

Assessment of Climate Change Variables Impact on Fishing Livelihood of some Fishing Communities in Badagry Local Government Area of Lagos, Nigeria

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ABSTRACT

This study examined the impact of climate change variables on fishing livelihood in some communities in Badagry Local Government Area of Lagos State, Nigeria. It utilized a well-structured questionnaire that was distributed among the 306 respondents randomly to inquire into the demographic, fishing activities, perception on climate change and adaptation mechanism of respondents to climate change. It was found that 86.3% of the respondents were familiar with the climate change variables such as rainfall, windfall, drought etc. Also, 92.5%, and 85.8% of the respondents claimed to know that erratic rainfall and temperature respectively is due to climate change and affected their fishing activities. The perception of the respondents on the climate variability impact on the fishing activities has nothing to do with their gender at $t(238) = -1.440$, $p = 0.151$. A significant correlation was discovered in the perceived climate change variables and their effect on the fishing activities of the fisher folks in each of the communities ($r = 0.274$; $p < 0.05$). Perceived oscillation of unusual dry and wet season in the past few years was significant, $\chi^2(1, N = 240) = 86.40$, $p < 0.05$ with the fishing activities and income. Lastly, Employment status, annual income and education share a non-significant relationship [$F(2, 240) = 0.171$, $p = 0.843$] to swift adaptation to climate variable effects among the fish farmers. In conclusion, reduction in the fishing activities livelihood and income of the fisher folks in the communities has been ascribed to the effect of climate change variables.

Keywords: Badagry, Climate change, Fishing, Rainfall, Temperature, Variables, Windfall

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INTRODUCTION

Climate change is a global occurrence which consequence keeps on creating attention and workers from different sectors of the economy are exposed to numerous types of hazards connected with climate change with respect to the nature of work, location, season, and work period (Olu and Majekodunmi, 2020). The recent disparity in seasonal weather patterns has created many concerns for the global community. Climate change has also continued to be a major threat to development and productivity, while the third world countries with lesser reconciling abilities are more assailable (Olu and Majekodunmi, 2020). Variables of climate change include temperature, rainfall, windfall, flood, drought, etc., and have been reported to have changed globally.

Climate variability is also known as discrepancies in the signify conditions and additional demography of the climate on each of temporal and spatial measurements outwit that of discrete weather occurrence (Intergovernmental Panel on Climate Change (IPCC), 2007). Climate change is inescapably developing into climate variability changes and in the rate of occurrence, potency, spatial scope, period, and timing of uttermost weather and climate incidents (IPCC, 2012). The universe facet air temperature is forecasted to increase with all schemes, while aerosol and greenhouse gas concentrations remain the same. Changeability in climate is an innate inner process enclosed by the climate apparatus (internal changeability) although, for some years now, it has been aggravated by anthropogenic activities (external changeability) have aggravated this climate variability (IPCC, 2007).

Africa had witnessed an increase of 0.5°C in temperatures in the last century while the minimum temperatures appear to be increasing than the maximum (Niang *et al.* 2014). It has been demonstrated that across Africa, temperatures are rising twice as quickly as the estimated global temperature escalation of 0.4 and 1.2°C at both northern and southern hemispheres per century

(Davis and Vincent, 2017). West Africa's forecast for climate indicates a rise of over 3°C of temperature in coastal areas and for inland countries close to 4°C by 2100 are been forecasted (Belhabib *et al.*, 2016), and for East Africa, a rise of 2–3°C of temperature is anticipated (Adhikari *et al.*, 2015).

Africa is predominately semi-arid and this makes the continent, year after year, vulnerable to utmost rainfall variations (Nicholson *et al.*, 2018). Part of Southern Africa and West Africa has been experiencing a fast decline in rainfall (Girvetz *et al.*, 2019). Rainfall forecasting appears to be undetermined, and this revealed lofty spatial and seasonal reliance when compared to temperature forecast (Niang *et al.*, 2014). Apart from the eastern part of Africa, rainfall is expected to dwindle beneath the lofty greenhouse gas outflow outline (Girvetz *et al.*, 2019; Serdeczny *et al.*, 2017).

Drought and flood are the prominent devastating weather occurrence in sub-Saharan Africa (SSA) (Ongoma *et al.*, 2018). In southern Africa, the prominent devastating weather occurrences include droughts, floods, humongous storms, and wildfires (Davis and Vincent 2017). Increased drought cases across the SSA areas that are arid and semi-arid are forecasted to extend across 60 to 90 million hectares in size in a few years to come (Kotir 2011).

