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Adaptation Strategies to Combating Climate Variability and Extremity among Farmers in Selected Farm Settlements in Oyo State, Nigeria

[1]BOROKINI T.I., [2]OSEWA S.O, [3,4]BABALOLA F.D, [5]ALAMU O., [6]OLUBIYI M.R

[1]Plant Genetic Resources Unit, National Centre for Genetic Resources and Biotechnology (NACGRAB), Moor Plantation, Ibadan, Nigeria[2] Genetic Resources Unit, National Centre for Genetic Resources and Biotechnology (NACGRAB), Moor Plantation, Ibadan, Nigeria
[3]Centre for Environmental Economics and Policy in Africa, University of Pretoria, South Africa
[4]Department of Forest Resources and Management, University of Ilorin, Ilorin, Nigeria
[5]Plant Genetic Resources Unit, National Centre for Genetic Resources and Biotechnology (NACGRAB), Moor Plantation, Ibadan, Nigeria
[6]Plant Genetic Resources Unit, National Centre for Genetic Resources and Biotechnology (NACGRAB), Moor Plantation, Ibadan, Nigeria

Abstract:

The adverse effects of climate variability and extremities on agriculture in Africa have been widely reported. This calls for adaptive strategies in farming so as to reduce vulnerability and ensure food security. This study was therefore conducted to evaluate the awareness of farmers to climate variability and their adaptation strategies in four selected farm settlements in Oyo State, Nigeria. . Structured questionnaires were administered to 120 farmers using a stratified random sampling method. The results showed very high awareness of climate variability among the farmers. However, majority of the farmers acquired their land by lease, while local farm tools are still used by most of the farmers. Sole cropping, mixed cropping and crop rotation were mostly practiced by the farmers. The farmers reported prevalence of crops pests and diseases, flooding, disappearance of bi-modal rainfall, increased temperature and drought in their farmlands, leading to increase in poverty, higher production costs and poor crop harvests as evidences of harsh climatic conditions. Adaptation strategies used by the farmers were changing planting dates, planting new varieties, intercropping and alternative income generating activities. The farmers are encouraged to acquire more efficient farming system and equipment, while they should strongly consider other adaptation strategies such as agricultural insurance, agroforestry, water conservation methods, soil conservation farming, irrigation farming, organic farming and mechanized farming. Furthermore, land tenure policy that could constrain the farmers should be reviewed, while they should be given proper training.

Keywords: Climate variability, adaptation strategies, agriculture, vulnerability, Oyo State, Nigeria

1. Introduction

Nigeria is the 7th most populous nation in the world and world's most populous black nation. The nation's population is estimated at 162 million in 2011 and expected to be between 230 and 450 million people by year 2050 [1]. Nigeria is facing huge food security challenges, in spite of the fact that the country is largely agrarian. About 70% of the population lives on less than one hundred naira ($0.70) per day, 84% of the entire population earn less than $2.00 a day in 2009, while 68% of Nigerians live on less than $1.25 per day [2-3]. A report by Edo Agricultural Development Programme [4] noted that less than 5% of Nigerians are food secure, 65% are semi-food secure, while the remaining 30% are food insecure. Over 70% of Nigerian population lives below the poverty line, while 35% of them live in absolute poverty [5]. As a result of food insecurity, malnutrition, health deterioration, social vices, unemployment, high infant mortality and low life span have all being on the increase in Nigeria [6].

Furthermore, Nigeria has about 79 million hectares of arable land, of which only 32 million hectares are cultivated [7]. It was also reported that over 90% of food production in Nigeria is rain-fed while only about 1 million hectares of farmland is currently irrigated in the country [8]. Worse still, 90% of crop production is done with hand tools, 7% with animal-drawn tools and the remaining 3% by engine-powered technology [9]. The World Bank has shown that food production in Sub-Saharan Africa must increase by 4% in order to achieve food security [10]. In spite of the grave situation, the climate seems to be changing

*Corresponding author: Borokini T.I; E-mail: tbisrael@gmail.com
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and tending towards extremity in temperatures and rainfall patterns.

