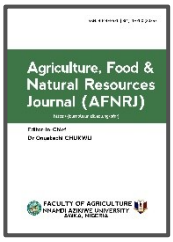
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Original Article

# Attitude of catfish farmers towards climate change in Ondo State, Nigeria

OPEN ACCESS

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**ABSTRACT**

*Climate change increasingly affects aquaculture in Ondo State, yet studies on catfish farmers' attitudes remain limited. This study examines their awareness, perceptions, and adaptation strategies regarding climate change to inform effective policies and promote sustainable aquaculture development in Nigeria. Data were collected through structured questionnaires administered to ninety (90) respondents selected using a three-stage sampling technique. Descriptive statistics such as frequency counts, percentages, and mean scores were used to analyze the data. The results revealed that 80% of respondents were male, 45.6% aged 31–40 (mean age 46), 77.8% married, 85.6% literate, 53.3% Christians, 44.4% had a 6–10 household size, mean farm size 4 ha, and mean farming experience 13 years. Also, 97.8% of the respondents were aware of climate change ($\bar{x}$ = 4.98). The attitudes of catfish farmers toward the perceived effects of climate change show that 77.8% believed the government is not committed to agriculture in terms of climate change ($\bar{x}$ = 3.89) and that climate has affected agriculture since they became involved in the sector ($\bar{x}$ = 3.76). However, most disagreed that climate change programmes or policies have significantly improved agriculture ($\bar{x}$ < 3.0). The study further revealed that local farmers (50.0%) and extension agents (16.7%) served as major information sources, while key challenges included high technology costs (33.3%), poor perception of climate change (22.3%), scarcity of trained manpower (16.8%) inadequate training (11.1%), and limited financial access (5.5%). The study recommends capacity building, financial support, and climate-resilient practices to improve catfish farmers' adaptive capacity to climate variability.*

**KEYWORDS:** *Adaptation strategies, Agricultural extension, Aquaculture, Climate Resilience, Socio-economic*

## INTRODUCTION

Fisheries are a crucial component of the global economy, playing a significant role in providing food security, employment, and economic growth worldwide. This sector encompasses the harvesting, processing, and distribution of aquatic organisms, including fish, shellfish, and seaweeds. Economically, fisheries contribute billions of dollars annually to the global economy through the sale of seafood products both domestically and internationally (Ayoola & Idowu, 2021). Beyond the direct revenue generated, fisheries support numerous ancillary industries such as fishing gear manufacturing, transportation, and seafood processing. Moreover, they create employment opportunities for millions of people, particularly in coastal communities and developing nations where fishing is a primary livelihood. Beyond economic

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significance, fisheries also hold cultural and social importance for many communities, shaping traditions, identities, and ways of life. They provide sustenance for coastal populations and play a vital role in the diets of billions of people worldwide, particularly those in developing countries who rely heavily on fish as a primary source of protein (Folorunso *et al*., 2021).

Inland fisheries refer to the harvesting of fish and other aquatic organisms from freshwater bodies such as rivers, lakes, and reservoirs, while coastal fisheries involve fishing activities in marine environments along the coastlines (Okeowo *et al*., 2017). Both inland and coastal fisheries support a diverse array of fishing practices, ranging from artisanal methods carried out by small-scale fishers using traditional techniques to commercial operations utilizing modern fishing vessels and equipment.

In Nigeria, as in many other regions around the world, both inland and coastal fisheries play a vital role in the economy, providing significant employment opportunities and contributing to the livelihoods of millions of people (Oluwaseun *et al.,* 2022). According to data, it is estimated that about 600 million livelihoods depend at least partially on fisheries and aquaculture (Olufayo, 2020). The employment provided by the fisheries sector in Nigeria encompasses a wide range of roles and activities. Fishermen and fisherwomen are directly involved in the capture of fish, using various fishing gears and methods suited to local conditions and target species.

