Strategies for Agricultural Adaptation to Climate Change in Kogi State, Nigeria

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ABSTRACT

The paper examined strategies for agricultural adaptation to climate change in eight selected rural settlements in Kogi State, Nigeria. A structured questionnaire was used to collect data on the strategies for agricultural adaptation of 99 farmers using a systematic sampling technique. The adaptation strategies were weighted for comparison among the selected settlements while the overall evaluation of the variations of the adaptation strategies among the selected settlements was investigated using chi-square (χ^2). The prevalence of the adaptation strategies were classified using simple percentages. The results revealed that the strategies for agricultural adaptation to climate change are unequally prevalent, giving rise to high, moderate and low categories. Overall, the strategies for agricultural adaptation to climate change vary significantly among the selected settlements ($\chi^2 = 152.250$, $p < 0.05$). It is concluded that the prevalence of the strategies for agricultural adaptation to climate change is mainly due to the uneven distribution of environmental and socio-economic resources. Therefore, efforts to boost the local farmers' adaptation to climate change should of necessity identify prevailing adaptation strategies with a view to mainstreaming them into intervention programmes.

Keywords: climate; agriculture; farmers; adaptation; strategies

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INTRODUCTION

Agriculture remains pivotal to Nigeria both as a source of food for her increasing population and as a prime employer of labour. Despite the significance of agriculture, it is threatened by the challenges of adapting to present and potential climatic conditions and the impending challenge of increased food production to manage climate variability and increasing population (ACPC, 2011). Climate change is increasingly being recognized as the most critical environmental challenge facing mankind in the 21st Century. The impacts of climate change are spatially diverse and it is held that developing countries will be more in jeopardy than developed countries due to their reliance on climate-sensitive sectors (Madu, 2010).

Africa has been identified as highly susceptible to climate change and climate variability, a condition provoked by the interaction of multiple stressors coupled with low adaptive capacity (Boko *et al.*, 2010; Atedhor, 2013). Apart from the climate change-induced stressors, accessibility to natural and socio-economic resources mutually determine the degree to which an individual, community or a region is vulnerable to climate change (Smit and Wandel, 2006; Adejuwon, 2006; Ajetomobi and Abiodun, 2010; Erikson and Selboe, 2012).

While adaptive capacity describes the ability of a system to adjust to actual or expected climate stresses, or cope with the consequences (Olmos, 2001; Brooks, 2003; O'Brien et al, 2004), adaptation refers to initiatives and measures to reduce the vulnerability of natural and human systems against actual and expected climate change effects (IPCC, 2007). Adaptive capacity is irregular transversely and within societies (Adger et al., 2007) owing to the uneven distribution of environmental and socio-economic resources. Although some of the strategies used by local farmers against adverse climatic events are age-long practices, their prevalence is further reinforced by the intensifying climate induced environmental stress and socio-economic trajectories (Atedhor, 2014a & b).

The predominance of rain-fed agriculture in Nigeria exposes local farmers to the adverse consequences of climate change. Under rain-fed circumstances, increased variability and abnormality in rainfall are key factors of crop failure (ACPC, 2011). Sensitivity is the degree to which a system is affected by, or responsive to climate change (Marshall et al, 2010). The sensitivity of a system is subject to both ecological and socio-economic conditions and influences the scale to which a system will be affected adversely or otherwise by climate change (Adesina and Odekunle, 2011). Thus, apart from the climate change-induced stressors, the availability of natural and socio-economic resources determines the extent to which an individual, community or region is vulnerable to climate change (Smit and Wandel, 2006; Adejuwon, 2006; Ajetomobi and Abiodun, 2010; Erikson and Selboe, 2012). The socio-economic factors that influence the agricultural adaptation to climate change include access to credit facilities, extension services, pesticides and education. The socio-economic factors do not only influence the scale of agricultural operations but also farmers' ability to cope with climate change-induced stress such as drought, flood, pests and diseases.

