Climate Change Perception and Adaptation Strategies in Catfish Farming in Ilaro Metropolis: Implications for Food Security

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ABSTRACT

The small-scale catfish farmers who depend on fish farming for survival encounter major obstacles from climate change effects in their operation areas. This research examines catfish farming community members' responses toward climate change as well as their adaptation approaches within the Ilaro Metropolis situated in Yewa South Ogun State of Nigeria. Primary data were obtained through a well-structured questionnaire and interview schedule. A purposive sampling technique was used to select one hundred (100) respondents. Data were analyzed using descriptive statistics and chi-square tests. The findings show that 90% of the respondents agree that increased rainfall leads to elevated production levels, while 87% of the respondents reported that drought negatively affects aquaculture operations. Many (98%) aquaculture farmers exhibited misconceptions regarding the effect of temperature on oxygen solubility, suggesting a gap between local knowledge and established scientific understanding. The chi-square analysis identified three leading catfish farming techniques as embankment construction with ($\chi^2 = 194.240$), stocking healthy fingerlings with ($\chi^2 = 171.140$), and pond fertilization with ($\chi^2 = 117.020$). The farmers adopted salt baths as an aquaculture strategy combined with improved fish variety selection and using banana trees for shade. The study concludes that understanding climate change perception and implementing effective adaptation strategies are important for enhancing catfish production in the study area.

Keywords: Climate Change, Catfish Farming, Adaptation Strategies, Food Security

Introduction

Climate change stands as the most severe environmental problem facing modern times since it endangers human survival and the planet. Many sub-Saharan African countries including Nigeria face a major food security threat from agriculture because of this problem (Okoli and Ifeakor, 2014). Climate change exists as statistically significant variations which endure across prolonged periods reaching decades or beyond according to the Intergovernmental Panel on Climate Change (IPCC 2007). This phenomenon consists of changed sporadic weather patterns that affect both event frequencies and magnitudes together with persistent global temperature elevation. The United States Global Climate Change Programme (USGCRP, 2024) identified climate change as weather phenomenon extreme reactions which generate damaging consequences for agricultural resources, water resources, human health and ozone depletion and vegetation and soil resources up until carbon dioxide concentration doubles in the ecosystem. The current climate shifts that include unreliable weather cycles and high temperatures combined with flooding and water shortages affect numerous Nigerian territories and jeopardize both environmental food security and national economic stability.

Catfish farming significantly enhances Nigeria's food industry because fish makes up 40% of animal protein consumption while catfish forms a substantial portion of this total fish production (at least one-quarter). About 1 million individuals find employment in the Nigerian catfish value chain while 285,000 producers are directly involved with more than 60% operating on small-scale farms. (FAO, 2023). Nigeria stands out worldwide for its position as the top catfish producer

which accounts for 64% of its entire fish production (Yakubu et al., 2022). Nigeria represents the largest aquaculture sector in Sub-Saharan Africa and places second in Africa behind Egypt with its annual fish production reaching 260,000 metric tons (FAO, 2020). The country persistently struggles to fulfill its national fish requirements despite its progress in fishing development. Annual fish demand in Nigeria amounts to 3.6 million metric tonnes whereas domestic production reaches just one million tonnes (Manyise et al., 2024). Nigeria fills its fish supply gap through yearly imports of approximately 2.5 million tonnes of frozen fish. Current import volumes demonstrate the pressing necessity to develop Nigeria's aquaculture industry while increasing productivity in popular fish farming species. The production enhancement of catfish is a national priority because of its widespread acceptance and inexpensive nature especially among lower-income groups (Dauda et al., 2018).

