INFORMATION ON CLIMATE CHANGE IMPACT: ACCESSIBILITY AND FISH FARMER'S PERCEPTION IN KUMBOTSO LOCAL GOVERNMENT AREA OF KANO STATE (NIGERIA)

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ABSTRACT

This study assessed fish farmers' access to information and perceptions on climate change in Kumbotso Local Government Area, Nigeria, using purposive sampling and descriptive statistics. Most respondents were young men (84%) under 35, with tertiary studies (40%). While 62.5% were aware of climate change, only 41.7% had strong knowledge of adaptation strategies, and 29.1% were aware of policies. Key challenges included temperature changes (62.5%) and water scarcity (66.7%). Adaptation measures like species diversification (77.1%) and climate-resilient feeds (62.5%) were common, though sustainable practices were underutilized (18.8%). Improved accessibility to information and resources are needed.

RÉSUMÉ: Informations sur l'impact du changement climatique: accessibilité et perception des pisciculteurs dans la zone de gouvernement local de Kumbotso, État de Kano (Nigeria).

Cette étude a évalué l'accès des pisciculteurs à l'information et leurs perceptions du changement climatique dans la zone de gouvernement local de Kumbotso, au Nigéria, à l'aide d'un échantillonnage raisonné et de statistiques descriptives. La plupart des personnes interrogées étaient des jeunes hommes (84%) de moins de 35 ans, diplômés de l'enseignement supérieur (40%). Alors que 62,5% étaient conscients des impacts du changement climatique, seuls 41,7% avaient une solide connaissance des stratégies d'adaptation et 29,1% connaissaient les politiques. Les principaux défis comprenaient les changements de température (62,5%) et la pénurie d'eau (66,7%). Les mesures d'adaptation telles que la diversification des espèces (77,1%) et les aliments résistants au climat (62,5%) étaient courantes, bien que les pratiques durables soient sous-utilisées (18,8%). Une meilleure accessibilité à l'information et aux ressources est nécessaire.

REZUMAT: Informații despre impactul schimbărilor climatice: accesibilitatea și percepția piscicultorului în zona guvernamentală locală Kumbotso din statul Kano (Nigeria).

Acest studiu a evaluat accesul crescătorilor de pește la informații și percepțiile asupra schimbărilor climatice în zona administrației locale Kumbotso, Nigeria, utilizând eșantionare intenționată și statistici descriptive. Majoritatea respondenților au fost bărbați tineri (84%) sub 35 de ani, cu studii terțiare (40%). În timp ce 62,5% erau conștienți de impactul schimbărilor climatice, doar 41,7% aveau cunoștințe solide despre strategiile de adaptare, iar 29,1% erau conștienți de politici. Principalele provocări au inclus schimbările de temperatură (62,5%) și deficitul de apă (66,7%). Măsurile de adaptare precum diversificarea speciilor (77,1%) și furajele rezistente la climă (62,5%) au fost comune, deși practicile durabile au fost subutilizate (18,8%). Este necesară o accesibilitate îmbunătățită la informații și resurse.

INTRODUCTION

Climate change has emerged as one of the most significant global challenges of the 21st century, with far-reaching consequences for natural ecosystems, agriculture, and livelihoods (Dube et al., 2016) including aquatic organisms (Olopade et al., 2015). According to the Intergovernmental Panel on Climate Change (IPCC), it refers to a change in the state of the climate that can be identified through statistical analysis of changes in its mean and/or variability (Canadell et al., 2023). These changes persist over extended periods, typically decades or longer, and encompass both climate variability and long-term shifts, with their impacts often exacerbated by the interplay of multiple stressors and limited adaptive capacity, particularly in developing regions.

Anthropogenic activities, including greenhouse gas emissions, are likely to amplify the frequency and magnitude of such events in the future (Bănăduc et al., 2022). Ogunrinde et al. (2023) note that rising emissions and global mean surface temperatures may heighten the probability of abrupt climatic shifts. In the Sahel region, such shifts could result in prolonged periods of severe aridity with dramatic consequences (Ogunrinde et al., 2023). Although Africa contributes minimally to global greenhouse gas emissions, the continent suffers disproportionately from the impacts of global warming and climate change (Adedini et al., 2023).

