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PERCEPTION AND ADAPTATION TO CLIMATE CHANGE AMONG ARTISANAL FISHERMEN IN FISHING COMMUNITIES ALONG ANAMBRA RIVER NIGERIA

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Abstract
Climate change is threatening the attainment of self-sufficiency in fish production in Nigeria. As a result, artisanal fishermen are developing adaptation practices that will reduce their vulnerability to climate change. The study therefore investigated perceptions and adaptation behavior of climate change among Artisanal Fishermen in Fishing Communities along Anambra River in South East Nigeria. The study adopted multistage sampling technique to select 240 Artisanal Fishermen. The results showed that the mean age of Artisanal Fishermen was 50 years and household size of 4 persons, with 52.5% married. On average, the Artisanal Fishermen have spent about 15 years. Majority (85%) of the respondents have formal education. Also, majority of the Artisanal Fishermen had access to credit for male (67.5%). Furthermore the result revealed that Artisanal Fishermen ($\bar{x}$ = 2.99) were aware of the occurrence of climate change and the most widely used adaptation practice of the Artisanal Fishermen were changing of Diversification of livelihoods ($\bar{x}$ = 3.28), Information dissemination ($\bar{x}$ = 3.10), Improved housing ($\bar{x}$ = 3.112), Financial Support ($\bar{x}$ = 2.699). Ordinary least Square regression result factors influencing adaptation behavior of climate change among artisanal fishermen in fishing communities along Anambra river Nigeria with an R^2 value of 88.3% shows that marital status (5%), member of cooperative society (10%) and extension services (1%) were positively related to number of mitigation strategies used by artisanal fishermen in fishing communities, while household size (1%) was significant and negative. The study therefore, recommends that extension workers should be continuously trained and educated on current information about climate change to enable them enlighten and disseminate to fish farmers. This will enable update and synchronization of ideas with the Artisanal Fishermen.

Keywords: Perceptions, Adaptation Behavior, Climate Change, Artisanal Fishermen

Introduction

Climate change is a pressing global threat recognized at international, regional and local levels and has left humans and other living organisms vulnerable to the point of adjusting their system (Burton, 2011). According to American Meteorological Society, (AMS, 2011) climate is the average weather condition of a place taken over a prolonged period of time. Several climate change manifestations have been registered, including increases in average global air and ocean temperatures, widespread melting of snow and ice, rising global average sea level, and increased frequency and severity of extreme weather such as heavy rains (causing flooding), droughts and hurricanes. Consequent losses of human lives and property, and reduced agricultural productivity have been witnessed (Stern, 2006). Even, studies have predicted further changes which may result in more stressful negative impacts on the livelihoods of especially the poor (IPCC, 2014; Stern, 2006). Climate change has led to changes in soil moisture, soil quality, resilience, yield, atmospheric temperatures, flooding, unprecedented droughts, sea level rises and many more (Ozor and Nnaji, 2011). The impacts of these events include among others reduced landslides, destruction of property and human life, food insecurity, and reduction of farmers' incomes (NAPA, 2007; Oxfam, 2008). The effects of climate change to date seem to be small, but are projected to be progressively increasing in all countries and regions of the world. In Nigeria, climate change often appears very obscure but it is real.

One of the ways of reducing the effect of the climate change is adaptation of practices. Adapting to climate change entails taking the right measures to reduce the negative effects of climate change on production by making appropriate adjustments and changes (Akinnagbe and Irohibe, 2014). The Intergovernmental Panel on Climate Change (IPCC, 2007) defines

adaptation as adjustments in natural or human systems in response to actual or expected climatic stimuli or effects, which moderates harm or exploits beneficial opportunities. It also refers to actions that people, countries, and societies take to adjust to climate change that has occurred. The adaptation responses have been classified according to the scale at which they occur; intent; timing with respect to the climate stress; duration; form/type; and effect (Adger *et al*., 2007). Adaptation has three possible objectives: to- reduce exposure to the risk of damage; develop the capacity to cope with unavoidable damages; take advantage of new opportunities. Perception of farmers on climate change is a pre-requisite for adaptation. It gives a clue to determine the type and stage of adoption of strategies. Artisanal Fishermen's appreciation of the veracity of climate change, degree of worry about impact, and opinion on the personal and wider responsibilities for addressing the climate change shocks are imperative for influencing action. Artisanal Fishermen's perception should be well-integrated with adaptation strategies at their choice to improve the adaptive capacity.