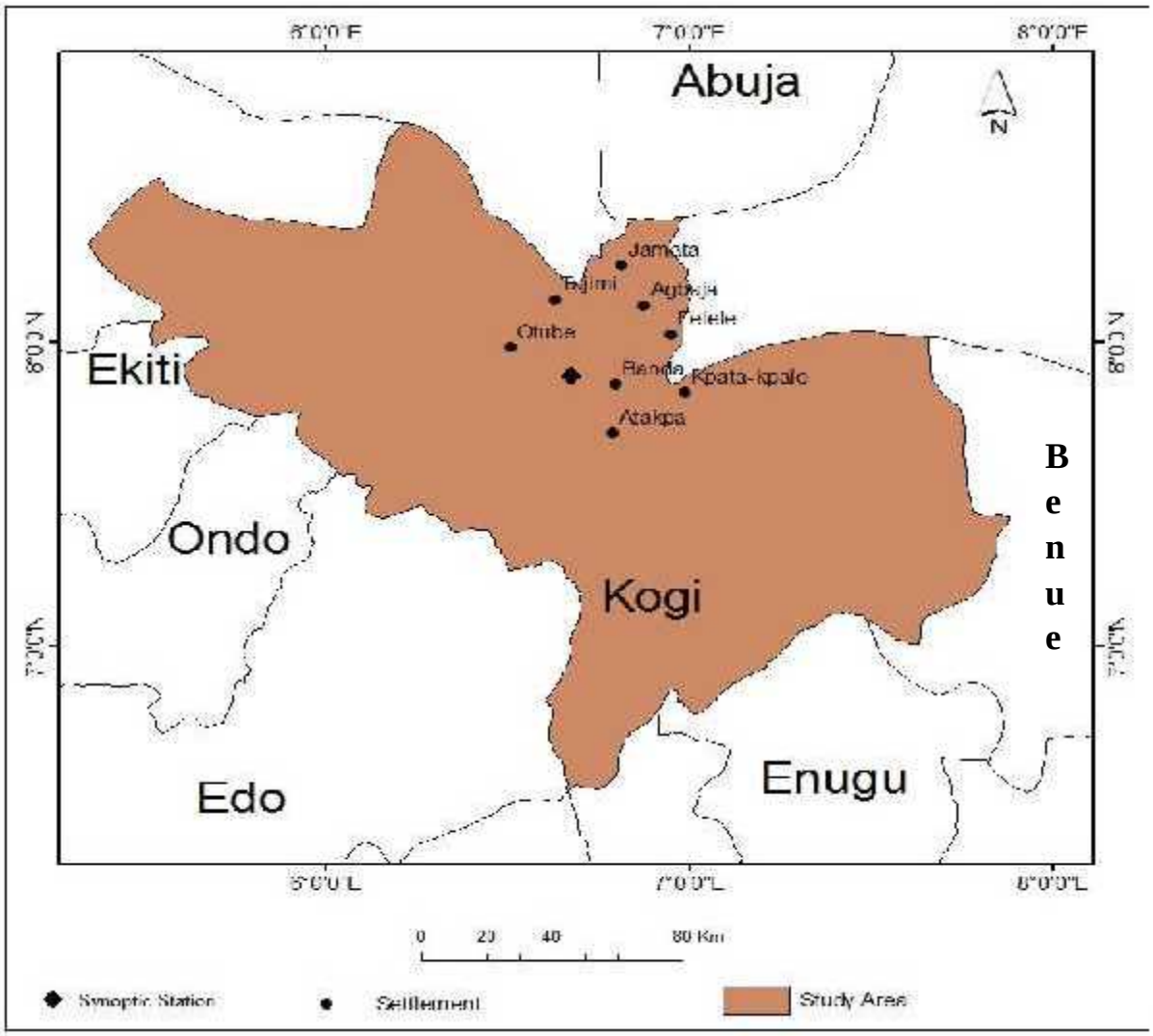
Kogi State falls within the Southern Guinea Savanna belt of Nigeria which is a transition from the rainforest to a savanna ecological landscape. Consequently, the cultivation of root crops and grains flourishes in the State as in other places within the Southern Guinea Savanna belt of the country. The area exhibits increasing annual rainfall and mean temperature trends coupled with a decreasing annual rain-days trend amid seasonal fluctuations (Atedhor, 2013). Unfortunately, as Odjugo (2009) noted, the response of local farmers to climate change has not received adequate attention. Thus, while it is imperative to seek agricultural innovations which search for scientific and technological best practices, it is important to identify prevailing practices among local farmers for mainstreaming into planned climate change intervention programmes. This study, therefore, examines the strategies for agricultural adaptation to climate change in some selected rural settlements in Kogi State, Nigeria. Specifically, the study seeks to know if some strategies for agricultural adaptation to climate change are more prevalent than others and whether there is a significant difference in the overall prevalence of the strategies for agricultural adaptation to climate change among the selected settlements.

