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Measuring the Degree of Adaptive Capacity of Farmers to Climate Change along River Niger in Kogi State, Nigeria

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ABSTRACT

Climate change threatens people with increased flooding, extreme heat, increased food and water scarcity, more disease, and economic loss. Human migration and conflict can also be a result. The World Health Organization calls climate change the greatest threat to global health in the 21st century. In Nigeria, the effects of climate change are expected not to stop at just affecting the agricultural production, it will surely affect the lives, health, and overall development of the country. In order to formulate appropriate programs and policies addressing this vulnerability, it is essential to understand their degree of adaptive capacity. This study measures the degree of adaptive capacity of farmers to climate change along River Niger in Kogi State. Primary data were collected from respondents, multistage sampling techniques were used to select respondents in Kogi State. Descriptive statistics, using the threshold concept for discrete variables results show that irrigation farming is the most used adaptation strategy to climate change in the study areas. It was concluded that the degree of adaptive capacities to climate changes in mulching material and planting of cover crops. The study recommends that to reduce the effect of climate change in these areas, there is a need for policymakers to engage communities when taking decisions relating to their livelihood.

INTRODUCTION

Climate change describes global warming, the ongoing increase in global average temperature, and its effects on Earth's climate system. Climate change BBC News. Nigeria floods: Overwhelming Disaster left more than 600 people dead in 2022. People with increased flooding, extreme heat, increased food and water scarcity, more disease, and economic loss. Human migration and conflict can also be a result. The World Health Organization (WHO) calls climate change the greatest threat to global health in the 21st century International Panel on Climate Change (IPCC), 2022. Climate change will affect people in Africa more than anywhere else in the world due to the nature of changes being witnessed, deteriorating terms of trade, inappropriate policies, high rates of population growth, the inequitable distribution of land, over-dependence on natural-resource-based livelihoods and over-reliance on rain-fed agriculture (Intergovernmental Panel on Climate Change (IPCC, 2022). Africa's climate is already changing Bennett, et al.,2018. In general, the continent is becoming warmer and drier. Rainfall is becoming less predictable. Meanwhile, storms, droughts and floods are becoming more common and intense. Africa's

average temperature rose at a rate of 0.05°C per decade from 1900 to 2000 for a total increase of 0.7°C (IPCC, 2022). Temperatures are due to rise by a further 0.2 to 0.5°C per decade, with the greatest warming occurring over the interior or semi-arid margins of the Sahara and central southern Africa (IPCC, 2022).

In an ever-progressing world, with an increasing demand for energy and animal agriculture, it is difficult to avoid climate change and its impacts on societies, both locally and globally Oppenlander et al. 2020. Climate change affects social development factors, such as poverty, infrastructure, technology, security, and economics across the globe. Although, climate change affects everything we see around us, the interrelation between climate change and social vulnerability and inequality is particularly evident in impoverished communities. In particular, impoverished communities experience reductions in safe drinking water, as well as food security as a result of climate change (IPCC, 2022). These typically rural, isolated communities do not exhibit sufficient financial and technical capacities to manage the risks associated with climate change Ekemhonye, et al. 2020. Recent events of the flood that affected 34 States in Nigeria displaced over 1.4 million people, killed over 603 people, and injured more than 2,400 persons. About 82,035 houses had been damaged, and 332,327 hectares of land had also been affected. The Nigerian government has blamed the floods of 2022 on unusually heavy rains and climate change BBC News, 2020. Gaps in knowledge of the degree of adaptive capacities to climate change research are still in a rather primitive stage and climate change in the region has not been fully identified or understood. Hence, although a lot is known about the science of climate change, there remain many uncertainties about its potential impact on the degree of adaptation BBC News, 2020. Yet, this message has failed to penetrate public discussions on climate change and adaptation policies. At the moment, few studies that have considered measuring degrees of adaptive capacities to climate change were from a global perspective or regional aggregates. This research has narrowed it down to a State along River Niger in Nigeria for easy use by policymakers. Thus, this study is expected to add to the scanty knowledge in this area of research.

METHODOLOGY

Data for this study were collected from primary sources. The data were obtained through the administration of a questionnaire to elicit information from the respondents, on the socio-economic characteristics of the farmers such as age, marital status, gender, education, household size, farming experience, farmland size, the extent of awareness of climate change, annual income, and various adaptation measures to climate change. The researcher was assisted by trained enumerators from the State's Agricultural Development Programme to carry out data collection.

METHODS OF DATA ANALYSIS

Objectives were achieved using descriptive statistics tools such as mean, frequency, and percentages.