For over 200 million individuals in SSA, fish is seen as their major avenue of animal protein (Mohammed and Uraguchi 2013; Obiero *et al.*, 2019; Tran *et al.* 2019). The fisheries sector serves as a major livelihood for nearly 10 million individuals in SSA and about 100 million individuals practice fishing as an alternative means of livelihood (Du Preez 2018; Kolding *et al.*, 2016; Mohammed and Uraguchi 2013). It has also been established that in the SSA inland region, the fishery and aquaculture industries employed about 5 million individuals (De Graaf and Garibaldi, 2014). The stress associated with the ecological, physical, and socio-economic of the

coastal area of Africa and more than 50% of the fishes produced in SSA are aggravated by changes in the climate (Mohammed and Uraguchi, 2013). Climate change constitutes a potential danger to fisheries beyond other simultaneous forces like; habitat debasement, excessive fishing, pollution, new species presentation, etc., (Brander, 2010). It has been reported that species dispersion changes, population movement, and organism features changes are some of the ways that freshwater and marine biodiversity react to conditions created by climate change (Poloczanska *et al.*, 2013; Wabnitz *et al.*, 2018).

The livelihood of residents in the coastal area chiefly relies on fish and agricultural engagements which have been threatened by environmental challenges including climate change (Owolabi and Adejumo, 2016). Climate change has been attributed to be an aggravator that impacts negatively on food security and recruitment of livelihoods like; agriculture, fisheries, and tourism activities (Martins *et al.*, 2019; Martins and Gasalla, 2020). Climate change has caused species dynamism with a reduction in the main prey that could be available due to increased CO₂ levels that might lead to acidification, coral reef loss, and disparity in ocean biogeochemistry (Sumaila and William, 2010).

The vulnerability idea is vital in the conversation on livelihood development, dangers, worldwide environmental changes, and flexibility (Etongo and Arrisol, 2021). Studies on vulnerability to climate change amalgamate both natural and social science views. Evaluation of climate vulnerability has surfaced to talk to the requirement in quantifying how people adjust to transposing environmental conditions (Etongo and Arrisol, 2021). Susceptibility of livelihood is a consequence of merged but uneven effects of biophysical and socio-economic attributes of households and communities (Islam *et al.*, 2013). Some studies show that climate change has been delineated to adversely modify freshwater ecosystems, and significantly influence fish

proficiency and human communities whose food and livelihood are fishery resources (Ndebele-Murisa *et al.*, 2014; Niang *et al.*, 2014; Woolway *et al.*, 2020).

It has been estimated that 660 to 820 million individuals across the world livelihood has been supported by fisheries with 16.6% animal protein source for the global populace (Food and Agriculture Organization (FAO), 2012). Recruitment in the fisheries industry has kept on increasing speedily than recruitment in the agriculture sector (FAO, 2012). Fishing is quite vital for the individuals since it is a style of life propelling social identification and not like every other livelihood activity (Coulthard *et al.*, 2011).

Some studies have been conducted to comprehend the climate change influence in marine fisheries (Belhabib *et al.*, 2016; Katikiro and Macusi 2012; Lam *et al.* 2016), inland fisheries catching (Cohen *et al.*, 2016; Plisnier *et al.*, 2018; Utete *et al.*, 2018), aquaculture (Asiedu *et al.*, 2018; Freeman, 2017) and fisheries provision to livelihoods, and food safety (Chan *et al.*, 2019; Temesgen *et al.*, 2019; Tran *et al.*, 2019) In the SSA.

The pattern of livelihoods remains not the same across the globe pattern and this is guided by five (5) assets (which serve as livelihood foundation) namely; financial, human, natural, physical, and social capital. These assets largely determine how people react to the changes in climate and its effects and widen the process of adjustment scope.

Evaluation of the impact of changes of climate variables on fishing livelihood in some fishing communities in Badagry local government area of Lagos State, Nigeria, is the aim of this study.

METHODOLOGY

Study Location

This study was carried out in Badagry Local Government Area of Lagos State, Nigeria. Badagry is an ancient town situated on the Southwest coast of Nigeria, popularly recognized

for slave trading in the past and presently known for activities such as fishing, farming, and salt making. It is located between the geographical coordinates of latitude 6° 24' 54.07" and longitude 2° 52' 52.75". The sampling areas of this study are Ajido, Marina, Akarakumo and Topo in Badagry local government area of Lagos State, Nigeria. The choice of this area of study was borne out of the fact that are riverine community.

