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Research Article

Adapting to climate changes: The challenge for rural farmers in the forest and southern Guinea savanna ecologies of Nigeria

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Abstract
Agriculture provides food for the ever growing population, supplies raw material for industrial sector and generates foreign exchange for economies. However, the onset and threat of climate change imposes stresses on rural farming activities given that agricultural activities are largely rain-fed in Nigeria. The research design adopted was the survey method with a population sample of 600 questionnaires and interview guide administered to 10 rural farming communities in Oyo and Osun States located within the forest and southern guinea savanna ecologies of Nigeria. Lack of capital (61.1% in Oyo and 57.2% in Osun) among other constraints such as lack of information, shortage of labour, lack of access to water, and poor health were identified as constraints to climate change adaptation by farmers. More than 80% (88.7% and 82.6%) of farmers acknowledged the climate had changed over the past 5-10 years mainly in terms of decrease in rain and change in its timing. The main implications for climate change are deterioration in quality of life, increased migration, and threats to social cohesion among others. The paper concludes that, the burden of climate change cannot be borne alone by rural farmers and recommends a rural development policy in providing support to rural farmers facing climate risks.

Keywords
agriculture–climate change–rural farmers–Nigeria

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1. Introduction

Climate change is one of the most serious environmental and human threats that are undermining the achievement of the Millennium Development Goals (MDGs) as well as the efforts of the international community to reduce extreme poverty. Climate change has therefore been a key issue around which global development policy is being framed especially in African countries. The predominance of rain-fed agriculture in their economies, the scarcity and in some cases lack of capital for adaptation measures, their tropical climates and heightened exposure to extreme weather events serve as a threat to food security in Africa (Fisher et al, 2005). There is a consensus that erratic and less reliable rainfall patterns will be major impacts of climate change in West Africa (Sarr, 2012). These impacts are expected to affect the commencement and span of growing seasons, particularly in semi-arid areas where yields from rain-fed agriculture could be reduced by up to 20–50% by 2050 (Sarr et al., 2007).

1.1 Impacts of climate change on agricultural production

Akinbobola et al. (2015) examined the impact of climate change on the composition of agricultural output in Nigeria for the period 1981 to 2011. Using an Ordinary Least square (OLS) estimation technique, the study observed that with exception to fishery production, climate change had a significant and positive impact on the composition of agricultural output in Nigeria. This result is not only surprising but also in contrast with a priori expecta- tion as well as the findings obtained in similar previous studies. Akpodiogaga & Odjugo (2010) did a general overview of climate change impacts in Nigeria and observed that

temperature in Nigeria has increased by 1°C while rainfall has dropped by 81 mm. While rainfall amount is generally decreasing in Nigeria, the coastal region of the country has been experiencing slightly increasing rainfall since the early 1970s. The short-dry-season popularly known as August break is currently being experienced more in the month of July. Sea-level rise is observed to have inundated 3,400 square km of Nigeria coastal region while desert encroachment is reducing arable lands from the northern part of the country by 1-10km per year. Iheoma (2014) identified the recent dominance of climate change on the one hand and the survival of agricultural production systems on the other hand in international debates. The study adopted two approaches in the analysis: when climate change is captured in the model and when it is not. The results reveal that if climate change is isolated from the model, irrigation, fertilizer, arable land and agricultural labour significantly positively correlated with crop production both on the aggregate and on individual sample bases.

2. Materials and Methods

The current study was carried out in Oyo and Osun states (Figure 1) of Nigeria which fall in the tall grass savanna and rain forest ecological zones, respectively (Figure 2). A semi-structured questionnaire was employed for data collection. In all, five communities were chosen in each State making a total of ten communities and a sample size of 300 farmers from each State. Purposive sampling was used in selecting the communities for the study which allowed us to choose a case because it illustrates some features or process in which we are interested" (Silverman,2010).

