Review of Small Holder Farmers' Climate Change Knowledge Level in North Central (Benue State) Nigeria

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Authors' contributions

This work was carried out in collaboration between both authors. Author IO designed the study collected the data designed the study and performed the statistical analysis while author DIO wrote the protocol and wrote the first draft of the manuscript. Both authors managed the literature searches. Both authors read and approved the final manuscript.

Original Research Article

ABSTRACT

Farmers in Nigeria lack adequate knowledge of climate change. Farmers' knowledge of climate change is a critical factor in the development of a sustainable climate change adaptation framework for Nigeria and other developing countries. This study examines the knowledge of farmers in the Benue State of Nigeria on climate change in 2016, and the data were analysed using IBM SPSS 21. Multi-stage and Probability Proportional to Size sampling technique was used to select 360 respondents from three agricultural zones in the study area. Data was collected using interview schedule. Descriptive (mean, percentages and frequencies) and inferential statistics were utilised in data analysis. A 5-point Likert scale was adopted using a composite knowledge score to achieve the mean cut-off level. Results show that a higher proportion (40.2%) of the farmers had moderate knowledge of climate change, 39.6% had high knowledge while 20.1% had low knowledge of climate change. The majority (>60%) of the respondents agree that bush burning, air pollution, tree felling and global warming are causes of climate change. However, only a few

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proportions (20.2%) of the respondent's belief that industrial activities and firewood usage causes climate change. A majority (>60%) of the respondents agree that mixed cropping system, use of irrigation, use of the drought-tolerant crop, livelihood diversification and use of improved variety is a means of coping with the adverse effects of climate change. All (100%) of the respondents are aware of climate change. A majority (92.5%) of the respondents are male with mean household size, farm size (in hectares) years of farming experience (in years) of 5.3, 2.3 and 20.4 respectively. It was recommended that the knowledge level of farmers on climate change should be improved by providing them relevant information through the mass media, movies and by providing climate change educational platforms in schools and through outreaches.

1. INTRODUCTION

Climate change is arguably the world's biggest threat to livelihood and the environment. According to [1] and [2] underdeveloped and developing countries are the worst victims of climate change impacts because they rely significantly on rain-fed agriculture and poor adaptation strategies. Rainfall and temperature patterns have been reported to be statistically unstable leading to adverse effects on aggregate agricultural productivity [2]. Evidence of climate change often manifests in the forms of the increased period of dryness during the raining season leading to wilting of crop plants, the death of livestock and decline in agricultural productivity [3].

Climate change and all its negative impacts are therefore a reality the world needs to cope with Coping with the effects of climate change require implementation of sustainable adaptation policy framework both at the global, regional and national levels [4]. Although there seems to be a sharp divide and lack of global consensus among some key developed countries regarding the allocation of emission targets, there is, however, a global consensus on the need to develop adaptation policy framework to aid countries (especially developing countries) in mitigating the adverse effects of climate change. Adaptation can be either autonomous (that is, adaptation occurring without any intervention) or deliberate (that is happening through planned intervention) [5]. Planned adaptation is particularly important in rain-fed agriculture to guarantee stable agricultural productivity. Adaptation at farm level is therefore crucial to achieving livelihood sustainability [6].

African farmers also depend on livestock for income, food and animal products. Climate can affect livestock both directly and indirectly [7].

Direct effects of climate variables such as air, temperature, humidity, wind speed and other climate factors influence animal performance such as growth, milk production, wool production and reproduction. Climate can also affect the quantity and quality of feed kinds of stuff such as pasture, forage, and grain and also the severity and distribution of livestock diseases and parasite. Hence the totality of agricultural sector is considered by examining agricultural productivity. Rainfall is by far the essential element of climate change in Nigeria and water resources potential in the country. The northeast region of Nigeria is increasingly becoming an arid environment at a high-speed rate per year occasioned by the rapid reduction in the amount of surface water, flora and fauna resources on land [8].

A balanced knowledge of climate change among all the key actors of climate change is essential in tackling its menace on agricultural productivity. The farmers are pivotal in the development of any viable adaption framework for climate change. [9] reported that the climate changes knowledge level of youth farmers – though moderate- was inadequate in ensuring sustainable adaption practices. Therefore, the knowledge levels of farmers on the subject of climate change become a critical factor in the advocacy of climate change and sustainable adaptation strategies. This paper accesses the climate change knowledge levels of farmers in Benue.

1.1 Purpose of the Study

The aim of the study to evaluate the climate change knowledge level of farmers in Benue State, Nigeria by assessing the farmers' climate change knowledge level of cause, effects, and adaptation.