STUDY AREA

Kogi State extends from Latitude 6.33^0 N to 8.44^0 N and from Longitude 5.40^0 E to 7.49^0 E (Figure 1). It encompasses a landmass of about 75,000 square kilometers with a population of 3,278,487 based on the 2006 Census, out of which over 70 % resides in the rural areas (Ibitoye, 2012). The State is mainly drained by the rivers Niger and Benue with the confluence of the two rivers occurring around Lokoja. These rivers, with their extensive flood plains, drain the area across sedimentary rocks which characterize the lowing-lying plains that are studded in places with flat-topped hills of elevation generally less than 300 m (Ologe, 2002).

As in other parts of the Southern Guinea Savanna, the State is characterized by a wet season which lasts from April to October (Odekunle, 2004) with an annual rainfall ranging between 800 and 1100 mm (Sani and Haruna, 2010). The agro-climatic conditions of Kogi State make it suitable for the cultivation of food and tree crops. Yam, cassava, sorghum, rice, cowpea, groundnut, and melon constitute the main food crops while cashew, mango, oil palm and cocoa are some of the economic trees cultivated by farmers in the State. Fishing is carried out along rivers Niger and Benue as well as their tributaries. Due to the relatively extensive dry season which calls for alternative water supply (Sowomi and Akintola, 2010), dry season farming is practiced where farmlands are adjacent to the tributaries of the rivers Niger and Benue. Besides farming activities, non-farm livelihoods such as petty trading also thrive in the selected settlements, especially those located along the Lokoja-Abuja Highway.

Figure 1: The selected settlements and synoptic station



MATERIALS AND METHODS

A structured questionnaire was used to collect data on the local farmers' strategies for agricultural adaptation to climate change in eight randomly selected rural settlements. The settlements were selected within 45 km radii of the synoptic weather station in Lokoja (Figure 1) because the climatic data from the synoptic station were used to establish climate change as reported in Atedhor (2013) of which this work is an aspect. A sample size of 99 respondents, which represents 5.12 % of the projected 2010 total household sizes (1939) of the selected settlements, was computed based on Berenson and Levine (1998) as follows:

$$n = \frac{z^2 p(1-p)}{e^2}$$

Where n is the sample size, *P* is the proportion of households in the total population, *e* is the permitted sampling error and *Z* is the level of confidence. The 99 copies of the structured questionnaire were proportionally distributed among the selected settlements based on their household sizes (Table 1). Systematic sampling technique was used to select farmers in each settlement. For example, in Agbaja, every 20th household was selected until a sample size of 31 was reached.

Table 1: Distribution of questionnaire among the selected settlements.

Settlements	Projected 2010 population	Number of households	Distribution of copies of questionnaire by settlements
Agbaja	2439	625	31
Atakpa	521	134	7
Kpata-kpale	913	234	12
Banda	981	252	13
Jamata	585	150	8
Otube	608	156	8
Tajimi	585	150	8
Felele	930	238	12
Total	**7,562**	**1,939**	**99**

The frequencies of each of the agricultural adaptation strategies were weighted for the purpose of comparing their prevalence among the selected settlements. The significance of the overall variations of the strategies for agricultural adaptation to climate change among the selected settlements was investigated using chi-square (χ^2). The test statistics for computing χ^2 is given as:

$$\chi^2 = \sum_{i=1}^{n} \frac{(O_i - E^i)^2}{E^i}$$

Where *O* is observed frequency, *E* is expected frequency and *n* is number of categories.

Simple percentages were used to classify the prevalence of each of the agricultural adaptation strategies as follow:

Percentage	Classification
0-30	Slight
31-60	Moderate
≥60	High

RESULTS AND DISCUSSION

Socio-Economic Characteristics of the Respondents

Table 2 reveals that the 30-39 years age group is the most dominant with 28 (29%) while the age distribution of the other respondents is 1 (1%), 40-49 (22%), 50-59 (18%), 20-29 (17%) and 60 years and above (13%). These statistics reveal that 68 (68.7%) of the respondents are less than 50 years of age. This agrees with Sani and Haruna (2010) which reported approximately similar age distribution in Kogi State. The age distributions suggest that the farmers are fairly youthful. Out of the 99 selected respondents, 35 (35.4%) have no formal education, 27 (27.3%) have primary education, 23 (23.2%) have secondary education, 11 (11.1%) have OND/NCE (Ordinary National Diploma/National Certificate Examination) while 3 (3%) have HND/B.Sc (Higher National Diploma/Bachelor of Science). The fairly high proportion of respondents with no formal education is an indicator of agricultural vulnerability and a low capacity to adapt to climate change since the higher the educational attainment of a farmer, the more knowledgeable and amenable he/she will be to accepting alternative strategies (Van der Land and Hummel, 2013). Besides, lack of education and training is recurrently a major restraining factor to smallholder and development (Mustapha *et al*., 2012). The analysis shows that 34 (34.3%), 26 (26.3%), 10 (10.1%), 8 (8.1%), 7 (7.1%) and 14 (14.1%) fall into N10,000-19,000, N20,000-29,000, N30,000-39,000, N40,000-49,000 and N50,000 and above monthly income levels respectively. Thus, 60 (60.6%) of the selected respondents earn less than N20,000 monthly, that is, less than 100 US dollars per month based on the official exchange rate of ₦ 198 to a US dollar. This affirms the World Bank Economic Report (2014), which states that over 60% of the poor reside in the northern part of the country.