With the understanding that neither quantitative nor qualitative methods are sufficient in themselves to yield data to appropriately understand the situation on the ground (Creswell and Clark, 2007), the study adopted a mixed methods approach. This was with a view to bring to light the adaption strategies of rural farmers and the challenges they faced due to climate change and make recommendations for future adaptation. Quantitative data from the farmers' responses to the questionnaire were coded and analysed using means, percentages, standard deviation and frequencies. The results were presented graphically in charts, graphs and tables for discussion. Data collected from interview guides complemented the quantitative data and were analyzed by first transcribing and translating them from local languages to English and then organizing them into themes.

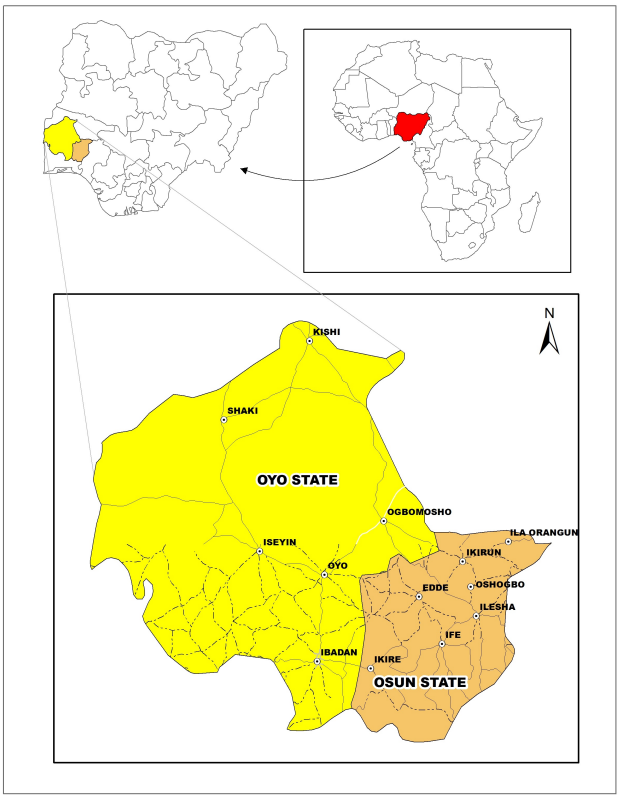

Figure 1. Map of Oyo and Osun States

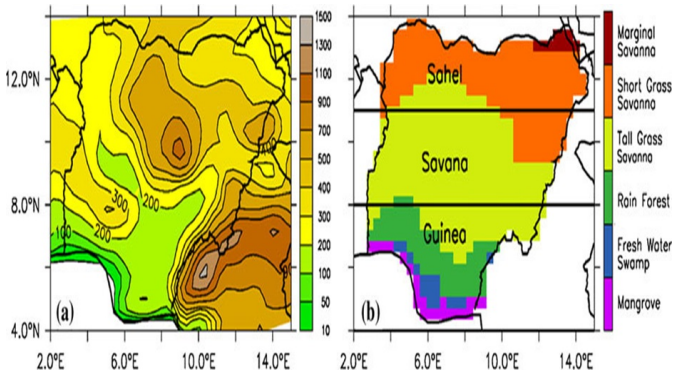

Figure 2. Topography domain and ecological zones in Nigeria with the regions designated as Guinea, Savanna and Sahel. (Abiodun et al., 2012)

3. Results and Discussion

Mean family size in this study was 6 in Oyo State and 7 for Osun State (Figure 3). Generally, farmers in Osun State had smaller households (1-6) compared with Oyo States that had larger households (>7) and the margin of difference was greater in the latter category than the former. Of all respondents, 225 (37.5%) had a household size of 4 to 6. Out of this, 116 were from Osun state while 109 were from Oyo state. Similarly, 160 (26.7%) of the farmers had 7 to 9 members in the family. Eighty four of them were from Oyo while 76 were from Osun State. Of the 124 farmers who had family size of more than 10 members, 60% was from Oyo State