The sustainability and productivity of catfish farming in Nigeria encounter serious hurdles because of climate change effects. Catfish farming in ponds suffers from negative impacts resulting from temperature alterations, variations in air humidity and rainfall. Studies conducted by Allison et al. (2007), Coulthard (2009), and Egwuonwu (2022) showed that climate change affects fish production through increased rainfall frequency, strong winds, drought occurrence and flooding of farm areas, prolonged harmattan season, larger ponds, and higher precipitation amounts. The modified conditions produce negative effects on pond water quality, affecting fish growth and disrupting the stability of ecosystem balances (Ayanwamide, 2002 and Egwuonwu, 2022). The disruption of water sources leads to important declines in catfish productivity and quality, according to Adebayo (2012), creating severe threats for household and national food security. Farmers who grow catfish depend on good quality water for producing abundant harvests, so their livelihoods remain at stake in these circumstances.
Adaptation is a key strategy for reducing the adverse effects of climate change on catfish production. 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; and Okezie, et al., 2021). According to the IPCC (2007), “adaptation refers to adjustments in natural or human systems in response to actual or expected climatic stimuli or effects, which moderate harm or exploit beneficial opportunities.” The ongoing population growth in Nigeria, requires catfish farmers to implement effective climate adaptation approaches to boost yield production.

Although Yewa South hosts numerous fish hatcheries and pond-based farms (Yusuff et al., 2021), local aquaculture is subject to climate-induced land-use changes and rainfall variability. While farmers across Ogun State are adopting modern pond technologies (Samuel, 2024), there is limited research on their ecological understanding of pond environments under climate stress. Studies in other Nigerian states show that farmers are aware of drought and flooding but lack insight into how high temperatures affect pond oxygen and fish health (Egwuonwu, 2022). This study fills that gap by exploring farmers’ perceptions and ecological knowledge among catfish producers in Ilaro, Yewa South. This study, therefore, focuses on catfish farmers' perspectives on climate change and the adaptive measures they utilize.

2.0 METHODOLOGY

2.1 STUDY AREA

The study was conducted in the Ilaro Metropolis, the administrative headquarters of Yewa South Local Government Area (LGA), Ogun State, Nigeria. Geographically, Ilaro is located at 6.889°N latitude and 3.014°E longitude, within the humid tropical rainforest zone of southwestern Nigeria. The region experiences a bimodal rainfall pattern, with an average annual precipitation of approximately 916 mm. Temperatures typically range between 25 °C and 35 °C, and relative humidity often exceeds 80% during the rainy season climatic conditions that are conducive to aquaculture activities.

Ilaro is predominantly an agrarian town where residents engage in both arable and cash crop farming (e.g., cassava, maize, cocoa, and coffee). In recent years, catfish farming has gained prominence due to its high market demand, adaptability, and quick maturity cycle. The majority of farmers operate small to medium-scale fish farms using concrete, earthen, or tarpaulin pond systems. The presence of surface water bodies, shallow groundwater, and market access to nearby urban centers like Abeokuta and Lagos further supports aquaculture development. The main fish species cultivated in the area include *Clarias gariepinus* (catfish) and tilapia, with catfish being the dominant due to its profitability and suitability for varied pond types.

2.2 Sampling Procedure and Sampling Size

Purposive sampling was used to select 100 catfish farmers in the Ilaro metropolis, as the study specifically targeted individuals actively engaged in catfish aquaculture. This method enabled the deliberate inclusion of respondents with relevant knowledge and experience regarding climate change and adaptation practices. Farmers were identified with the assistance of local extension agents, fishery associations, and community leaders to ensure broad and diverse representation across the metropolis.

2.3 Data Collection and Analysis

Data were collected using a structured questionnaire and semi-structured interview schedules administered to catfish farmers in the Ilaro metropolis. The questionnaire covered two main sections:

1. **Perception of Climate Change:** This section explored farmers' awareness and beliefs about various climatic factors such as temperature changes, rainfall variability, drought, and harmattan and their effects on catfish production. A 4-point Likert-type scale (Strongly Agree = 4 to Strongly Disagree = 0) was used to assess responses. Statements with a mean score of 2.5 or higher were interpreted as agreement.
2. **Adaptation Strategies:** This section focused on the techniques and practices farmers employ to cope with climate-related challenges in catfish farming, including water management, timing of stocking, and feeding adjustments.

Semi-structured interviews were conducted to gain deeper insights into farmers' lived experiences and to complement the questionnaire data. These interviews explored local climate observations, challenges encountered during extreme weather events, and the rationale behind specific adaptation strategies.