Sub-Sahara Africa is one of the most vulnerable regions to climate variability and extremity impacts, because majority of the people in this part of Africa live in abject poverty and depends mainly on rain-fed agriculture for their economic and livelihood sustenance [11]. In Nigeria, available meteorological data show increasing temperature and changing rainfall patterns in various parts of the country [12-14].

Several studies have been carried out on the adverse effects of climatic variability on agricultural production in various parts of Africa [15-19], revealing a decline in agricultural production due to flooding, wilting of crops, proliferation of crop pests and diseases, poor crop germination and overall crop failure. In order to meet increasing food demands as a result of population increase, farmers are now involved in farming practices that are directly leading to rapid depletion of fertile soils, groundwater, biodiversity, forest cover and other natural resources [20]. To reduce the impacts of climate extremities, farmers need to prepare with adaptation strategies. FAO [21] explained adaptation to climatic variability in terms of awareness to the risks and farmers' capacity to carefully plan and implement adaptation strategies. While farmers' awareness can be achieved by providing agricultural extension services and through information dissemination; planning and implementation on the other hand involves technical developments and government insurance, and these are principally the responsibility of public agents, agribusiness and government [21].

Farm settlement scheme was introduced in Nigeria in 1959 with the main objective of providing lands for young school leavers as a way of encouraging them to undertake farming business rather than migrating to urban areas in search of white collar jobs [22]. However, the scheme failed as a result of young age and inexperience in farming of the benefactors coupled with government's eventual withdrawal of allowances and lack of capital for effective farm establishment [23]. All these factors eventually led to massive drop-outs among the farm settlers [23]. Today, only few of the farm settlements remain, mainly concentrated in Southwestern Nigeria. This study was therefore conducted to evaluate the awareness of farmers to climate variability and their adaptation strategies in Oyo State, located in Southwest Nigeria.

2. Materials and Methods

Oyo State is an inland state in Southwestern Nigeria, with Ibadan as its capital city. The state covers an approximate 28,454 square kilometres (10,986 square miles). The estimated population of the State in 2007 was 6,617,720 people, with a population density of 200 persons/kilometer (510 persons/square mile). The State is homogenous, mainly inhabited by Yoruba ethnic group, who are primarily agrarian. The main crops cultivated are maize, yam, cassava, millet, rice, plantains, cocoa and many other food and cash crops. There are several farm settlements in Oyo State, which include Ijaye, Ipapo, Eruwa, Ilora, Ogbomosho, Iresaadu, Akufo, Lalupon, Iseyin, Fashola and others.

The study was conducted in 4 selected farm settlements in Oyo State, which are Ijaye, Eruwa, Iseyin and Akufo (Figure 1). Before commencement of actual data collection, reconnaissance visits were conducted to these settlements. The reconnaissance visits were conducted to determine the distribution of the farmers and their farming activities, understand the demographic characteristics as well as familiarize with the terrain of the communities and the local farmers, and to seek necessary approval from the Government officials and town leaders for the data collection.

Data collection was carried out between October and December 2012. Thirty farmers were randomly selected in each of the 4 farm settlements for questionnaire administration supplemented with one-on-one interview. The questions were read and interpreted to the illiterate farmers, while proper explanations of terminologies in the questionnaire were also properly done for appropriate responses.

The questionnaires contained structured questions which focused on demographic characteristics of the farmers, farm implements used in farming operations, land tenure systems practiced by the communities, farming systems practiced by the farmers, farmers' awareness of climate variability, evidences of climate variability in farmlands, and adaptation strategies adopted by the farmers to reduce vulnerability. All the 120 questionnaires administered were completed and returned.

Data compiled from the survey were processed and analysed using appropriate statistical tools. Binomial Test was used to determine the level of significance of the farmers' responses on their farming systems,

awareness of climate change, evidence of climate change, and adaptation strategies.