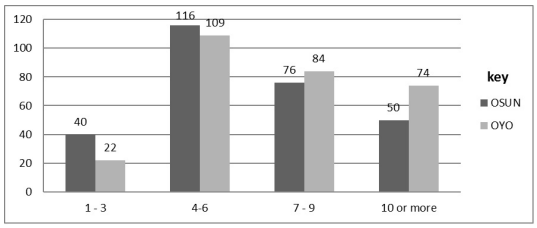

Figure 3. distributions of states by size of households. Source: Field Survey May, 2016

About 225 farmers earned an average monthly income of between 10,000-30,000 Naira out of which about 41.5% and 38.9% are from Oyo and Osun respectively. The study showed that farmers in Osun earn higher than those in Oyo as majority of the farmers with multiple income sources were from Osun with average income greater than the total average for the study. About 16.4% of the respondents from Osun earned more than 50,000 Naira monthly. The main food crops produced by farmers in Osun State were cassava (77.3%), cocoyam (50%) and plantain (27.7%) while yam (69.7%) and maize (82.7%) were largely produced in Oyo state.

3.1 Acknowledging climate change

Several studies have been undertaken on farmers acknowledgment of the reality of climate change and have provided e regard- evidence regarding farmers' consciousness of climate change and factors that influenced their choice of adaptation methods. Outcomes of such studies were reflective of the geographical locations where they were carried out. While Ishaya and Abaje (2008) reported a lack of awareness and knowledge by farmers in Jema'a, Nigeria, Deressa et al. (2009) reported that farmers in the Nile Basin of Ethiopia had observed increasing temperatures and decreasing rainfall over the 20 years preceeding the study. In this study, about 88.7% and 82.6% of the respondents from Oyo and Osun states respectively agreed that the climate had changed in the past 5 to 10 year as shown in Table 1. The fact that majority of these respondents had lived in the respective communities for more than ten years gave credibility to their responses and therefore affirms that these climatic change observations were from the cumulative experiences of the responding farmers. About 72% had farmed for more than five years in the study areas. Interestingly, 17.4% and 11.3% of respondents from Osun and Oyo states had not observed any climate change in the past 5 to 10 years. In the face of noticeable manifestations of climate change, Handmer and Dovers (2009) noted notidentify that the denial of its existence tends to keep the system functioning as business-as-usual. This legitimizes the focus on routine practices leaving little space for innovation hence adaption to the risk of climate change.

Table 1. Distribution of climatic change by states

	STATE		Total
Climatic change in past 5-10 years	OSUN(%)	OYO(%)	Total
Yes	82.6%	88.7%	85.6%
No	17.4%	11.3%	14.4%
Total	100.0%	100.0%	100.0%

Source: Field Survey May, 2016

Maddison (2006) emphasized that what farmers perceive about climate change are somewhat based on past observations with key interest on the recent climatic events to form their perceptions of climatic conditions which informs their decisions about adaptive behaviour. Respondents were asked to describe the change in rainfall pattern over the last 5-10 years. About 50.3% and 54.7% of respondents from Oyo and Osun States acknowledged a decline in the days of rainfall over the period while 25.2% from Osun and 21.8% from Oyo States pointed to a decrease in rains and change in the timing of rainfall as presented in Table 2. The next variable of interest that is change in temperature showed that 67.6% and 54.8% of the farmers from Oyo and Osun, respectively, held that temperature, had increased. About 21.1% and 10.4% of the farmers in Osun pointed to a fluctuating

and unpredictable temperature level. However, 10.25% of the Oyo farmers consider the temperature unpredictable and 9.6% respondents in each state consider it fluctuating and decreasing.