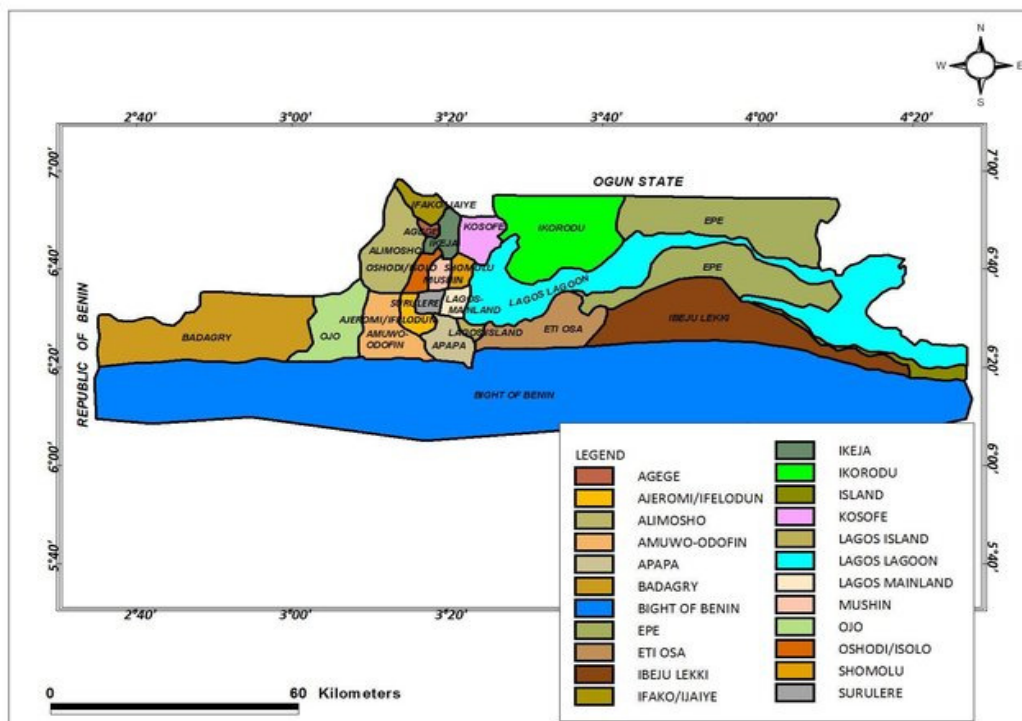


Fig. 1: Lagos state map showing all the local government

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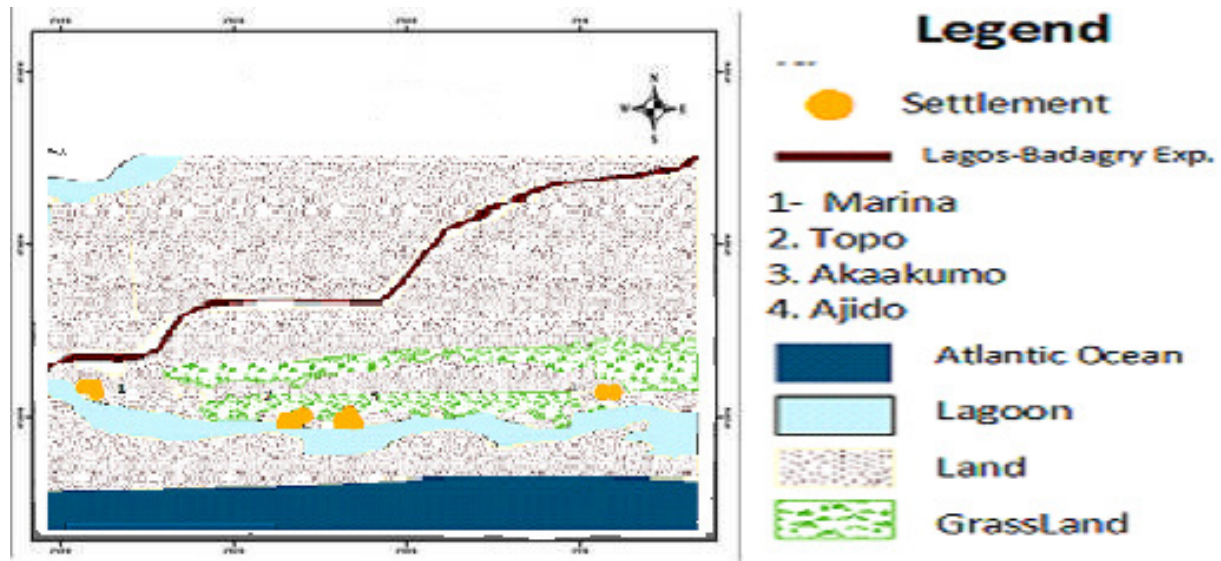


Fig. 2: The studied fishing communities digitized map location in Badagry Local government

Population and sample size of the Study

Fisher farmers in the study location were this study population.

Sample size was evaluated using the formula postulated in *Olu et al., (2022)* and *Yasmin and Ferdaous (2023)* used when population size cannot be ascertained:

$$n = (Z_{1-\alpha/2})^2(1 - \rho) \rho / e^2$$

At 95% confidence interval (CI) ($Z_{1-\alpha/2} = 1.96$), 4% error of margin and 5% non-response rates. So, the prevalence was taken to be 20%, $Z_{1-\alpha/2}$ as standard normal Z value corresponding to a cumulative probability of $1-\alpha/2$. $P = 0.15$; precision = 0.05; $\alpha = 0.05$ $Z_{1-\alpha/2} = Z_{0.975} = 1.96$

$$n = \frac{1.96^2 \times 0.85 \times 0.15}{(0.04)^2}$$

$$n = \frac{0.4898}{0.0016}$$

$$n = 306$$

Data Collection

A well-structured questionnaire classified into 4 sections was employed in amassing the data from the respondents who were randomly selected. The demographic, fishing activities, perception on climate change, and adaptation mechanism adopted towards climate change made up the

questionnaire sections. The perception on climate change category consisted of 15 items dichotomous questions, while the adaptation mechanism adopted category is composed of 10 items Likert-type questions ranging from strongly disagree to strongly agree

Analysis of Data

The data obtained during this study was subjected to descriptive and inferential statistics using Statistical Package for the Social Sciences (SPSS) (version 24). The feedback acquired from the questionnaire distributed was evaluated for internal reliability using Cronbach Alpha and Average Variance Extraction (AVE). Also, Composite Reliability was employed to evaluate construct validity. The instrument's unidimensionality was evaluated prior to the construct validity determination.