The Binomial Test procedure compares the observed frequencies of the two categories of a dichotomous variable to the frequencies that are expected under a binomial distribution with a specified probability parameter [24]. The equation for the two-tailed probability is given thus:

$$\min\left(1, 2\left(\sum_{i=0}^{m}\binom{N}{i}0.5^{N}\right)\right)$$

Where m = min ($n1$, $n2$); $N = n1+n2$

Kruskal-Wallis ranking analysis was used to assess the land tenure practices among the farmers in the study area. The land tenure represents the different ways by which the farmers obtained the land on which their farms are established. The equation for estimating the ranks is outlined thus:

$$H = \frac{12}{(N+1)}\sum_{i=1}^{ni}\frac{1}{ni}\frac{[Ri - ni(N+1)^2}{2}$$

Where Ri, is the sum of the ranks assigned to observation in the ith sample and

$\frac{ni(N+1)}{2}$ isthe expected sum of ranks for the ith treatment [25].

3. Results and Discussions

3. 1 Demographic information of the farmers

The survey was conducted to evaluate awareness level of farmers on climate variability and their level of preparedness for climate extremities. The results of demographic information of the sampled farmers presented in Table 1 show that 50.8% were within the age range of 31-50 years, while family sizes of 1-5 and 6-10 were each 48.3%. Furthermore, 65% of the respondents were males, 54.2% were Muslims while 44.2% were Christians. About 80% of the respondents were married, while only 10.8% were single. Only 34.2% of the farmers had education up to tertiary level (Table 1). The main farm implements used for farming in the 4 farm settlements was cutlass (97.5%), followed by spade (38.3%), hand trowel (34.2%) and hoe (33.3%) among others (Table 2).

Table 1: Demographic information of the farmers

Demographic characteristics	**Frequency**	**Percentage**	**Demographic characteristics**	**Frequency**	**Percentage**
Age (years)			***Size of family***		
Less than 20	0	0	1 – 5	58	48.3
21 – 30	21	17.5	6 – 10	58	48.3
31 – 40	31	25.8	11 – 15	4	3.3
41 – 50	30	25.0	16 – 20	0	0
51 – 60	29	24.2	More than 20	0	0
More than 60	9	7.5			
Gender			**Religion**		
Male	78	65.0	Christianity	53	44.2
Female	42	35.5	Islam	65	54.2
			Traditional	2	1.7
Marital status			**Highest level of Education**		
Married	96	80.0	No formal education		
Single	13	10.8	Primary	15	12.5
Divorced	4	3.3	Secondary	21	17.5
Widowed	7	5.8	Tertiary	43	35.8
				41	34.2

Table 2: Farm implements used by the farmers

Implements	Frequency	Percentage
Cutlass	117	97.5
Spade	46	38.3
Hand trowel	41	34.2
Hoe	40	33.3
Rake	29	24.2
Shovel	24	20.0
Garden fork	12	10.0
Secateurs	11	9.2
Shear	5	4.2
Wheel barrow	4	3.3
Others	4	3.3
Axe	1	0.8

3.2 Land tenure and farming systems practised by the farmers

Furthermore, the results indicate that majority (59.2%) of the farmers acquired the farmland by lease, while other notable source of land acquisition include inheritance (20.8%) and purchase (11.7%) (Table 3). The results of the binomial test for the farmers' responses indicate that sole cropping, mixed cropping and crop rotation were practised by majority of the farmers (Table 4). All the farming systems were highly significant at 1% (p = 0.01), except for multiple cropping (p=171) and shifting cultivation (p=235). This means that the null hypothesis for multiple cropping and shifting cultivation is retained, indicating that these farming systems were not practised by the farmers.

Table 3: Statistics and Kruskal Wallis Test for the land tenure among the farmers

Land tenure	N	Percentage	Mean values	Rank
Freehold	2	1.7	35.50	1
Inheritance	25	20.8	50.28	2
Others	2	1.7	61.00	3
Lease	71	59.2	61.32	4
Purchase	14	11.7	69.43	5
Gift	6	5.0	80.67	6
Total	120	100		

$\chi^2 = 6.170$; df = 5; Sig = 0.290

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Table 4: Farming systems practised by the farmers

Farming systems	***Frequency (n=120)***	***Percentage***	***Significant level***
Sole cropping	120	100	.000**
Mixed cropping	111	92.5	.000**
Crop rotation	105	87.5	.000**
Multiple cropping	68	56.7	$.171^{ns}$
Shifting cultivation	53	44.2	$.235^{ns}$
Irrigation farming	24	20.0	.000**
Silvopasture (livestock and tree with shrubs)	18	15.0	.000**
Agroforestry (trees and shrubs with crops)	1	8.0	.000**
Alley cropping (crops and trees)	3	2.5	.000**
Silvoarable (trees and arable)	1	0.8	.000**