Africa, as highlighted in the Special Report on Emission Scenarios (SRES), is among the most vulnerable regions globally, with Nigeria exemplifying these vulnerabilities. The country's adaptive responses will play a crucial role in mitigating the adverse effects of climate change on its socio-economic and environmental systems. Nigeria, identified by the IPCC as a climate change "hotspot", faces significant weather shifts in the 21st century, evidenced by long-term trends in temperature and rainfall, including a mean air temperature increase of 1.1°C over 105 years (Akuraga and Uganden, 2024). The reality of climate change in Nigeria is evident in increased disease incidence, declining agricultural productivity, and more frequent heatwaves, all of which are profoundly altering lives and livelihoods across the country (Gana et al., 2024).

The fisheries and aquaculture sector in Nigeria is highly vulnerable to the impact of climate change, which threaten aquatic ecosystems, fish production, and the livelihoods of millions who depend on these resources. However, a critical challenge lies in the accessibility and dissemination of accurate, timely, and actionable information on climate change and its effects on this sector. According to Muthoka et al. (2024), many stakeholders in Sub-Saharan Africa, including fishers, aquaculture farmers, and policymakers, often lack sufficient awareness or access to climate-related information, limiting their ability to adapt and mitigate the associated risks. The absence of localized data, inadequate communication channels, and low levels of literacy further exacerbate the situation, leaving communities ill-prepared to respond effectively to changing environmental conditions. This information gap not only undermines adaptive capacity but also hinders sustainable planning and decision-making in the sector, thereby endangering the food security, livelihoods, and Nigeria's economic resilience in the face of climate change.

Fish farmers in Kumbotso face growing challenges due to climate-induced stressors, including erratic weather patterns, reduced water availability, and changes in aquatic environments. Despite the importance of climate change adaptation, there is limited evidence on the accessibility of climate change information and how fish farmers perceive its relevance to their operations. According to Antwi-Agyei and Stringer (2021), inadequate access to this

information can hinder the adoption of adaptive strategies, exposing farmers to greater risks and reducing the sector's overall productivity. Furthermore, the lack of structured data on the specific climate information needs of fish farmers in this region highlights a critical gap in addressing their vulnerabilities. This study seeks to investigate the accessibility of climate change information, perception of its impact on fish farming, and the barriers to its effective utilization in Kumbotso Local Government Area. It is necessary to bridge the gap between the dissemination of climate change information and its practical application by fish farmers in Kumbotso. By evaluating the accessibility of and perceptions regarding climate information, the findings will provide valuable insights for policymakers, extension agents, and other stakeholders in tailoring climate services to meet the specific needs of fish farmers. Enhancing access to relevant information will empower fish farmers to make informed decisions, adopt sustainable practices, and mitigate the adverse effects of climate change on their livelihoods. This study will contribute to the broader goal of strengthening climate resilience in Nigeria's aquaculture sector and ensuring food security confronted with the global climate challenges.

MATERIAL AND METHODS

Study area

Kumbotso is a local government area in Kano State, Nigeria, situated between latitudes 11°55'17' and 12°0'N and longitudes 8°25'0''E and 8°35'30'' (Sani et al., 2018). It shares boundaries with six other local government areas: Kano-Municipal, Gwale, and Tarauni to the north, Madobi to the west, Dawakin Kudu to the south, and Gezawa to the east (Fig. 1). The region has a semi-arid climate, with an average daily temperature of 30°C. During cooler months, such as December and February, temperatures drop to around 20°C. Rainfall is seasonal, with a rainy period from May to October and a dry season from November to April. Annual rainfall averages 884 mm, increasing southward, with areas like Riruwai and Doguwa receiving up to 1,200 mm (Liman et al., 2014). The area experiences four distinct seasons: dry and cool, dry and hot, wet and warm, as well as dry and warm.