Exploratory Factor Analysis (EFA) was used to check for commonality between variables. Factor analysis (FA) was carried out on the items in the adaptation mechanism adopted section of the questionnaire and subscales were generated. The 10 items of the adaptation mechanism adopted scale was exposed to PCA. Before conducting the PCA, the aptness of data for FA was evaluated. Examination of the correlation matrix divulges the

existence of numerous coefficients of 0.3 and beyond. The value of Kaiser-Meyer-Okin was 0.633, greater than the advocated worth of 0.6 (Kaiser, 1970, 1974) and the Bartlett's Test of Sphericity (Bartlett, 1954) arrived at statistical importance, bearing the correlation matrix factorability. The sum score was computed for the obtainable items that were requisite. Scores were computed by totaling the numeric value of each feedback in the subscales.

An Independent T-test was employed to evaluate the connection between gender and the perception of the fish farmers in Badagry fishing communities on the influence of climate change variable on the fishing activities with significance established at $p < 0.05$. A Pearson coefficient correlation analysis was carried out on the connection within the climate change variables (rainfall and temperature) with their effect such as flood and drought on the fishing activities of fisher folks in each of the communities from their perspective with significance accepted at $p < 0.05$. A three-way analysis of variance was conducted with adaptation to climate variable effects as the dependent variable and employment status, annual income, and educational level were the independent variable with significance set at $p < 0.05$. A chi-square analysis was conducted on the relationship between the irregular/unusual dry and wet seasons in the past few years and the income (a categorical variable) of fisher folks in Badagry fishing communities with significance established at $p < 0.05$.

RESULTS AND DISCUSSION

The respondents constitute 62.9% as male and 37.9% as female as stated in Table 1. In line with this study, it has been reported that the fishing industry had more male participation than females for many years (Harper *et al.*, 2013; Huruma 2014). This discernment likely affects the climate change adjustment possibilities practiced in lots of countries in Africa to be swayed in the direction of the male gender (Yusuf *et al.*, 2015). In addition, 20% of the respondents are between the ages of 18 and 25. 31.7% are between the age

of 26 and 35 while 27.5% are between the ages of 36 and 50. The result shows that a large number of the respondents fall between the age of 26 and 35 years. As shown in Table 1, 17.5% of the respondents have lived in the fishing communities for less than 5 years, 27.5% of them have lived in the community between 5 to 10 years and 55.0% of the respondents have lived in the community above 10 years with 77.1% of the respondents been permanent residents of the fishing communities and 22.9% of the respondents are temporary residents of the fishing communities. Numerous of the respondents (47.9%) appeared to be married, and 23.3% of the respondents have a total household range of 1-5 while 76.7% of the respondents have a total household range of 6-10. Also from Table 1, 15.8% of the respondents have been practicing fish farming between 1-4 years, 32.1% have been practicing fish farming between 5-9 years, 20.0% have been practicing fish farming between 10-14 years and 32.1% have been practicing fish farming for more than 15 years. Marx *et al.* (2007) in different studies reported that age and experience in fishing might be liable for expanding the chance of remembering crucial climate occurrences. Furthermore, 45.4% of the respondents have inshore as their fishing location while 54.6% of the respondents have offshore as their fishing location, 16.7% of the respondents spend less than 3 hours fishing per day, 38.8% of the respondents spend between 3-5 hours fishing per day, 35.4% of the respondents spend 6-10 hours fishing per day and 9.2% of the respondents spend more than 10 hours daily. From Table 1, 39.2% of the respondents in this study claim that the fishing trend has decreased slowly and 60.8% of the respondents in this study claim that the fishing trend has been decreasing moderately.

The Table 2 makes it obvious that 27.5% of the respondents are engaged with boat renting as a fishing activity while 72.5% of the respondents did not practice boat renting. 59.6% of the respondents practice fish processing as a fishing activity while 40.4% did not practice fish trading.

Table 1: Respondents socio-demographic placement

	Frequency	Percentage
Gender		
Male	149	62.9
Female	91	37.1
	240	100
Age		
18-25	48	20.0
26-35	76	31.7
36 -50	66	27.5
51 and above	50	20.8
Total	240	100
Marital status		
Single	74	30.8
Married	115	47.9
Divorced	23	9.6
Widow/Widower	28	11.7
Total	240	100
Educational Qualification		
Primary	36	15.0
Secondary	109	45.4
Tertiary	56	23.3
No formal education	39	16.3
Total	240	100
Employment Status		
Fishing Employee	53	22.1
Fishing Self employed	181	75.4
Unemployed	6	2.5
Total	240	100
Experience in fishing activities		
1-4 years	38	15.8
5-9years	77	32.1
10-14 years	48	20.0
> 15 years	77	32.1
Total	240	100
Fishing Location		
Inshore	109	45.4
Offshore	131	54.6
Total	240	100
Annual Income		
N200,000-500,000	164	68.3
N501,000-800,000	65	27.1
N801,000-1,100,000	11	4.6
	240	100
Fishing trend		