Last column for results of Binomial Test

**Significant at 0.01; ns = Not significant at 0.05

3.3 Farmers' awareness of climate change

Table 5 indicates the farmers' awareness of climate change. All the tested predetermined factors among the farmers were significant at either 1% or 5%. From the results, 99.2% of the farmers are aware that the climate is changing (p=0.000). Ranking topmost among the tested factors was common occurrence of flood (89.2%, p=0.000) closely followed by changing in cropping season (84.2%, p=0.000). Other significant factors from the farmers awareness were disappearance of bi-modal rainfall (39.2%, p=0.022), appearance of foreign crops (38.3%, p=0.014), frequent drought (37.5%, p=0.008), increase in sunshine intensity (33.3%, p=0.000), among others.

Table 5: Farmers' awareness of climate change

Awareness	***Frequency (n=120)***	***Percentage***	***Significant level***
Farmer's awareness that climate is changing	119	99.2	.000**
There is common occurrence of flood	107	89.2	.000**
Cropping calendar is changing	101	84.2	.000**
The bi-modal rainfall is disappearing	47	39.2	.022*
There is growth of crops that were not known in the area before	46	38.3	.014*
There is frequent drought	45	37.5	.008*
The sun intensity has increased over the years	40	33.3	.000**
Quality of crops is reducing	36	30.0	.000**
Decrease in soil fertility due to increase in temperature	32	26.7	.000**
Farm produce are easy to store without spoilt	10	8.3	.000**
Climate variation has affected soil structure	8	6.7	.000**

Last column for results of Binomial Test [analysis of yes (1) and no (2) responses by the farmers]
**Significant at 0.01; *Significant at 0.05

3.4 Evidence of climate change

On the evidence to show that climate is changing, the farmers were subjected to a set of questions and the results are presented in Table 6. Among the top ranking and significant factors on the evidence of climate change as indicated by the farmers include prevalence of crop diseases (95.0%, p=0.000), incidence of flood after rain (95.0%, p=0.000), high cost of produce (79.2%, p=0.000), poor harvest of crops (69.2%, p=0.000), disappearance of bi-modal rainfall (66.7%, p=0.000), and increase in soil water evaporation (63.3%, p=0.005).

3.5 Impacts of climate variability

As indicated by the farmers, the impacts of climate variability within the farm settlements are presented in Table 7. Although more than half of the farmers (51.7%) affirmed that they have lost interest in farming, and some also indicated that climate variability is causing malnutrition (43.3%), reduction in quality of crops (43.3%), and loss of agricultural land suitable for crops (42.5%), however, the results were not significant. Other results on the impacts of climate variability in the settlements were significant, though with majority having fewer responses below the average number of the sampled farmers. Some of the significant results on impacts of climate variability with considerable responses include insufficient of yearly rains to support crop production (40.0%, p=0.036), increase in poverty due to reduction in production (33.3%, p=0.000), easy spoilage of harvested produce (30.8%, p=0.000), increase in cold spells (30.0%, p=0.000), social conflicts over land are on the increase (17.5%, p=0.000), among others.

3.6 Adaptation strategies to climate change

The adaptation strategies to climate change adopted by the farmers are presented in Table 8. Among the adaptation strategies that the farmers always use include taking early rains into consideration before planting (71.7%), use of local knowledge in weather forecast (70.8%) prior plantingdecisions, and engage in alternative income generating activities (60.8%), engaging in alternative income generating activities (60.0%), zero tillage (52.5%), planting new varieties (46.7%), use of organic fertilisers (41.7%), mixed farming (38.3%), and multiple cropping (35.8%). Among the occasional

adaptation strategies include mulching (80.0%), changing planting dates (70.0%), multiple cropping (54.2%), and cereal/legume intercropping (47.5%)