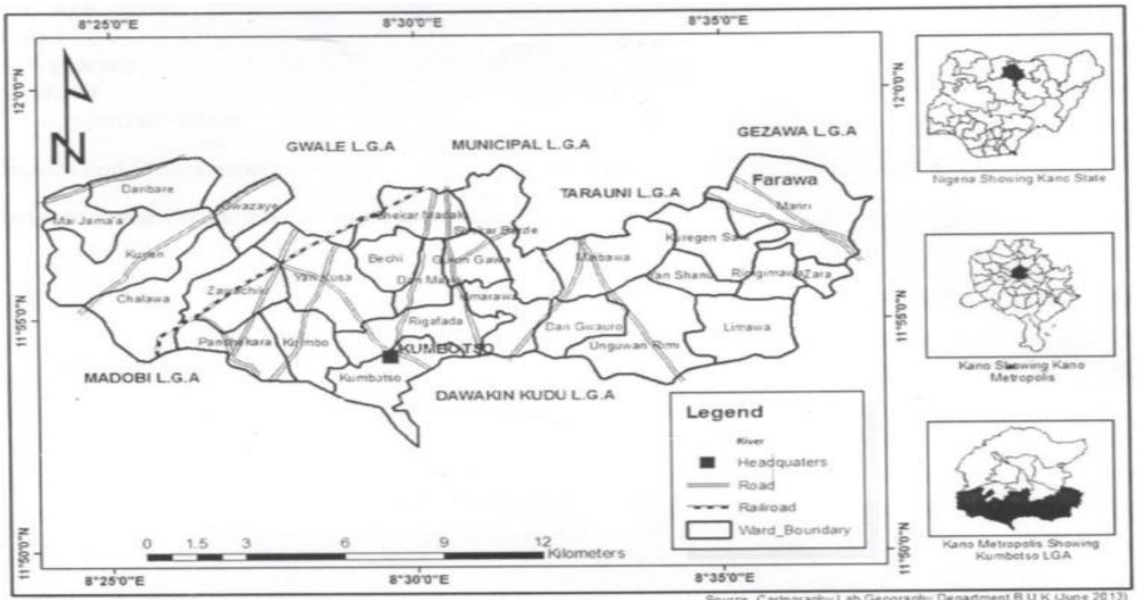

Figure 1: Map of the study area showing Kumbotso Local Government Area Kano State.

Kano State, located on the northern high plains at elevations between 450 m and 650 m, features soils derived from two main geological formations; the basement complex and the Chad formation, with the well-structured and deep soils of the basement complex supporting the cultivation of staple crops (Essiet, 2014; Olofin, 2014). The residents are predominantly Hausa and sedentary Fulani pastoralists, adhering to socio-cultural practices governed by Islamic law. According to Sani (2018), the 2006 National Population Census, Kumbotso had a population of 294,391). Settlements in the area are characterized by homogeneous populations and households constructed primarily with locally made mud bricks.

Sampling and instruments

A sample size of 50 fish farmers was established using Taro Yamane's formula. Structured questionnaire, as instrument was used to elicit data on the understanding of fish farmers' perception of climate change issues in the study area. Four point Likert scale was employed in order to understand respondents' opinion about to the extent of impact without being neutral on a specific item. The questionnaire was structured on four response scale ratio of Less Extent (LE), Moderate Extent (ME), Great Extent (GE), Very Great Extent (VGE), and the scales attract the following points: LE-1 point, ME-2 points, GE-3 points, while VGE-4 points. Also data was collected on personal data obtained from the sample of the respondent.

Data analysis

With the aid of statistical package for social science (SPSS) version 20.0, descriptive statistics was employed for the analysis of generated data.

RESULTS AND DISCUSSION

Table 1 presents the socioeconomic characteristics of fish farmers in Kumbotso. The age group 26-30 years is the most represented (46%), followed by 21-25 years (22%). Individuals below 35 years dominate (92%), suggesting the sample predominantly consists of a youthful population. The dataset is mainly male (84%), and 16% females. This dominance of younger individuals and the gender disparity aligns with findings by Anyanwu et al. (2022), who reported similar younger age and male dominance in artisanal fishing due to physical labour and cultural factors. However, regions emphasizing aquaculture or processing often report a higher female representation (St. Louis and Oliveira, 2022). Most respondents are married (62%), followed by single participants to the interview (24%). This suggests that fishing may provide economic stability to support family life. Tertiary education (40%) slightly surpasses secondary (38%), with Qur'anic schooling (16%) and primary education (6%) also represented. Consistent with Anyanwu et al. (2022), where married individuals were dominant in fishing communities, reflecting the industry's role as a primary livelihood source, but contrast in educational levels as secondary education was dominant. The increase in tertiary-educated fishers may signal improved access to education or diversification of fishing techniques requiring advanced skills. Most households consist of 6-10 members (58%), followed by 1-5 members (32%). Similar trends were observed by Omitoyin and Aderanti (2020) in Northern Nigerian fishing communities, highlighting large household sizes to optimize labour availability and share resources. Smaller household sizes (32%) could indicate urbanization influences or adoption of modern fishing practices. Respondents with 6-10 years of experience (50%) dominate, followed by 11-15 years (24%) and 1-5 years (22%). Only 4% have over 16 years of experience. This aligns with Anyanwu et al. (2022), where mid-level experience (6-10 years) was most common. However, the low representation of highly experienced fishers (16+ years) suggest career transitions to other occupations or retirement.