Table 2:Socio-economic characteristics of the respondents

Age (years)					
<20	20-29	30-39	40-49	50-59	60 and above
1	17	29	22	18	13
Income groups (₦)					
<10,000	10,000-19,000	20,000-29,000	30,000-39,000	40,000-49,000	≥50,000
34	26	10	8	7	14
Educational attainmentss					
No formal education	Primary	Secondary	NCE/ND	HND/B.Sc	
35	27	23	11	3	

Agricultural Adaptation Strategies

Irrigation remains fundamental to agricultural adaptation to climate change (Seo, 2011). Although it is an age-long practice for enhancing crop-moisture needs, especially in the semi-arid eco-climatic belts of Nigeria, its use is reinforced due to erratic rainfall coupled with increasing temperatures. Irrigation helps to reduce seasonal constraints and crop moistures stress. The results reveal that the prevalence of irrigation as agricultural adaptation strategy is low with 21(21.2%) of the selected farmers using it (Table 3). Out of the selected settlements, irrigation is most adopted in Atakpa with a weighted value of 1.71 while it is least adopted in Felele and Agbaja, each with a weighted value of 0.00. The settlements that least practice irrigation are located far from the rivers Niger and Benue and their tributaries. The use of the labourious traditional irrigation techniques, particularly in farmlands adjacent to the tributaries of the rivers Niger and Benue, accounts for the low adoption of irrigation amongst the selected farmers. As O'Brien *et al.* (2004) noted, areas with higher irrigation rates and/or superior facility are anticipated to have a higher capability to adjust to climate change and other economic upsets. Thus, farmers in Atakpa, Jamata and Otube who have access to natural surface water resources, have a higher capacity to cope with erratic rainfall onset and cessation.

Stigter (1984) defines mulch as a superficial layer established naturally or artificially at the soil/air interface with characteristics differing from the original unmodified soil surface layer. Besides, reducing conductivity and turbulent exchange of heat and moisture between the soil and atmosphere which keep the soil cool and reduce evaporative losses (Wilken, 1972; Oke, 2000; Isenmila, 2005), mulch application increases soil porosity and the stability of aggregate organic matter content, as well as decreases bulk density (Jordán, *et al.*, 2010). The study reveals that mulching as adaptation strategy is moderately prevalent, with 45 (45.5%) out of the sampled farmers mulching their farms. The strategy is most practiced in Agbaja with a weighted value of 1.35 and it is least adopted in Felele with a weighted value of 0.33.

