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Climate Change Perceptions and Adaptation Practices Among Indigenous Aquaculture Practitioners in Southwestern Nigeria

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ABSTRACT

Climate change stances significant threats to fisheries and aquaculture systems, particularly in developing regions where livelihoods depend heavily on natural resources. This study examined perceptions of climate change and adaptation strategies among indigenous aquaculture practitioners in Southwestern Nigeria. A Multistage sampling technique was used to select the study area and the number of respondents. A total number of two hundred (200) respondents were selected from major fish farms in Ondo and Oyo States. Snowball method was also employed to ascertain the respondents fish farms in the study area. Both primary and secondary data were used. Primary data were collected through structured questionnaires and analyzed using descriptive statistics, chi-square analysis, and logistic regression models. The results revealed a high level of awareness of climate variability among respondents, with irregular rainfall (mean = 3.62), corresponding to annual rainfall patterns ranging from 1,200 mm to 1,800 mm, and increased temperature (mean = 3.55), reflecting average temperature conditions between 25°C and 32°C in the study area (NiMet, 2022). Flooding was also identified as a key indicator of climate change in the study area. The results also revealed a high level of awareness of climate variability among respondents. Seventy one percent (71%) of the respondents adopt water management practices while pond reinforcement (64%) These methods were the more commonly adopted climate adaptation strategies in the study area. The results further revealed that gender differences in access to credit, participation in cooperatives, and water management practices were statistically significant at ($p < 0.05$) level of significance. The logistic regression results showed that education level, fish farming experience, access to credit, and cooperative membership were significant determinants of adaptation decisions. Indigenous knowledge was widely shared through oral traditions, daily livelihood activities, community meetings, and intergenerational exchanges between elders and youth.

Keywords: Climate change; Perception; Adaptation Strategies; Indigenous aquaculture; Nigeria

Introduction

Climate change remains one of the most significant environmental challenges of the 21st century, with far-

reaching impacts on ecosystems, livelihoods, and food systems globally (Intergovernmental Panel on Climate Change [IPCC], 2021). In Nigeria, the effects of climate change are increasingly evident through rising temperatures, irregular rainfall patterns, and the growing frequency of extreme weather events (Odjugo,

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2010; Nigerian Meteorological Agency [NiMet], 2022). These changes pose serious risks to climate-sensitive sectors such as fisheries and aquaculture, which are critical sources of food, income, and employment for many households (Food and Agriculture Organization, 2022).

In Southwestern Nigeria, fisheries and aquaculture activities are highly vulnerable to climate variability due to their dependence on stable environmental conditions (Oladimeji *et al.*, 2022). Variations in temperature and rainfall can significantly affect water quality, fish growth, and overall productivity, thereby threatening the sustainability of livelihoods within the sector (Allison and Bassett, 2023). Small-scale fish farmers, in particular, often face limited access to financial resources, infrastructure, and institutional support, making them more susceptible to climate-related shocks (Ogunji and Wuertz, 2023).

Indigenous knowledge, developed through long-term interaction with the environment, plays an important role in how local communities perceive and respond to climate variability (Berkes, 2012; UNESCO, 2021). Fish farmers and other actors within the aquaculture value chain rely on observable environmental indicators, such as changes in rainfall patterns, water levels, and temperature, to guide production decisions and risk management strategies (Apraku *et al.*, 2021; Olaniyan and Govender, 2023). These locally grounded perceptions provide valuable insights into how communities interpret climate change and develop coping mechanisms.