Methodology

The study was conducted in three fishing communities along Anambra River Basin, Nigeria. The study adopted two-stage sampling technique. In the first stage, three fishing communities were selected, from the enlisted fishing communities along the River; Ogurugu, Otuocha, and Out-Nsugbe. Secondly, the assistance of Extension and Fishery officers of the ADP's and State Ministry of Agriculture was employed to help identify 10 Artisanal Fishermen engaged in fishing, giving a sample size of 240 Artisanal Fishermen. The study used primary data, collected with the use of structured and pre-tested questionnaire administered to fish farmers in the study area.

Model Specification

Binary logistic regression for factors affecting use of climate adaptation behavior among artisanal fishermen in fishing communities along Anambra River, Nigeria is explicitly specified as;

$$L_i = In\left[\frac{pi\ (y=1)}{1-pi\ (y=1)}\right] = = \beta_0 + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_4X_4 + \beta_5X_5 + \beta_6X_6 + \beta_7X_7 + \beta_8X_8 + \beta_9X_9 + e_i \ldots. (1)$$

Where,

L_i = Climate adaptation behavior = $\frac{pi}{1-pi}$

P_i (y = 1) = Probability of not using climate adaptation behavior

y = Use of climate change adaptation behaviour

β_0 = intercept

$\beta_1 - \beta_{10}$ = Coefficients estimated

X_1 = Household size (Number)

X_2 = Marital status (1=married, 0= otherwise)

X_3 = Age of the respondents (years)

X_4 = Experience in fishing (years)

X_5 = Level of education (number of years spent in formal schooling)

X_6 = Membership of cooperative society (Dummy: 1=yes; 0=otherwise)

X_7 = Access to extension services (number of extension visits)

X_8 = Access to credit facilities (amount of loan received (N)

X_9 = Monthly Income (N)

e_i = error term

Results and Discussion

The results in Table 1 show the socio-economic characteristics of Artisanal Fishermen in the study area.

Table 1: Socio-economic Characteristics of the Artisanal Fishermen

Variables	Frequency	Percentage (%)
Age (years)		
16-25	66	27.5
26-35	48	20
36-45	48	32.5
46-55	78	20
Mean	**50**	
Household size(number of persons)		
1-4	156	65
5 – 8	72	30
9-12	6	2.5
Mean	**3.93**	
Marital status		
Single	42	17.5
Married	126	52.5
Widowed	48	20
Divorced	24	10
Experience (years)		
1-5	24	10
6-10	18	7.5
11-15	48	20
16-20	150	62.5
Mean	14.75	
Education		
No formal education	36	15
Primary Education	54	22.5
Secondary Education	84	35
Tertiary Education	66	27.5
Access to credit		
Yes	162	67.5
No	78	32.5
Total	**240**	**100**

