Academic Journal of Agricultural and Horticultural Research
Vol.2, No.4; October-December-2022;
ISSN (5201–3992);
p –ISSN 7239-4203

EFFECTS OF CLIMATE CHANGE AND ADAPTATION STRATEGIES ON CATFISH PRODUCTION IN IMO STATE

EGWUONWU, Helen Adeola
Faculty of Agriculture and Veterinary Medicine, Imo State University, Owerri, Nigeria

Abstract: This paper examined the effects that climate change had on catfish production and their adaptation strategies. Structured questionnaire was used to collecting data for the study. Descriptive and inferential statistical tools were used in analyzing data for the study. Climate change was aware by the majority (97.50%) of the catfish farmers. Effect of climate change on fish production were flooding of the farm area ($\bar{x}$ = 3.55), Increase in fish production due to long period of harmattan season ($\bar{x}$ = 3.48), drought increases production of fish ($\bar{x}$ = 3.53), increase in precipitation increases fish production ($\bar{x}$ = 3.04), occurrence of drought decrease fish production ($\bar{x}$ = 2.96), reduction in fish farming activities ($\bar{x}$ = 2.96), reduction in fish quality ($\bar{x}$ = 2.55), increase in fish mortality ($\bar{x}$ = 2.54) and high incidence of disease infestation ($\bar{x}$ = 2.53). Catfish farmers identified adaptation strategies adopted as ponds construction near water sources (98.9%), provision of alternative water supply during dry seasons (96.3%), adjustment in the time of stocking (87.5%), stocking good species of catfish that are more favourable to climate change (87.5%), getting more expose to new adaptation strategies (85.0%), avoiding pond leakage (81.3%), building embankments to prevent flood (80.0%), use of good water circulating system (75.0%). Production of catfish was threatened by climate change in the area of study. The study recommends that extension agents should double their efforts in training and enlightening programmes on adaptation strategies to climate change on fish production.

1.0 INTRODUCTION

Fish farming involves rearing of fish usually for food or commercial purposes in enclosures on land or over natural occurring water bodies (United State Department of Agriculture (USDA), 2018). In Nigeria, desirable fish species that are cultured are Tilapia species and catfish species however, catfish production is the most prevalent due its demand, easily domesticated and able to carried out on a small-medium scale. This is emphasized by Ike and Chuks-Okonta (2014) that fish farmers in Nigeria focus on catfish production which has a market value of about three times that of tilapia. This is because catfish is the fastest-growing fish under captivity. It can thrive in a wide range of conditions because it is hardy and can tolerate dense stockings (Ume *et al.*, 2016). However due to increase in climate change variability, fisheries resources have been threatened due to habitat degradation, over exploitation, pollution, parasites and diseases and more recently. While the other threats have received considerable attention, climate variability and change, which intensified since the last three decades of the 20th century [Intergovernmental Panel on Climate Change (IPCC), 2011] has received limited attention. The threat to climate change is not only on the development of socio economic and agricultural activities of any nation but to the totality of human existence (Adejuwon, 2004).

The IPPC (2007) defined climate change as the average weather within a given duration. It is the statistical description in terms of the mean and variability of relevant quantities over a period of time ranging from months to thousands or millions of years. The variability of temperature, air humidity and total rainfall shows negative signs to aquaculture production in ponds system. These problems have contributed to major loss of production and increase in socio-economic and income vulnerability among farmers. Allison *et al.* 2007; Coulthard, 2009 identified effects of climate change on fish production as: increase in rate of rainfall, too much wind increase fish production, season starting earlier increase, production of fish, occurrence of drought, increase in drought, occurrence of flood in the farm area, long period of harmattan season, pond size and increase in precipitation.

The effect of climate change in Nigeria on catfish is noted as overall reduction in productivity to yield quality

Academic Journal of Agricultural and Horticultural Research
Vol.2, No.4; October-December-2022;
ISSN (5201–3992);
p –ISSN 7239-4203

which invariably threatens food security situation at both national and household levels (Adebayo, 2012). The effect on fish production are loss of fish and changes in the water quality caused by drought, flooding and depositions of silt which causes loss of fish and great changes in the quality of water (Ayanwamide, 2002). Invariably, catfish farmers livelihoods are affected as they depend on good quality water to get abundant production. Good adaptation strategies are necessary to help the catfish farmers to cope with the impacts of climate change.