Table 3: Climate Change Adaptation Strategies in the Selected Settlements

Strategies	Response/Weight	Otube	Felele	Jamata	Banda	Agbaja	Tajimi	Atakpa	Kpata-kpale	Total and percentages	Classification
Irrigation	Frequency	4	0	5	3	0	2	6	1	21 (21.2)	Low
	Weight	1	0	1.25	0.46	0	0.5	1.71	0.17		
Mulching	Frequency	2	2	4	4	21	4	3	5	45 (45.5)	Moderate
	Weight	0.5	0.33	1	0.62	1.35	1	0.86	0.83		
Changing planting date	Frequency	6	9	8	12	31	8	7	12	93 (93.9)	High
	Weight	1.5	1.5	2	1.85	2	2	2	2		
Cultivating different crops	Frequency	6	10	8	13	31	8	7	12	95 (96)	High
	Weight	1.5	1.67	2	2	2	2	2	2		
Cultivating short duration crops	Frequency	8	6	8	13	31	8	7	12	93 (93.9)	High
	Weight	2	1	2	2	2	2	2	2		
Planting cover crops	Frequency	4	12	5	11	27	6	7	11	83 (83.8)	High
	Weight	1	2	1.25	1.69	1.74	1.5	2	1.83		
Cultivating drought resistant varieties	Frequency	6	7	5	7	26	7	7	11	76 (76.8)	High
	Weight	1.5	1.17	1.25	1.08	1.68	1.75	2	1.83		
Weeding farm more frequently	Frequency	5	11	7	10	26	5	6	10	80 (80.8)	High
	Weight	1.25	1.83	1.75	1.54	1.68	1.25	1.71	1.67		
Combining farming with non-farm livelihood	Frequency	4	10	4	3	19	3	1	5	49 (49.5)	Moderate
	Weight	1	1.67	1	0.46	1.23	0.75	0.29	0.83		
Use of credit facilities	Frequency	0	0	0	0	0	3	2	1	6 (6.1)	Low
	Weight	0	0	0	0	0	0.75	0.57	0.17		
Use of storage facilities	Frequency	0	0	3	6	12	1	5	5	32 (32.3)	Moderate
	Weight	0	0	0.75	0.92	0.77	0.25	1.43	0.83		
Use of insurance facilities	Frequency	1	0	0	1	2	1	0	0	5 (5.1)	Low
	Weight	0.25	0	0	0.15	0.13	0.25	0	0		
Rearing hybrid livestock	Frequency	3	0	1	3	0	1	0	1	9 (9.1)	Low
	Weight	0.75	0	0.25	0.46	0	0.25	0	0.17		
Increasing period of fallow	Frequency	0	8	2	5	23	6	4	9	65 (65.7)	High
	Weight	0	1.33	0.5	0.77	0.48	1.5	1.14	1.5		
Livestock diversification	Frequency	5	12	8	12	31	8	6	12	94 (94.9)	High
	Weight	1.25	2	2	1.85	2	2	1.71	2		
Use of pesticides	Frequency	8	12	7	13	19	6	7	9	81 (81.8)	High
	Weight	2	2	1.75	2	1.23	1.5	2	1.5		
Use of ICT	Frequency	0	3	0	0	0	0	3	1	7 (7.1)	Low
	Weight	0	0.5	0	0	0	0	0.86	0.17		
Government aids	Frequency	0	3	0	0	0	0	3	1	7 (7.1)	Low
	Weight	0	0.5	0	0	0	0	0.86	0.17		
Increase in farm size	Frequency	6	6	2	9	22	7	7	9	68 (68.7)	High
	Weight	1.5	1.5	0.5	1.38	1.42	1.75	2	1.5		
Use of fertilizers/animal dung	Frequency	0	0	0	0	0	3	2	1	6 (6.1)	Low
	Weight	0	0	0	0	0	0.75	0.57	0.17		
Use of shelterbelts	Frequency	1	1	1	1	2	2	0	1	9 (9.1)	Low
	Weight	0.25	0.17	0.25	0.15	0.13	0.5	0	0.17		

Delayed onset and cessation of the rains, especially in the absence of irrigation, make farmers stagger planting dates even after preparing seedbeds. Alteration of planting date helps farmers to avoid crop failure resulting from poor germination and growth due to deficiency in soil moisture. The analysis reveals that the strategy is highly prevalent, with 93 (93.9%) of the sampled farmers practicing it. The strategy is most prevalent in Jamata, Banda, Agbaja, Tajimi, Atakpa and Kpata-kpale, each with a weighted value of 2.00, while it is least adopted in Otube and Felele, each with a weighted value of 1.5. The high proportion of the selected farmers who alter their farming schedules in line with prevailing climatic variations shows that most of the selected farmers are conversant with unfolding climatic events. However, accurate and timely dissemination of weather

forecasts and overhauling of extension services could further help farmers align their farming activities with unfolding climatic events.

The cultivation of different crops insulates farmers against the consequences of total crop failure owing to adverse circumstances such as drought, pests and diseases. While pests and diseases may be selective in their attacks, some crops are more resilient to adverse climatic conditions than others. Thus, the cultivation of different crops could serve as a useful strategy against climate change. The findings show that cultivation of different crops as a strategy against climate change is highly prevalent, with 95 (96%) out of the sampled farmers employing the strategy. The crops which are often cultivated under a mixed cropping system include cassava, yam, vegetables and melon. The cultivation of different crops is most practiced in Jamata, Banda, Agbaja, Tajimi, Atakpa and Kpata-kpale, each with a weighted value of 2.00, while it is least practiced in Otube, with a weighted value of 1.5.

A constricted wet season has adverse effects on the growth and yield of crops. Early maturing crops are advantageous in that they can be conveniently grown in areas with a short or shrinking growing season and also bring quick returns to farmers. Besides, early maturity reduces farmer's exposure to the risk of extreme weather events including drought (Mustapha *et* al., 2012). The results reveal that 93 (93.9%) of sampled farmers cultivate short duration crops, which implies that it is highly prevalent. Out of the selected settlements, apart from Felele which has weighted value of 1.00, the cultivation of short duration crops is well adopted in the selected settlements, with each settlement having a weighted value of 2.