Despite growing recognition of the importance of indigenous knowledge in climate adaptation, there remains limited empirical evidence on how these perceptions translate into practical adaptation strategies within fisheries and aquaculture systems in Nigeria (Donkor and Mearns, 2023). Furthermore,

while studies have acknowledged that adaptation capacity is unevenly distributed among actors, few have provided empirical, location-specific analysis of these inequalities within inland and coastal aquaculture systems in the study area. Understanding how fisheries and aquaculture actors perceive climate change, the impacts they experience, and the strategies they adopt is therefore essential for designing effective and inclusive adaptation policies (Food and Agriculture Organization, 2022). Examining gender differences in adaptation practices offers critical insights into structural inequalities and provides a basis for targeted interventions to enhance resilience. In view of this, there is a clear need for this study to fill these gaps by empirically examining climate change perceptions and adaptation practices among indigenous aquaculture practitioners in Southwestern Nigeria. This study, therefore, examine climate change perceptions and adaptation practices among indigenous aquaculture practitioners in Southwestern Nigeria. Specifically, it. assess respondents' perceptions of climate change indicators in the study area; examine the effects of climate change on aquaculture systems; identify adaptation practices adopted by respondents in response to climate variability; analyze gender differences in adaptation practices among fisheries and aquaculture actors; and. determines the socio-economic factors influencing adaptation practices among respondents. Ondo and Oyo States were chosen because they represent key centers of fish production and trade within this region (Oladimeji *et al.*, 2022; Yusuf *et al.*, 2023).

Materials and Methods

The Study Area

This study was conducted in Ondo and Oyo States, both located in the Southwest geopolitical zone of Nigeria, these areas have favorable climatic

conditions, access to markets, and concentration of fish farming operations. Southwest Nigeria lies between latitudes 5°N and 9°N and longitudes 2°E and 6°E, bordered to the south by the Atlantic coast and to the north by the forest-savanna transition belt. The region's humid tropical climate, fertile soils, and availability of inland water resources support a thriving aquaculture industry. Ondo State is located in the southwestern part of Nigeria, stretching from the inland forest zones to the coastal lowlands. The state capital is Akure (approximately 7.25°N, 5.20°E). Ondo is well-known for its mix of small- and medium-scale aquaculture enterprises, primarily focused on catfish (*Clarias gariepinus*) and tilapia (*Oreochromis niloticus*). The state's tropical climate, with distinct

wet and dry seasons, provides favorable conditions for fish farming. Akure, the principal field site, was selected due to its accessibility, economic activity, and concentration of aquaculture value chain actors, including feed suppliers, processors, and marketers (Adegbite *et al.*, 2020). Oyo State has Ibadan as its capital city (approximately 7.38°N, 3.93°E). The state is one of Nigeria's largest fish-producing areas, hosting numerous smallholder and commercial aquaculture farms. Oyo is characterized by a tropical wet and dry climate, with annual rainfall ranging from 1,200 mm to 1,800 mm and average temperatures between 25°C and 32°C ((Nigerian Meteorological Agency (NiMet), 2022)).