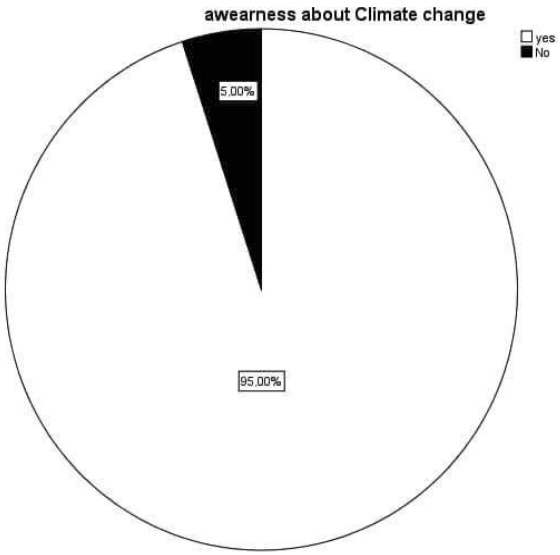
Descriptive statistics and chi-square tests were performed using **SPSS version 23** to analyze the data.

3.0 Result and discussion

3.1 Catfish Farmers Perception towards Climate Change

3.1.1 Awareness about Climate Change

The result in Figure 1 reveals that almost all the catfish farmers (95%) were aware of climate change, while the remaining 5% of the respondents were unaware of climate change. This result implies that there is adequate awareness of climate change nowadays. The result is in line with EGWUONWU (2022), who revealed that most (97.50%) of the catfish in Imo State, Nigeria, are aware of climate change.



Source: Field survey 2024

3.1.2: Catfish Farmers Perception towards Climate Change

Table 1 illustrates catfish farmers' views concerning climate change together with its consequences on fish farming within the study region. The respondents assessed their perceptions on ten statements through a

5-point Likert-type rating scale using the response options from Strongly Agree (SA) to Strongly Disagree (SD). The survey results show that 90% of the participants either strongly agreed or agreed that more rainfall leads to improved fish yields. Egwuonwu (2022) supported these findings by demonstrating that Imo State farmers positively link increased precipitation to better water conditions and improved pond fisheries. 35% of the respondents either agreed or strongly agreed that excessive wind causes eggs to fail during hatching, whereas 35% remained undecided and 30% disagreed or strongly disagreed. These response patterns indicate farmers hold diverse perceptions because they might experience different levels of wind affecting fish egg hatching rates or possess varying awareness. When asked about fish production during extended hot seasons, most farmers (65%) disagreed or strongly disagreed, 25% agreed or strongly agreed, and 10% were undecided. This implies that most farmers in the study area do not view prolonged hot seasons as destructive to their fish farming operations. The study by Adebayo (2012) supports these findings since he discovered that catfish farmers in Oyo State (86.7%) did not view prolonged hot seasons as threatening their fish production outcomes.

Furthermore, 77% of the respondents agreed that early rainy season arrival enhances fish production rates and 20% of the respondents disagreed with 3% leaving their responses undecided. This implies that most farmers view early rainfall as producing positive results for their aquaculture operations. The findings match the results of Adebayo (2012), who show 82.2% of farmers view early rainy seasons positively for their aquaculture operations. Majority (87%) of the respondents agreed or strongly agreed that drought occurrence results in negative consequences for fish production. Egwuonwu (2022) reported similar findings about water availability concerns affecting aquaculture among fish farmers in Imo State. 87% of the respondents expressed disagreement toward the idea that drought leads to improved fish production, while only 11% agreed or strongly agreed, and 2% were undecided. The uniform opinion of farmers indicates drought produces adverse results for aquaculture operations. Most (91%) farmers rejected the idea that farm floods increase fish production while remained undecided. This implies that majority of farmers view floods negatively due to concerns about fish escape incidents and pond destruction and water contamination. The perception that long harmattan seasons lead to decreased fish reproduction received agreement from 82% of the respondents. This implies that most farmers express negative views about long harmattan durations which damage fish reproductive activities. Egwuonwu (2022) confirmed this observation about prolonged harmattan seasons which diminish fish breeding activities in Imo State of Nigeria.