The significance of the fisheries sector extends beyond just providing employment; it also contributes to food security and nutrition by supplying a valuable source of protein to the Nigerian population. Fish is a staple food for many Nigerians and is an essential component of the local diet, particularly in coastal communities where it is readily available (Okeowo *et al*., 2017). As a major source of animal protein, fish provides essential nutrients such as high-quality protein, omega-3 fatty acids, vitamins, and minerals, contributing to overall health and well-being. For many Nigerians, especially those living in coastal regions and along riverine areas, fish is a dietary staple that forms the foundation of meals, often served in various forms, including grilled, fried, stewed, or smoked. Beyond its nutritional and culinary importance, fish holds cultural significance in Nigerian society (Folorunso *et al*., 2021). It is often associated with celebrations, festivals, and religious ceremonies, where it serves as a symbol of abundance, prosperity, and communal unity. Traditional fishing practices, folklore, and artisanal fishing techniques are passed down through generations, preserving cultural heritage and fostering a strong connection to the aquatic environment.

Catfish farming has become increasingly popular among Nigerian fish farmers due to several factors. Catfish, particularly species such as African catfish (*Clarias gariepinus*) and Giant catfish (*Heterobranchus bidorsalis*), are known for their fast growth rates and high feed conversion efficiency, allowing farmers to achieve rapid and cost-effective production. This makes catfish farming a profitable venture for many small-scale and commercial fish farmers across the country (Folorunso *et al*., 2021). Catfish is highly sought after in the Nigerian market due to its distinctive flavor, firm texture, and versatility in cooking. It is a popular choice for making traditional dishes such as pepper soup, barbecue, and fish stew, as well as being used in various snacks and appetizers. The strong demand for catfish in local markets and restaurants drives its higher market value compared to other fish species like tilapia Folorunso *et al*., 2021).

Climate change, characterized by shifts in temperature patterns, precipitation levels, and extreme weather events, has emerged as a major concern for agricultural systems worldwide, including aquaculture. In Ondo State, climate change impacts such as irregular rainfall patterns, prolonged droughts, and increased frequency of extreme weather events have the potential to disrupt catfish farming operations, affecting production yields, water quality, and overall farm profitability. Understanding the attitudes of catfish farmers towards climate change is essential for developing effective adaptation strategies and resilience-building measures to mitigate the impacts of climate variability on aquaculture livelihoods. Climate change is mainly characterised by the prevalence of severe weather and temperature events and varying rainfall patterns (Ayoola & Idowu, 2021). Efforts to deal with the current impact of climate change will require adaptation and irrigation responses (Ojo *et al.,* 2021).

Climate change poses a significant threat to agricultural systems globally, including aquaculture, which contributes substantially to food security and economic growth. In Nigeria, and particularly in Ondo State, catfish farming represents a major component of the agricultural sector (Oluwaseun *et al.,* 2022). However, this sector is highly climate-sensitive and increasingly vulnerable to adverse climate conditions such as irregular rainfall, rising temperatures, flooding, and water quality deterioration. These challenges, compounded by socio-economic factors such as poverty, inadequate housing, poor infrastructure, and limited education, have severely impacted the livelihoods and productivity of catfish farmers. Despite the growing importance of climate adaptation in agriculture, there is limited research focused specifically on how catfish farmers perceive and respond to climate change in the region (Oluwafemi *et al.,* 2021). Understanding their awareness, attitudes, and adaptive behaviours is essential for developing targeted interventions that support resilience and sustainability in aquaculture.

Therefore, the goal of this study is to assess the attitude of catfish farmers towards climate change in Ondo State, Nigeria, by examining their socio-economic characteristics, level of awareness, perception of climate impacts, sources of climate information, and the challenges they encounter. This study is guided by five key research questions addressing: (1) the socio-economic profile of farmers, (2) their awareness of climate change, (3) their attitudes toward its effects, (4) sources of information accessed, and (5) the specific problems they face. By addressing these aspects, the research aims to generate

evidence that will inform climate-resilient aquaculture policies and farmer-support strategies in the region.