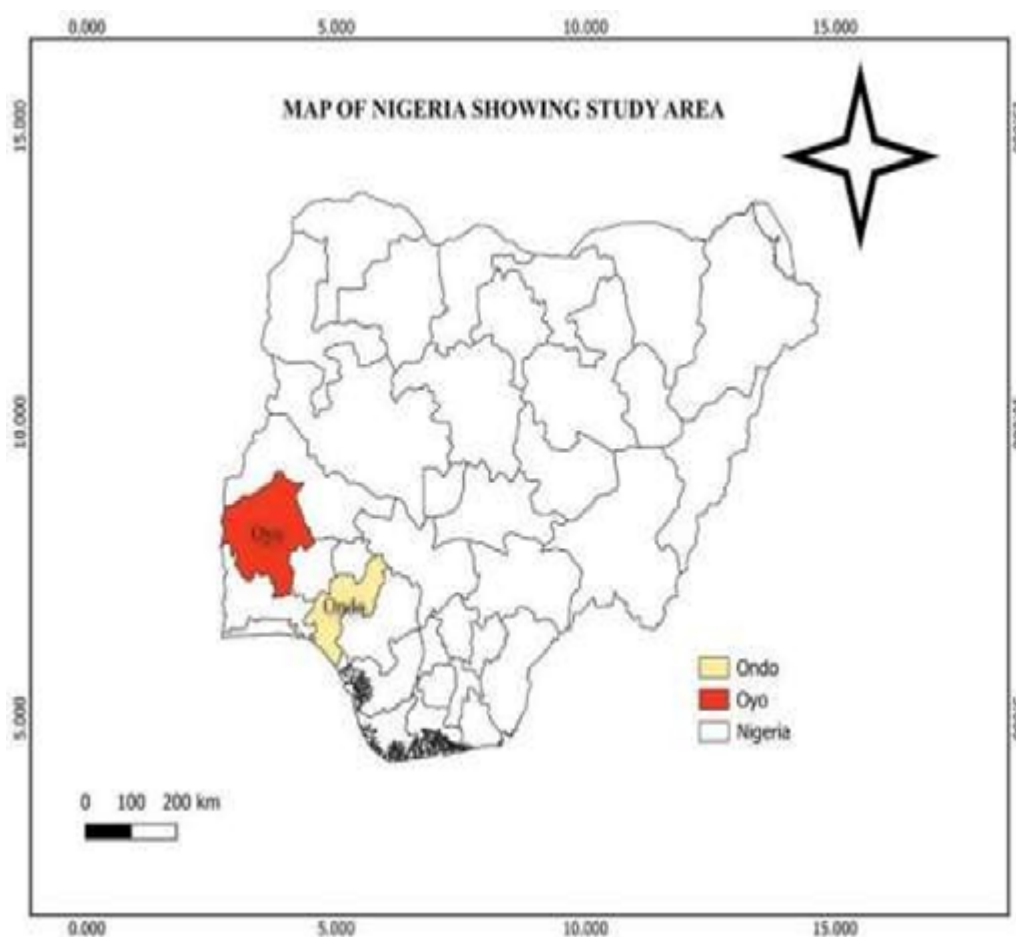


Plate 1: Map of Nigeria showing the study area: Oyo and Ondo States

Source: Created QGIS, 2025

Sampling Techniques and Size

Multistage sampling techniques were employed to select the study area and number of respondents. The first stage was the purposive sampling selection of the two States due to the predominance indigenous fish farming activities in the area and snowball sampling technique was used to select respondents. Communities where aquaculture is predominantly practiced in Ondo and Oyo States were also purposively identified at the second stage. At the third stage, initial respondents were selected purposively within these communities and additional participants were reached through snowball sampling to capture a wider range of indigenous aquaculture practitioners. A total of 200 respondents were involved in the study. Data were collected using structured questionnaires and interviews schedule and Focus Group Discussion was employed on clustered fish farms in some communities.

Method of Data Collection

In this study, primary data were collected directly from the field using structured questionnaires administered on respondents with relevant knowledge and experience of climate change. A total of 200 completed questionnaires were retrieved from respondents in Ondo and Oyo States cumulatively. The data collected were carefully organized and analyzed using Statistical Package for the Social Sciences (SPSS, version 25).

Data Analysis

Coded data were subjected to descriptive statistics, including frequency counts, percentages, and mean scores, were used to summarize respondents' characteristics and key variables. Inferential statistics, specifically chi-square analysis and logistic regression, were engaged to examine gender differences and

determine the socio-economic factors influencing adaptation strategies in the study area.

Results

Socio-economic Characteristics of Respondents

Table 1 presents the Socio-economic characteristics of respondents. Most of the respondents were male (56%), while 44.0% were female, indicating a slightly higher participation of men in the study area. In terms of age distribution, most respondents fell within the economically active age groups, with 34.0% aged 31–40 years and 28.5% aged 41–50 years, while 17.0% were between 20–30 years and 20.5% were above 50 years. This suggests that most participants are in their productive years and are actively engaged in fish farming activities. The marital status revealed that a large percentage (64.5%) of the respondents were married, compared to 24.0% who were single and 11.5% classified as others, implying that many respondents likely have family responsibilities that may influence their fish farming and other economic engagement.

