years and 4% have more than 10 years of farming experience. It can be seen that majority of the respondents have more than 3 years of farming experience. This indicates that the respondents have adequate knowledge about the climate change and adaptation strategies to climate change. This is in agreement with findings of Gashua (1991) that greater the experience of a farmer the higher the chances of knowing the techniques used in adapting to drought. Duration of experience is therefore an advantage for any farmer because he is conversant with the climate of the area and also very experienced with the adaptation mechanisms being employed in his area of occupation.

Impact of Climate Change on rural farmers

Table 2 presents some impacts of climate change as perceived by respondents in the study area. This reveals their symmetry or otherwise

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with conventional indicators of measuring the perception of the impact of climate change. From the table 2, majority of the respondents (58%) strongly agreed that there is increase in the cost of horticultural crops production as a result of climate change. This followed by 26% of them that also agreed that the high cost of crop production is because of climate change while about 5% of them disagree with the declaration and a little over 3% of the sampled farmers strongly disagree with the statement.

On the assertion that, there is an increase incidence of floods during rainy season in the area, about 45% of the respondents agree to that. Also, a little over 32% of them strongly agree that there are increase cases of flood in the study area during rainy season while 2% strongly disagree. This is line with findings by Abaje, Sawa and Ati (2014) in Dutsin-Ma LGA of Katsina state that 83% of the people perceived that flood occurrences are increasing. Records have shown that this extreme weather event (flood) is becoming an annual occurrence in the northern parts of the country leading to loss of lives and property.

From the data shown in table, 41% of the respondents agree that there have been increased incidence of drought during rainy season and a little over 11% strongly agree to this assertion. Only about 8% and close to 4% disagree and strongly disagree with the statement that there has been increased incidence of drought during rainy season. The finding is in line with Zonkwa (2012) and Bambale (2014) where 53.1% and 57% of the sampled farmers agreed that, there is increased of drought during rainy season. But this is also in variance with most of the recent researches related to drought occurrences in the northern parts of the country using recorded climatic data. For examples, Ati *et al*., (2007); Ati *et al*., (2009); Odekunle *et al*., (2008); Abaje *et al*., (2012); Abaje *et al*., (2013) observed that drought occurrences in this zone is decreasing in recent years.

The perception of the respondents on the issue whether climate change has led to increase in crop pests and diseases reveal that, 58% agree with the above statement and 16% strongly agree that increased in pests and diseases is because of climate change. The result concurred with finding of Bambale (2014) which showed that 48.5% of the sampled farmers agreed that pestes and disease are as the result of climate change. This again is line with the findings by Zonkwa (2012) which showed 49.5% agreeing to the above statement. It is also noted that, close to 54% and

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12% of the respondents agree and strongly agree respectively that there is gradual heat stress in the study area. While 6% disagree with the assertion and a little over 5% strongly disagree. This observation can be based on observations of decreasing rainfall, increasing temperature which results in decreased agricultural productivity and production, high evaporation rates and reduced soil moisture, lowering of the groundwater table and shrinking of surface water.

Furthermore, about (59%) of the respondents agree that, there is gradual reduction in vegetation cover, close to 6% strongly agree that, there is reduction in vegetal cover while 5% strongly disagree. This is in variance with findings by Nicholson (2001) who carried out studies in Sudan and reported no evidence of widespread removal of vegetation cover in the villages. However, the study revealed that vegetation changes was as a result of drought and noted that there was full recovery of the land as soon as drought ended. Results from the table also show that a little over 41% of the respondents agree that there is decrease in crop yields and close to 32% out of them strongly agree that there is decrease in crop yields as a result of climate change. This result agreed with IPCC (2001) which stated that climate change in the form of higher temperature, reduced rainfall and increase rainfall variability reduces crop yield and threatens food security in low income and agriculture based economics.