Table 2. Change in rainfall and temperature

		STATE		
Variables	Response	OSUN(%)	OYO(%)	Total(%)
Change in rainfall days over the last 5-10 years	Increased	8.4%	3.40%	5.9%
	Declined	**50.3%**	**54.7%**	52.5%
	Change in the timing of rains	12.4%	17.8%	15.1%
	Decrease in rains and change in timing	**25.2%**	**21.8%**	23.5%
	Change in frequency of droughts/floods	1.7%	0.7%	1.2%
	Others	0.7%	1.0%	0.8%
	Don't know	1.3%	0.7%	1.0%
Change in temperature for the past 5-10 years	Increasing	**54.8%**	**67.6%**	61.1%
	Decreasing	10.0%	9.6%	9.8%
	Fluctuating	**21.10%**	9.6%	15.4%
	Constant	3.0%	2.7%	2.9%
	Unpredictable	10.4%	**10.2%**	10.3%
	Don't know	0.7%	0.3%	0.5%

Source: Field Survey May, 2016

3.2 Main constraints to adaptation measures

In the two States, majority of the farmers (61.1% in Oyo and 57.2% in Osun) identified lack of capital as the dominant constraint to climate change adaptation (Figure 4). In order of magnitude as measured by the number of respondents identifying, the other constraints were lack of informa- tion, shortage of labour, lack of access to water, and poor health. The prioritization of these constraints reflect that the farmers are sufficiently aware of the need for measures to adapt to changes in climate and they have ideas, presumably from accumulated indigenous knowledge relevant to farming, about what measures were necessary. The need for supplementation of these traditional knowledge with externally-generated or scientific knowledge appears to be relevant as the farmers also identified the lack of information as a major constraint. All the other constraints identified are, to a large extent, tied to the financial capacities of the farmers and it is therefore not surprising that lack of capital was rated the most limiting constraint. Apata et al. (2010) and Onyeneke and Madukwe (2010) opined that capital constitutes a severe challenge to agricultural adaptation

An earlier study by Idrisa et al. (2012) in Borno State of Nigeria also revealed that poor financial resource base of farmers was a major constraint to climate change adaptation. According to Oyekale (2009), farmers, as a result of their low resource base, were more susceptible and less able to cope with the consequences of climate change. They are also unable to access weather and other relevant technical information and lacked capacity to develop technologies on their own. This is in line with the views shared by Deressa et al. (2008) that adaptation to climate change is costly, and the need for intensive labour use exacerbates this cost. The identification of health status of the farmers as a major constraint by about 5% of the farmers in Oyo State is noteworthy because about 44% of the farmers were between 46 and 65 years old at the time of the survey with an additional 13% being over 66 years old.

The health status is also reflective of the lack of medical facilities through which health challenges could easily be attended to. There was no single hospital in the entire study area in Oyo State with the closest community health facility about 20 km from the communities sampled and a standard hospital about 75 km away. Accessing these facilities will require that the farmers commit a substantial fraction of their grossly inadequate funds to transportation and payment for medical services.

The responses to the type of information required to adapt to climate change reflects the level of exposure of the farmers as well as their readiness to adopt appropriate adaptation measures and technologies that may be recommended to them. In both States, a higher proportion of the farmers (44% in Osun and 59% in Oyo) believe that adapting to climate change required both traditional

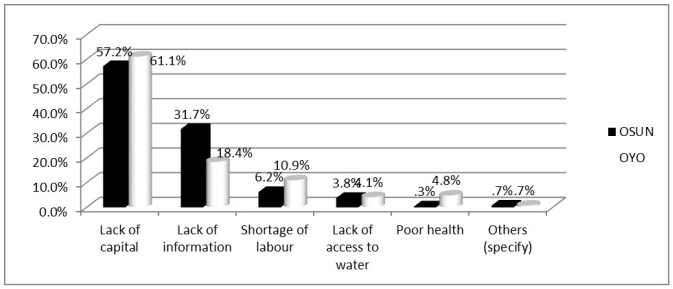

Figure 4. Major constraint to adaptation by states
Source: Field Survey May, 2016