When asked whether higher temperatures reduce oxygen solubility in catfish ponds, an overwhelming 98% of respondents either disagreed or strongly disagreed, with only 2% strongly agreeing. This widespread misconception highlights a significant gap between scientific understanding and farmers' beliefs. It may reflect limited access to formal training or reliance on experiential knowledge that does not align with current research on pond ecology. Pond management procedures should be reconsidered after establishing how insufficient knowledge about pond conditions influences fish survival rates during summer heat waves. Lastly, regarding the perception that pond size affects climate change, 63% of respondents either disagreed or strongly disagreed, while 33% agreed and 4% were undecided. This indicates that most farmers do not perceive pond size as a contributing factor to climate change dynamics. This finding corroborates Adebayo (2012), who similarly reported that 73.3% of catfish farmers in Oyo State did not consider pond size to influence climate change effects.

Table 1: Catfish Farmers Perception towards Climate Change

***SA-Strongly Agreed, A-Agreed, U- Undecided, SD-Strongly Disagreed, D- Disagreed**

Climate change perception	SA %	A %	U %	D %	SD %
Increase in precipitation increases fish production.	9	81	6	1	3
Too much wind reduces hatching of eggs	0	35	35	18	12
Long period of hot season decreases fish production	19	6	10	29	36

Rain season starting earlier increases fish production	49	28	3	18	2
Occurrence of drought decreases fish production	53	34	6	2	5
Increase in drought increases fish production	3	8	2	36	51
Occurrence of flood in the farm area increases fish production	0	0	9	16	75
Long harmattan season reduces hatching and fry survival	42	40	1	0	17
Higher temperatures reduce oxygen solubility in catfish pond	2	0	0	53	45
Pond size affects climate change	0	33	4	41	22

Source: Field survey 2024

3.1.3 Climate Change Adaptation Strategies Adopted by Catfish Farmers

The chi-square analysis results from table 2 show widespread adoption of adaptation methods for building embankments against floodwater intrusion ($\chi^2 = 194.240$) along with stocking healthy fingerlings ($\chi^2 = 171.140$) and pond fertilization ($\chi^2 = 117.020$). Farmer-run adaptation strategies demonstrate proactive approaches to managing both biotic stressors, including disease outbreaks and poor fish immunity, along with abiotic stressors such as flooding, water acidity, and oxygen depletion, which climate change exacerbates. The widespread implementation of these strategies demonstrates farmers' practical comprehension of climate effects in their local environment. This finding aligns with Egwuonwu (2022), who showed that irrigation embankments to shield ponds during the rainy season have become a standard practice for 80% of Imo State farmers. Egwuonwu also found that fingerlings with good health status are commonly used because disease levels rise by 63% when water temperatures increase. Correspondingly, this result matches Adebayo (2012), who found that Oyo State catfish farmers typically use pond fertilization methods to combat low dissolved oxygen levels, which occur at peak ambient temperatures.

Additionally, preventive strategies that were identified include fish stocking adaptations ($\chi^2 = 99.260$) as well as frequent salt baths used to treat diseases ($\chi^2 = 97.220$). It shows the primary and secondary patterns accompanied by innovative tactics of early disease management plus contingency measures concerning the threat of seasonal risks such as the onset of rain and occurrence of diseases during functional heat conditions. The use of improved fish varieties ($\chi^2 = 73.960$), regular pond water exchange ($\chi^2 = 62.160$), and the usage of higher quality feed ($\chi^2 = 55.940$) clears the fact that a multiple approach could be taken for stabilization of the pond and sustainability of fish growth under the changing climatic conditions. The results are consistent with research work of Maulu (et al.) 2021, which confirm that erratic rainfall packing coupled with water quality degradation and thermal stress present immense limitations to aquaculture activities hence the need for focused adaptive mechanisms based on efficient fitness management practices and improved approaches in conservation of water. Likewise, Areola et al (2024) study shows that Nigerian catfish producers regularly treat Clarias gariepinus with salt baths for parasitic and bacterial infections. Microclimate regulation methods include shading banana trees and putting banana leaves in the ponds, but the results were found significant at $\chi^2 = 18.620$ and $\chi^2 = 27.920$, respectively, with low chi-square values. Farmers use the principles outlined above because they know that natural ways maintain the ecological balance of the fish ponds.