Negative effects of climate change can be reduced by adaptation which was identified by Kurukulasuriya and Mendalsohn (2006) as one of the policy options. Climate change adaptation means ability to adjust to natural or human system in response to actual or expected climatic stimuli or their effects which moderates harm or exploits beneficial opportunities (IPCC) 2001. Catfish farmers can therefore adapt to climate change by diversifying to other livelihoods, migrating, shifting to other species, at worst exiting fish production (Coulthard, 2008). Therefore to increase the catfish yield to feed the ever growing population, catfish farmers need to practice adaptation strategies to cushion the effects of climate change. Therefore, the study specifically ascertained catfish farmers' awareness of climate change; identify observable climate change occurrence in the study area; examine perception of climate change on catfish production; determine catfish farmers' perceived effect of climate change on catfish production; ascertain catfish farmers' adaptation strategies to reduce climate change effect.

2.0 METHODOLOGY

This research was carried out in Imo State, Nigeria. Imo State is one of the thirty six States in Nigeria and situated in the in the Eastern zone of the country. The State geographical location lies between Latitudes of 4°45′N and 7°15'N and also Longitude of 6°50'E and 7°25'E (Nigerian Meteorological Agency (NiMET), 2016). The State shares boarders with Abia State on the east, River Niger by the west and Delta State; and also shares boarder with Anambra State by the north, while shares with Rivers State by the south (National Boundary Commission (NBC), 2020). The State has three Agricultural zones namely Okigwe, Owerri and Orlu. Two Agricultural zones (Owerri and Orlu) were used in selecting catfish farmers for the study. First, two Local Government Area were purposely selected from each from the selected agricultural zones, secondly two autonomous communities were purposely selected from each of the LGA based on the large concentration/number catfish farmers in the area. Lastly, 10 catfish farmers were selected from each of the selected autonomous communities given the total of 80 catfish farmers for the study. Primary data was used with the use of structured questionnaires to collect data for the study. Descriptive and inferential statistical tools were used in analyzing data for the study. The objectives were achieved using frequency count, mean and percentage, while specifically Likert type rating scale of 4-point was used to derived mean scores for the perception of climate change on catfish production and perceived effect of climate change. The weighted values were added up and then divided by the number of scales to obtain the mean scores. For example, with four scales of (4+3+2+1)/4 = 2.50 cut-off point was obtained. It was stated as follows; SA = Strongly Agreed (4); A = Agreed (3); D = Disagreed (2); SD = Strongly Disagreed (1).

3.0 RESULTS AND DISCUSSION

3.1 Catfish farmers awareness of climate change on fish farming

The result Table 1 reveals that all most the catfish farmers (97.50%) were aware of climate change while the remaining (2.50%) of the respondents were unaware of climate change. This result implies that there is adequate awareness of climate change nowadays however, this contradict the study of Aphunu and Nwabeze (2012) and Nzeadike *et al*, (2011) that catfish farmers are not aware of climate change and the impacts of climate change is still low. However, farmers that are aware of climate change will seek adequate knowledge or information to cope with the effects of climate change in their farms.

Table 1: Catfish farmers awareness of climate change

Awareness	Frequency	Percentage
Aware	78	97.50
Not-aware	2	2.50
Total	80	100.00

Academic Journal of Agricultural and Horticultural Research
Vol.2, No.4; October-December-2022;
ISSN (5201–3992);
p –ISSN 7239-4203

Source: Field survey, 2022

3.2 Observable climate change

The result in Table 2 shows catfish farmers distribution according to climate change observable by the catfish farmers. From the result, the catfish farmers majorly observed climate change were identified as incidence of heavy rainfall (98.8%), increased in precipitation (77.5%), decreased in precipitation (67.5%), fluctuation in rainfall pattern (93.8%), heavy wind storm (83.8%), excessive sunshine (72.5%) and high temperature day and night (62.5%). This corroborates efforts of IPCC (2001) and Oyebola (2021) that observed climate change as changes in rainfall pattern, changes in precipitation pattern irregularities in seasons, shortening of the wet season, drought, decrease in river water volume and increase in temperature both day and night.

