Journal of Agriculture and Ecology Research International

22(4): 58-69, 2021; Article no.JAERI.72608
ISSN: 2394-1073

Climate Change and Fisheries: Perspectives from Small-Scale Fishing Community in Badagry, Lagos, Nigeria

O. J. Aderinola[1*], G. O. Mekuleyi[2], V. Kusemiju[1], A. A. Adu[3] and O. O. Babalola[1]

[1]Department of Zoology and Environmental Biology, Lagos State University, Nigeria.
[2]Department of Fisheries, Lagos State University, Nigeria.
[3]Department of Botany, Lagos State University, Nigeria.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/JAERI/2021/v22i430197
Editor(s):
(1) Dr. Chandra Shekhar Kapoor, Mohan Lal Sukhadia University, India.
Reviewers:
(1) Samiran Patra, West Bengal University of Animal and Fishery Sciences, India.
(2) Nguyen Quang Linh, Hue University, Vietnam.
(3) Javan Ominde Ogola, University Of Eldoret, Kenya.
Complete Peer review History: https://www.sdiarticle4.com/review-history/72608

Original Research Article

Received 15 June 2021
Accepted 24 August 2021
Published 16 September 2021

ABSTRACT

The present study focused on impact of climate change on livelihood of Ganyingbo fishing community in Badagry, from June to September, 2020. Data were collected through administration of 58 structured questionnaires to artisanal fishermen while test of significance of research hypotheses was conducted using chi-square and t-test at 95% confidence interval. The results showed that the fisher folks composed of 83% male and 17% female. The most common age group among fishermen was 30-39 years (27.58%) and 57% do not have other job apart from fishing. Majority (37.93%) of the fishermen did not attain beyond secondary school education while only 3.45% had tertiary education. Calculated coefficient of marketing efficiency indicated that 54.8% and 72.26% of their sales revenue were taken up by costs before and after the effect of climate change respectively. Total expenditure of fishermen increased by 24.9% while income decreased by 5.26%. The t-test analysis indicated significant ($p<0.05$) difference between the total cost associated with fishing in Ganyingbo before (N17850.0± 2015.22) and after (N22300.0 ±

**Corresponding author: E-mail: oluwatoyin.aderinola@lasu.edu.ng;*

6297.40) effect of the climate change. Fishermen (87.93%) believed that adopting coping strategies to mitigate the climate change is germane for artisanal fisheries systems. A significant ($p<0.05$) difference was observed ($X^2 = 30.56: 9.49$) between expected and observed perspective of fishermen based on viability of artisanal fisheries in Ganyingbo community. As noted in this study, fishing business in Ganyingbo is still viable however more effective mitigation measures are required to ensure its sustainability.

Keywords: Perception; fisherfolks; fishing community; mitigation and adaptation; climate change.

1. INTRODUCTION

Whether natural or human driven, climate change affects every areas of human lives and wellbeing. Apart from global increase in temperature, some of the current and projected manifestations of climate change include; sea level rise, shifting in global climate zones, melting of polar ice, increased incidence and severity of extreme weather events, increased drought, desertification, and flooding. It can also result in a significant loss in food security, natural disasters, vanishing coastlines, human displacement, natural resource depletion, scarcity of safe drinking water, fauna migration, pests management challenge, diseases and other health problems, loss of cultural practices and traditional ways of life, economic losses and energy crises, among others [1].

Climate change will exacerbate existing physical, ecological, and socioeconomic stresses on the African coastal zone [1]. It also poses significant and long-term risks to artisanal fisheries in many tropical developing countries in general and Sub-Saharan African (SSA) countries in particular. Globally, some 43.5 million people work directly in fisheries sector, with the great majority in developing countries. Adding those who work in associated processing, marketing, distribution and supply industries, and fisheries sector supports nearly 200 million livelihoods [2].

According to Nelson [3], agriculture's vulnerability (fisheries and aquaculture inclusive) to climate change will put millions of people in developing countries at greater risk of poverty, hunger, and malnutrition thus impacting on their food security's status. The impacts of climate change on food web arrangement will affect fish distribution in the water ecosystem and thus alter the spread of pelagic fishes. Omitoyin and Tosan [4] divulged that artisanal fishery provides employment for about 5.8% of the Nigerian population and supplied 81.9% of the total domestic fish production. Artisanal fisheries have been seen to be a vital section of the remote trade in numerous Nigeria areas. Over 90% of fish consumed in Nigeria were offered by artisanal fisheries [5].