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Increasing slowly	--	--
Increasing moderately	--	--
Constant	--	--
Decreasing slowly	94	39.2
Decreasing moderately	146	60.8
Total	240	100
Fishing duration per day		
<3 hours	40	16.7
3-5 hours	93	38.8
6-10 hours	85	35.4
>10 hours	22	9.2
Total	240	100

From this study, the respondents that earn much from the fishing activities, do not practice just one activity, they do combine some other activities. Bryan *et al.*, (2013) reported that families that make more money appear to be quick to react to climate change. The keenness to invest in program that cushion household immediate needs that could emanate as a result of dwindling fish catches is chiefly controlled by high income realized through fishing (McGrath *et al.*, 2007).

The perception of respondents towards climate change is as reported in Table 3 which exhibits that 86.3% of the respondents in this study claimed to be familiar with the climate change

variables while 13.8% of the respondents claimed not to be familiar with the phenomenon. 92.5% of the respondents in this study claimed to know that erratic rainfall is due to climate change while 17.5% claimed not to be aware. 85.8% of the respondents in this study claimed that drought as a result of increased temperature affected their fishing activities. 95.4% of the respondents also reported that their fishing activities have been affected by the unusual season while 4.6% claimed otherwise. Majority of the respondents reveal that the reduction in their income makes them susceptible to climate change impacts.

Table 2: Fishing Activities

Fishing Activities	Yes (%)	No(%)
Boat Renting	66(27.5)	174(72.5)
Fish Catching	150(62.5)	90(37.5)
Gear Renting	14(5.8)	226(94.2)
Fish Processing	91(37.9)	149(62.1)
Boat Crew	53(24.3)	184(76.7)
Fish Trading	143(59.6)	97(40.4)

From Table 3, 77.9% of the respondents in this study claimed to know that an increase in environmental temperature is caused by climate change. And 80.8% of the respondents opined that climate change which is also responsible for

the increase in environmental temperature has been responsible for the irregular/unusual dry/wet season effect that has led to lesser fishing activities and a decrease in income

Table 3: Respondents Climate Change Perception

Items	Yes (%)	No (%)
Are you familiar with Climate change and its variability	207(86.3)	33(13.8)
Are you familiar with rainfall as a climate change variable	226(94)	14(9.8)
Are you familiar with increase in temperature as a climate change variable	150(62.5)	90(37.5)
Are you familiar with windfall as a climate change variable	186(77.5)	54(22.5)
Are you familiar with drought as a climate change variable	174(72.5)	66(27.5)
Have there been erratic rainfall and increase in temperature in the past few years	237(98.8)	3(1.3)
Do you know erratic rainfall is due to climate change	198(92.5)	42(17.5)
Do you know erratic rainfall can cause flood	219(91.3)	21(8.8)
Does flood from erratic rainfall affect your fishing activities and income	230(95.8)	10(4.2)
Are you aware that extreme rise environmental temperature are caused by climate change	187(77.9)	53(22.1)
Do you know increase in temperature can cause drought	209(87.1)	31(12.9)
Has drought from increased temperature affected your fishing activities and income before	206(85.8)	34(14.2)
Have you witnessed irregular/unusual dry and wet season in the past few years	233(97.1)	7(2.9)
Was your fishing activities affected by these unusual season	229(95.4)	11(4.6)
Did the unusual dry/wet season effect due to climate change lead to more fishing activities and increase in income.	46(19.2)	194(80.8)

In a study by Ikeh and Zimoghen (2015), it was reported that water bodies do experience conditions alteration like rising temperature, salinity increase, and introduction of hostile water species, and these may lead to the dispersion of fish from the dominant area to different water bodies. This pressurizes fishermen to sojourn on a distance fishing trip in search of copious contribution of fishes. Additionally, Sumaila and William (2010) indicated that local species in the water bodies are pressurized to migrate to pleasant locations due to the changes that take place in water bodies and subsequently augment the encroachment of trespassing species into the indigenous area.

Submission by Limuwa et al., (2018) on seasonal differences and year-to-year rainfall disparity are indistinguishable from the one described by Ngongondo et al., (2011) that alteration of the rainfall subsequently causes rainfall patterns in Malawi as a whole to change. Also in this study, 95.8% of the fishing communities’ respondents believe that the erratic rainfall is disrupting fishing

activities and also led to unusual dry/wet seasons. This backs the claim made by 60.8% of the respondents that the fishing trend has decreased slowly.

From Table 4 it can be exhibited that 30.4% of the respondents in this study agree that harsh conditions due to climate variability have led to changes in jobs in fishing communities while 22.1% of the respondents strongly disagreed with this claim. 42.5% of the respondents intensely concur with the claim that people increase their practices due to unfavorable seasons while 2.9% of the respondents strongly disagreed with the claim. 39.6% of the respondents strongly disagreed with the claim that religious practices and beliefs affected their fishing beliefs while 13.3% of the respondents disagreed with the claim. 62.5% strongly agreed with the claim that support from the government can ameliorate the vulnerabilities of fish farmers to climate.