Table 6: Evidence of Climate Change

Evidences of climate change	***Frequency (n=120)***	***Percentage***	***Significant level***
Prevalence of crop diseases	114	95.0	.000**
Incidence of flood after rain	114	95.0	.000**
High cost of produce	95	79.2	.000**
Poor harvest of crops	83	69.2	.000**
Disappearance of bi-modal rainfall	80	66.7	.000**
Increase in soil water evaporation	76	63.3	.005*
Increase in pest infestation	67	55.8	.235*
Increase in temperature	66	55.0	.315*
Loss of interest in farming	62	51.7	.784^{ns}
Flooding of farmland is less common	59	49.2	.927^{ns}
Rain are usually accompany with storms	56	46.7	.523^{ns}
Incidence of drought during rainy season	53	44.2	.236^{ns}
Malnutrition	52	43.3	.171^{ns}
Reduction in quality of crops produced	52	43.3	.171^{ns}
Loss of agricultural land suitable for crops	51	42.5	.121^{ns}
Yearly rains are not supporting crop production	48	40.0	.036*
Increase in poverty due to reduction in production	40	33.3	.000**
Harvested produce get spoil easily	37	30.8	.000**
Cold spells are now on the increase	36	30.0	.000**
Increase in farm size	34	28.3	.000**
Social conflicts over land are on the increase	21	17.5	.000**
Poor germination of crop	17	14.2	.000**
Rapid loss of soil nutrient	13	10.8	.000**
Insurgence of foreign crops in the area	8	6.7	.000**
Reduction in working hours of farmers	6	5.0	.000**
Crops takes longer time to mature	6	5.0	.000**
Farming operations are becoming more tedious	3	2.5	.000**

Last column for results of Binomial Test [analysis of yes (1) and no (2) responses by the farmers]

**Significant at 0.01; *Significant at 0.05; ns = Not significant at 0.05

Table 7: Impacts of climate variability

Impacts of climate change	***Frequency***	***Percentage***	***Significant level***
Loss of interest in farming	62	51.7	.784^{ns}
Malnutrition	52	43.3	.171^{ns}
Reduction in quality of crops produced	52	43.3	.171^{ns}
Loss of agricultural land suitable for crops	51	42.5	.121^{ns}
Yearly rains are not supporting crop production	48	40.0	.036*
Increase in poverty due to reduction in production	40	33.3	.000**
Harvested produce get spoil easily	37	30.8	.000**
Cold spells are now on the increase	36	30.0	.000**
Social conflicts over land are on the increase	21	17.5	.000**
Rapid loss of soil nutrient	13	10.8	.000**
Insurgence of foreign crops in the area	8	6.7	.000**
Reduction in working hours of farmers	6	5.0	.000**
Crops takes longer time to mature	6	5.0	.000**
Farming operations are becoming more tedious	3	2.5	.000**

Last column for results of Binomial Test [analysis of yes (1) and no (2) responses by the farmers]

**Significant at 0.01; *Significant at 0.05; ns = Not significant at 0.05

Table 8: Adaptation strategy employed by farmers

Adaptation strategies	*Always*	*Occasional*	*Rarely*	*Never*
Consulting rainmaker	0.8	6.7	24.2	68.3
Planting new varieties	46.7	40.8	11.7	0.8
Use local knowledge of weather forecast	70.8	28.3	0.8	0
Planting different crop varieties	31.7	37.5	28.3	2.5
Ridges across the slope	0	26.7	70.0	3.3
Use of organic fertilisers	41.7	34.2	10.8	13.3
Zero tillage	52.5	29.2	8.3	10.0
Cereal/legume intercropping	19.2	47.5	22.5	10.8
Changing planting dates	0	70.0	29.2	0.8
Mixed farming	38.3	31.7	30.0	0
Fadama farming / irrigation	3.3	21.7	49.2	25.8
Mulching	10.0	80.8	8.3	0.8
Planting trees	0.8	20.0	55.8	23.3
Multiple cropping	35.8	54.2	6.7	3.3
Planting drought resistance varieties	2.5	10.0	60.0	27.5
Taking early rains into consideration before planting	71.7	26.7	1.7	0
Engage in alternative income generating activities	60.8	35.8	0	3.3
Use of inorganic fertiliser	35.8	22.5	41.7	0
Combating land degradation	0	6.7	49.2	44.2

Figures in tables are in percentages

Much had been written and reported about climate variability and extreme weather in Nigeria and Africa; however, the level of preparedness and adaptation, especially in the agricultural sector are inadequate. Previous studies have shown that without adaptation, climate extremity has huge negative effects on agriculture, but adaptation strategies can help reduce the effects [26-37].