2. RESEARCH METHODS

2.1 Study area

The study was conducted in Benue state. The state has abundant human and material resources, and state is located in the rich agricultural land of the Guinea Savannah zone of Nigeria. The state has two major rivers – the Benue and Katsina-Ala Rivers and several lakes, ponds, and streams which are suitable for both upland and fadama crop production. The state has two main seasons, the rainy season which usually starts from April and ends in October with average precipitation of 1500 mm, the daily mean temperature during the rainy season is $28^{°}$C. The dry season normally is from November to March. Harmattan winds characterise it for the most part. The soil and climate of Benue state support the production of crops such as yam, cassava, cocoyam, sweet potatoes. Other crops produced in the state include rice, maize, millet, sorghum, soybeans, beniseed, groundnut, cowpea, ginger, and sugar cane among others. Benue State is a state in the mid-belt region of Nigeria with a population of about 4,253,641 in 2006 census. It is inhabited predominantly by the Tiv and Idoma peoples, who speak the Tiv language and Idoma, respectively. The state lies on $7.3508^{°}$N, $8.8363^{°}$E. Benue State was chosen for this study because of its suitability to the study as it has witnessed both drought and flooding – which are the key climate change impact variables under study.

2.2 The scope of the Study

The study was limited to farmers in Benue state. It assessed the climate change knowledge levels farmers in Benue state. It also disaggregated climate change in knowledge in effects, cause, and adaptation for ease of comprehensive assessment of knowledge levels.

2.3 Research Design

The research design was a cross-sectional survey design, which utilizes quantitative approach. It is a cross-sectional design because both exposures and outcomes were collected at the same time.

2.4 Sources of Data

Primary data was obtained from farmers using structured interviewer-administered questionnaire. The primary data collected include household socio-economic characteristics and other bio-physical attributes.

2.5 Data Collection Instrument

The instrument for data collection was structured questionnaire and interview schedule. The questionnaire was constructed in such a way as to elicit the desired response from the respondents. The enumerators were selected from the study areas where they enjoy proficiency in the languages of the respondents and are familiar with the geographical terrain and culture of the region. The researcher trained the enumerators.

2.6 Validation of Research Instrument

To ensure the validity of the data gathering instrument, Face and Content validity was adopted. Experts' opinions in the field of Agricultural Economics and Extension were sought – this included in-depth criticism and viable suggestions. The instrument was subjected to the rigorous test for reliability: the reliability of an instrument measure the consistency of the instrument i.e, was the instrument deliver the same results if administered on the respondents at different times? The reliability of the instrument was established using the Cronbach-Alpha method. The Cronbach-Alpha method has an important advantage as it allows for the reliability of an instrument to be determined by using data taking at one point in time. A coefficient greater than 70% was obtained for this instrument. A reliable coefficient value of greater than or equal 0.70 is considered the acceptable indication of the reliability of the instrument.

2.7 Sampling Technique

A multi-stage sampling technique was adopted for the study.

Stage One

The first stage involved the purposive selection of the Three (3) agro-ecological zones namely Benue North, Benue South and Benue Central. The choice of the three agro-ecological zones was to achieve a balanced representation of the climate change variables (primarily flooding, drought and dry spell).

Stage Two

The second stage involved the purposive selection of two Local Government Areas (LGAs) from the three agro-ecological zones based on exposure to climatic variability making six LGAs for the study.

Stage Three

Three communities were selected from each of the six LGAs using purposive selection based on exposure to climatic variability. The numbers of households in each of the 18 selected communities were obtained from the LGA offices.

Stage Four

Based on the number of the households in each of the 18 communities, a probability proportional to size approach was used to compute and assign the number of households that were

selected from the communities as shown in Table 1.

Stage Five

A simple random sampling technique was adopted in selecting a total of 360 households for the study.

2.8 Measurement of Variables

2.8.1 Farmers' knowledge of climate change

The assessment of the farmers' level of climate change knowledge was done using composite knowledge score index. This was achieved by asking the farmers to tick 'yes' or 'no' to indicate their response to a set of thirty (30) positive and negative statements on the causes (10 statements), effects (10 statements) and adaptation measures (10 statements) to the