Source: Field survey, 2020

Age distribution of the respondent is presented in Table 1; the result shows that the mean age of respondents was 50 years. This implies that the farmers are ageing. This could be adduced to youth emigration to cities for white collar jobs. This result agrees with Nnadi and Amaechi, (2007) that youth migration from the rural to the urban areas left agriculture in the hands of the old and ageing farmers. This might influence their adoption of climate mitigation strategies in the area, as they will be used to their traditional methods of farming. Distribution of the respondent according to their household size showed that the mean household size was 4 persons. Large family size would have positive effect on production. The economic implication is that it will provide the Artisanal Fishermen with family labour and reduce cost of fishing and increase their revenue. This collaborates with Adegbite and Oluwalana (2004), that a relatively large household size may likely enhance family labour supply. Nwaru (2004) reported that Artisanal Fishermen may rely more on their household labour than hired workers for labour for their fishing activities. Also Ayuya *et al*. (2011) noted those large households have the capacity to relax the labour constraints required during introduction of new technology. The distribution of the respondents according to their marital status showed that about 52.5% were married. This shows that there were more married Artisanal Fishermen in the area. This implies that a greater percentage of the population had family members. This corroborates with the findings Nwaru (2004), who noted that married implies stability which creates conducive environment for good citizen training, development of personal integrity and entrepreneurship. The dominance of the married people in production in the area may be because married people are more settled as it relates to giving appropriate attention to fishing operation. The implication is that there are more stable households which are better positioned to engage in active fishing and its related activities. Distribution of the respondents according to their experience as presented in the Table shows that on average, the fish farmers has spent about 15 years. This concur with findings of Nwaru (2004), who noted that the number of years an Artisanal Fisherman has spent in business may give an indication of the practical knowledge he has acquired on how he can overcome certain inherent fishing problems. Artisanal Fishermen would count more on their experiences for improved catching ability rather that educational attainment. Distribution of the respondent according to their level of education as presented revealed that majority (85%) of the respondents have formal education, indicating that majority of the Artisanal Fishermen were literate. Higher literacy level would make them more favorably disposed to accessing

information that would increase their fish catch. Improved education level brings about positive changes in the knowledge, attitude and skills through research and extension (Imburr *et al*, 2008). The implication is that these respondents are better positioned to take advantage of new techniques and innovation that could improve adoption of change mitigation strategies in the area. However according to Fawole and Fasina (2005), level of education positively influence farmers' participation in development programme and adoption of conservation practice that could improve agricultural productivity. Also, majority of the Artisanal Fishermen had access to credit (67.5%), and by virtue of access to credit have better access to new innovation which will boost fishing and its related activities.

The study sought to establish Artisanal Fishermen perception of climate change in the study area. This construct had seven (7) items on which it was measured using a 4-point rating scale whereby respondents were expected to indicate their perception of climatic factors by ticking either of 1-4 for strongly disagree, disagree, agree, and strongly agree in that order. Table 2 presents the results of the descriptive analysis (means, standard deviations, skewness and kurtosis) of the fish farmers. Overall, the descriptive statistics resulted in a mean of 2.99 and a standard deviation of 1.10. This implies that the Artisanal Fishermen are aware of climate change in the area. Furthermore, the mean response for the variables ranged from 2.025 for "Relative Humidity is changing" to 3.7 for Heavy Rainfall. The largest variation was in Sunlight/Day length is changing (SD = 1.3623) and the least was Heavy Rainfall (SD = 0.775). The most occurring climate factor in the area was Heavy Rainfall; realistically in over five decades, heavy rainfalls have led to flood, and have submerged and destroyed settlement of fishermen (Ibekwe, 2012). Areas that have been highly modified by human activity tend to suffer more deleterious effects from increased rainfall. Furthermore, all these climatic factors tend to further degrade already degraded systems. Removal of vegetation in and around rivers, increased channel size, dams, river banks and catchment clearing all work to degrade the hill-slopes, rivers and floodplains, and increase the erosion and transfer of both sediment and nutrients (Douglas *et al.*, 2005). While cycling of sediments and nutrients is essential to a healthy system, too much sediment and nutrient entering a waterway has negative impacts on downstream water quality. The skeweness and kurtosis coefficients ranges from 0 – 4, indicating that the data was normal and qualified for use in parametric analysis such as regression analysis.