The results of this study reveal that the farmers in the farm settlements have high awareness of climate variability. The high awareness of the farmers to climate variability has also been reported among farmers across Sub-Saharan Africa [28-30]. The high level of climate change awareness in the farm settlement may be due to the fact that majority of the farmers are educated with up to 87% having formal education. The level of education of the farmers also assists them in developing good knowledge of the local weather forecast and making good decisions in agriculture In addition, since the farmers resides in the farm settlements, their weekly farmer group meetings would have helped in sharing technical information relating to farming systems among themselves.

More than 59.2% of the farmers acquired their land through lease, because it is the extant policy with respect to giving land in government farmlands to the farmers in the scheme. Also, land acquisition in Nigeria is very expensive and many people, including farmers, cannot afford to buy it. Generally, there is limitation to what a farmer can do on a leased land. For example, agroforestry is one of the adaptation strategies to climate variability, but the farmers may not be able to plant trees on plots allocated to them. However, secured land ownership increases chances of agroforestry [31-32]. This could be one of the reasons why agroforestry, irrigation farming and silvopasture farming systems are not common among the farmers. Therefore, there is the need to address land tenure policies for agriculture in order to achieve effective adaptation strategy with respect to planting of multipurpose trees as adaptation to extreme climate variability.

The use of local implement by the farmers is an indication of low level of farming practices in the settlement. Many State Governments in Nigeria have introduced farm schemes that help purchased farm machineries for the farmers; unfortunately some State Governments bought the machineries but are yet to distribute them to the farmers mostly due to political reasons. The use of local farm implements in farming in these farm settlements is an indication of low preparedness for climate variability extremes. Furthermore, lack of finance and access to financial assistance are another challenge to the farmers preventing them from adopting some adaptation practices such as the use of irrigation equipment.

These financial limitation could be overcome by government's provision of agriculture-based credit schemes or joint farmers' group savings.

Climate variability was experienced in the study area in form of prevalence of crop pests and diseases, flood, disappearance of bi-modal annual rainfall, increase in temperature, poor crop germination, among others, leading to poor crop harvest, high production cost, poverty and the need to increase farm size. This agrees with previous reports from West Africa where farmers experienced delayed rainfall and early cessation, and excessive rain and strong winds, which sometimes leads to flooding [29,34-35]. Similarly in Southern Africa, farmers noted that summer periods are becoming hotter, while winter periods are becoming drier and colder [30, 36-37].

The evidences of varying climatic patterns reported by farmers in this study correspond to those reported by earlier authors in other parts of Africa [30, 36-38]. All these are indicators of loss of farm income, increase in poverty and a general deterioration of farmers' welfare [35, 39-40].

The key adaptation strategies adopted by the farmers in this study include local knowledge of weather forecast before planting, planting new varieties, alternative income generating businesses, occasional changing of planting dates and occasional mulching. However, in other parts of Sub-Saharan Africa, farmers were reported to shift cultivation to low water-requiring crops, cultivating short-term plants so as to avoid flooding [29-30, 38-39]. In addition, farmers were also reported to change their planting dates in line with changes in rainfall patterns, planting tree crops, mixed cropping and alternative income generating activities[29-30, 37, 39-40]. Farmers in water-stressed African countries were observed to adopt water conserving methods such as water harvesting, waste water recycling and crop irrigation, as well as soil conservation methods[37, 39-40],while some farmers in parts of South and East Africa abandoned arable farming for livestock farming [29,40].

4. Conclusions

This present study has shown a high level of awareness on climate change among farmers in the Oyo State farm settlements. This is a positive indicator of the awareness strategies for the farmers through association, extension services, and high level of education, provided to farmers in farm settlements. However, there is a lot of room for improvement in the adaptation strategies. The farmers need to be encouraged in agricultural insurance, agroforestry, organic farming, water conservation and recycling methods and soil conservation methods, especially leguminous cover cropping and mulching. Irrigation farming, mechanized farming, organic farming and agroforestry need to be encouraged among the farmers. The land tenure policy constraints that could discourage the farmers should be addressed and reviewed. Proper training and extension services geared towards effective adaptation strategies should be given to the farmers, in order to ensure food security.