Farmers' Adaptation Strategies to some Climate Change Indices

Respondents claimed to have variety of adaptive strategies to withstand some impacts of climate change. Results are depicted in Table 3 that, close to 14% of the respondents argued that cultivating resistance varieties of crops is the method employed for adapting to some indices of climate change, 10% practice adaptation by planting pests and diseases resistance and tolerant crops, another 20% of the respondents indicated that planting of cover crops is adaptation strategy for flood and drought as effect of climate change, 12% of the respondents employed the method of mulching to adapt to the delayed rainfall and other similar problems of climate change, majority 30% adapted by planting of trees to adapt and also mitigate the effects of climate change in the study area, while crop rotation are practiced by 14% of respondents, and only 1% adopting other methods

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not mentioned, like increased in the use of organic manure. Most of the respondents combine two or more options to adapt. This is in line with findings by Ifeanyi-Obi *et al*., (2012) who stated that, adaptation options/ strategies must not be used in isolation. Farmers combine two options where necessary in order to achieve the desired result.

Table 1: Demographic Characteristics of Respondents

Variables	**Frequency**	**Percentage**
Age		
Below 20 years	7	3
21- 30 Years	33	22
31-40 Years	61	43
41-50 Years	41	29
50 Years and above	7	3
Total	**150**	**100**
Marital Status		
Single	35	23
Married	89	64
Divorced	4	1
Widowed	6	2
Separated	17	10
Total	**150**	**100**
Farm Size		
Less than 2 hectare	61	43
2-4 hectare	12	6
4-6 hectare	40	27
More than 6 hectare	37	24
Total	**150**	**100**
Farming Experience		
Less than 2 years	37	25
2 – 4 yeas	61	43
5 – 7 years	38	26
8 – 10 years	6	2
10 years and above	8	4
Total	**150**	**100**

Source: Field Survey, 2019.

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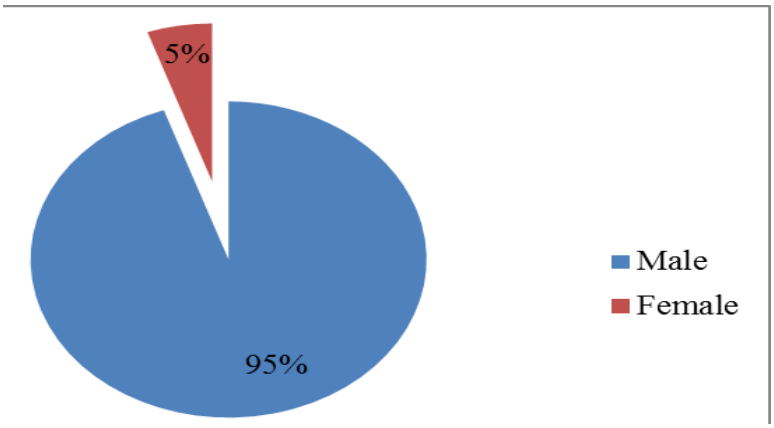