Empirical measurement of adaptive capacity

Following the procedures adaptive capacities of farmers were determined using the threshold concept for discrete variables Okezie, et al. 2016 Nakuja, et al. 2012. Five attributes comprising knowledge of adaptation strategy, use of adaptation strategy, availability of adaptation strategy, accessibility to adaptation strategy, and farmers' consultation make on specific adaptation strategy. The adaptation strategies that were considered in this research are practices irrigation, use of improved seeds, livestock production, change in land preparation pattern, change of weeding pattern, application of fertilizer, change planting dates, fish farming, bush allowing, mono /sole cropping, diseases resistant variety, Okada service, early maturing variety, plant drought resistant variety, change from crop to livestock, engage in small-scale business, mixed cropping, crop rotation practice, practice water-harvesting scheme, planting of cover crops and change mulching material.

Climate change adaptation strategies

In measuring the adaptive capacities quantitatively, respondents were asked to indicate their degree of attainment of each attribute. The highest degree of attainment of each of the attributes or factors affecting adaptive capacities was scored 4.0 followed by a higher degree of 3.0, a high degree of 2.0 and the lowest degree was 1.0. Therefore, the degree of each respondent's knowledge of each adaptation strategy was sorted out. In terms of knowledge, the higher the degree, the better knowledge the respondents have

on a particular adaptation strategy. Table 1 summarizes how each attribute was measured.

The Adaptive Capacity (AC) is obtained by dividing the total score of the attributes for the respondent by the sum of the most desirable score of all attributes, thereby reducing the adaptive capacity to a scale of between 1 and 4.

Table 1: Rating level of respondents' achievements of adaptive capacity attributes

Degree	Scores	Knowledge	Use	Availability	Accessibility	Consultation
Highest	4.00	Very well	Several	Very regular	Easily accessible	Several
Higher	3.00	Well	Twice	Regular	Accessible	Twice
High	2.00	Fairly well	Once	Occasionally available	Not easily	Once
Low	1.00	Not well	Never	Never	Not accessible	Never

Source: Modified from Nakuja et al. (2012).

$$AdapCap_{ij} = \sum (K_{ij}, U_{ij}, V_{ij}, A_{ij}, C_{ij},)/T \quad (1)$$

Where:

AdapCapij = represents the ith farmer's to jth Adaptive capacity to climate change;

K = Knowledge;

U = Usage;

V = Availability;

A= Accessibility;

C = Level of consultation; and

T = the sum of the most desirable scores for all attributes.

The average adaptive capacity of respondents to the jth adaptation strategy was calculated using the equation (1).

$$Ave\ Adap\ Cap_j = \frac{\sum \text{Adap Cap}_i}{N} \quad (2)$$

Where N = the number of observations

Ave Adap Capj = Average adaptive capacity of respondents to jth adaption strategy

The cut-off point for each level was based on the dispersion of data by setting three intervals based on the median (1.33). These were namely: low, moderate, and high adaptive capacity levels.

Table 2: Respondent's degree adaptive capacities to climate change

Degree	Range	Ranges of indices
Low adaptive capacity	0 <*AdapCapij* < 1.33	0 <*AveAdapCap* < 1.33
Moderate adaptive capacity	1.34≤ *AdapCapij* <2.66	1.34≤*AveAdapCap*< 2.66
High adaptive capacity	2.67≤*AdapCapij* ≤ 4.00	2.67≤*AveAdapCapij* ≤ 4.00

Source: Modified from Nakuja et al. (2012)

RESULTS AND DISCUSSION

Respondents' adaptive capacities to climate change

Respondents' levels of adaptive capacities measures to climate change results are presented in Table 3. The results reveal that the practice of irrigation farming was ranked 1st out of the twenty-one adaptation questions raised on the level of respondent adaptive capacities to climate change with an adaptive capacities value of 3.91. This was followed by the use of improved seeds, livestock production, and change land preparation patterns which were ranked 2nd, 3rd, and 4th with adaptive capacities scores of 3.89, 3.70, and 3.66 respectively. The result implies that respondents residing in the study area practice irrigation farming as a major adaptive capacity to climate change since this is possible because of their proximity to the river which will enable them to practice both rain-fed and dry-season farming. The findings are in line with Oppenlander et al. 2020 who observed that the overall unreliability and inconsistency in the temporal and spatial distribution coupled with the inadequacy of the rainfall, recurrent droughts, and rapid population growth have all combined to make irrigation an essential factor in the food security strategies in Nigeria.

Use of improved seeds was the second most adaptive capacity to climate change used by respondents. This finding is in line with the Food and Agricultural Organization, 2022. The definition of improved seeds

is seeds that aim at increasing the quality and production of crops by having characteristics such as drought tolerance, high yielding, and early maturity. This implies that, because of its increases in quality of yield, farmers may tend to adopt it as an adaptive capacity to climate change compared to others in the study areas.