Educational background of the respondents indicates that 39.5% attained secondary education, representing the largest group, while 21.5% had tertiary education, 21.0% had primary education, and 18.0% had no formal education. This reflects a moderate level of literacy among the respondents, which may affect their ability to adopt improved aquaculture practices. More than half of the respondents (51.0%) were involved in fish farming, making it the dominant activity in the study area, while 26.0% were engaged in fish marketing and 23.0% in fish processing. This distribution highlights that although fish farming is the core occupation, because, other segments of the value chain such as

Table 1: Socio-Economic Characteristics of Respondents

Variable	Category	Frequency (n=200)	Percentage (%)
Gender	Male	112	56.0
	Female	88	44.0
Age(years)	20-30	34	17.0
	31-40	68	34.0
	41-50	57	28.5
	>50	41	20.5
Marital Status	Married	129	64.5
	Single	48	24.0
	Others	23	11.5
Education	No formal education	36	18.0
	Primary	42	21.0
	Secondary	79	39.5
Primary Occupation	Fish farming	102	51.0
	Processing	42	23.0
	Marketing	52	26.0

Source: Field Survey, 2025

processing and marketing are also well represented in the study area.

Indigenous Perception of Climate Change Indicators

Table 2 shows respondents’ perception of climate change indicators. Irregular rainfall ranked highest (mean = 3.62), followed by increased temperature (3.55) and flooding incidents (3.48), indicating strong agreement that these changes are occurring. The results on climate change indicators show that respondents strongly perceived irregular rainfall as the most significant indicator, with the highest mean score of 3.62 and a standard deviation of 0.84, ranking first. This was closely followed by increased temperature, which had a mean score of 3.55 and a standard deviation of 0.79, ranking second. Flooding incidents ranked third with a mean score of 3.48 and

a standard deviation of 0.88, indicating that it is also a major concern among respondents.

Additionally, prolonged dry season was ranked fourth, with a mean score of 3.32 and a standard deviation of 0.91, while changes in water level ranked fifth with a mean score of 3.26 and a standard deviation of 0.87. Overall, the relatively high mean scores across all indicators suggest that respondents are quite aware of multiple manifestations of climate change, with irregular rainfall and rising temperatures being the most prominent experiences in the study area.

Effects of Climate Change on Aquaculture and Climate Change Indicators in the Study Area

The results presented in Table 3 reveal the major effects of climate change on aquaculture as perceived

Table 2: Indigenous Perception of Climate Change Indicators

Climate Indicator	Mean Score	Std. Dev	Rank
Irregular rainfall	3.62	0.84	1
Increased temperature	3.55	0.79	2
Flooding incidents	3.48	0.88	3
Prolonged dry season	3.32	0.91	4
Changes in water level	3.26	0.87	5

(Scale: 1 = Strongly Disagree to 4 = Strongly Agree)
Source: Field Survey, 2025

by the respondents. Reduced income emerged as the most significant impact, with the highest mean score of 3.81, ranking first, indicating that climate-related changes have greatly affected the economic returns of aquaculture practitioners. This was followed by fish mortality, which had a mean score of 3.58 and ranked second, suggesting that increased deaths of fish due to unfavourable environmental conditions are a major concern. Furthermore, reduced fish growth ranked third with a mean score of 3.46, implying that climate change may be slowing down fish development, possibly due to stress or poor feeding conditions. Pond overflow damage was ranked fourth with a mean score of 3.41, highlighting the destructive impact of flooding and excessive rainfall on aquaculture infrastructure. Lastly, water quality deterioration ranked fifth with a mean score of 3.35, indicating that although it is the least ranked among the listed effects, it still represents a significant challenge affecting fish health and

productivity. Overall, the high mean scores across all variables suggest that climate change has substantial negative effects on aquaculture, particularly in terms of income reduction and increased fish mortality. Table 3 indicates that fish mortality (mean = 3.58) was the most severe reported impact, followed by reduced growth performance and pond infrastructure damage. Figure 3 reveals the results of the various climate change indicators in the study area. Irregular rain fall, increased temperature, flooding incidents, prolong dry season and water level change were various indicators identified in the study area.