## MATERIAL AND METHODS

### Study Area

Ondo State (7°10′N 5°05′E / 7.167°N 5.083°E) is located in the southwestern region of Nigeria, bordered by Ekiti and Kogi states to the north, Osun State to the northwest, Ogun and Lagos states to the southwest, and Edo State to the east. It has a coastline along the Atlantic Ocean to the south (Figure 1). The state covers an area of approximately 15,500 square kilometers and is known for its diverse geography, which includes coastal areas, forests, rivers, and highland regions. Ondo State experiences a tropical climate with two distinct seasons: the rainy season, which lasts from April to October, and the dry season, spanning November to March. The average temperature ranges between 22°C and 32°C (Ojo *et al.,* 2020). In recent years, climate variability has been more pronounced, with irregular rainfall patterns and occasional extreme weather events like flooding, impacting agriculture and water availability (Ojo *et al.,* 2021).

### Sampling Procedures

The target population for this research consisted of all catfish farmers in Ondo state.

The multistage sampling technique was used to select respondents for the study. In the first stage, five local government areas were purposively selected. In the second stage, from these local government areas, two communities were randomly selected from each of the selected local government areas. In the third stage, 15 catfish farmers were randomly selected from each community. A total of 90 catfish farmers were randomly selected for the final data analysis. A structured questionnaire and interview schedule will be used for the study (Table 1).

**Table 1: Multistage sampling technique used to select respondents for the study**

| Sampling Stage | Description | Number Selected |
|---|---|---|
| Stage 1 | Purposive selection of Local Government Areas (LGAs) | 5 LGAs |
| Stage 2 | Random selection of communities (2 per LGA) | 2 communities × 5 LGAs = 10 communities |
| Stage 3 | Random selection of catfish farmers (15 per community) | 15 farmers × 10 communities = 90 farmers |
| Total Sample | Structured questionnaire and interview schedule administered | 90 catfish farmers |

### Data Analysis

Data collected from the catfish farmers were analysed using descriptive statistics of frequency counts and percentages, which will be used for the study. A 5-point Likert scale of Strongly Agree (5), Agree (4), Undecided (3), Disagree (2), and Strongly Disagree (1) was used to analyse the attitudes of catfish farmers towards the perceived effect of climate change. The level of awareness was also measured through a 4-point Likert scale of Extremely Aware (4), Moderately Aware (3), Slightly Aware (2), and Not Aware at All (1). To ensure accurate interpretation of responses, benchmark scores for the weighted mean were established for both the attitude and awareness scales. For attitudes towards climate change, a 5-point Likert scale was used: Strongly Agree (5), Agree (4), Undecided (3), Disagree (2), and Strongly Disagree (1). The benchmark weighted mean was calculated as 3.0, indicating that any score above 3.0 reflects a positive attitude, while scores below 3.0 suggest a negative attitude. For the level of awareness, a 4-point Likert scale was employed: Extremely Aware (4), Moderately Aware (3), Slightly Aware (2), and Not Aware At All (1). The benchmark weighted mean for awareness was 2.5, with values above this indicating high awareness and those below suggesting low awareness. These benchmarks provided a standard for ranking and interpreting respondents' perceptions and awareness levels regarding climate change.

## RESULTS

### Socio-Economic Characteristics

This involves a descriptive analysis of the various socio-economic characteristics of the respondents. On gender, 80.0% of the respondents were male, while 20.0% were female. This implies that both males and females were involved in catfish farming, but male respondents and participation in farming are preferred by their male counterparts. Table 2 shows the distribution of respondents by age. 5.6% of the respondents were below 30 years of age, 45.6% of the respondents were between 31 – 40 years of age, 37.8% of the respondents were between 41 – 50 years of age, while 11.0% of the respondents were above 50 years of age. The mean age of the respondents was 46 years. This implies that the respondents were young and in their active years and expected to be agile to undertake rigorous activities such as catfish farming.