Other various methods that significantly enhanced catfish production were lime application to neutralize water acidity achievement ($\chi^2 = 101.840$) and isolation of sick fish to prevent transmission of disease ($\chi^2 = 29.400$) from time-to-time fishing ($\chi^2 = 78.740$) and the use of multivitamins for fish health ($\chi^2 = 40.220$). Other forms of adaptation practices observed during the assessment include sourcing climate-related information ($\chi^2 = 41.780$), preventing leakage from ponds ($\chi^2 = 27.440$), using aerators to improve the dissolved oxygen levels in water ($\chi^2 = 46.800$), using chemical means to cure diseases ($\chi^2 = 33.200$), and acquiring weather/water monitoring kits for daily monitoring ($\chi^2 = 56.420$). These strategies

are a demonstration of active contribution by the farmers in the adaptation of climate change as they operate with the complete comprehension of the situation and show they practice catfish sustainability under the most insensitive environmental conditions.

Table 2: Climate Change Adaptation Strategies Adopted by Catfish Farmers

Climate change adaptation strategies	Chi-Square	P-value
Stocking of healthy fingerlings	171.140	0.000
Build embankments to prevent flood water	194.240	0.000
Adjustment in the time of stocking	99.260	0.000
Adding of lime to reduce acidity	101.840	0.000
Regular change of pond water	62.160	0.000
Isolation of sick fish	29.40	0.000
Use of improved varieties of fish	73.960	0.000
Introduction of organic material like banana leaves to maintain water quality	27.920	0.000
Seeking/listen to information about climate change	41.780	0.000
Avoid pond leakage	27.440	0.000
Changing of fish feed to more quality ones	55.940	0.000
Fertilization of ponds	117.020	0.000
Procurement of weather/water monitoring kits/daily water checks	56.420	0.000
Planting of banana trees as shade	18.620	0.000
Use of aerators to improve the oxygen content of water	46.800	0.000
Sorting intermittently to avoid overcrowding and stress to fish	78.740	0.000
Use of chemical conventional drugs to treat disease outbreak	33.200	0.000
Use of frequently salt bath to prevent or mitigate disease outbreak	97.220	0.000
Multivitamin usage to boost fish immunity	40.220	0.000

Source: Field survey 2024

The study shows that catfish farmers in Ilaro are highly aware of climate change and have adopted several adaptation strategies, such as embankments, disease control, and pond fertilization, to sustain production. These practices support local food security and livelihoods by maintaining fish yields despite climatic challenges. However, the widespread misconception that high temperatures do not reduce pond oxygen levels reveals a critical knowledge gap that could compromise fish survival during hotter seasons. If unaddressed, such ecological misunderstandings could lead to declining production, threatening local food availability and the sustainability of farmers' livelihoods over time. This study is limited by its reliance on self-reported data and the purposive sampling of farmers within a single town, which may affect the generalizability of the results.

4.0 CONCULSION AND RECOMMENDATION

4.1 CONCULSION

This study provides empirical evidence on the perceptions and climate change adaptation strategies of catfish farmers in Ilaro Metropolis, Ogun State. The findings show that farmers are highly aware of climate elements such as rainfall, drought, and harmattan and have adopted practical adaptation strategies. However, a critical knowledge gap exists regarding the impact of high temperatures on pond oxygen levels and fish health. While many farmers associate early rains with improved production and view drought and floods as threats, limited scientific understanding of pond ecology could compromise long-term sustainability. These perceptions are consistent with previous studies in Nigeria, indicating broader trends in climate awareness and adaptation among fish farmers.

4.2 RECOMMENDATION

The recommendation suggested are based on the findings of this study which includes:

- Government agencies should strengthen farmer cooperatives by enhancing their capacity to bulk-purchase and distribute essential aquaculture inputs such as water quality test kits, improved fingerlings, and pond aerators.
- These stakeholders should also promote peer learning platforms where farmers can share experiences and best practices related to climate change adaptation in aquaculture.
- Agricultural Extension Services should intensify farmer education on key aspects of pond ecology, particularly the relationship between temperature, oxygen solubility, and fish health and survival. They should also develop and distribute localized training materials using visual aids and indigenous languages to improve understanding among farmers with limited formal education.

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