Table 2 Observable change in climates by the catfish farmers

S/N	Observable climate change	*Frequency	Percentage
1	Continuous heavy rainfall	79	98.8
2	Increased in precipitation	62	77.5
3	Decreased in precipitation	54	67.5
4	Fluctuation in rainfall pattern	75	93.8
5	Heavy wind storm	67	83.8
6	Excessive sunshine	58	72.5
7	High temperature day and night	50	62.5
8	Increased Flooding	42	52.5
9	Prolong dry season	26	32.5

***Multiple responses recorded; Source: Field survey, 2022.**

3.3 Perception of climate change on catfish production

The result of distribution of catfish farmers based on perception of climate change on catfish production is presented in Table 3. The climate change perceptions were rated with Likert-type rating scale questions of 4-points rated as Strongly Disagreed = 1; Disagreed = 2; Agreed = 3 and Strongly Agreed =4. Findings shows that some of the items which were perceived as climate change in catfish farming included flooding of the farm area ($\bar{x}$ = 3.98; S.D = 0.16), no acceptance of feed by fish ($\bar{x}$ = 2.86; S.D = 0.45) pollution ($\bar{x}$ = 3.85; S.D = 0.45), effect of harsh sun to fish production ($\bar{x}$ = 2.69, S.D = 1.00), pond size affect climate change and increase in rate of fish production ($\bar{x}$ = 2.58, S.D = 1.04). These farmers perceptions of climate change on production of catfish were rated above the cut of points of mean of 2.5. Therefore, it becomes clear that the catfish farmers were able to understand and perceived climate change correctly in the area. The results are in line with Tierney *et al* (2010) who observed changes in climate affects catfish production as a result of changes in temperature that leads to changes in water balance, water circulation, nutrient dynamics, and stratification which eventually dissolved oxygen levels in aquatic systems. The effects of climate change on production of fish are reduction in fish yields, both quantity and quality, also affect fishery productivity processes, then thereby affecting livelihoods of fish farmers (IPCC, 2007).

However, the standard deviations (S.D) values of the perception of climate change on fish production indicate that the catfish farmers varied in their responses. The grand mean for perception of catfish farmers on climate change in catfish production was 3.0 which is above the discriminatory score ($\bar{x}\geq 2.50$). This therefore confirms and implies that there were different perceptions of climate change in catfish production in the area.

Table 3: Perceptions of climate change on catfish production

S/N	Perception	Mean	S.D
1	Flooding of the farm area	3.98	0.16
2	Pollution	3.85	0.45
3	Pond size affect climate change	2.58	1.30
4	Increase in rate of fish production	2.58	1.04
5	Increase in precipitation	2.47	0.93

Academic Journal of Agricultural and Horticultural Research
Vol.2, No.4; October-December-2022;
ISSN (5201–3992);
p –ISSN 7239-4203

6	Effect of harsh sun to fish production	2.69	0.96
7	No acceptance of feed by fish	2.86	1.00

Grand mean = 3.0 Source: Field survey, 2022.

3.4 Perceived effect of climate change on catfish production

The result on Table 4 reveals the catfish farmers perceptions on the climate change effects on catfish farming in the area. Likert-type of four points rating scale questions were used to elicit information, these ranges from Strongly Agreed =4; Agreed =3; Disagreed =2 and Strongly Disagreed =1. Findings show that most (10) of the (14) perceptions were rated high. For instance, instance, flooding of the farm area ($\bar{x}$ = 3.55; S.D = 0.77), increase in fish production due to long period of harmattan season ($\bar{x}$ = 3.48; S.D = 0.80), drought increases production of fish ($\bar{x}$ = 3.53; S.D = 0.83), increase in precipitation increases fish production ($\bar{x}$ = 3.04; S.D = 0.95), occurrence of drought decrease fish production ($\bar{x}$ = 2.96; S.D = 0.80), reduction in fish farming activities ($\bar{x}$ = 2.96; S.D = 0.74), reduction in fish quality ($\bar{x}$ = 2.55; S.D = 0.98), increase in fish mortality ($\bar{x}$ = 2.54; S.D = 0.86) and high incidence of disease infestation ($\bar{x}$ = 2.53; SD = 1.07). This is in line with the study of Adebayo (2012) that "in Nigeria, the effect of climate change on fish ranges from overall reduction in productivity to yield quality which invariably threatens food security situation at both national and household levels''. Meanwhile, low stocking rate ($\bar{x}$ = 2.46; S.D = 0.91), poor distribution of fish in water ($\bar{x}$ = 2.30; S.D = 0.83), alteration in fish growth and productive capacity ($\bar{x}$ = 2.31; S.D = 0.96), decrease in quality of water ($\bar{x}$ = 2.33; S. D = 1.02) were not highly perceived by the catfish farmers as effects of climate change on fish production in the study area. Finally, from the aggregate mean ($\bar{x}$ = 2.82) which is above the discriminatory score ($\bar{x} \geq 2.50$); it shows that the respondents perceived rightly the effects of climate change in the study area. Evidence of climate change effects on fisheries resources was noted by Allison *et al*. (2007) with various changes in diversity of fish species, size and composition, species distribution, possible species extinction and reduction in production. FAO (2010) also predicted that climate change will shift fisheries to smaller, faster growing, opportunistic less valuable species that can adapt fast to the changing environment. These will bring changes in aquatic productivity processes and fisheries production that will ultimately affect the livelihoods of the people dependent on fishery resources.