Several empirical studies were conducted to investigate the different impacts of climate change on Nigeria fisheries and aquaculture which includes the work of Idowu *et al*. [6] and Ipinjolu et al. [7] on the impact of climate change in Nigeria; the potential impacts of climate change on fisheries and aquaculture in Nigeria [8]; climate change, effects and mitigation strategies on aquaculture: a review [9] ; impacts of climate change on fisheries: implications for food security in Sub-Saharan Africa [10], and fish farmers' perception of climate change impact on fish production in Delta State, Nigeria (Leon and Antonio, 2015). According to these authors, climate change scenario especially through temperature and carbon dioxide increase will continuously warm the earth with resultant effects on fisheries and aquaculture, and that Nigeria vulnerability is high.

Therefore, the present study focused at investigating the perception of fishermen (in Ganyingbo fishing community of Badagry) on impact of climate change on artisanal fisheries and their livelihood.

2. MATERIALS AND METHODS

2.1 Study Area

The study was conducted in Ganyingbo fishing community in Badagry, Lagos State, Nigeria. The study area (Fig.1) was selected based on its significant contribution to fish supply in Badagry Local Government Area. Badagry lies between *Latitude:* 6° 24' 54.07" N and *Longitude:* 2° 52' 52.75" E.

2.2 Determination of Sample Size

The sample size of the population of the study was determined by using the following equation:

$$n = \frac{N}{1+N \times (e)^2}$$ [11].

Where n = sample size, N = population size = 68, e = 95% confidence level = 0.05.

Therefore, from the total population (N) of the community estimated as 68, n = 58.

2.3 Collection of Data

Data were collected through administration of structured questionnaires. A total of 58 questionnaires were randomly administered to artisanal fishermen in the study area. The questionnaire was sub-divided into five sections. The survey method used in this study also involves interviews and direct observation.

2.4 Validity of the Instrument

The instrument (questionnaires) was validated by: (1) Supervisor for this study. (2) Other experts in the faculty of science, Lagos State University.

2.5 Method of Data Analysis

The data collected were analyzed using statistical package for social sciences (SPSS) version 20. The categorical variables were analyzed using descriptive statistics (frequency and percentage) and inferential statistics. The results obtained from demographic variables were presented in the form of tables, and percentage (%).The test of significance of research hypotheses was conducted using t-tests and chi-square at 95% confidence interval, with p- value of 0.05 or less considered statistically significant.

3. RESULTS

Table- 1 represent the socio characteristics of the Ganyingbo fishing community that included the fisherfolk's gender, age, marital status, education level, training undergone and years of experience. About eighty three percent (82.76%) of the fisherfolks were males while 17.24% of them were females. The most common age group found among fishermen in Ganyingbo was 30-39years (27.58%), while the least age group were 20-29 years and 61 years and above age group which were 3.45% and 3.45% respectively. Over 65% of the fisher folks did not undergo any training before starting their fish business while 57% of them do not have other job apart from fishing. Majority of the fisher folks (34.48%) were engaged in vulcanizing while the least works as processors (12.08%).

It was found that 41.38% of the fisherfolks were mostly experienced in fishing more than 16 years and above. In case of school education, 37.93% of the fishermen in Ganyingbo fishing community did not attain beyond secondary school education while only 3.45% had tertiary education.

The summary of the total expenditure incurred after the effect of climate change by fisherfolks at Ganyingbo fishing community was significantly ($p < .05$) higher than expenditure recorded before the effect of climate change (Table- 2). On the contrary, significant higher income was obtained before the effect of climate change as compared to income obtained after the effect of climate change. The expenditures for fishing increased by 24.93% while the income (revenue) declined by 5.26%. The marketing efficiency was calculated using Shepherd Futrel method (Arene, 2008) which is stated as: ME =TC/TR X100. Where ME = coefficient of marketing efficiency, TC = total cost incurred and TR = total value of product sold as shown in Table -2. The total cost associated with fishing in Ganyingbo before and after effect of the climate change were #17850.0± 2015.22 and 22300.0 ± 6297.40 respectively.

On the other hand, the revenues from the fishers were #32571.43± 6757.88 and # 27857.14 ±3325.92 respectively. The coefficient of marketing efficiency for fisherfolks were 54.8% and 72.26% before and after the effect of climate change respectively.