Regarding the marital status of the respondents, 77.8% were married, 10.0% were separated, and 12.2% were widowed. This indicates that the majority of the respondents were married. As shown in Table 4 below, 14.4% of the respondents had no formal education, 67.8% had primary education, and 17.8% had secondary education. This suggests that the majority of the respondents (85.6%) were literate and had primary education in the study area. The religion of the respondents is shown in Table 2. It indicates that 53.3% of the respondents were Christians, 33.3% were Muslims, and 13.4% were traditional worshippers. This demonstrates the dominance of Christianity in the study area. The household sizes of the respondents, as presented in

**Table 2: Socio-economic characteristics of respondents**

| Demography | Variable | Freq. | Perc. (%) |
|---|---|---|---|
| Gender | Male | 72 | 80.0 |
| | Female | 18 | 20.0 |
| Age | Below 30 years | 5 | 5.6 |
| | 31 – 40 years | 41 | 45.6 |
| | 41 – 50 years | 34 | 37.8 |
| | Above 50 years | 10 | 11.0 |
| Marital Status | Single | 0 | 0 |
| | Married | 70 | 77.8 |
| | Separated | 9 | 10.0 |
| | Widowed | 0 | 0 |
| | Divorced | 11 | 12.2 |
| Educational Attainment | No Formal Education | 13 | 14.4 |
| | Primary Education | 61 | 67.8 |
| | Secondary Education | 16 | 17.8 |
| Religious Background | Christianity | 48 | 53.3 |
| | Islam | 30 | 33.3 |
| | Traditional | 12 | 13.4 |
| Household Size | 1 – 5 | 30 | 33.3 |
| | 6 – 10 | 40 | 44.4 |
| | Above 10 | 20 | 22.3 |
| Farm Size | 1 – 5 hectares | 70 | 77.7 |
| | 6 – 10 hectares | 15 | 16.7 |
| | Above 10 hectares | 5 | 5.6 |
| Years of Farming Experience | 1 – 5 years | 20 | 22.3 |
| | 6 – 10 years | 30 | 33.3 |
| | Above 10 years | 40 | 44.4 |

Source: Field Survey, 2025

Table 2, reveal that 33.3% of the respondents had household sizes between 1 and 5, 44.4% had sizes between 6 and 10, while 22.32% had sizes above 10. This suggests that most household sizes of catfish farmers were between 6 and 10.

Regarding the farm size of the respondents, the mean farm size is 4 hectares. This implies that the majority of the respondents had between 1 – 5 hectares of catfish farm size. The years of farming experience of the respondents are presented in Table 8 below. 22.3% of the respondents were between 1 - 5 years, 33.3% of the respondents were between 6 – 10 years, while 44.4% of the respondents were above 10 years. The mean years of farming experience of the respondents was 13 years. This implies that the majority of the respondents in the study area had been engaging in catfish farming for a long period of time.

**Level of awareness of climate change among catfish farmers in the study area**

Table 3 revealed the respondents' level of awareness of climate change among catfish farmers in the study area. The table revealed that 62.2% of the respondents were highly aware of the change in climate change in fish production, 23.3% were moderately aware, 12.2% were fairly aware, while 2.2% of the respondents were not aware.

**Table 3: Level of awareness of climate change among catfish farmers in the study area**

| Level of Awareness | Frequency | Percentage |
|---|---|---|
| Highly Aware | 56 | 62.2 |
| Moderately Aware | 21 | 23.3 |
| Fairly Aware | 11 | 12.2 |
| Not Aware | 2 | 2.2 |

Source: Field Survey, 2025

**Attitudes of catfish farmers towards the perceived effects of climate change**

Table 4 presents the attitudes of catfish farmers toward the perceived effects of climate change. The results show strong agreement among respondents that they are aware of climate change ($\bar{x}$ = 4.98), which ranked 1st. This was followed by the belief that the government is not committed to agriculture in the context of climate change ($\bar{x}$ = 3.89), and that climate has affected agriculture since they became involved in the sector ($\bar{x}$ = 3.76), ranked 3rd. Respondents also agreed that little has been achieved in agriculture regarding climate change ($\bar{x}$ = 3.61), ranked 4th.