5. References

1. Food and Agriculture Organization (FAO): **Historical and Projected Population of Nigeria.** United Nations Food and Agriculture Organization, http://www.fao.org, 2012.
2. Central Bank of Nigeria (CBN): **Annual Reports and Statements of Accounts for Year ended December 2008-December, 2009**; Central Bank of Nigeria, Abuja, 2010.
3. World Bank: **Poverty headcount ratio at national poverty line.** The World Bank; 2013. Retrieved from www.worldbank.org on February 8, 2014
4. Edo Agricultural Development Programme: **Edo State Agricultural Development Programme participating Rural Appraisal for Need Assessment of Form of Special Food Security**. Edo Agricultural Development Programme, 2002.
5. USAID: **Nigeria**. United States Aid for International Development, http://www.usaid.gov, Retrieved 15 July 2011.
6. Uko-Aviomoh EC: **Family Education, Vocationalism and Food Security of the Nigerian Child.***Journal of Home Economics Research* 2005; **6** (2): 70-79
7. Nwajiuba C: **Nigeria's Agriculture and Food Security Challenges**,
8. 2012. http://www.ng.boell.org/downloads/agriculture_-_green_deal_nigeria_study.pdf. Retrieved February 5, 2014.
9. Madu DB, Gundiri MN, Musa IK, Nwa EU, Adamu MS, Bala MS, Jada A, Musa IK, Ogunniyi EO: **Country Profile – Nigeria.** Federal Ministry of Water Resources, Abuja;

2010.

10. Onwualu AP, Pawa NP: **Engineering infrastructure for the manufacture of agricultural engineering machines in Nigeria: The role of NASENI.** Proceedings of the 2nd International Conference of the West African Society of Agricultural Engineering, Kumasi, Ghana. 20-24 Sept. 2004.
11. International Bank for Reconstruction and Development (IBRD): **Sub-Saharan Africa: From Crises to Sustainable Development. A long Term Perspective.** The World Bank. Washington D.C.; 1989.
12. Juana JS, Kahaka Z, Okurut FN: **Farmers' Perceptions and Adaptations to Climate Change in Sub-Sahara Africa: A Synthesis of Empirical Studies and Implications for Public Policy in African Agriculture.***Journal of Agricultural Science* 2013, **5** (4): 121-135.
13. Federal Ministry of Environment: **National Communication on Climate Change** (Final Draft). Federal Ministry of Environment, Abuja; 2003.
14. Odjugo PAO, Ikhuoria AI: **The impact of climate change and anthropogenic factors on desertification in the semi-arid region of Nigeria.***Global Journal of Environmental Science* 2003, **2**(2): 118-126.
15. Adefolalu DOA: **Climate change and economic sustainability in Nigeria.**Paper presented at the International Conference on Climate Change, NnamdiAzikwe University,Awka 12-14 June 2007.
16. Kowal JM, Komal DO: **The Pattern of Water Availability and Water Requirement for Grain Sorghum Production at Samaru, Nigeria.***Tropical Agriculture Trinidad* 2002, **50**:21.
17. Gbetibouo G, Hassan R: **Measuring the economic impact of climate change on major South African field crops: a Ricardian approach.***Global and Planetary Change* 2005, **47**(2–4): 143–152.
18. Molua EL: **Climate variability, vulnerability and effectiveness of farm-level adaptation options: the challenges and implications for food security in southwestern Cameroon.***Environment and Development Economics* 2002, **7**: 529–545
19. Seleka TB: **The impact of Botswana's traditional arable agriculture: growth rates and the impact of the accelerated rain-fed arable programme (ARAP).***Agricultural Economics* 1999, **20**:121-133.
20. Borokini TI, Ojo A: **Management of protected areas in Sahel savannah ecoregion of Nigeria under the threat of desertification.***Scientific Annals of the Danube Delta Institute* 2013, **19**: 13-20
21. Abrahamson D: **The challenge of global warming.** Island Press; 1989.
22. Food and Agriculture Organization (FAO): **Additional Production and Design Group Publishing Management Services**, 2008. http://www.fadama.org//accessed 23/05/13.
23. Iwuchukwu JC, Igbokwe EM: **Lessons from Agricultural Policies and Programmes in Nigeria.***Journal of Law, Policy and Globalization* 2012, **5**: 11-21
24. Amalu UC: **Agricultural Research and Extension Delivery systems in Sub-Saharan Africa.** University of Calabar Press; 1998.
25. SPSS: **Binomial Test (nonparametric tests algorithms).** Statistical Package for Social Science (SPSS) Version 22. IBM Corporation; 2013.
26. Wayne DW: **Applied Non-parametric Statistic**: PNS-Kent Publishing Company; 1990.
27. Reilly J, Schimmelpfennig D: **Agricultural impact assessment, vulnerability and the scope for adaptation.** *Climatic change* 1999, **43**: 745–788.
28. Smit B, Skinner MW: **Adaptations options in agriculture to climate change: A typology.***Mitigation and Adaptation Strategies for Global Change* 2002, **7**: 85–114.
29. Deressa T, Hassan R, Ringler C, Alemu T, Yesuf M: **Analysis of the Determinants of Farmers' Choice of Adaptation Methods and Perceptions of Climate Change in the Nile Basin of Ethiopia.**IFPRI Discussion Papers No. 798, International Food Policy Research Institute, Washington DC, 2008.
30. Acquah-de Graft H., Onumah E: **Farmers' perceptions and adaptations to climate change: An estimation of willingness to pay.***AGRIS On-line Papers in Economics and Informatics*2011, **3**(4): 31-39.