Table 1. Sampling design

Total number of households for the 6 LGAs	Local government areas (No. HHs)		Households allocated to LGAs (n/N) x LGA HHs	Communities (No. HHs)		HHS selected from communities
	LGA	**LGA HHs**	**n = 360**	**Communities**	**HHs**	
N=301,577	Otukpo	49,908	(360/301,577)x49,908 = **59**	Adim	2,104	10
				Asa 2	5,876	27
				Olena	4,814	22
				Total	12,794	59
	Ado	34,880	(360/301,577)x34,880 = **42**	Apa	1,733	11
				Igumale	2,224	14
				Utonkon	2,568	17
				Total	6,525	42
	Katsina-Ala	41,608	(360/301,577)x41,608 = **50**	Akata	2,007	22
				Mbamo	968	11
				Shitile	1,582	17
				Total	4,557	50
	Kwande	47,353	(360/301,577)x47,353 = **57**	Kohov	885	13
				Mbakunu	2,034	29
				Yaasa	1,022	15
				Total	3,941	57
	Makurdi	59,816	(360/301,577)x59,816 = **71**	Achusa	2,346	27
				Dagba	2,038	24
				Mbabun	1,711	20
				Total	6,095	71
	Gboko	68,012	(360/301,577)x68,012 = **81**	Akaajime	1,101	22
				Kontien	903	18
				Mbakwen	2,047	41
				Total	4,051	81
Total		301,577	360			**360**

effects of climate change. Each correct answer was scored as one (1) while an incorrect answer was scored zero (0). Each respondent's score was calculated. Respondents were subsequently group based on their score as low knowledge (1-10), moderate experience (11-20), and high knowledge (21-30).

3. FARM AND NON-FARM INCOME

The pooled result from Table 2 shows that farm income (N19, 829.99) constitute only 22.1% of the total household income (N 89, 629.88) while non-farm income constitutes the highest (N 86, 780.53) proportion of the household income. This finding is in line with the outcomes of [10] which states that 6 out of 10 farming households in Nigeria are growing crops or rearing livestock but only a few of the farming activities earn household income. About one-third of these households are engaged in farming for consumption. The farmers are constrained to explore others sources of income as a result of the low revenue accruable from farm income.

3.1 Gender

Data in Table 2 show that majority (92.5%) of the respondents were male while 7.5% were female. This finding is in concurrence with similar studies in Benue state by [11] which revealed that most of the farming population in Benue state is dominated by male farmers. The findings from research conducted by [12] in the Nasarawa state of Nigeria also re-enforces this finding. The population structure also presents a unique advantage of independence because men in most cases in Africa are the major determinants of house hold decisions [13]. However, women are more engaged in agricultural processing activities than the male folks [13].

3.2 Age

40% of the respondents were aged between 41 to 50 years. The implication if this is that most of the farming communities in Benue state as sampled is predominantly made up of young and active farmers with high energy to meet the strenuous demands of farming operations. This finding is consistent with the research outcomes of [10] that revealed that younger farmers in Benue state are most knowledgeable about climate change. [13] in a similar research conducted in Benue state to review the effects of socio-cultural factors on effective agricultural training programs for farmers by the Benue state agricultural development authority, discovered that the farming population in Benue state is made up of grossly farmers within the active age group.

3.3 Household Size

The mean household size was 5.36. The Nigeria Bureau of Statistic, NBS (2013) puts the average household size as 6 and 5 persons for rural and urban respectively. [10] also puts the average household size for North-Central as 6 persons. The implication of this finding is that the average household size for the study area is consistent with the national average. Rural farming is characterized by high-level drudgery and as such requires more hands and hence the need for farmers to constantly increase their household size. The findings of the [11] further re-enforces this finding, especially for the farming population of the North-East Nigeria that has higher household size primarily for farming activities. [3] supports this argument as they opined that large family size is required for optimal agricultural outcomes because farming is predominantly a family business. In rural farming communities in sub-Sahara Africa, particularly in Nigeria, especially in Northern Nigeria, large household size has been reported to be a significant determinant of food security among farming households in Borno state [12].

Increased household size has also been reported as a livelihood diversification strategy in Nigeria, particularly in some farming communities in Ondo state. Larger household size allows for easy adoption of high-yielding agricultural technologies, diversification into other non-farm income generating activities and high adaptive capacity against agricultural climatic shocks and other income shocks [14].

3.4 Years of Farming Experience

Table 2 shows that a higher proportion (46.9%) of the respondents have been in farming occupation for a mean value of 20.4 years. This implies that majority (82.2%) of the respondents have been long enough in the farming occupation to have experienced climate change impacts. This is in line with [5] which states that it takes a minimum of ten years for climate change to occur. This further also implies that the majority of the respondents are qualified to give information on climate change impacts on agricultural production since they have been in the farming occupation for more than one decade.