Conversely, respondents disagreed with several statements, including: stakeholder commitment has not improved agriculture ($\bar{x}$ = 2.92), participation in climate change programmes has not helped agriculture ($\bar{x}$ = 2.68), and that well-organized programmes have not contributed to agricultural improvement ($\bar{x}$ = 2.57). They also disagreed that climate change has not altered agricultural and livestock production plans ($\bar{x}$ = 2.68), that climate change has positively impacted agriculture ($\bar{x}$ = 2.32), and that government policies on climate change have significantly helped agriculture ($\bar{x}$ = 2.32).

**Sources of information on climate change that catfish farmers in the study area rely on**

Table 5 revealed the sources of information on climate change that catfish farmers in the study area rely on. The table revealed that 5.6% confirmed their source to be a newspaper, 16.7% of the respondents said Internet, 50.0% of the respondents confirmed that local farmers, 4.4% of the respondents chose radio, and 22.3% of the respondents chose friends and relatives as their source.

**Table 4: Distribution of respondents by their attitudes towards the perceived effects of climate change**

| Statement | SA (F) | (%) | A (F) | (%) | U (F) | (%) | SD (F) | (%) | D (F) | (%) | Mean | Rank | Decision |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| I am aware of climate change | 88 | 97.8 | 2 | 2.2 | 0 | 0 | 0 | 0 | 0 | 0 | 4.98 | 1st | Agreed |
| Climate change has impacted agriculture positively | 8 | 8.9 | 20 | 22.2 | 9 | 10.0 | 9 | 10.0 | 44 | 48.9 | 2.32 | 8th | Disagreed |
| Government policies on climate change have helped agriculture greatly | 11 | 12.2 | 14 | 15.6 | 7 | 7.8 | 19 | 21.1 | 39 | 43.3 | 2.32 | 8th | Disagreed |
| Since I have been involved in agriculture, the climate has affected agriculture | 22 | 24.4 | 42 | 46.7 | 8 | 8.9 | 18 | 20.2 | 0 | 0 | 3.76 | 3rd | Agreed |
| The government is not committed to agriculture in terms of climate change | 21 | 23.3 | 54 | 60.0 | 7 | 7.8 | 0 | 0 | 8 | 8.9 | 3.89 | 2nd | Agreed |
| The commitment of stakeholders in agriculture has not helped agriculture improve | 22 | 24.4 | 5 | 5.6 | 25 | 27.8 | 20 | 22.2 | 18 | 20.0 | 2.92 | 5th | Disagreed |
| Climate change has not altered the production plan in agriculture and livestock | 10 | 11.0 | 16 | 17.8 | 14 | 15.6 | 25 | 27.8 | 25 | 27.8 | 2.57 | 7th | Disagreed |
| Participation in the climate change programme has not helped agriculture | 10 | 11.0 | 16 | 17.8 | 12 | 13.3 | 39 | 43.3 | 13 | 14.6 | 2.68 | 6th | Disagreed |
| Little has been achieved in agriculture in terms of climate change | 27 | 30.0 | 29 | 32.2 | 13 | 14.4 | 14 | 15.6 | 7 | 7.8 | 3.61 | 4th | Agreed |
| A properly organized programme has not helped agriculture at all in terms of climate change | 0 | 0 | 25 | 27.8 | 31 | 34.4 | 14 | 15.6 | 20 | 22.2 | 2.68 | 6th | Disagreed |

*Source: Field survey (2025).* ***Grand Mean = 3.17.*** *Keywords: SA – Strongly Agreed, A – Agreed, U – Undecided, D – Disagreed, SD –Strongly Disagreed, Key for decision: SA = 5.00 – 4.00,A = 3.99 – 3.00, U = 2.99 – 2.00, D = 1.99 – 1.00, SD = 0.99 – 0.00*

**Table 5: Distribution of respondents by the sources of information on climate change that catfish farmers in the study area rely on**

| Sources | Frequency | Percentage (%) |
|---|---|---|
| Newspaper | 5 | 5.6 |
| Internet | 0 | 0 |
| Extension agents | 15 | 16.7 |
| Local farmers | 45 | 50.0 |
| Radio | 4 | 4.4 |
| Friends and relatives | 21 | 23.3 |