Figure 1: Gender of Respondents

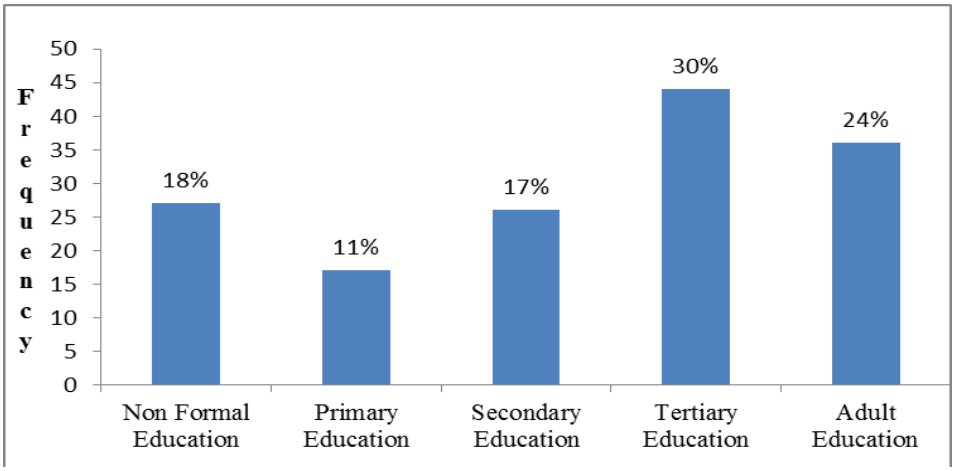

Figure 2: Level of Education of Respondents

Table 2: Impact of Climate Change on Rural Farmers

Descriptions	SA	A	UD	D	SD	Total
Increased Production Cost	81 (58%)	38(26%)	15 (8%)	9 (5%)	7 (3%)	150 (100%)
Cause Flood	46 (32%)	64 (45%)	25 (16%)	9 (5%)	7 (2%)	150 (100%)
Cause Drought	19 (11%)	66 (47%)	43 (30%)	14 (8%)	8 (4%)	150 (100%)
Cause Pests and Diseases	25 (16%)	81 (58%)	24 (15%)	8 (4%)	12 (7%)	150 (100%)
Heat Stress	20 (12%)	75 (54%)	35 (23%)	11 (6%)	10 (5%)	150 (100%)
Red. in Vegetal Cover	11 (6%)	82 (59%)	36 (24%)	11 (6%)	9 (5%)	150 (100%)
Reduce the Yield	46 (32%)	58 (41%)	24 (15%)	11 (6%)	11 (6%)	150 (100%)

SA- Strongly Agreed, A- Agreed, UD- Undecided, D- Disagreed, SD- Strongly Disagreed
Source: Field Survey, 2019.

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Table 3: Adaptation Strategies to Some climate Change indices

Climate Change Indices / Adaptation Strategies	Increased Rainfall	Decreased Rainfall	Delayed Rainfall	Lower Temp	Higher Temp	Total
Resistance Variety of Crops	17 (12%)	8 (5%)	17 (10%)	45 (31%)	25 (16%)	112 (14%)
Pests and Diseases Resistance Crops	22 (14%)	14 (8%)	6 (4%)	25 (16%)	16 (7%)	84 (10%)
Cover Crops	9 (4%)	20 (12%)	59 (42%)	21 (13%)	42 (29%)	151 (20%)
Mulching	9 (4%)	26 (16%)	42 (29%)	0	17 (9%)	95 (12%)
Planting of Trees	79 (57%)	63 (45%)	26 (17%)	26 (17%)	22 (14%)	216 (30%)
Crop Rotation	27 (17%)	25 (15%)	0	34 (22%)	26 (16%)	112 (14%)
Others	8 (2%)	7 (1%)	7 (1%)	7 (1%)	0	29 (1%)

CONCLUSION AND RECOMMENDATIONS

It was concluded that since the study area is a rural area and level of development is low, which makes the community quite vulnerable to the impact of climate change. Various adaptive measures are being employed by the farmers. These include planting of drought tolerant crops, mulching of crops to reduce water loss, increase in the use of organic manure and planting of different varieties of crops amongst others. The problems of climate change are already evident. Therefore to properly address the issue of self - sufficiency in food production and export, thereby enhancing virile economy, it is recommended as follows:

i. More emphasis on dissemination of climate change issues through the mass media is highly needed. Government should broadcast programs to enlighten farmers on adaptation strategies to reduce factors that aggravate climate change and as well as showcase successful adaptation techniques adopted elsewhere that have local relevance.

ii Also there is need for extension agents, policy makers and researchers to try and get farmers to effectively adapt to climate change. This can be achieved by providing free extension advice; information on early warning signals and improved farmer education to create proper awareness on climate change and effective adaptation processes that can be employed by farmers.

iii. There is need for Igabi local government council to partner with multilateral and international agencies to build capacities of horticultural farmers in relevant areas so as to strengthen the

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farmers' ability to develop and implement adaptation strategies and plans that would reduce her vulnerability to the impacts of climate change. Some of these areas include, providing financial resources which will increase their ability to adopt crop, water and soil management strategies in response to climate change.

iv. Also there is a need for international agencies, researchers and extension agents to provide programmes such as female cooperative groups that support female farmers from being extremely vulnerable to climate change. By so doing, it will go a long way in improving the standard of living of households in the Igabi LGA of Kaduna State, Nigeria.

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