Table 1: The socioeconomic characteristics of fish farmers in Kumbotso.

Age (year)	Frequency	Percentage (%)	Cumulative percent (%)
16-20	2	4	4
21-25	11	22	26
26-30	23	46	72
31-35	10	20	92
36-above	4	8	100
Gender			
Male	42	84	84
Female	8	16	100
Marital Status			
Single	12	24	24
Married	31	62	86
Divorced	5	10	96
Widow	2	4	100
Educational level			
Primary	3	6	6
Secondary	19	38	44
Tertiary	20	40	84
Qur'an school	8	16	100
Household size			
1-5	16	32	32
6-10	29	58	90
11-15	4	8	98
16-above	1	2	100
Fishing experience (Year)			
1-5	11	22	22
6-10	25	50	72
11-15	12	24	96
16-above	2	4	100

Table 2 illustrates the levels of climate change awareness among fish farmers in Kumbotso, categorized under ten variables. Approximately 62.5% of the fish farmers demonstrated a high level of awareness regarding the potential impacts of climate change on fish farming. Furthermore, 75% actively monitor climate-related information, while 60.4% seek additional resources, reflecting an eagerness to stay informed. A significant proportion, 79.2%, expressed strong concern, acknowledging climate change as a threat to fish farming. However, only 41.7% were highly knowledgeable about effective adaptation strategies, with 45.8% displaying moderate knowledge, highlighting gaps in practical mitigation understanding. Awareness of government policies related to climate change and fish farming was notably low, with only 29.1% being highly informed, underscoring the need for enhanced policy communication. Despite these gaps, 62.5% of farmers have integrated climate change considerations into their practices, albeit at a moderate level. Additionally, 50% expressed a strong willingness to adopt climate-resilient practices, signaling a proactive approach toward sustainability. These findings align with studies by Fahad et al. (2020), which revealed high levels of awareness among fish farmers about climate change impacts. However, Talanow et al. (2021) emphasized that while farmers often acknowledge climate threats, their practical adaptation knowledge is limited, consistent with the findings in Kumbotso.

Table 2: Fish farmers' level of climate change awareness in Kumbotso; Less Extent (LE), Moderate Extent (ME), Great Extent (GE), Very Great Extent (VGE).

S/No.	Variables	VGE	GE	ME	LE
1.	I am aware of the potential impacts of climate change on fish farming.	30 62.5%	16 33.3%	1 2.1%	1 2.1%
2.	I understand the key factors contributing to climate change affecting fish farming (e.g. temperature fluctuations).	18 37.5%	28 58.3%	2 4.2%	0 0%
3.	I am aware of adaptation strategies to mitigate the effects of climate change on fish farm.	20 41.7%	22 45.8%	2 4.2%	4 8.3%
4.	I regularly monitor climate-related information that may affect fish farming.	36 75%	12 25%	0 0%	0 0%
5.	I integrate climate change considerations into my fish farming practices (e.g. adjusting stocking densities).	30 62.5%	14 29.1%	2 4.2%	2 4.2%
6.	I am aware of government initiatives and policies related to climate change that impact fish farming in my area.	14 29.1%	12 25%	14 29.1%	8 16.6%
7.	I actively seek out information and resources on climate change and its potential effects on fish farming.	29 60.4%	18 37.5%	1 2.1%	0%
8.	I believe that education on climate change is crucial for sustainable fish farming.	19 39.5%	24 50%	2 4.2%	3 6.3%
9.	I believe that climate change poses a threat to the success of fish farming.	38 79.2%	8 16.6%	0 0%	2 4.2%
10.	I am willing to adopt new climate-resilient practices in my fish farming operation.	24 50%	20 41.6%	1 2.1%	3 6.3%