and applied scientific knowledge such as weather forecast, proper use of external inputs, land management and soil fertility improvement methods, and adaptation technologies as far as these knowledge relate to their on-going experiences rather than to the abstract scientific basis of climate change. The locations of the farmers also influenced their priorities and reflect the differential effect of climate change based on ecological peculiarities. While farmers in the savanna (Oyo State) rated early warnings from weather and meteorological information as the most important scientific information, those in the forest ecology (Osun State) rated knowledge about soils and how to improve its fertility as the most important required scientific information. These priorities clearly reflect differences in the indicators of the changes in climate that the farmers are adapting to. In both States, a significant proportion of the respondents (66% and 77% respectively in Osun and Oyo States) also recognized the need to address land rights and associated contractual agreements. Both States, like other ones in the southern part of Nigeria, have witnessed incessant and fatal communal unrests associated with competition for land between farming and grazing. In addition, a higher proportion of respondents in Oyo State revealed the festering of ethno-social distrust prevalent in the predominantly farming communities in the northern parts of the State fondly referred to as the 'Food basket of the State'. Native land owners now have challenges of exercising ownership rights over migrant farmers that had settled, and in some instances intermarried, within communities in the study area over the last four decades. On the other hand, a new generation of the so-called migrant farmers who were born within the communities have emerged for whom the idea of paying royalty or rents over land is repulsive because they knew no other place than these communities where they were born and raised. The main type of information provided to farmers to adapt includes scientific, agricultural practices, knowledge and information, economic/commercial information, social information, legal and government efforts. Table 3 shows the most relevant information farmers need to adapt to climatic change. About 44.4% of these respondents from Osun needs legal information

on land right. The result showed 40.2% of the farmers from Osun expressed need for scientific information on knowledge about soil and how to improve its fertility while 37.4% indicated their need for social information on cultural and sustainable adaptation. Farmers from Oyo State placed more premium on Economic and commercial information, scientific and social information and government support. A significant proportion (60.8%) of the respondents wanted informa- tion on financial opportunities associated with climatic change. Also, 60.2% of the farmers wanted weather and meteorological information such as early warnings. Social information in the form of blending scientific and local knowledge to support adaptation to climate changes recorded 58.5% of the total respondents. Legal information on land tenure issues was required by 32.8% of the total response.

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Table 3. Type of information needed to increase ability to adapt to climate change impacts by state

		STATE	Total	
Variables	**Response**	**OSUN**	**OYO**	**freq.**
Social information	Local and traditional adaptation knowledge and technologies	18.9%	23.3%	96
	Culture and sustainable adaptation	**37.4%**	18.2%	118
	Blending scientific and local knowledge to support adaptation	43.7%	**58.5%**	234
Scientific information	None		0.4%	1
	The causes of climate change	15.50%	11.3%	59
	Weather and meteorological information (e.g. early warnings)	35.6%	**60.2%**	223
	Knowledge about soils and how to improve its fertility	**40.20%**	19.50%	128
	Predictions in relation to climate change	8.8%	8.6%	39
Agricultural Practices, knowledge information- incentives availability and access, eg inputs	Better management of agricultural land for sustainable production	19.20%	28.1%	117
	Proper use of agricultural inputs	**32.2%**	**28.9%**	147
	Climate change and sustainable farming systems	7.9%	8.9%	41
	Crop varieties tolerant to harsh climatic conditions	13.1%	10.7%	57
	Intensification of agriculture	4.2%	3.3%	18
	Adaptation knowledge and technologies for farmers	**23.4%**	20.0%	104
Economic/Commercial Information	Crops commanding good prices in the market	24.2%	19.8%	107
	Financial opportunities arising from climate change	41.1%	**60.8%**	256
	Credits availability and access	**34.7%**	19.4%	129
Legal Information	Land tenure issues	13.1%	**32.8%**	97
	Land rights	**44.4%**	30.6%	142
	Contracts issues	8.1%	14.2%	46
	Strategic and Policy information	**34.4%**	22.4%	107
Government efforts to address the challenges of climate change and variability	Alternative livelihoods options to reduce severity of climate change impacts	15.8%	22.4%	81
	Crop insurance	31.5%	36.6%	143
	Sustainable climate change adaptation policies and strategies	**44.00%**	**37.9%**	169
	Others (specify)	4.3%		8
	Don't know	4.3%	3.0%	15