3.1 Impact of Climate Change on Livelihood of Ganyingbo's Fisherfolks

The most frequent climatic disaster experienced by the fishermen was flood (50%) as presented in Table- 3 while drought (17.24%) was the least experienced. Sixty nine percent (69%) of the respondents had their livelihood being affected by climate change while the livelihoods of 31.03% of them were not affected by climate change. Catch output of 91.38% of respondents have decreased due to climate change. Eighty six (86%) of the fishermen responded that effects of climate change resulted in catch of less adult fishes, changes in fish distribution and physiological, morphological, reproductive, migratory and behavioural responses of fish. Similarly, 89.66% of fisherfolks believed that climate change could lead to extinction of certain species of fish.

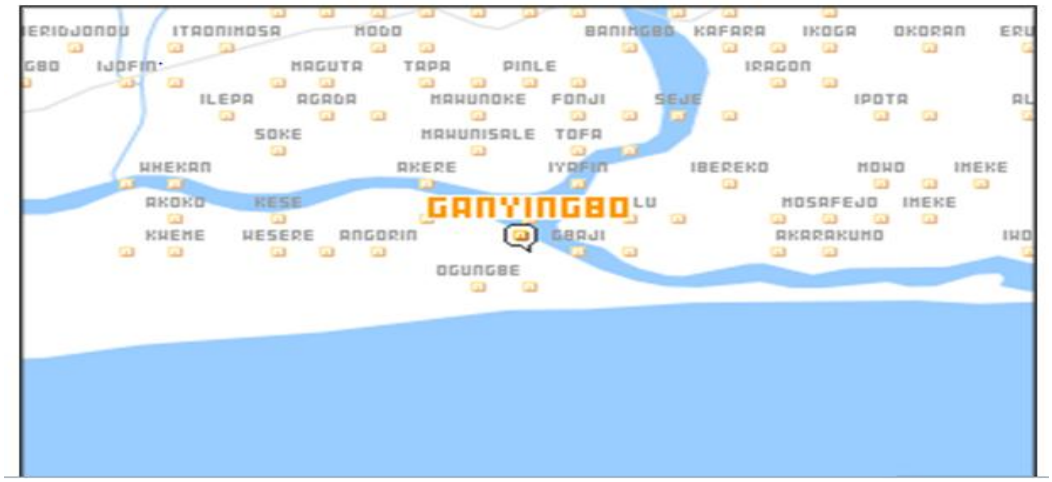

Fig. 1. Map of Badagry showing the location of Ganyingbo fishing community

Table 1. Socio characteristics of Fisherfolks in Ganyingbo community

Variables	Frequency	Percentage (%)	Cumulative Percent
Sex			
Male	48	82.76	82.76
Female	10	17.24	100
Age			
20-29	2	3.45	3.45
30-39	16	27.58	31.03
40-49	14	24.14	55.17
50 and above	9	15.52	70.69
51-60	15	25.86	96.55
61 and above	2	3.45	100
Marital Status			
Single	17	29.31	29.31
Married	41	70.69	100
Education Level			
Unschool	14	24.14	24.14
Primary	22	37.93	62.07
Secondary	20	34.48	96.55
Tertiary	2	3.45	100
Undergo training before starting fish business			
Yes	20	34.48	34.48
No	38	65.52	100
Other Job Outside Fishing			
Yes	25	43.10	43.10
No	33	56.90	56.90
Activities apart from Fishing			
Net making	10	17.24	17.24
Welding	13	22.41	39.65
Mechanic	8	13.79	53.44
Vulcanizing	20	34.48	87.92
Processing	7	12.08	100
Number of Years spent in Fishing			
6-10	18	31.03	31.03
11-15	16	27.59	58.62
16 and above	24	41.38	100

Table 2. Average weekly fishing expenditure and income of Fishermen at Ganyingbo

Parameter	Before Effect of Climate Change	After Effect of Climate Change	Percentage Increase/ Decrease (%)
Expenditure(#)	17850.0± 2015.22[a]	22300.0± 6297.40[b]	24.93
Income (#)	32571.43± 6757.88[a]	30857.14 ± 3325.92[b]	5.26
ME(TC/TR)X100	54.8	72.26	-

Mean with different superscripts =significant difference at p<0.05

Table 3. Effects of climate change on livelihood of fishermen

Parameters	Frequency	Percentage (%)
Climate disaster you have experienced		
Flood	29	50.00
Drought	10	17.24
Storms	19	32.76
How intense was the disaster		
Fair	20	34.48
Severe	18	31.04
Very Severe	20	34.48
Did it affect your livelihood		
Yes	40	68.97
No	18	31.03
Any decrease in catch output		
Yes	53	91.38
No	5	8.62
There were less Adult fishes and changes in fishes distribution		
Yes	50	86.20
No	8	13.80
Physiological, morphological, reproductive, migratory and behavioural responses of fish is affected		
Yes	50	86.20
No	8	13.80
Climate change influence price of fish		
Yes	45	77.59
No	13	22.41
Climate change influence some fish to go to extinction		
Yes	52	89.66
No	6	10.34