Table 2: Fish Famers perception of climate change

	Mean	Std. Deviation	Skewness		Kurtosis	
Famers perception			**Statistic**	**Std. Error**	**Statistic**	**Statistic**
Frequency of floods	2.888	0.842	-0.324	0.192	-0.716	0.381
Sea level is rising	3.125	1.217	-0.645	0.192	0.142	0.381
Heavy Rainfall	3.700	0.775	-2.618	0.192	3.743	0.381
Average temperature is increasing	3.225	1.052	-1.087	0.192	-0.193	0.381
Sunlight/Day length is changing	2.675	1.362	-0.224	0.192	-1.791	0.381
Relative Humidity is changing	2.025	1.264	0.691	0.192	-1.267	0.381
Strong wind	3.281	1.198	-1.204	0.192	-0.380	0.381
Grand Mean	**2.99**	**1.10**	**-0.77**	**0.19**	**-0.07**	**0.38**

Source: Field survey; 2020. Decision mean $\bar{} \geq 2.5$

A four-point rating scale whereby respondents were expected to indicate their perception of their climate change mitigation strategies by ticking either of 1-4 for strongly disagree, disagree, agree, and strongly agree in that order. Table 3 presents the results of the descriptive analysis (means, standard deviations, skewness and kurtosis) of the Artisanal Fishermen. Overall, the descriptive statistics resulted in a mean of 2.582 and a standard deviation of 1.028. The largest variation was in Medical support (SD = 1.356) and the least was Financial Support (SD = 0.890). This implies that these climate change mitigation strategies adopted by Artisanal Fishermen in the study area were highly valued by the Artisanal Fishermen. According to Ajani *et al*. (2013) changing farm production activities through these strategies help potential to reduce exposure to climate related risks and increase the flexibility of production to changing climatic conditions, thereby increase the performance of the Artisanal Fishermen. Furthermore, the skeweness and kurtosis coefficients are indication that the data was normal. This implies that the data qualified for use in parametric analysis such as regression analysis.

Table 3: Artisanal Fishermen Adaptation Preferences

Adaptation Strategies	Mean	Std. Deviation	Skewness		Kurtosis	
			Statistic	Std. Error	Statistic	Statistic
Infrastructure development	2.350	0.940	0.489	0.192	-0.635	0.381
Financial Support	2.969	0.835	-0.663	0.192	0.098	0.381
Safety and security	2.025	0.876	1.090	0.192	0.832	0.381
Improved housing	3.112	1.070	-0.945	0.192	-0.425	0.381
On board communication and safety equipment	2.194	1.320	0.385	0.192	-1.549	0.381
Reinforcement of fishing boats and nets	2.444	1.008	0.324	0.192	-1.008	0.381
Community representative in disaster management	2.699	0.973	0.170	0.194	-1.261	0.386
Coastal afforestation	2.275	0.890	0.730	0.192	-0.150	0.381
Information dissemination	3.106	1.097	-0.880	0.192	-0.648	0.381
Medical support	2.350	1.356	0.184	0.192	-1.795	0.381
Disaster management training	2.388	0.997	0.200	0.192	-0.994	0.381
Mulching	2. 375	1.057	0.366	0.192	-1.080	0.381
Diversification of livelihoods	3.275	0.951	-1.066	0.192	-0.025	0.381
Grand Mean	**2.582**	**1.028**	**0.030**	**0.192**	**-0.665**	**0.381**