Table 4: Catfish farmers perceived effects of climate change on catfish farming

S/N	Perceived effect of climate change	Mean	S.D
1	Drought increases production of fish	3.53	0.83
2	Flooding of the farm area	3.55	0.77
3	Increase in fish production due to long period of harmattan season	3.48	0.80
4	Increase in precipitation increases fish production	3.04	0.95
5	Decrease in fish production as a result of long period of hot season	2.90	0.74
6	Occurrence of drought decrease fish production	2.96	0.80
7	Reduction in fish farming activities	2.96	0.74
8	Reduction in fish quality	2.55	0.98
9	Low stocking rate	2.46	0.91
10	Increase in fish mortality	2.54	0.86
11	Poor distribution of fish in water	2.30	0.83
12	Alteration in fish growth and productive capacity	2.31	0.96
13	High incidence of disease infestation	2.53	1.07
14	Decrease in quality of water	2.33	1.02

Grand mean = 2.82; Source: Field survey, 2022.

Academic Journal of Agricultural and Horticultural Research
Vol.2, No.4; October-December-2022;
ISSN (5201–3992);
p –ISSN 7239-4203

3.5 Adaptation Strategies to cope with the effects of climate change by catfish farmers

Adaptation strategies to climate change effects on catfish production are shown in Table 5. To reduce the negative impact of climate change, small-scale catfish farmers need to adopt adaptation strategies, The result shows that some of the major adaptation strategies adopted by catfish farmers were build ponds close to water sources (98.9%), dig bore hole/wells to supply water during dry seasons (96.3%), adjustment in the time of stocking (87.5%), stocking fish species that are more favoured by climate change (87.5%), seeking/listening to information about climate change (85.0%), avoiding pond leakage (81.3%), build embankments to prevent flood water (80.0%), good water circulating system (75.0%). Fisher communities can adapt by migrating, intensifying fisheries activities, shifting to other species, exiting fishing or diversifying to other livelihoods (Allison *et al.* 2005; Coulthard, 2008).

Table 5: Climate change adaptation strategies

S/N	Adaptation Strategies	Frequency	Percentage
1	Build ponds close to water sources	79	98.8
2	Dig bore hole/wells to supply water during dry seasons	77	96.3
3	Adjustment in the time of stocking	70	87.5
4	Seeking/listening to information about climate change.	68	85.0
5	Stocking fish species that are more favoured by climate change	70	87.5
6	Avoiding pond leakage	65	81.3
7	Good water circulating system	60	75.0
8	Procurement of weather/water monitoring kits	51	63.8
9	Build embankments to prevent flood water	64	80.0
10	Stocking of healthy fingerlings	62	77.5
11	Use of improved varieties of fish	61	76.3
12	Regular clearing pond summarily	42	52.5
13	Good inlet and outlet	45	56.3
14	Diversion of water ways	42	52.5
15	Good water circulation	37	46.3
16	Planting of banana trees as shades	44	45.0

Source: Field survey, 2022.

4.0 CONCLUSION AND RECOMMENDATION

The study revealed that nowadays catfish farmers are adequately aware of climate change in the study area. The catfish farmers were able to perceived climate change on fish production as occurrence of flood in the farm area; no acceptance of feed by fish, pollution; effect of harsh sun to fish production; pond size affect climate change and Increase in rate of fish production. Climate change poses threat to fish production in the study area. The catfish farmers therefore perceived effect of climate change as flood in the farm area; increase fish production; long period of harmattan season; increase in drought increase fish production; increase in precipitation; occurrence of drought; decrease fish production. Based on the findings of this study, the study recommends that: extension agents should double their efforts in training and enlightening programmes on adaptation strategies to climate change on fish production. Also, policy makers should incorporate some of the identified adaptation strategies to effects of climate change on catfish production in policy formulation.