3.1.1 Climate change and adaptive strategies adopted by fisherfolks in Ganyingbo

Ganyingbo fishing community agreed that 84.48% fishermen had modified fishing activities over the last 5 years due to climate change (Table - 4). However, 74.14% of fishermen disclosed that there was positive change in artisanal fisheries of Ganyingbo over the last 10 years. Furthermore, 79% of them agreed that when habitat destruction and pollution of water bodies were prevented, stress in fresh water and brackish water would decline. A total of 87.93% of fishermen believed that adopting coping strategies to impacts of climate change is a must for artisanal fisheries systems. On the other hand, 100% of fishermen agreed that establishment of community stakeholders to identify and give immediate response against impacts of climate change is necessary.

3.1.2 Effectiveness of mitigation measures on impacts of climate change at Ganyingbo fishing community

It was found that 83% of fishermen responded that mitigation avoid significant human interference with climate change, while 86% of them connoted that development of sophisticated monitoring programmes and models will be crucial in combating climate change (Table-5). However, 89.66% of them disclosed that mitigation measures were limited in Ganyingbo fishing community and there was no enough effective approach in combating climate change. While 77.59% of respondents in Gayingbo fishing

community believed that reduction in flow of heat- trapping green house gases into atmosphere would have positive impact on climate change, 22.41% of them had contrary view.

3.1.3 Fishermen's opinion on the viability of artisanal fisheries in Gayingbo community

Table- 6 showed the results on Fishermen's opinion on the viability of artisanal fisheries in Gayingbo. Fifty nine (59%) percent of the respondents agreed that fishing business is a profitable trade, while 19.19% agreed that fishing business is more profitable than sand mining. However, 24.66% agreed that price of fish is beyond the reach of most people. Sixty six (66%) of respondents agreed that reduced fish prices will automatically lead to improved sales. On the other hand, 38.35% of the respondents agreed that they will still make a marginal profit if selling price of fish is reduced regardless of fishing cost due to effect of climate change. In term of gender dominance in the fishing business, 80% of fishermen agreed that fishing is totally dominated by men. The test of significant for these variables using chi-square showed that there is a significant difference between expected and observed perspective of fishermen on the viability of artisanal fisheries in Gayingbo community at 0.05 significant alpha level (X^2 = 30.56: 9.49).

4. DISCUSSION

In this study, majority of the fishermen (consisting of more than 80% male) in Ganyingbo fishing community falls within the youthful age of 30-39 years. Similar active age groups and gender dominance have been reported in Ondo State by Omitoyin and Tosan [4] and Akinwunmi *et al.* [12]. Over 55% of the fisherfolks that do not have other job apart from fishing could suggest that the fishermen output is still reasonable regardless of impact of climate change.

The dominant number of fishing experience in Gayingbo fishing community are 16 and above and this imply that fishermen in Ganyingbo community are well experienced in the fishing business. The fishing experience recorded in this study was similar to the findings of Olusola *et al*.(2017). However, majority of the fishermen in Gayingbo fishing community did not attain beyond secondary school education. The literacy level of respondents in this study was very low in comparison to the findings of Akinwunmi *et al*. [12] and Adeosun and Adebukola [13].

Table 4. Impact of climate change on adaptive strategies of artisanal fisheries in Gayingbo fishing community, Badagry

Variables	Frequency	Percentage (%)
Changes or adjustment in fishing activities has been done over the last 5 years due to climate change		
Yes	49	84.48
No	9	15.52
Any Positive change in artisanal fisheries over the last 10 years		
Yes	43	74.14
No	15	25.86
To reduce stress in fresh water and coastal waters, habitat destruction and pollution should be avoided		
Yes	46	79.31
No	12	20.69
Adopting coping strategies to impacts of climate change is a must for artisanal fisheries systems as it affects livelihood		
Yes	51	87.93
No	7	12.07
Establishment of community stakeholders to identify and give immediate response against impacts of climate change is necessary		
Yes	58	100
No	0	0

Table 5. Effectiveness of mitigation measures on reduction of effect of climate change on Gayingbo fishing community