Adaptation Strategies Adopted by Respondents

Table 4 shows that water management practices (71%) and pond reinforcement (64%) were the most adopted adaptation strategies. Cooperative participation

Table 3: Effects of Climate Change on Aquaculture

Impact Variable	Mean	Std. Dev	Rank
Reduces Income	3.81	0.88	1
Fish mortality	3.58	0.76	2
Reduced fish growth	3.46	0.83	3
Pond overflow damage	3.41	0.90	4
Water quality deterioration	3.35	0.81	5

Source: Field Survey, 2025

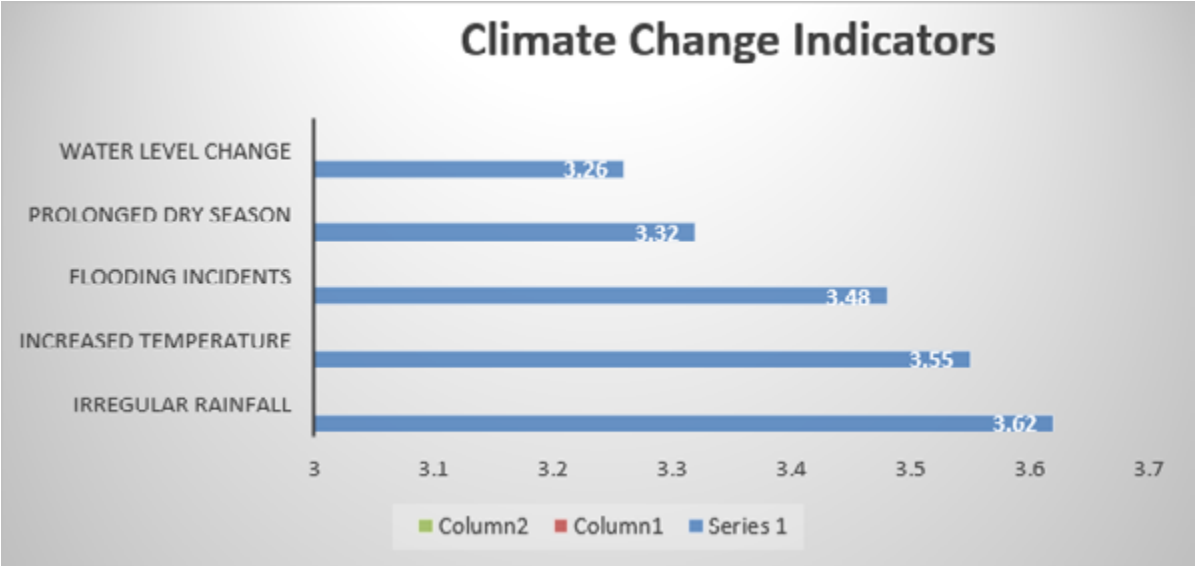


Figure 3: Bar Chart showing Climate Change Indicators
Source: Field Survey, 2025

recorded the lowest adoption (36.5%). The results on adaptation strategies show that respondents have adopted various measures to cope with the effects of climate change in aquaculture. The most used strategy is water management practices, adopted by 142 respondents (71.0%), indicating its importance in maintaining suitable pond conditions and mitigating climate-related impacts. This is followed by pond reinforcement, practiced by 128 respondents (64.0%), suggesting efforts to protect aquaculture infrastructure from flooding and other environmental disturbances.

In addition, diversification of livelihood was reported by 116 respondents (58.0%), reflecting a strategy to reduce dependence on aquaculture alone and spread risk. Early harvesting was adopted by 101 respondents (50.5%), likely as a way to minimize losses from adverse climate events. Lastly, cooperative participation had the lowest adoption rate, with 73 respondents (36.5%), indicating that fewer respondents rely on group-based approaches for support and resource sharing.