REFERENCES

Adebayo, O.O (2012). Climate Change Perception and Adaptation Strategies on Catfish Farming in Oyo State, *Nigeria. Global Journal of Science Frontier Research Agriculture and Veterinary Sciences.* Volume 12 Issue 6.

Adejumo, S. A. (2004): Impact of climate variability and climate change on crop yield in Nigeria. Contributed paper to state holders workshop on Assessment of impact and Adaptation to climate change (AIACC) 2-8.

Allison, E. H., Adger, W. N. & Badjeck, M. C. (2005). Effects of climate change on the sustainability of capture and enhancement fisheries important to the poor: analysis of the vulnerability and adaptability of fisherfolk living in poverty. Project No. R4778J. Final Technical Report, Fisheries Management Science Programme, MRAG/DFID, London; 164.

Aphunu, A & Nwabeze, G.O (2012). Fish Farmers' Perception of Climate change impact on fish production in Delta State, Nigeria. *Journal of Agricultural Extension*, Vol. 16 (2).

Ayanwamide, F.M. (2002) Aquaculture and Aquarree Design it Agricultural production methods and technology G Faniyi (ed) Andiran Publication series.

Coulthard, S (2008). Adapting to environmental change in artisanal fisheries-Insights from a South Indian Lagoon. *Global Environ. Change*, 18, 479–489.

FAO (2010). World Aquaculture 2010, Aquaculture service of the fisheries and aquaculture resources use and conservation division. FAO fisheries and aquaculture technical paper 500/1. Rome.

Idowu, A. A., Ayoola, S.O, Opele, A.I & Ikenweiwe, N.B (2011). Impact of Climate Change in Nigeria. *Iranica Journal of Energy & Environment*, 2(2), 145-152.

Ike, P. C. & Chuks-Okonta,V. A.(2014). Determinants of output and Profitability of aquaculture fish farming in Burutu and Warri South West Local Government Areas of Delta State. Nigeria. *Journal of Biology, Agriculture and Healthcare*, 4 (28):102-109.

Intergovernmental Panel on Climate Change (2001) Climate Change: the scientific basis. http://www.ipcc.ch.

Intergovernmental Panel on Climate Change-IPCC (2007). Climate change Impacts, adaptations and vulnerability. In: Parry, M.C., Canzien, O.F., Palutikot, J.P., vander Linden, Paul, J. and Hanson, C. (eds.). Contribution of Working group II to the 4th Assessment Report of the IPCC. Cambridge: University Press, Cambridge.

Intergovernmental Panel on Climate Change. (2011). Climate issues in the 21st century. www.ipcc.com

Kurukulasuriya P & Mendelsohn R (2006): Crop selection: Adaptating to Climate change in Africa CEEPA; Discussion Paper No. 26.).

National Boundary Commission (NBC) of Nigeria (2020). Boundaries across South east, Nigeria, Retrieved on 10 April from https://nnn.ng/tag/national-boundary-commission-nbc/

Nigerian Meteorological Agency (NiMET) (2016).Drought and Flood Monitoring in South-East Bulletin. Retrieved on 10 April, 2022 from www.nimet.gov.ng

Nzeadike, T.C., Egbule, C.L., Chukwuone, N.A. & Agu, V.C. (2011). Climate Change Awareness and Adaptation in the Niger Delta Region of Nigeria. African Technology Policy Studies Network. Working Paper Series/No. 57.

Oyebola, O.O (2021). Potential adaptation strategies for climate change impact among flood-prone fish farmers in climate hotspot Uganda. Environment, *Development and Sustainability* (2021) 23:12761–12790

Ume, S. I., Ebeniro, L. A., Ochiaka, C.D. & Uche, F. O. (2016). Economic analysis of catfish production in Anambra State, Nigeria. *International Journal of Environment, Agriculture and Biotechnology (IJEAB)*, 1(3): 476-481.

United State Department of Agriculture (2018). Census of Aquaculture: 2018. USDA, Volume 3.