Farmers cultivate cover crops such as melon and groundnut in order to reduce crop-moisture stress and also boost the nitrogen content of the soil. The study reveals that the cultivation of cover crops as agricultural adaptation strategy against climate change is highly prevalent, with 83 (83.8%) of the selected farmers practicing it. The strategy is most practiced in Felele and Atakpa, each with a weighted value of 2, while it is least adopted in Otube, with a weighted value of 1.00. Apart from being significant as instrument for reducing moisture stress and for enhancing soil nitrogen status, cover crops also serve as weed suppressant. This is particularly important considering the relatively high rainfall in the study area which, coupled with high temperature, favours the proliferation of weeds. The cultivation of cover crops could therefore boost crop yield and help farmers to save the funds that would have been invested in the purchase of herbicides. Such resources could be channelled into other relevant uses.

Improved varieties of crops confer tolerance to drought and heat as well as early maturation in order to shorten the growing season and decrease farmers' susceptibility to the hazard of extreme weather events (Mustapha *et al.,* 2012). The occurrence of droughts of slight and moderate intensities in the study area has been reported in Atedhor (2013). This, coupled with a decreasing trend of annual rain-days and an increasing annual trend of mean temperature, could aggravate crop moisture stress. This therefore highlights the need for farmers to consider the cultivation of drought resistant varieties. The findings reveal that 76 (76.8%) of the sampled farmers cultivate drought resistant crops. This implies that the cultivation of drought resistant varieties is highly

prevalent in the selected settlements. The cultivation of drought resistant crops is most practiced in Atakpa, with a weighted value of 2.00, while it is least practiced in Banda, with a weighted value of 1.54.

An increasing rainfall trend has been reported in Kogi State (Atedhor, 2013). The fairly humid nature of the area, coupled with its high temperatures, provides moist and warm conditions which facilitate the proliferation of weeds. The proliferation of weeds induces soil impoverishment and unhealthy competition with crops. The results show that weeding of farms on a more frequent basis than before is highly prevalent, with 80 (80.8%) of the selected farmers employing the strategy. However, the strategy is most adopted in Felele, with a weighted value of 1.83, while it is least used in Otube and Tajimi, each with a weighted value of 1.25.

Vulnerability can be reduced by enhancing diversification of livelihoods (Adesina and Odekunle, 2011). Therefore, a combination of farming and non-farm livelihoods boosts farmers' income and reduces the risks they face due to adverse climatic conditions. Out of the sampled farmers, 49 (49.5%) combine farming with non-farm livelihood. This implies that the strategy is moderately prevalent. Out of the selected settlements, the strategy is most practiced in Felele, with a weighted value of 1.67, while it is least adopted in Atakpa, with a weighted value of 0.29. The proximity of some of the settlements such as Otube, and Banda to Lokoja, which is the State's Capital, and their location along the Lokoja-Abuja Express Way, may have enhanced their livelihood diversification since travelers along the route boost patronage. The selected farmers who have diversified livelihoods in addition to farming engages in activities such fishing, petty trading and vulcanizing.

The use of credit facilities helps farmers to adopt new practices as well as acquire technology that enhances their adaptive capacities to climate change (IPCC, 2007; Ishaya and Abaje, 2008; Adebo and Sekumada, 2013). Where farmers have access to superior technologies such as organic fertilizers and pesticides, the huge outlay of such input hampers their usage (ACPC, 2011). Thus, for farmers to be able to acquire fertilizers and pesticides and practice irrigation farming, they must of necessity have access to credit facilities. Unfortunately, only 6 (6.1%) of the selected respondents have access to credit facilities, which implies low prevalence. The uniformity of the weighted values among the selected settlements further shows the inaccessibility of credit facilities to most local farmers with the exception of Tajimi and Atakpa which have weighted values of 0.75 and 0.57 respectively. The concentration of financial institutions in the urban areas and the lack of collateral and other conditions for acquiring loans make credit facilities inaccessible to farmers.

Storage facilities enhance farmers' adaptive capacity by reducing post-harvest losses occasioned by pest attacks as well as spoilage arising from poor preservation. The use of storage facilities, whether created with local or foreign technology, also helps farmers to target the seasons of high demand and low supply and consequently enhance profit. The results reveal that the use of storage facilities is moderately prevalent in the selected settlements, with 32 (32.3%) of the selected farmers employing the strategy. However, the strategy is most prevalent in Atakpa, with a weighted value of 1.43, while Otube and Felele have the least prevalence with a weighted value of 0.00.