Questions	Frequency	Percentage (%)
Mitigation avoid significant human interference with climate change		
Yes	48	82.76
No	10	17.24
Development of sophisticated monitoring programmes and models will be importance in combating climate change		
Yes	50	86.21
No	8	13.79
Restoration of mangrove forest can protect shorelines from erosion and provide breeding ground for fish		
Yes	52	89.66
No	6	10.34
Mitigation measures are limited and no enough effective approach in combating climate change		
Yes	52	89.66
No	6	10.34
Reduction in flow of heat- trapping green house gases into atmosphere would have positive influence on climate change		
Yes	45	77.59
No	13	22.41

Table 6. Assessment of fishermen's perspective on the viability of artisanal fisheries in Gayingbo community

Statements	SA(%)	A(%)	U(%)	D(%)	SD(%)
Presently, fishing in Badagry is a highly profitable trade	26.02	32.88	5.48	16.44	19.18
Fishing is more profitable than sand mining	9.59	9.60	6.84	41.09	32.88
Due to effects of climate change, the price of fish recently is beyond the reach of most people	9.59	15.07	24.66	30.14	20.55
Reduced fish prices will automatically lead to improved sales	28.77	36.99	9.59	9.59	15.07
If I reduce selling price of fish irrespective of impact of climate on the cost of catching, I will still make a marginal profit	12.33	26.02	5.48	41.10	15.07
Fishing business is totally dominated by men	50.0	30.0	8.0	2.0	10.0
Chi-Square Test	X^2_{Cal} (30.56)[a]		X^2_{Tab} (9.49)[b]		

SA = strongly agree, A= agree, U=undecided, D= disagree, SD= strongly disagree; [a,b]= significantly different at 5% level of probability ($p<0.05$)

The summary of the total expenditure and income of fishermen before and after the effect of climate change which revealed a 25% increase in expenditures and 5% decrease in income generation, could suggest that climate change have notable effect on Ganyingbo fishing community. This suggestion was buttressed by the calculated coefficient of marketing efficiency which indicated that 54.8% and 72.26% of their sales revenue are taken up by costs before and after the effect of climate change respectively. Since the lower the coefficient of marketing efficiency the higher the level of efficiency, it implies that gain in fishing business at Ganyingbo is more efficient before the effect of climate change.

The test of significant for variables using chi-square which showed that there is a significant difference between expected and observed perspective of fishermen on the viability of artisanal fisheries in Gayingbo community indicated that artisanal fishing business in Ganyingbo fishing community is viable and lucrative and similar observation was reported by Anyanwu *et al.*[8] in Onitsha River Niger.

The most frequent climatic disaster experienced by the fishermen was flood. In line with the finding of this study, Ikot Ibom Itam community, in Akwa Ibom had experienced heavy flood that led to the disappearance of four local streams [14]. The present finding also corroborates the report of Chidi and Ominigbo [15] that climate change causes exacerbating problems of too much water (flood) to little water (droughts) and reduced water quality, salt water intrusion, sea level rise, and drying.

Catch output of 91.38% of respondents have decreased due to climate change. Most of the fishermen responded that effects of climate change resulted in catch of less adult fishes, changes in fish distribution and physiological, morphological, reproductive, migratory and behavioural responses of fish. Similarly, 89.66% of fisherfolks believed that climate change could lead to extinction of certain species of fish.

As presented in Table- 5, Eighty three (83%) of fishermen responded that mitigation avoid significant human interference with climate change, while 86% of them connoted that development of sophisticated monitoring programmes and models will be crucial in combating climate change. However, 89.66% of them disclosed that mitigation measures are limited in Ganyingbo fishing community and there was no enough effective approach in combating climate change. While 77.59% of respondents in Ganyingbo fishing community believed that reduction in flow of heat- trapping green house gases into atmosphere would have positive impact on climate change, 22.41% of them had contrary view.

Inioni and Oyaide [16] carried out a study on the assessment of artisanal fish in the Delta State. The result of their study revealed that a Net Margin/fisher/year is ₦111,677.62. Anyanwu *et al*. [8] in their study of Economics of fish Artisanal within Niger River in native North authority place of Anambra State obtained a Gross Margin of ₦96,002.29 per fisherman per month. Most fisheries exploitation in freshwaters and coastal waters are carried out by artisanal (small scale) fishermen, employing simple fishing gear and equipments.

However, with changing conditions in the water bodies such as temperature rise, increased salinity and invasion of aggressive water species, the fish dominated region seems to be affected causing the fishes to move to different part of the water body thus forcing the fishermen to travel longer distance in search of abundant supply of fishes for a good catch [17].