Table 2. Socio-economic characteristics of respondents

	Benue south		Benue central		Benue north		Total	
	Mean	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
Age group (years)	44.66	9.60	43.10	11.81	41.95	14.18	43.15	12.14
Household size	5.41	2.37	5.17	2.19	5.54	2.26	5.36	2.26
Farming experience (years)	20.62	9.80	19.83	7.95	21.10	9.36	20.48	8.97
Farm income per annum	33504.95	19079.64	33514.49	22155.14	32636.36	17667.77	33216.67	19829.99
Non-farm income/annum	66683.17	151021.32	42739.13	37781.03	46454.55	39848.88	50705.56	86780.53
Total Income (N)	100188.12	152181.19	76253.62	46070.73	79090.91	44690.98	83922.22	89629.88
Total farm size (ha)	2.34	.78	2.21	.86	2.12	.88	2.22	.85
Flock size of livestock	3.01	1.59	2.37	1.78	2.21	1.83	2.50	1.77

The pooled results from Table 3 showed that majority (>60%) of the respondents agree that bush burning, air pollution, tree felling and global warming are causes of climate change. However, only few proportion (20.2%) of the respondent's belief that industrial activities and firewood usage causes climate change. It was observed that most of the farmers depend on firewood for cooking and so they could not conceive how such important resource can be a cause of the dreaded climate change.

Table 3. Distribution of respondents by knowledge on causes of climate change

	Freq	%
Bush-burning	289	80.28
Air pollution	289	80.28
Tree Felling	288	80.00
Indiscriminate disposal	288	80.00
Global warming	218	60.56
Carbon monoxide	215	59.72
Increase in nitrous oxide	145	40.28
Industrial activities	73	20.28
Using firewood	73	20.28

Table 4. Distribution of Respondents by knowledge of effects of climate change

	Freq	%
Drought	274	80.3
Flooding	273	75.8
Wilting of plant	270	75.0
Late rainfall	230	63.9
Land degradation	213	59.2
Gully erosion	210	58.3
Death of livestock	197	54.7
Excessive heat at night	195	54.2
Early rainfall	176	48.9

The results from Table 4 show that the highest proportion (80.3%) of the respondents perceives drought as an effect of climate change followed by 75.8% (flooding), 75% (wilting of plants), 63.9% (late rainfall), 59.2% (land degradation), 58.3% (gully erosion), 54.7% (death of livestock), 54.2% (excessive heat at night) and 48.9% (early rainfall). These results further highlight the findings of [8] which emphasized the predominance of flooding and drought over other climate change hazards in Nigeria.

The Table 5 depicts an evaluation of the farmers' knowledge on adaptation as a key component of

climate change. A majority (>60%) of the respondents agree that mixed cropping system, use of irrigation, use of the drought-tolerant crop, livelihood diversification and use of improved variety is a means of coping with the adverse effects of climate change. This result shows that the climate change knowledge level of the respondents in terms of adaptation is moderate and adequate. This is also in line with the findings of

Table 5. Distribution of respondents by knowledge of climate change adaption strategies

	Freq	%
Mixed cropping system	289	80.28
Use of irrigation	288	80.00
Use of drought-tolerant crops	287	79.72
Diversification	287	79.72
Use of improved variety	217	60.28
Increased use of fertilizer	146	40.56
Land ownership	145	40.28
Membership of an association	71	19.72
Access to credit	71	19.72

Table 6. Categorization of respondents based on knowledge of climate change

	Freq	%
Low (score: 1-10)	66	20.12
Moderate (11-20)	132	40.24
High (21-30)	130	39.63
Total	328	100.00

The Table 6 shows the climate change knowledge level of farmers in the study area. From the Table, a higher proportion (40.2%) of the farmers had moderate knowledge of climate change, 39.6% had high knowledge while 20.1% had low knowledge of climate change. This finding has revealed that farmers in the area have moderate knowledge of climate. This outcome is consistent with the outcomes of [10] who also observed that youth farmers in Benue state had moderate knowledge of climate change. The farmers may not fully understand the science behind climate change [13] but they have the capacity to observe the various forms and variations of climate change. This finding is also in sync with the observation of [5] which opined that any farmer with a minimum farming experience of 10 years has experienced climate change at least once. A possible reason for the relatively high proportion of farmers with

moderate knowledge of climate change could be attributed to the level of education of the respondents. The result from the socioeconomic evaluation of the respondents showed that a higher proportion (40%) of the respondents have secondary education. This means that majority of the respondents can read and comprehend possible information on climate change.

The assessment of the farmers' level of climate change knowledge was done using composite knowledge score index. This was achieved by asking the farmers to tick 'yes' or 'no' to indicate their response to a set of thirty (30) positive and negative statements on the causes (10 statements), effects (10 statements) and adaptation measures (10 statements) to the effects of climate change. Each correct answer was scored as one (1) while an incorrect answer will be scored zero (0). Each respondent's score was calculated. Respondents was subsequently group based on their score as low knowledge (1-10), moderate knowledge (11-20), and high knowledge (21-30).

4. CONCLUSION AND RECOMMEN-DATION

The study concludes that although the farmers in the study area are aware of climate change with moderate knowledge, there is, however, a need for the government to consider a climate change policy mix that will prioritise capacity building on climate change for farmers in the study area.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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