Agriculture is predominantly susceptible to unfavorable natural events such as droughts or floods, and the economic costs of key disasters may even escalate further in the future due to climate change (Nnadi *et al*., 2013). Insurance provides indemnity against risks which may be induced by climate change. Crop insurance is therefore very necessaryy to ensure economic support for farmers, stabilize farm income, and encourage farmers to invest in agriculture, decrease indebtedness and reduce their need for aid in the event of crop failure (Swain, 2014; Romario and Molina, 2015). Despite the importance of insurance facilities as a cushioning effect against adverse effects of climate, only 5 (5.1%) of the sampled farmers use insurance facilities, which implies low prevalence. The use of insurance is highest in Banda with a weighted value of 0.25 and lowest in Felele, Jamata, Atakpa and Kpata-kpale, each with a weighted value of 1. The concentration of insurance firms in the urban areas coupled with poor awareness amongst the selected farmers may be responsible for the low percentage of farmers who use insurance as adaptation strategy against climate change.

Rearing of hybrid livestock facilitates quick returns and therefore boosts the income of farmers. High breeds also have the advantage of enhancing the resistance of livestock against diseases and adverse weather conditions. The results reveal that 9 (9.1%) of the selected farmers rear hybrid livestock, which portrays low prevalence. Rearing of hybrid livestock is most practised in Otube, with a weighted value of 0.75, while it is least practised in Felele, Agbaja and Atakpa, each with a weighted value of 0.00.

Apart from helping to regain soil nutrients, increasing the period of fallow also help to control the prevalence of pests and diseases. Thus, where there is low pressure on agricultural land, the bush fallow farming system is widely practiced. The results show that 65 (65.7%) of the respondents practised increased period of bush fallowing than before. This implies that the increasing period of fallow is highly prevalent. The high percentage of respondents who increase the period of fallow corroborates the findings of Ayodele et al. (2012). Where pressure on land is high, application of fertilizers could serve as alternative to the bush fallow system. Increasing the period of fallow as a climate change adaptation strategy among the selected settlements is most practiced in Tajimi and Kpata-kpale, each with a weighted value of 1.5, while it is least practiced in Otube, with a weighted value of 0.00.

Rearing different livestock not only increases farmers' income but also reduces the risks that farmers face during adverse climatic conditions since livestock respond differently to climatic stress. For instance, it has been reported that goats do better than cattle during dry season and drought (Abaje *et al*., 2010). While 94 (94.9%) of the selected farmers practise livestock diversification, which implies high prevalence, it is most practised in Felele, Jamata, Agbaja, Tajimi and Kpata-kpale, each with a weighted value of 2.00. The strategy is however least practiced in Otube, with a weighted value of 1.25.

The analysis reveals high prevalence of the use of pesticides, with 81 (81.8%) of the selected farmers employing the strategy as agricultural adaptation to climate change. With the exception of Agbaja, Tajimi and Kpata-kpale, the use of pesticides as agricultural adaptation against climate

change is equally practiced among the selected settlements, with each settlement having a weighted value of 2.00, while the use of pesticides is least practiced in Agbaja, with a weighted value of 1.23. The high number of the selected farmers who use pesticides could be attributed to the warm and humid climate of the Guinea savanna belt which favours high prevalence of pests. Amongst the pests that are prevalent in the study area are grasshoppers, rodents, ticks and grass cutters. If not controlled, pests are capable of drastically reducing crop yields before and after harvests (Enobakhare, 2012).

Effective communication of best practices and technologies in agriculture to rural farmers remains a veritable approach for enhancing agricultural output (Abubakar *et al*., 2009). Such information usually includes weather forecasts, best methods of applying fertilizers and insecticides, improved methods of cultivation and soil conservation, techniques of planting, harvesting and storage of crops as well as the price of agricultural products. The study reveals that only 7 (7.1%) of the selected farmers use ICT, which portrays low prevalence. With the exception of Felele, Atakpa and Kpata-kpale, with weighted values of 0.5, 0.86 and 0.17 respectively, the strategy is not used in the other selected settlements. The low prevalence of the use of ICT as agricultural adaptation to climate change amongst the selected settlements could be ascribed to the concentration of ICT facilities mainly in the urban areas and the high prevalence of illiteracy amongst small scale farmers.