Table 3 presents the various sources of climate change information available to fish farmers in Kumbotso, emphasizing their perceived reliability and trustworthiness. Notably, 64.6% of farmers identified organizations like WWF and Greenpeace as the most reliable sources of climate change information. Additionally, 54.2% of respondents viewed scientific journals as dependable for understanding climate science, while 56.3% trusted academic institutions for accurate information. Online news platforms, including websites and apps, were considered up-to-date and trustworthy by 41.7% of farmers, and 43.8% believed educational programs effectively enhanced their understanding of climate change. Similarly, 41.7% of respondents valued climate information centers for providing accurate data. Traditional media outlets, such as TV, newspapers, and radio, garnered trust from 37.5% of farmers, though 12.5% expressed skepticism. Social media platforms were perceived as effective by only 20.8% of farmers, with 18.8% expressing doubts about their reliability. Government reports were trusted by 27.1%, with 33.3% remaining uncertain about their accuracy. Furthermore, opinions on conferences were divided; 37.5% of respondents found them valuable, while others expressed reservations. These results align with findings from Yusufu et al. (2024), which revealed that farmers in similar regions prioritized non-governmental and scientific sources for reliable climate information. Similarly, Amoak et al. (2023) reported a strong reliance on academic institutions among rural farmers for credible climate-related knowledge.

Table 3: Sources of information on climate change for fish farmers in Kumbotso; Less Extent (LE), Moderate Extent (ME), Great Extent (GE), Very Great Extent (VGE).

S/No.	Variables	VGE	GE	ME	LE
1.	Traditional media outlets provide accurate and reliable information on climate change.	18 37.5%	19 39.6%	6 12.5%	5 10.4%
2.	Online news platforms provide up-to-date and trustworthy information on climate change.	20 41.7%	16 33.3%	10 20.8%	2 4.2%
3.	Information from scientific journals is a reliable source for understanding the climate change.	26 54.2%	18 37.5%	2 4.2%	2 4.2%
4.	Information from government reports is trustworthy when it comes to climate change.	13 27.1%	15 31.3%	16 33.3%	4 8.3%
5.	Environmental organizations (e.g. WWF, Greenpeace) provide accurate information.	31 64.6%	12 25%	0 0%	5 10.4%
6.	Information from research institutions is a reliable source for learning about climate change.	27 56.3%	20 41.7%	0 0%	1 2.1%
7.	Information from climate change conferences is valuable for global perspectives on climate.	18 37.5%	18 37.5%	6 12.5%	6 12.5%
8.	Social media platforms are effective sources for staying informed about climate change.	10 20.8%	12 25%	17 35.4%	9 18.8%
9.	Climate information centers provide valuable and accurate data on climate change.	20 41.7%	21 43.8%	0 0%	0 0%
10.	Educational programs are effective in enhancing understanding of climate change.	21 43.8%	23 47.9%	1 2.1%	3 6.3%

Table 4 explores fish farmers' perceptions of climate change impacts on fish farming in Kumbotso. A majority (62.5%) identified temperature changes as significantly affecting fish production, while 66.7% highlighted water scarcity as a critical issue exacerbated by climate change. Additionally, 52.1% noticed that water quality deterioration due to climate change negatively impacts fish health and growth. Changes in fish migration patterns were noted by 60.4%, and 39.6% reported altered fish behavior. While 22.9% perceived extreme weather events like floods and storms as detrimental to fish farming, 25% acknowledged their influence to some extent. Half of the farmers (50%) linked increased disease outbreaks directly to climate change, and 37.5% reported its effect on the availability and quality of fish feed. Furthermore, 33.3% considered climate change-related regulations a challenge to their farming activities, but only 29.2% have adopted climate-resilient practices to mitigate these impacts. These findings resonate with similar studies, Cascarano et al. (2021) highlighted the link between extreme weather events and heightened disease outbreaks in fish farming, while Yadav et al. (2024) emphasized the importance of adopting climate-resilient practices, they observed that implementation remains slow, hindered by restricted access to resources.

Table 4: Fish farmers' perception of climate change impact in Kumbotso; Less Extent (LE), Moderate Extent (ME), Great Extent (GE), Very Great Extent (VGE).