Table 4: Adaptation Strategies Adopted by Respondents

Adaptation Strategy	Frequency	Percentage (%)
Water management practices	142	71.0
Pond reinforcement	128	64.0
Diversification of livelihood	116	58.0
Early harvesting	101	50.5
Cooperative participation	73	36.5

Source: Field Survey, 2025

Gender Differences in some Adaptation Strategies Employed in the Study Area

The results of the chi-square analysis in Table 5 reveal that there are significant gender differences in some adaptation strategies used by respondents. Specifically,

water management practices show a significant difference between male and female respondents ($\chi^2 = 6.42$, $p = 0.011$), indicating that gender influences the adoption of this strategy. Similarly, access to credit ($\chi^2 = 8.37$, $p = 0.004$) and cooperative membership ($\chi^2 = 5.18$, $p = 0.023$) are also statistically significant, suggesting that male and female respondents differ in their ability or likelihood to access financial resources and participate in cooperative groups.

On the other hand, early harvesting ($\chi^2 = 1.72$, $p = 0.189$) was found to be not statistically significant, implying that there is no meaningful difference between male and female respondents in the adoption of this strategy.

Table 5: Gender Differences in Adaptation Strategies (Chi-Square Analysis)

Variable	χ^2 Value	p-value	Decision
Water manage- ment	6.42	0.011	Significant
Access to credit	8.37	0.004	Significant
Cooperative membership	5.18	0.023	Significant
Early harvesting	1.72	0.189	Not Signifi- cant

Source: Field Survey, 2025

Determinants of Adaptation (Logistic Regression Summary)

Table 6 shows that gender, education level, farming experience, access to credit, and cooperative membership significantly influenced adaptation decisions ($p < 0.05$). The logistic regression results in Table 6 reveal that several socio-economic factors significantly influence respondents’ adaptation decisions to climate change in aquaculture. Specifically, gender has a positive and significant effect ($\beta = 0.421$, $p = 0.018$), indicating that gender plays an important role

in determining the likelihood of adopting adaptation strategies. Education level is also positively significant ($\beta = 0.536$, $p = 0.009$), suggesting that respondents with higher levels of education are more likely to adopt adaptation measures, possibly due to better access to information and improved decision-making capacity.

In addition, farming experience significantly influences adaptation ($\beta = 0.392$, $p = 0.021$), implying that more experienced farmers are better able to respond to climate-related challenges. Cooperative membership ($\beta = 0.517$, $p = 0.007$) is another important factor, indicating that belonging to social or farmer groups enhances access to shared knowledge, resources, and support systems that facilitate adaptation. Furthermore, access to credit has the strongest positive effect ($\beta = 0.648$, $p = 0.003$), showing that financial capacity greatly increases the likelihood of adopting adaptation strategies.

Table 6: Determinants of Adaptation (Logistic Regression Summary)

Variable	Coeffi- cient (β)	Std. Error	p-value
Gender	0.421	0.178	0.018
Education level	0.536	0.202	0.009
Farming experience	0.392	0.164	0.021
Cooperative membership	0.517	0.187	0.007
Access to credit	0.648	0.219	0.003

Source: Field survey, 2025

Discussion

This study examined perceptions of climate change and adaptation strategies among indigenous aquaculture

practitioners in Southwestern Nigeria. The findings demonstrate that respondents clearly perceive climate variability through observable environmental indicators, with irregular rainfall and increased temperature ranked highest. These perceptions are consistent with regional climate assessments that document increased rainfall variability and rising temperatures across West Africa (Intergovernmental Panel on Climate Change [IPCC]), 2023; World Meteorological Organization, 2023, Adeleke and Luetz 2023). The strong local awareness observed suggests that fishers and fish farmers rely heavily on experiential ecological knowledge in interpreting climatic changes.

The reported influence on fish mortality, reduced growth performance, and pond infrastructure damage highlight the biological and economic vulnerability of aquaculture systems to climate stressors. Increased temperatures influence fish metabolism and dissolved oxygen dynamics, increasing mortality risks and reducing productivity (Allison and Bassett, 2023). Similarly, erratic rainfall and flooding compromise pond stability and water quality, which directly affects aquaculture output. These findings align with evidence that small-scale aquaculture systems in developing countries are particularly sensitive to hydrological variability due to limited infrastructure resilience (Ogunji and Wuertz, 2023).