Often farmers are not able to afford some of the farm inputs necessary for adapting to climate change because they are expensive. Under this circumstance, most farmers rely on the government for the provision of subsidized farm inputs such as fertilizers, pesticides as well as the building of dams and the provision of electricity and good roads. The analyses reveal that 7 (7.1%) of the farmers use government aids, which implies low prevalence. It must also be stressed that to benefit from some of these government aids require strong political influence which is often beyond the local farmer. The weighted values for the selected settlements show that few farmers benefit from government aids as a climate change adaptation strategy.

Increase in farm size leads to economies of scale, thereby reducing loss incurred by farmers due to climate change, since large-scale farmers use more sophisticated farming techniques which translate into high adaptive capacity. The results reveal that 68 (68.7%) of respondents increase farm size as a strategy against climate change, which illustrates high prevalence. Increase in farm size as a strategy for agricultural adaptation to climate change is most practised in Atakpa, with a weighted value of 2.00, while it is least practised in Jamata, with a weighted value of 0.5.

Continuous cultivation of a farmland in an environment with sparse vegetal cover impoverishes the soil due to inadequate leaf litter. Application of fertilizers is therefore a useful measure for enhancing the nutrient status of the soil. However, the majority of the respondents in the selected settlements have no access to fertilizers, with only 6 (6.1%) using fertilizers, which implies low prevalence. The use of fertilizers is most practised in Tajimi, with a weighted value of 0.75, and least practised in Otube, Felele, Jamata, Banda and Agbaja, each with a weighted value of 0.00.

Violent winds usually pose a serious danger to crops as well as well as the dwellings of farmers. Over the years, farmers have recognized the importance of reducing the velocity of the wind by placing obstacles along its path. This adaptation strategy is particularly useful in places with sparse vegetation such as the semi-arid eco-climatic belt of Nigeria, which is less dense compared to the rainforest belt. Trees with enormous canopies and a strong capacity to survive moisture stress are popularly planted adjacent to the farms based on the farmers' knowledge of the wind direction. The analysis reveals that 9 (9.1%) of the respondents use shelterbelt as adaptation strategy in the selected settlements. This indicates low prevalence of the strategy amongst the selected farmers. The use of shelterbelts is most prominent in Tajimi, with a weighted value of 0.5, while it is least practised in Atakpa, with a weighted value of 0.00.

The observed and expected frequencies of agricultural adaptation strategies to climate change and the test statistics are presented in Tables 4 and 5. The analysis reveals that the overall strategies for agricultural adaptation to climate change vary significantly among the selected settlements (χ^2 =151.250, $p < 0.05$). This demonstrates that agricultural adaptation to climate change is a function of availability of environmental and socio-economic resources which are spatially and temporally unevenly distributed (Atedhor, 2014a and b). Thus, the variations of the prevalence or the adoption of a particular adaptation strategy depends on the availability of the natural resources and development inequalities.

Table 4: Observed and expected frequencies of agricultural adaptation strategies

	Observed N	Expected N
0	34	8.0
1	17	8.0
2	10	8.0
3	13	8.0
4	8	8.0
5	12	8.0
6	14	8.0
7	11	8.0
8	11	8.0
9	5	8.0
10	4	8.0
11	4	8.0
12	10	8.0
13	3	8.0
19	2	8.0
21	1	8.0
22	1	8.0
23	1	8.0
26	2	8.0
27	1	8.0
31	4	8.0
Total	168	

Table 5: Test Statistics

	Agricultural adaptation strategies
Chi-Square	151.250
df	20
Asymp. Sig.	.000

CONCLUSION

The study examined the strategies for agricultural adaptation to climate change in eight selected rural settlements in Kogi State, Nigeria. The results revealed that the strategies for agricultural adaptation to climate change are unequally prevalent, giving rise to high, moderate and low categories. The highly prevalent adaptation strategies include changing planting date, cultivating different crops, drought resistant varieties and short duration crops, planting cover crops, weeding farms more frequently, increasing the period of fallow, diversifying livestock, using pesticides and increasing farm size. The moderately prevalent adaptation strategies include mulching, combining farming with non-farm livelihoods and using storage facilities, while use of irrigation, credit and insurance facilities, rearing of hybrid livestock, use of fertilizers/animal dung and shelterbelts have low prevalence. Overall, the strategies for agricultural adaptation to climate change vary significantly among the selected settlements. The paper concludes that the prevalence of the strategies for agricultural adaptation to climate change is mainly due to the uneven distribution of environmental and socio-economic resources. Therefore, efforts to boost the local farmers' adaptation to climate change should of necessity identify prevailing adaptation strategies on a place-specific basis with a view to mainstreaming them into intervention programmes. This is particularly imperative with resounding clamours for the diversification of the nation's economy from crude oil.

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