31. Mandleni B, Anim F: **Perceptions of Cattle and Sheep Framers on Climate Change and Adaptations in the Eastern Cape Province of South Africa.***Journal of Human Ecology* 2011, **34**(2): 107-112.
32. Pattanayak SK, Mercer DE, Sillis E, Yang JC: **Taking stock on agroforestry adoption studies.***Agroforestry systems* 2003, **57** (3): 173-186.
33. Gyau AM, Chiatoh SF, Asaah E, Donovan J: **Determinants of farmers' tree planting behavior in the northwest region of Cameroon: the case of *Prunusafricana*.***International Forestry Review* 2012, **14** (3): 265-274.
34. Ogalleh SA, Vogl CR, Eitzinger J, Hauser M: **Local Perceptions and Responses to Climate Change and Variability: The Case of Laikipia District, Kenya.***Sustainability* 2012, **4**: 3302-3325.
35. Apata TG, Samuel KD, Adeola AO: **Analysis of Climate Change Perception and Adaptation among Arable Food Crop Farmers in South Western Nigeria.** Contributed Paper prepared for presentation at the International Association of Agricultural Economists' 2009 Conference, Beijing, China, August 16-22, 2009
36. Mertz O, Mbow C, Reenberg A, Diouf A: **Farmers' Perceptions of Climate Change and Agricultural Adaptation Strategies in Rural Sahel.***Environmental Management* 2009, **43**: 804-816.
37. de Wit M: **The perception of and adaptation to climate change in Africa**. CEEPA discussion Paper No. 10, CEEPA, University of Pretoria, 2006.
38. Gandure S, Walker S, Botha JJ: **Farmers' perceptions of adaptation to climate change and water in a South African rural community.***Environment Development*2012, **5**: 39-53
39. Gbetibouo G: **Understanding Farmers' Perceptions and Adaptations to Climate Change and Variability, the Case of the Limpopo Basin**. IFPRI Discussion paper 00849, South Africa, 2009.
40. Mengistu DK: **Farmers' perception and knowledge of climate change and their coping strategies to the related hazards: Case study from *Adiha*, central Tigray, Ethiopia.***Agricultural Sciences*2011, **2**(2): 138-145.

Sofoluwe N, Tijani A, Baruwa O: **Farmers' Perception and Adaptations to Climate Change in Osun State, Nigeria.***African Journal of Agricultural Research*2011, **6**