Table 4: Respondents views on Adaptation and Mitigation to Climate Change

Items	SD n(%)	D n(%)	NS(%)	A n(%)	SA n(%)
When harsh conditions due to climate change e.g., flood occurs people in the fishing community change their job.	53(22.1)	42(17.5)	20(8.3)	73(30.4)	52(21.7)
The people practicing fishing activities migrate to other communities during climate change induced disaster on fishing activities.	16(6.7)	41(17.1)	18(7.5)	148(61.7)	17(7.1)
When there is unfavourable season, the people practicing fishing activities in the communities resolve to increase in time of their operations.	7(2.9)	21(8.8)	38(15.8)	72(30.0)	102(42.5)
There is enough awareness on mitigating climate change effect on fishing activities for us in our communities.	33(13.8)	81(33.8)	88(36.7)	31(12.9)	7(2.9)
Our religion practices and believes in our communities hamper our interest in adapting and mitigating climate change variable impacts	95(39.6)	63(26.3)	40(16.7)	32(13.3)	10(4.2)
Low education standard among us affects our response to climate change and its mitigation practices	13(5.4)	17(7.1)	25(10.4)	131(54.6)	54(22.5)
Lack of capital for the procurement of modernised tools for fishing activities is affecting adaptation and mitigation to climate change variables influence on fishing activities in our communities	-	3(1.3)	11(4.6)	117(48.8)	109(45.4)
Enforcement of law guiding the best fishing practices during harsh weather could help in increasing fishing activities	-	13(5.4)	48(20.0)	128(53.3)	51(21.3)
Prevention of biodiversity loss can help in reducing the effect of climate change variables on vulnerable fishing activities	4(1.7)	5(2.1)	49(20.4)	137(57.1)	45(18.8)
Support by government in areas of capital, awareness creation, provision of infrastructure could go a long way in ameliorating climate change variables impact on vulnerable fishing communities	1(0.4)	--	3(1.3)	86(35.8)	150(62.5)

SD-Strongly disagree, D-Disagree, NS- Not sure, A-Agreed, SA-Strongly agreed

Table 5. Question set exploratory analysis for Adaptation and Mitigation to Climate Change

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy.		0.633
Bartlett's Test of Sphericity	Approx. Chi-Square	308.543
	Df	45
	Sig.	.000

Adaptation and Mitigation to Climate Change	
Item	Communalities
1	0.605
2	0.617
3	0.690
4	0.680
5	0.609
6	0.626
7	0.417
8	0.613
9	0.819
10	0.571

To verify Exploratory Factor Analysis (EFA) adequacy for the data secured under the adaptation and mitigation to climate change section in this study, Kaiser–Meyer–Olkin (KMO) index was employed as illustrated by Yusuf *et al.* (2022), from Table 5, KMO = 0.633, this indicates that the obtained data were suitable for factor analysis. Bartlett’s sphericity test of $\chi^2 = 308.543$, $df = 45$, $p < 0.05$ was significant, enabling the EFA to be conducted. In determining the unidimensionality of the instrument employed, the EFA was conducted for individual factors by

commonality, employing the PCA. Taking a look at Table 3, the communality for the questions item was enclosed in the range of 0.417 and 0.819. In the question model, the higher the commonality, the larger the explanatory power of a disclosed item, with individual items exceeding 0.5 (Kirch *et al.*, 2017). Each one of the items in this study as illustrated in Table 3 exhibit greater explanatory power.

Table 6: Reliability and Validity of the Constructs

Variables	Number of Indicators	Average Variance Extracted	Composite reliability Coefficient	Cronbach’s Alpha
Adaptation and Mitigation to Climate Change	9	0.425	0.868	0.803

To evaluate the internal consistency and reliability of the items, a composite reliability coefficient was used, and according to Hair *et al.* (2011), the minimum suitable level of 0.70, signifying

satisfactory internal consistency and reliability of the constructs. From Table 6, the items had a satisfactory composite reliability. Also, according to Hair *et al.* (2011), 0.50 minimum AVE indicates

that a minimum of 50% of the variance of the item in question is explained. As shown in Table 6, AVE of the constructs of latent was able to explain 42.5% satisfied the requirement, except.

As stated by Yusuf *et al.* (2022) reliability test in Cronbach alpha if at a value >0.9, > 0.8, > 0.7, >0.6, > 0.5 and < 0.5, is said to be excellent, good, acceptable, questionable, poor, and unacceptable respectively. The items from Table 6 had a

reliability of Cronbach’s alpha that is not only acceptable but good.

To investigate the relationship between perceived climate change variables i.e., rainfall and temperature with their effect such as flood and drought on the fishing activities of fisher folks in each of the communities Pearson’s product-moment correlation coefficient (*r*) was employed at Alpha level of 0.05.