Table 3: Respondents adaptive capacities to climate change in Kogi State

Adaptations' strategies	Knowledge of attribute score	Accessibility of attribute score	Availability of attribute score	Consultation of attribute score	Uses of attribute Score	Adaptive capacity	Rank
Practices irrigation	3.83	3.93	3.84	3.98	3.97	3.91	1
Use of improved seeds	3.83	3.91	3.83	3.98	3.91	3.89	2
Livestock production	3.30	3.68	3.76	3.93	3.83	3.70	3
Change the land preparation pattern	3.26	3.66	3.63	3.92	3.83	3.66	4
Change of weeding pattern	3.26	3.66	3.63	3.60	3.66	3.56	5
Application of fertilizer	3.20	3.47	3.41	3.49	3.65	3.44	6
Change planting dates	3.11	3.38	3.40	3.37	3.58	3.37	7
Fish farming	3.06	3.33	3.28	3.31	3.48	3.29	8
Bush fallowing	2.92	3.3	3.20	3.29	3.46	3.23	9
Mono /sole cropping	2.84	3.16	3.19	3.27	3.41	3.17	10
Diseases resistant variety	2.65	2.92	3.17	3.19	3.30	3.05	11
Okada service	2.54	2.9	3.15	3.08	3.26	2.99	12
Early maturing variety	2.53	2.93	3.03	2.97	3.25	2.94	13
Plant drought-resistant variety	2.45	2.83	2.83	2.87	3.16	2.83	14
Change from crop to livestock	2.39	2.72	2.80	2.68	3.15	2.75	15
Engage in small-scale business	2.20	2.62	2.60	2.63	3.12	2.63	16
Mixed cropping	2.10	2.49	2.53	2.51	2.72	2.47	17
Crop rotation practice	2.05	2.16	2.35	2.51	2.68	2.35	18
Practice water-harvesting scheme	1.93	1.95	2.17	2.36	2.65	2.21	19
Planting of cover crops	1.2	1.17	1.27	1.19	1.21	1.21	20
Change mulching material	1.1	1.2	1.25	1.07	1.14	1.15	21

Source: Computation from field survey, 2021

Degree of adaptive capacities of respondents to climate change

The adaptive capacities of respondent to climate change is presented in Table 4. The result in Table 4 shows that most of the respondents interviewed have high adaptive capacities to practice irrigation farming, use of improved seeds, livestock production, change land preparation pattern, change of weeding pattern, application of fertilizer, change planting dates, fish farming, bush allowing, mono /sole cropping, diseases resistant variety, okada service, early maturing variety, plant drought-resistant variety and change from crop to livestock. This is because their adaptive capacities are within the range of 2.67 ≤Adap Capij ≤ 4.00. Among these adaptation strategies with high adaptive capacities, practices of irrigation farming and change mulching material recorded the highest and lowest with 3.91 and 1.15 degrees respectively.

The adaptation strategies with moderate adaptive capacities are small-scale business, mixed cropping,

practice crop rotation, and water-harvesting schemes. Out of 21 adaptation strategies used, farmers are moderately adaptive to only 4 of them. Among adaptation strategies in which farmers are moderately adaptive, small-scale businesses had the highest adaptive capacity value of 2.63 while crop rotation practice recorded the lowest with 2.21 degrees. This implies that farmers in the study area need additional knowledge, skills, and resources to improve their business activities. These will further assist respondents in increasing their degree of adaptive capacities to climate change.

Table 4: Degree of adaptive capacities of respondents to climate change

Adaptation's strategies	Adaptive capacities	Rank	Degree of adaptive capacities
Irrigation practices	3.91	1	High
Use of improved seeds	3.89	2	High
Livestock production	3.70	3	High
Change land preparation pattern	3.66	4	High
Change of weeding pattern	3.56	5	High
Application of fertilizer	3.44	6	High
Change planting dates	3.37	7	High
Fish farming	3.29	8	High
Bush allowing	3.23	9	High
Mono /sole cropping	3.17	10	High
Diseases resistant variety	3.05	11	High
Okada service	2.99	12	High
Early maturing variety	2.94	13	High
Plant drought resistant variety	2.83	14	High
Change from crop to livestock	2.75	15	High
Engage in small-scale business	2.63	16	Moderate
Mixed cropping	2.47	17	Moderate
Crop rotation practice	2.35	18	Moderate
Practice water-harvesting scheme	2.21	19	Moderate
Planting of cover crops	1.21	20	Low
Change mulching material	1.15	21	Low
Average	2.94	-	High

Source: Computation from field survey, 2021

CONCLUSION

It was concluded that the degree of adaptive capacities to climate change was high among the adaptation strategies sample across the State except for changes in mulching materials and planting of cover crops. The study recommends that to reduce the effect of climate change in these areas, there is a need for policymakers to engage community stakeholders when making decisions relating to their livelihood.

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