Source: Field Survey May, 2016

3.3 Future adaptation strategies to climatic changes

Hansen et al. (2011) posited that climate changes were disincentive to agriculture making farmers to take precautionary measures to safeguard against it. Respondents were asked about their future adaptation strategies if climate change persists. The results showed that 46.2% (Osun) and 38% (Oyo) of respondents will continue changing agricultural practices in line with the changes in the climate. About 13.3% of the respondents from Osun said they would seek to obtain more knowledge, information and education on adaptation to climate change while 8.4% of the farmers requested government support through the introduction of new and modern adaptation options. As shown in Table 4, 14.2% respondents from Oyo will use irrigation farming should the change persist. However, 7.5% of them said abandoning agriculture at the expense of other economic activities may be the best option. The same proportion prefers to ask for government support in introducing new and modern adaptation options.

Table 4. Respondents future adaptation strategies if climate change persist

VARIABLE	RESPONSE	STATE		Total
		OSUN	OYO	
Future adaption strategies if climate change persist	Abandon agriculture at the expense of other economic activities	6.3%	**7.5%**	40
	Abandon the current farms and move to wetter areas	0%	2.4%	7
	Emigrate from your village to other areas with better conditions	3.5%	5.4%	26
	Continue changing agricultural practices in line with the changes in the local climate	**46.2%**	**38.0%**	244
	Ask for government support like introduction of new and modern adaptation options	**8.4%**	**7.5%**	46
	Seek to obtain more information, knowledge and education on adaptation to climate change	**13.3%**	12.2%	74
	Promote irrigation using underground water	2.8%	**14.2%**	50
	Others (specify)	12.2%	8.8%	61
	Don't know	7.3%	4.1%	33

Source: Field Survey May, 2016

4. Conclusion and recommendation

Climate change is a threat to food security (Sanchez, 2000; Siwar et al., 2013) because of its negative impacts on food crop production, and it associated consequences for markets, food prices and supply chain infrastructure. Agriculture accounts for about 30.9% of the Gross domestic product (GDP) and 70 percent of employment in Nigeria (Akpan & Edet, 2016). There is no doubt climate change will have consequences for livelihoods and food security and therefore there is need for action to be taken to address and mitigate these consequences. There is the need therefore to make agricultural adaptation a key agenda point in Nigeria. Efforts should be channeled in bolstering national research and extension programs by investing in adaptive scientific research aimed at generating new technologies targeted at addressing the challenges of climate change. At the national level, there should be collaboration among the Nigerian Federal Ministries of Agriculture, Science and Technology and Education and non-governmental organizations to sustain a holistic approach to addressing climate change and its challenges. Partnerships with international organizations will also facilitate sharing and learning from success stories in other places. The important role of extension cannot be emphasized enough since that is the most useful tool in disseminating relevant information to rural areas and technologies to farmers. Extension is key in information sharing by transferring technology, facilitating interaction, and building capacity of farmers. Extension services should address issues of climate-change adaptation by broadcasting and illustrating information to rural farmers. Finally, farmers' livelihood should be improved through access to credit and the creation of safety nets, both formal and informal. The study agrees with Kates (2000) that whether adaptation is expressed in terms of assets, capital resources, financial means, wealth, or poverty, the economic condition of groups such as rural farmers is a strong determinant of adaptive capacity. Farmers are better equipped to adapt if their economic conditions are good.

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