S/No.	Variables	VGE	GE	ME	LE
1.	Changes in temperature have a significant impact on fish production in my area.	30 62.5%	18 37.5%	0 0%	0 0%
2.	Extreme weather events influenced by climate change affect fish farming.	11 22.9 %	12 25 %	13 27.1 %	11 22.9 %
3.	Climate change contributes to variations in water quality, impacting fish health.	25 52.1%	17 35.4%	3 6.3%	3 6.3%
4.	Climate change has led to observable changes in the behavior of fish species.	19 39.6%	19 39.6%	5 10.4%	5 10.4%
5.	Climate change has caused noticeable shifts in the migration patterns of fish.	29 60.4%	15 31.3%	0 0%	4 8.3%
6.	Climate change contributes to an increased risk of disease outbreaks in fish farming.	24 50%	22 45.8%	1 2.1%	1 2.1%
7.	Climate change impacts the availability and quality of fish feed for my operations.	18 37.5%	23 47.9%	4 8.3%	3 6.3%
8.	Climate change has led to water scarcity issues, affecting fish production.	32 66.7%	16 33.3%	8 16.7%	9 18.8%
9.	Climate change-related regulations pose challenges to fish farming activities.	16 33.3%	15 31.3%	8 16.7%	9 18.8%
10.	I have adopted climate-resilient practices to mitigate the impacts of climate change.	14 29.2%	22 45.8%	7 14.6%	5 10.4%

Table 5 outlines the coping strategies employed by fish farmers in Kumbotso to address the impacts of climate change on their farming activities. Regular monitoring of environmental conditions, such as temperature and water quality, is practiced by 79.2% of farmers to adapt to shifting climate patterns. Species diversification, ensuring resilience in farming operations, is adopted by 77.1% of farmers. Water management practices, including efficient irrigation, are utilized by 54.2% of farmers to address changing conditions, while 62.5% rely on climate-resilient feeds that are less vulnerable to climate-related effects. Technological advancements, such as automated monitoring systems, have been integrated into operations by 43.8% of fish farmers. Collaborative efforts among farmers to collectively tackle climate challenges are practiced by 56.3%, while 52.1% participate in training sessions to enhance their adaptive capacity. Early warning systems to anticipate and respond to climate-related threats are in place for 54.2% of farmers. However, only 18.8% have embraced sustainable farming practices, which are vital for minimizing the overall environmental impact of climate change. Oyebola et al. (2021) identified species diversification as a prevalent strategy among fish farmers in regions with unpredictable climate conditions. Yadav et al. (2024) highlighted water management practices, including efficient irrigation, and emphasized the importance of climate-resilient feeds as key measures to counter climate impacts and mitigate temperature changes and other climate-induced stresses on aquaculture.

Table 5: Fish farmers' coping strategies of alleviating climate change impact in Kumbotso; Less Extent (LE), Moderate Extent (ME), Great Extent (GE), Very Great Extent (VGE).

S/No.	Variables	VGE	GE	ME	LE
1.	I have actively chosen and adopted fish species that are more resilient to the effects of climate change.	13 27.1%	25 52.1%	4 8.3%	6 12.5%
2.	I employ water management practices to cope with changing climate conditions in my fish farming.	20 41.7%	26 54.2%	1 2.1%	1 2.1%
3.	Diversifying fish species in my farming operation is a strategy I use to reduce climate change impact.	37 77.1%	11 22.9%	0 0%	0 0%
4.	I use climate-resilient feeds that are less susceptible to the effects of climate change on fish farming.	30 62.5%	16 33.3%	2 4.2%	0 0%
5.	Incorporating technological advancements is a strategy I employ to cope with climate change.	16 33.3%	21 43.8%	9 18.8%	2 4.2%
6.	I regularly monitor environmental conditions to adapt my fish farming practices to changing climate.	38 79.2%	10 20.8%	0 0%	0 0%
7.	I have established and use early warning systems to anticipate and respond to climate-related challenges.	14 29.2%	26 54.2%	5 10.4%	3 6.3%
8.	Participating in capacity-building programs and training sessions has enhanced my ability to cope with climate change impacts on fish farming.	25 52.1%	23 47.9%	0	0
9.	Collaborating with other fish farmers is an effective strategy I use to address climate change impacts.	27 56.3%	21 43.8%	0	0
10.	I have adopted sustainable farming practices that contribute to reducing the overall environmental impact of climate change on fish production.	7 14.6%	9 18.8%	28 58.3%	4 8.3%