Source: Field survey; 2020. Decision mean $\bar{} \geq 2.5$

Factors affecting Choice of Adaptation to Climate Change by Artisanal Fishermen

Table 4 shows the logit estimates of the determinants of adaptation to climate change by Artisanal Fishermen in the study area. The Chi Square value of 53.49 was highly significant at 1% level indicating that the model was good. From the maximum likelihood estimates of the model, the Pseudo R^2 was 0.6158 which implies that about 61.58% of the likelihood of choice of adaptation to climate change by artisanal Fishers is strongly explained by the independent variables. The result shows that marital status, member of cooperative society and extension services were positively related to number of mitigation strategy used by Artisanal Fishermen in fishing communities along Anambra River Nigeria, this implies that increase in any of these variables will increase the choice of climate change adaptation practices used. Specifically, the coefficient of marital status was significant at 1%; this implies that artisanal fishermen who are married have more adaptation behavior of climate change than those who are single**.** According to Nwaru (2012), marriage creates more stable households who practice serious production, thus increasing the number of climate adaptation practices. The result shows that coefficient of extension contact was significant at 1% and directly related to choice of climate change adaptation practices used. This implies that as number of extension contact increase, the number of climate change adaptation practices used also increases. Higher extension contact would make them more favourably disposed to accessing information that would increase their climate change adaptation practices. Improved extension brings about positive changes in the knowledge, attitude and skills (Kabir *et al*, 2016). Membership of cooperative society had a positive coefficient and was significant at 10% level, indicating that being a member of cooperative society increases the of choice climate change adaptation strategies adopted. The sign identity of this variable conforms to *a priori* expectation. This presupposed that membership of cooperative society aids in receiving and evaluating information for improvement and productivity (Ajagbe *et al*., 2007). Furthermore, household size was significant at 5% level and negatively related to choice of number of strategies adopted. The implication is that an increase in household size reduces the number of climate change adaptation practice used. This is in line with findings of Ndamani and Watanabe (2016) who reported that higher family size reduced the number of climate change adaptation practices used as farmers channel their resources for upkeep of their family. Also the coefficient of farm income was significant at 1% and negatively related to choice of adaptation to climate change, this is against *a priori* expectation and findings of Adégnandjou and Dominique (2018) where they obtained a positive relationship between farm income and choice of adaptation to climate change. The implication of this finding is that incomes of the artisanal fishermen are channeled to other uses rather than adaptation to climate change. Farm families are faced with various challenges at household level, thus income generated maybe channeled into basic need based on scale of preference.

Table 4: Estimates of factors affecting choice of adaptation to climate change

Parameter	Coefficient	Odds Ratio	Std. Error	Z	P>|z|
Household size (X_1)	-.6094796	1.839474	.2602887	-2.34**	0.134
Marital status (X_2)	.740748	2.097504	.2590911	2.86***	0.004
Age (X_3)	-.0747107	.9280119	.2573583	-0.29	0.772
Experience (X_4)	.0061011	1.00612	.0410899	0.15	0.882
Education (X_5)	.0949933	1.099651	.3278351	0.28	0.742
Cooperative (X_6)	.3881166	1.474202	.1562961	2.48**	0.013
Extension services (X_7)	.0000474	1.000047	.0000125	3.78***	0.000
Credit facilities (X_8)	.0169462	1.017091	.0113026	1.50	0.019
Farm income (X_9)	1.62e-06	1.000002	1.41e-06	1.15	0.250
Intercept	-4.023588		2.255503	-4.31***	0.000
LR chi2	53.49				
Prob > chi2	0.00000				
Log likelihood	-94.22982				
Pseudo R^2	0.6158				

Source: Field survey (2020). ***** Significant at 1%, ** Significant at 5%, *significant at 10%**

Conclusion

Findings of this study served as a premise for making the following conclusions: The Artisanal Fishermen are aware of climate change which include; frequency of extreme events like floods, cyclone is increasing, sea level is rising, heavy rainfall, average temperature is increasing, sunlight/day length is changing, relative humidity is changing and strong wind. In other to curb the menace of climate change, a number of mitigation strategies were used by Artisanal Fishermen, these include; diversification of livelihoods, information dissemination, improved housing, financial Support, community representative in disaster management, etc. important factors influencing choice of climate adaptation strategies include; marital status, household size, extension services, membership of cooperatives and income. The results therefore call for the need to continuously train Extension Workers on current information about climate change, to enable them enlighten and update the Artisanal Fishermen. Artisanal Fishermen in all fishing communities along Anambra River should be encouraged by providing incentives and subsidizing fishing gears and vessels for them. This will go a long way in improving fish catch especially as most Artisanal Fishermen agree to continue even with the observed changes. The fishermen should be encouraged to form groups to enable them easy access to credit and information most especially.

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