Table 7: Pearson correlation for perceived climate change variables with their effect on the fishing activities

	Does flood from erratic rainfall affect your activities and income	Has drought from increased temperature affected your fishing activities and income before
Does flood from erratic rainfall affect your activities and income	Pearson Correlation 1	.274**
Has drought from increased temperature affected your fishing activities and income before	.274**	Pearson Correlation 1

** . Correlation is significant at 0.05 level (2-tailed).

The result reveals that a significant correlation was found in the perceived climate change variables (rainfall and temperature) with their effect such as flood and drought on the fishing activities of fisher folks in each of the communities ($r = 0.274$; $p < 0.05$).

A negative connection had been revealed between the Nile pole and temperature in the study to investigate the influences of abiotic variables on the dissemination of the Nile perch of Lake Victoria revealing a negative relationship between temperature and the Nile pole (Nyboer *et al.*, 2020). In addition, James and Washington (2013), revealed households or societies that depend on fishery resources as their major source of livelihood do adjust and migrate in a circumstance where fish species move to a favorable habitat as a result of altering environmental states like rising temperatures.

Adaptation to changes associated with the climate by fishing communities can be independent or organized (Shelton, 2014), and can be done individually, societally, nationally, or regionally (Muringai *et al.*, 2021).

As indicated in Table 8, a chi-square test of goodness of fit was performed to scrutinize the connection between the perceived oscillation of unusual dry and wet seasons in the past few years and fishing-based derived income of fisher folks in Badagry fishing communities. The relationship between these variables was significant, $\chi^2 (1, N = 240) = 86.40$, $p < 0.05$. In a study by Chukwu (2014) to assess the reverberation of flooding in Pedro fishing community in Nigeria, dwindling fish catches which resulted into loss of income for their various families was accounted for by 76% of the respondents. Droughts have been

associated with high human forces on the persistent freshwater scarcity by removing freshwater for agricultural or manufacturing, which could likely dwindle connectivity of the habitat throughout dry days, and aquatic life is negatively affected (Bêche et al., 2009).

As maintained by Lake (2008), a shortfall of water connected to droughts can result in the shrinkage of streams in width and drop in level thereby a reduction in volume and surface area, and freshwater fish experience salinity increment.

Lake Chad shrinkage for instance has been associated with persistent droughts and continuous water removal for agricultural motives (Gao et al., 2011), and this consequently led to the misplacement of fish habitat with depletion in the production of fish (Eriegha et al., 2019). As stated by Roudier et al. (2014), fishery production dropped by 50% as a result of drought conditions in the Niger Delta area of Nigeria.

Table 8: Chi square for perceived oscillation of unusual dry and wet season fishing based derived income

Did the unusual dry/wet season effect due to climate change led to more fishing activities and income for you and your house hold	
Chi-Square	86.400
Df	1
Asymp. Sig.	.000

The relationship between the perception of fish farmers on the influence of climate variability on the fishing activities and their gender was

evaluated by an independent t-test as illustrated in Table 9.

Table 9: Independent t-test on perception of fish farmers on the influence of climate variability on the fishing activities with gender

	Sex	N	Mean(M)	Standard Deviation (S.D)	T	Df	Significant
Total score for Perception	Male	149	9.05	1.702	-1.440	238	0.151
	Female	91	9.37	1.710			

The result as shown in Table 9 indicates that the male gender scores (M=9.05, SD=1.702) and Female (M=9.37, SD=1.710) were not significant, $t(238) = -1.440, p > 0.05$ which simply implies that how the respondents perceived the influence of climate variability on the fishing activities has nothing to do with their gender. Although gender sways how an individual adjusts to varying roles and it has been proven that sociocultural establishments regulate what men and women do (Jerneck, 2018), for instance, fishing gear proprietorship and fishery-related activities involvement (Nunan et al., 2015).

In reviewing studies on farmers' insightfulness and climate change adaptations in numerous countries from SSA, Juana et al. (2013) discovered that gender is independent of the attention shower on farming concerning risks associated with climate when compared to other key sectors.

A three-way-between-groups univariate analysis of variance was employed to examine the relationship between employment status, annual income, and education to swift adaptation to climate variable effects among the fish farmers in Badagry fishing communities. From Table 10, The main effect of each of the independent variables-employment status, annual income, and

education with $F(2, 240) = 0.114$, $F(2, 240) = 2.890$, and $F(3, 240) = 4.618$ respectively on the dependent variable- swift adaptation to climate variable effects were not statistically significant at $p > 0.05$ except the education which shares a

significant relationship at $p = 0.004$. Also, the interaction effect of the independent factors on the dependent variable [$F(2, 240) = 0.171$, $p = 0.843$] did not reach statistical significance.