The number of people directly employed in fisheries and aquaculture is conservatively estimated at 43.5 million, of which over 90% are small-scale fishers [18]. In addition to those directly employed in fishing, there are “forward linkages” to other economic activities generated by the supply of fish (trade, processing, transport, retail, etc.) and “backward linkages” to supporting activities (boat building, net making, engine manufacture and repair, supply of services to fishermen and fuel to fishing boats, etc.). Taking into account these other activities, over 200 million people are thought to be dependent on small-scale fishing in developing countries, in addition to millions for whom fisheries provide a supplemental income [18]. Fisheries are often available in remote and rural areas where other economic activities are limited and can thus be important engines for economic growth and livelihoods in rural areas with few other economic activities [18]. Some fishers are specialized and rely entirely on fisheries for their livelihood, while for many others, especially in inland fisheries and developing countries, fisheries form part of a diversified livelihood strategy [19,20]. Fisheries may serve as a “safety

net" to landless poor or in the event of other livelihoods failing [18]. Many small-scale fisher folk live in poverty, often understood as resulting from degradation of resources and/or from the safety net function of fisheries' for the poorest in society. This generalized understanding of the economic poverty of fishers in the developing world captures some of the situation of small scale fishers, but misses both the fact that they may earn more than peers in their communities and that their poverty is multidimensional and related to their vulnerability to a variety of stressors including HIV/AIDS, political marginalization and poor access to central services and healthcare [21].

While poverty in fishing communities or other forms of marginalization reduces their ability to adapt and respond to change, increasingly globalized fish markets are creating new vulnerabilities to market disruptions which may result from climate change. A key feature of the socio-economics of inland fisheries, which may influence how they interact with climate change, is the intense seasonality of many highly productive floodplain fisheries, for example those in Southeast Asia (SEA) and Bangladesh [22]. Somewhat related to this trend is the tendency for inland fisheries to be conducted by people who do not define themselves as fishers, but rather engage with seasonal fisheries alongside other livelihood options [20].

Several empirical studies have been conducted to investigate the different impacts of climate change on Nigeria fisheries and aquaculture which includes the work of Idowu *et al*. [6] and Ipinjolu *et al*.[7] on the impact of climate change in Nigeria; the potential impacts of climate change on fisheries and aquaculture in Nigeria [8]; climate change, effects and mitigation strategies on aquaculture: a review [9] ; impacts of climate change on fisheries: implications for food security in Sub-Saharan Africa [10], and fish farmers' perception of climate change impact on fish production in Delta State, Nigeria (Leon and Antonio, 2015). According to these authors, climate change scenario especially through temperature and carbon dioxide increase will continuously warm the earth with resultant effects on fisheries and aquaculture, and that Nigeria vulnerability is high. Leon and Antonio (2015) asserted that warming has increased thermal stratification, reduction in surface water cold and warm mix thereby preventing upwelling effects of nutrients, and consequently affect primary productivity, the distribution and fecundity of marine fishes. Surprisingly, it was also observed that changing climate through reduced temperature will temporarily increase dissolved oxygen in water which will deplete afterwards due to increase in biochemical Oxygen demand; a natural phenomenon in water noted to regulate water quality. The effect would increase nutrient content of water bodies causing algal bloom, thus eutrophication of waters [23].

Increase in temperature can adversely increase food consumption by fish, especially small sized fishes, and resultantly increase the cost of inland aquaculture. Consequently, increase biological oxygen demand (BOD), deplete available dissolved oxygen (DO) and thus, pollution of water bodies and death in some cases. The quality of water body is a key to the survival of fish life, which is an important consideration for both marine and inland aquaculture assessment.

Changes or poor water quality has been reported to result to large scale fish death in ponds or marine ecosystems, especially as fish and shellfishes known to have suitable environmental conditions to thrive in some of these aquatic systems. Climate change through increased temperature reduces oxygen level in water. Thus increased biochemical oxygen demand (BOD) will deplete the available oxygen causing an anoxia in water bodies. Increase in dissolved oxygen has been observed to regulate water quality by reducing carbon dioxide concentration in waters [23].

Studies have shown that non-climate factors such as poverty, inequality, food insecurity, conflict, disease and globalization can increase vulnerability by affecting the exposure, sensitivity and adaptive capacity of systems, communities and individuals [24]. Vulnerability depends upon three factors: exposure to a hazard, in this case to the effects of climate change; sensitivity to the hazard and the degree to which the community, the region or the country depends on fisheries, and; the ability to adapt to, absorb or recover from the hazards [25].

Fishing communities that depend on just a few species are more vulnerable to fluctuations in stocks than communities that spread their dependency over an extensive range of marine resources. This vulnerability is aggravated in communities that have historically fished intensively or overfished [26].