Adaptation strategies used in the study area were predominantly autonomous and short-term coping strategies, such as improved water management, pond reinforcement, and early harvesting. While these measures demonstrate adaptive agency among respondents, they indicate responsive and immediate strategies rather than transformative adaptation strategies. Autonomous adaptation alone may be insufficient under increasing climate uncertainty. Structured institutional support including access to

climate information services, credit facilities, and technical extension are enhance adaptive capacity in fisheries systems (Food and Agriculture Organization of the United Nations, 2022). The findings suggest that respondents predominantly rely on practical, farm-level adaptation strategies, particularly water and pond management techniques, while social or institutional strategies like cooperative participation are less commonly utilized in the study area.

Analysis of the gender reveals important fundamental disparities. Significant differences in water management practices, access to credit, and cooperative participation indicate that adaptation capacity is not uniformly distributed in the area. Although women actively participate in aquaculture value chains, their access to financial capital and institutional networks appears more constrained as revealed by the study. The finding of this study align with other studies where the disparities are consistent with documented gender inequalities in aquaculture, where women often face systemic barriers to productive resources despite high labour contributions (Harper *et al.*, 2020; Kruijssen *et al.*, 2022; Rahma *et al.*, 2025). These findings suggest that gender plays an important role in shaping access to resources and participation in certain adaptation strategies, particularly those related to finance and collective action, while it does not significantly influence more general farm-level practices like early harvesting.

The regression results further confirm that education level, access to credit, cooperative membership, and farming experience significantly influence adaptation decisions. Education enhances information-processing capacity and technology adoption, while credit access improves the ability to invest in climate-resilient infrastructure. Cooperative participation may facilitate collective action, risk-sharing, and access to extension services. These findings reinforce the

Sustainable Livelihoods Framework perspective that adaptive capacity is shaped by access to multiple forms of capital. The findings demonstrate that both socio-economic characteristics and institutional factors significantly shape adaptation behavior, with access to credit and education emerging as particularly strong determinants.

The study revealed that climate change impacts in aquaculture in Southwest Nigeria are intervened not only by environmental exposure but also by socio-economic and institutional factors prevailing in the study area. Therefore, targeted policy interventions that address gender disparities and resource access inequalities, climate change may exacerbate existing livelihood vulnerabilities should be considered. These findings suggest that adaptation in aquaculture systems depends on access to resources and institutional support, hence, the need for integrated policy interventions to address the imminent and identified climate issues in the study area.

Conclusion

This study examined indigenous perceptions and adaptation practices among indigenous aquaculture practitioners in southwestern Nigeria. The emphasis is on the role of traditional knowledge in understanding environmental change and supporting adaptation in aquaculture. Data were collected from 200 respondents using structured questionnaires and analyzed descriptively. Findings showed a high level of awareness of climate change, based on both personal experience and scientific explanations. Indigenous knowledge was widely shared through oral traditions, daily livelihood activities, community meetings, and intergenerational exchanges between elders and youth. The results revealed a high level of awareness of climate variability among respondents, with irregular rainfall (mean = 3.62), corresponding to annual rainfall

patterns ranging from 1,200 mm to 1,800 mm, and increased temperature (mean = 3.55), reflecting average temperature conditions between 25°C and 32°C in the study area (NiMet, 2022). Flooding was also identified as a key indicator of climate change in the study area. The results also revealed a high level of awareness of climate variability among respondents. Seventy one percent (71%) of the respondents adopt water management practices while pond reinforcement (64%) These methods were the more commonly adopted climate adaptation strategies in the study area. The results further revealed that gender differences in access to credit, participation in cooperatives, and water management practices were statistically significant at ($p < 0.05$) level of significance. Analysis of the gender reveals important fundamental disparities. Significant differences in water management practices, access to credit, and cooperative participation indicate that adaptation capacity is not uniformly distributed in the area. The study concludes that indigenous knowledge is valuable for interpreting climate variability and enhancing adaptation strategies. However, stronger integration with scientific knowledge and improved collaboration among communities, researchers, and policymakers are needed to strengthen climate adaptation, particularly in the indigenous aquaculture systems in the study area.

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