Table 10: Analysis of variance on employment status, annual income and education to swift adaptation to climate variable effects

Source	Sum of squares	Mean Square	df	F	Sig.	R Square
Intercept	34772.63	34772.63	1	2257.52	0.000	
Employment status	3.507	1.754	2	0.114	0.892	
Annual income	27.412	13.706	2	2.890	0.412	0.262
Education	213.417	71.139	3	4.618	0.004	
Employment status* Annual income* Education	5.256	2.628	2	0.171	0.843	

Dependent variable: swift adaptation to climate variable effects

In this study, there exists devoid statistically significant relationship between employment status, annual income, and education to swift adaptation to climate variable effects among the fish farmers in Badagry fishing communities. From Table 10, education was the only independent variable with an important influence on the swift adaptation to climate variable effects among the fish farmers. As claimed by *Bryan et al. (2007)*, the tendency to adjust can be intensified with education because it is discovered to positively correlate to ingress to information related to the climate. The more educated the fishers are, the further they will have additional information on climate with them; this is crucial in aiding them in futuristics with their plans, rather than reacting.

Climate adaptation broadly needs implementing strategic plans in the long-term, Nigerians must be aware and approach comprehending climate change challenges and how they affect their day-to-day lives with measures for adaptation (*Awatt, 2023*). The adaptive mechanism can be improved in education broadly which will subsequently enhance reflection on the adaptive measure (*Feinstein and Mach, 2019*).

It has been reported that to effect strategies for climate change adjustment, numerous farm households depend on income generated from non-farm activities in addition to what they make from their various plantation (*Ojo and Baiyegunhi, 2020; Yiridomah et al., 2020*) and this is in agreement with this study finding in which employment status share a non-significant relationship with swift adaptation to climate variable effects among the fish farmers. To bloat yield, augment income, and reach the demand for food by a fast-growing citizen, undivided attention must be channeled on strategies to control the dangers of adaptation to climate change in agriculture (*Dhakai et al., 2022*). In this study, annual earned income does not share a significant relationship with swift adaptation to climate variable effects among the fish farmers. Low-income fisher households could become quite susceptible to negative climate change effects (*Huang et al., 2015; Obayelu et al., 2014; Trinh et al., 2018; Wang et al., 2014*).

CONCLUSION

This study has looked into the vulnerability, adaptation, and mitigation measures of four fishing communities concerning the influence of

climate variability and associated change in Badagry. Although fisher folks irrespective of their gender have been negatively affected by the variables of climate change. Harsh conditions linked to climate variability led to a change of jobs in fishing communities. The occurrence of these climate change variables has resulted in a wide range of negative impacts notably reduced income, and loss of life and properties. Education has been seen to be a factor in swift adaptation to climate variable effects from this study and climate change is not a respecter of age or gender in causing its damage.

With these research discoveries, the following recommendations are proffered.

1. The need to intensify the promotion of positive measures for adaptation, mitigation, reorient available policies, and further address the confrontation linked to the augmenting climate change variables.

In building the needed capacity for increased awareness, efforts should be geared towards addressing other limitations ideally by indigenous-driven mediation.

AUTHORS' CONTRIBUTION

OLU, J.: Developed the manuscript, designed the questionnaire, conducted and interpreted the data analysis.

OLAPEJO, A.: Was involved in the questionnaire development, administration and analysis

ADETUNJI, D.A., and ADETUNJI, O.A.: Worked on the editing of manuscript, and development of questionnaire.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest or bias influencing the conduct of this study.

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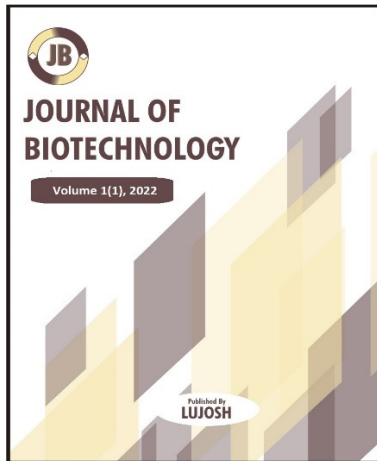
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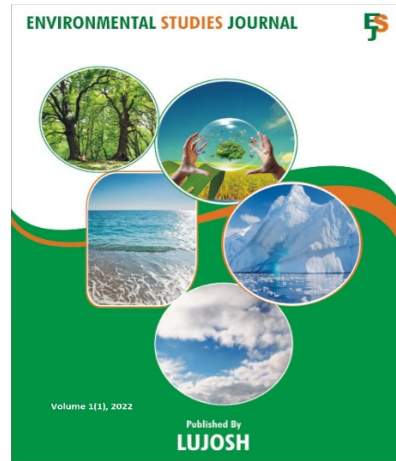
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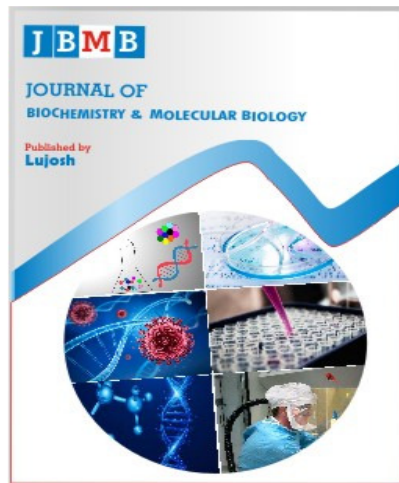
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