A livelihood can be defined as the capabilities, assets and activities required for means of living

[27]. The concept of sustainable livelihood seeks to bring together the critical factors, assets and activities that affect the vulnerability or strength of household strategies [19]. People can access, build and draw upon five types of capital assets: human, natural, financial, social and physical.

In addition to negative impacts, climate change is likely to create opportunities and positive impacts in some fisheries, although these are not well understood or described in the literature. In inland waters, fisheries created by increases in flooded areas may partially offset the loss of land for agriculture or other economic activities [28].

Fisher folk and their communities around the world are already constantly adapting to various forms of change [29]. Examples of adaptation in fisheries are dominated by diversification or flexible livelihoods [19], and migration in response to climate-mediated fluctuations in yield. Responses to direct impacts of extreme events on fisheries infrastructure and communities are believed to be more effective if they are anticipatory as part of long term integrated coastal and disaster risk management planning [30]. Adaptations to sea level rise and increased storm and surge damage include hard (e.g., sea walls) and soft (e.g., wetland rehabilitation or managed retreat) defenses, as well as improved information systems to integrate knowledge from different coastal sectors and predict and plan for appropriate strategies.

In the present study, the livelihood and catch output of most of the respondents was affected by climate change. The implication is that most of the fishermen may eventually become bankrupt. Artisanal fisheries are an important food source, and therefore, changes in the total amount or geographic distribution of fish available for catch could potentially affect food security [31]. From the results obtained in this study, the fishermen had various mitigating measure in place however, those mitigation measures are limited in combating climate change. Similar suggestion had been opined by Taucher and Oschlies [32] Sumeila et al. [17].

5. CONCLUSION

The findings of this study indicated that climate change had an impact on the artisanal fisheries of Ganyingbo fishing community in Badagry. Climate change impacts their livelihood, output and input, and as well as on the mitigation and adaptive measures. The results coefficient of marketing efficiency indicated that gain in fishing business is more efficient before the effect of climate change at Ganyingbo fishing community.

CONSENT

As per international standard or university standard, respondents' written consent has been collected and preserved by the authors.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Intergovernmental Panel on Climate Change (IPCC).Impacts, adaptation and vulnerability. Contribution of working group II to the Fourth Assessment Report of the IPCC. 2007;204.
2. Barange M, Perry RI. Physical and ecological impacts of climate change relevant to marine and inland capture fisheries and aquaculture. In: K. Cochrane, C. De Young, D. Soto and T. Bahri (eds). Climate change implications for fisheries and aquaculture: overview of current scientific knowledge. FAO Fisheries and Aquaculture Technical Paper. No. 530. Rome, FAO. 2010;7–106.
3. Nelson G. Agricultural adaptation to climate change. In the developing world: what will it cost; in report from the international food policy research institute (IFPRI) Workshop on Climate Change and Fisheries and Aquaculture: "Options for decision makers" FAO Headquarters Rome. 2009;2008.
4. Omitoyin SA, Tosan FB. Potential impacts of climate change on livelihood and food security of artisanal fisherfolks in Lagos State, Nigeria. Journal of Agricultural Science. 2012;4(9):20-30.
5. Federal Department of Fisheries. Fishery Statistics of Nigeria 4th Edition Federal Dept. of Fisheries Abuja. 2007;49.
6. Idowu AA, Ayoola SO, Ikenweiwe NB. Implication of climate change in Nigeria. Iranica Journal of Energy and Environment. 2011;2(2):145-152.
7. Ipinjolu JK, Magawata I, Shinkafi BA. Potential Impact of Climate Change on Fisheries and Aquaculture in Nigeria.