Table 6 presents the relationship between fish farmers' perceptions of climate change impacts and few independent variables. All respondents agree that the impact of climate change on fish farming varies by geographical location, underscoring the importance of local environmental factors such as proximity to water sources, elevation, and exposure to extreme weather. This perception came from experience, with 56.3% of farmers reporting a moderate perception, experience aids in recognizing climate change effects. Access to information plays a key role, as 62.5% of farmers with better access has more accurate perceptions, highlighting the importance of effective knowledge dissemination. 68.8% of educated farmers perceive the climate change effects as significant, proving the critical role of education in raising awareness and understanding climate issues. The adoption of technological tools also impacts perception, with 37.5% of farmers reporting very good perceptions and 39.6% reporting good perceptions, telling that technology enhances farmers to detect and adapt to climate. Farmers engaged in sustainable practices (60.4%) are more likely to perceive climate change as a significant issue, indicating that these practices heighten sensitivity to environmental changes. Government support positively influences perceptions, with 41.7% reporting good perceptions and 37.5% reporting very good perceptions, highlighting the role of initiatives in enhancing climate awareness. Financial access is another key factor, as 66.7% of farmers with limited resources have moderate or low perceptions, indicating that financial constraints hinder adaptation and understanding. Networking with peers fosters a shared understanding, with 60.4% reporting good perceptions. Access to support services also improves perception, with 58.3% of farmers reporting very good perceptions. These findings are consistent with prior studies like that of Oyebola et al. (2021) who demonstrated that geographic location significantly influences

farmers' perceptions due to varying environmental conditions. Lawson et al. (2020) highlighted that experienced farmers possess a more nuanced understanding of climate change and established that access to reliable information enhances both awareness and adaptive capacity. The correlation between education and perception has been widely noted, with Okeke-Ogbuafor et al. (2022) confirming that educated fish farmers are better equipped to comprehend the complexities of climate change. The findings in Kumbotso, particularly the influence of education and access to resources on perception, align closely with these studies.

Table 6: Relationship between perception of climate change impact and other independent variables in Kumbotso; Less Extent (LE), Moderate Extent (ME), Great Extent (GE), Very Great Extent (VGE).

S/No.	Variables	VGE	GE	ME	LE
1.	The perceived climate change impact on fish farming depend on geographical location of farm.	48 100%	0	0	0
2.	The level of experience in fish farming influences the farmer's perception.	4 8.3%	6 12.5%	27 56.3%	11 22.9%
3.	Farmers with better access to information on climate change have more accurate perceptions.	30 62.5%	18 37.5%	0 0%	0 0%
4.	The level of education among fish farmers is a factor that influences their perception.	33 68.8%	14 29.2%	1 2.1%	0 0%
5.	Farmers who actively adopt technological tools may have different perception of climate change.	18 37.5%	19 39.6%	11 22.9%	0 0%
6.	Farmers engaged in sustainable practices perceive climate change as a significant factor.	29 60.4%	15 31.3%	3 6.3%	1 2.1%
7.	Fish farmers' perception vary based on the level of government support and initiatives to farmers.	20 41.7%	18 37.5%	5 10.4%	5 10.4%
8.	Farmers with better access to finance may have a different perception of climate change.	16 33.3%	32 66.7%	0 0%	0 0%
9.	Farmers who actively network with other farmers are more likely to have a shared perception.	19 39.6%	29 60.4%	0 0%	0 0%
10.	Farmers who have access to support services may perceive climate change differently.	28 58.3%	20 41.7%	0 0%	0 0%

CONCLUSIONS

The study highlighted the significant role of demographic factors, access to information, and experience in shaping fish farmers' perceptions and responses to climate change in Kumbotso Local Government Area, Kano State, Nigeria. Despite high awareness of climate change impacts, with 62.5% of farmers acknowledging its potential effects on fish farming, knowledge of effective adaptation strategies remained limited. While many farmers were open to adopting climate-resilient practices, sustainable farming practices were still underutilized. The findings emphasized the importance of education, information access, and technological integration in improving farmers' adaptive capacity. Notably, educated farmers and those using sustainable methods were more likely to recognize climate change as a critical issue. Access to support services, government policies, and networking also influenced perceptions, suggesting that enhanced support, targeted training, and effective communication were crucial in empowering fish farmers to better adapt to climate change challenges. The study underscored the need for comprehensive policies and initiatives that addressed these gaps, promoting climate resilience and sustainable practices in fish farming.

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