*Source: Field Survey, 2025*

**Table 6: Distribution of respondents by the problems encountered by catfish farmers in the study area**

| Problems | Frequency | Percentage (%) |
|---|---|---|
| Cost of technology | 30 | 33.3 |
| Poor perception of respondents | 20 | 22.3 |
| Scarcity of trained manpower | 15 | 16.8 |
| Inadequate training | 10 | 11.1 |
| High cost of labour | 5 | 5.5 |
| Limited financial access | 5 | 5.5 |
| Improper packaging of technology | 5 | 5.5 |

*Source: Field Survey, 2025*

**Problems encountered by catfish farmers in the study area**

As presented in Table 6, the results highlight the major problems encountered by respondents in the study area. About 33.3% identified the high cost of technology as a major challenge, while 22.3% cited poor perception of climate change. Additionally, 16.8% reported scarcity of trained manpower, 11.1% noted inadequate training, and 5.5% each identified high labour costs, lack of funds, and improper packaging of technology as significant issues.**Discussion**

**Socio-Economic Characteristics of Catfish Farmers**

The socio-economic profile of catfish farmers in Ondo State offers crucial insight into the demographic and operational factors influencing their engagement with aquaculture and climate change adaptation. The predominance of male farmers (80.0%) aligns with cultural norms and the labor-intensive nature of aquaculture, though the 20.0% female representation suggests emerging inclusivity, particularly in supportive or managerial roles (Akinwalere *et al*., 2020). The age structure, with a mean age of 46 years and 45.6% of respondents within the 31–40 age bracket, reflects a predominantly youthful and active population. This is advantageous for adopting labor-intensive and adaptive aquaculture practices (Odebode *et al*., 2019). Marital status data revealed that 77.8% were married, supporting previous findings that marriage enhances agricultural stability and investment decisions (Yusuf *et al*., 2021).

Educational attainment was relatively high, with 85.6% of respondents having at least a primary education. This basic literacy facilitates understanding of extension messages, interpretation of climate-related advisories, and uptake of improved practices (Ozor & Cynthia, 2019). Most respondents were Christians (53.3%), followed by Muslims (33.3%) and traditional worshippers (13.4%). While religion may not directly influence farming, it affects community structure, group participation, and the dissemination of information (Adeogun *et al*., 2020). In terms of household size, 44.4% had between 6–10 members, providing a potential labor advantage for aquaculture operations. Nzeh & Eboh (2011) observed that larger households are often more resilient due to greater labor availability and resource pooling. Farm sizes averaged 4 hectares, mainly within the 1–5 hectare range, characteristic of Nigeria's small-to-medium scale aquaculture (Ayoola & Idowu, 2021). With 44.4% of farmers having over 10 years of experience and a mean experience of 13 years, there is substantial institutional knowledge and adaptive capacity among respondents (Olufayo, 2020). Collectively, these characteristics position the population well for climate adaptation, provided structural support systems are enhanced.

**Awareness and Attitudes Toward Climate Change**

The study revealed a high level of awareness of climate change among catfish farmers, with 62.2% reporting high awareness and only 2.2% indicating no awareness. This heightened awareness is likely driven by personal observations of climate variability affecting fish production, such as water temperature fluctuations, pond drying, and flooding. This corresponds with findings by Ojo and Baiyegunhi (2020), who reported that practical experiences serve as key drivers of climate knowledge in similar contexts. The high mean awareness score ($\bar{x}$ = 4.98) further confirms that farmers perceive climate change as an immediate reality. This mirrors Ifejika Speranza's (2018) assertion that local ecological changes often inform grassroots understanding of climate phenomena, especially in areas lacking formal meteorological outreach.

Attitudinal responses showed strong agreement that climate change adversely affects agriculture ($\bar{x}$ = 3.76) and that government responses are inadequate ($\bar{x}$ = 3.89). Respondents also expressed moderate agreement that little has been achieved in terms of adaptation progress ($\bar{x}$ = 3.61), highlighting a disconnect between awareness and satisfaction with current institutional responses. This reflects broader sentiments noted by Olufayo (2020) and Adebayo & Akinsorotan (2021), who highlighted skepticism towards the effectiveness of government climate initiatives. Interestingly, respondents disagreed with the statements that "climate change programmes have not helped agriculture" ($\bar{x}$ = 2.68) and "government policies on climate change have significantly helped agriculture" ($\bar{x}$ = 2.32), indicating a nuanced perception—acknowledging some effort but doubting their effectiveness. This gap underscores the need for locally driven, inclusive adaptation strategies that build on existing awareness but deliver practical results.