Journal of Fisheries and Aquaculture Science. 2014;9(5):338-344.
8. Anyanwu CN, Amadi-Eke AS, Nwaka DE, Ezeafulukwe CF, Adaka GS. Climate Change, Effects and Mitigation Strategies on Aquaculture: A Review. Agriculture, Forestry and Fisheries. 2015;4(3-1):70-72.
9. Essam YM, Zenebe BU. Impacts of Climate Change on Fisheries: Implications for Food Security in Sub-Saharan Africa. Global Food Security.2013;4:114-135.
10. Aphunu A, Nwabeze GO. Fish Farmers' Perception of Climate change impact on fish production in Delta State, Nigeria, Journal of Agricultural Extension. 2012;16(2):1-7.
11. Yamane T. Statistics: An introductory analysis, 2nd Ed., New York: Harper and Row;1967.
12. Akinwumi FO, Akinwumi IO, Ogundahunsi OA. Characterization of artisanal fishery in the coastal area of Ondo State, Nigeria. International Journal on Agricultural Science and Soil Science. 2011;1(3):83-89.
13. Adeosun O, Adebukola FB. Determinants of income from fish marketing in Ibarapa Area of Oyo State, Nigeria. Science Journal of Agricultural Research and Management. 2012;1:1-6.
14. Gwary OM. Climate change, food Security and Nigerian agriculture. A Paper submitted to Federal Ministry of Environment Abuja and UNDP Abuja. 2007;15.
15. Chidi HO, Ominigbo OE. Climate change and coastal wetlands: Nigeria perspective. International Journal of Environmental Issues. 2010;7(2):216-223.
16. Inioni OE, Oyaide WJ. Socio-economic analysis of artisanal fishing in the south agro-ecological zone of delta state, Nigeria. Agricultural Tropical ET Subtropical. 2007;40(7):135-149.
17. Sumaila UR, William LC. Cost of adapting global marine fisheries to climate change. International symposium on climate change effects on fish and fisheries: Forecasting impacts, assessing ecosystem responses, and evaluating management strategies, Sendai, Japan;2010.
18. FAO. National Aquaculture Sector Overview. Ecuador. National Aquaculture Sector Overview Fact Sheets. FAO Fisheries and Aquaculture Department; 2005. Available;http://www.fao.org/fishery/countrysector/ naso_ecuador/en.
19. Allison EH, Ellis F. The livelihoods approach and management of small-scale fisheries. Marine Policy. 2001;25(5):377–388.
20. Smith LED, Nguyen Khoa S, Lorenzen K. Livelihood functions of inland fisheries: policy implications for developing countries. Water Policy. 2005;7:359–383.
21. Bene C. When fishery rhymes with poverty: a first step beyond the old paradigm on poverty in small-scale fisheries. World Development. 2003;31(6) :949–975.
22. Dixon PJ, Sultana P, Thompson P, Ahmed M, Halls AS. Understanding livelihoods dependent on inland fisheries in Bangladesh and South East Asia. Synthesis report (draft), (2003),DFID/FMSP Project R8118.
23. Verweij W, Wiele VD, Moorselaar V, Grinten VE. Impact of climate change on water quality in the Netherlands. National Institute for Public Health and the Environment. RIVM report. 607800007. 2010;53.
24. Adger WN, Arnell NW, Tompkins E. Successful adaptation to climate change across scales. Global Environmental Change. 2007;15:77-86.
25. Brooks JF, Adger WN, Kelly MP. The determinants of vulnerability and adaptive capacity at the national level and the implications for adaptation. Global Environmental Change. 2005;15:151-163.
26. FAO. The Value of African Fisheries.Food and Agriculture Organization Fisheries and Aquaculture Circular. 2014;1093:1–9.
27. Chambers R, Conway GR. Sustainable rural livelihoods: practical concepts for the 21st century. Brighton, UK, Institute of Development Studies discussion paper;1992.
28. Arntz WE, Gallardo VA, Gutierrez D, Isla E, Levin LA, Mendo J, Neira C, Rowe GT, Tarazona J, Wolff M. El Nino and similar perturbation effects on the benthos of the Humboldt, California and Benguela Current upwelling ecosystems. Advances in geosciences.2006;6:243–265.
29. Coulthard S. Adaptation and conflict within fisheries: insights for living with climate change. In W.N. Adger, I. Lorenzoni, and K. O'Brien, eds. (2009 in press) Adapting to climate change: thresholds, values,

governance. Cambridge, UK, Cambridge University Press. 2009;255-268.

30. Nicholls RJ, Wong PP, Burkett VR, Codignotto JO, Hay JE, McLean RF, Ragoonaden S, Woodroffe CD. Coastal systems and low-lying areas. In Parry ML, Canziani OF, Palutikof JP, van der Linden PJ, Hanson CE, eds. Climate change: impacts, adaptation and vulnerability, pp. Contribution of working group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge, UK. Cambridge University Press. 2007;315–356.
31. Cheung WWL, Lam Vicky WY, Sarmiento JL, Kearney K, Watson R, Zeller D, Pauly D. Large scale redistribution of maximum fisheries catch potential in the global ocean under climate change. Global Change Biology. 2010;16:24-35.
32. Taucher J, Oschlies A. Can we predict the direction of marine primary production change under global warming? Geophysical Research Letters.2011;38:6.

Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle4.com/review-history/72608