**Sources of Climate Information and Challenges Faced**

The majority of respondents (50%) obtained climate information from fellow farmers, followed by friends and relatives (22.3%) and the Internet (16.7%). Mass media sources such as newspapers (5.6%) and radio (4.4%) were the least utilized. This reliance on informal networks suggests the strength of social capital and peer-to-peer learning, which remains critical in areas with weak extension systems (Adebayo & Oladele, 2020). Limited use of digital and traditional media may stem from infrastructure challenges, low digital literacy, and a lack of aquaculture-focused content. Ajewole *et al*. (2019) noted that while digital tools are promising, they remain underutilized due to access and usability barriers among smallholder farmers. Addressing these communication gaps will require revitalizing extension services, improving ICT access, and tailoring climate information to the aquaculture context. Blending formal and informal communication channels can enhance information reach and impact.

Farmers reported several challenges affecting climate change adaptation in aquaculture. The most prominent was the high cost of technology (33.3%), which limits the adoption of innovative practices. This aligns with Okeowo *et al*. (2017), who highlighted financial constraints as a critical barrier to resilient aquaculture. Other notable challenges included poor perception of climate change (22.3%), scarcity of trained manpower (16.8%), and inadequate training (11.1%), all of

which point to capacity deficits in both knowledge and human resources. These were compounded by secondary issues such as high labor costs, lack of funds, and improper packaging of technologies (5.5% each). These findings echo those of Edeoghon & Ajayi (2021), who emphasized the need for better-trained personnel and support structures in aquaculture extension. Overall, the findings reveal that while awareness is high, the pathway to effective adaptation is hindered by structural, financial, and informational barriers. Strengthening extension services, reducing technology costs, enhancing training, and tailoring communication strategies will be essential for building resilience in the sector.

## CONCLUSION AND RECOMMENDATIONS

This study highlights the complex interplay between socio-economic characteristics, awareness levels, attitudes, and adaptive challenges faced by catfish farmers in Ondo State amid increasing climate variability. Findings reveal that the majority of farmers are male, relatively young, moderately educated, and possess substantial farming experience, attributes that position them well for climate adaptation if adequately supported. While awareness of climate change is high, there remains a notable gap between knowledge and effective institutional support or policy-driven adaptation. Farmers largely depend on informal sources such as peers for climate-related information, and face significant constraints, including high technology costs, limited training, and poor access to reliable information channels. The study concludes that fish farmers in the study area had a relatively positive attitude toward the perceived effects of climate change, and the level of awareness regarding climate change issues was also relatively high.

To enhance resilience and adaptation among catfish farmers, it is recommended that government agencies and development partners strengthen extension services with a focus on climate-smart aquaculture. This includes subsidizing relevant technologies, improving access to digital platforms, and organizing targeted training programs that are both accessible and context-specific. Additionally, formalizing information dissemination through radio, mobile-based alerts, and farmer cooperatives will help bridge the gap between awareness and action. Creating enabling policies that integrate local knowledge systems, strengthen institutional trust, and ensure inclusive decision-making can significantly improve farmers' adaptive capacity and ensure sustainable aquaculture under a changing climate.

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**Authors' Contributions**

ATF conceptualized the study. ATF & AOT designed the experiment. ATF and AAO collected data and performed data analysis. AOT and AAO wrote the first draft of the manuscript. AAO performed literature searches and reviewed the first draft of the manuscript. All authors read and approved the final draft of the manuscript.

**Ethical Statement**

The authors confirm that all experiments were carried out following the approval of the appropriate ethical review committee of the Adeyemi Federal University of Education, Ondo State, Nigeria.

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