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Assessing the Effects of Flood Risk on Fish Farming in the Coastal Region of Delta State, Nigeria

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Abstract

This study explores the consequence of flood risk on fish agribusiness. Data from 116 respondents were analyzed using various tools such as descriptive statistics, the means of the Likert scale, cost and return analysis, and regression model. The findings indicate that respondents had an average age of 39 years, with most being educated and having around 7 years of fishing experience. The majority were married males with an average household size of 6 persons. Flood events occurred approximately four times on average, leading to significant disparities in cost and return of fish farming. The severity index of flood risk was 0.82%, with many respondents expressing willingness to discontinue fishing during floods. Most fish farmers lacked insurance coverage and government incentives, and many had limited access to credit. Factors contributing to flood risk severity included fish mortality, limited insurance access, income fluctuations, and decreased fish farm output. On average, 1345 fish were lost to flood incidents, with 58.6% of respondents facing high-risk levels. Coping strategies included pre-flood measures like embankment raising and post-flood actions like seeking assistance and applying lime to affected farms. The study recommends joining cooperative societies to improve access to funds and resources and offers insights for mitigating flood risks in the aquaculture business in Delta State.

Keywords: Incidence; Severity; Flood Risk; Fish Farming; Farmers

Introduction

Fishing stands as an indispensable cornerstone for the livelihoods of countless littoral communities globally, serving not only as a fundamental source of sustenance but also as a vital economic driver for millions. Nevertheless, these communities confront formidable challenges from environmental hazards, most notably the recurrent threat of flooding. Coastal regions, by their very nature, are vulnerable to inundation, a natural phenomenon whose consequences extend far beyond the marine ecosystem. According to De Souza FB, et al. [1], the implications of inundating are profound, disrupting established systems of drainage and wreaking havoc on coastal residents' lives. The peril of flooding is intricately intertwined with the escalating sea levels resulting from both ocean expansion and ice melt, a phenomenon extensively documented by researchers such as Griggs G, et al. [2], Hamlington BD, et al. [3], Yu X, et al. [4], Croteau R, et al. [5], Lawanson OI, et al. [6] and Kaze D [7]. The toll of inundation is acutely felt worldwide, as emphasized by

scholars like Dauda JH, et al. [8] and Buba FN, et al. [9], who underscore flooding as a significant environmental hazard imperiling lives and livelihoods globally.

In addition to endangering human lives and infrastructure, flooding ravages critical ecosystems like mangroves, disrupts agricultural activities, and decimates fisheries, perpetuating a cycle of economic hardship for coastal communities. Moreover, the toll extends to aquatic life, with fish mortality rates surging in ponds and rivers, and the displacement of millions exacerbating the humanitarian crisis [10]. Beyond the immediate physical damage, flooding precipitates long-term consequences, including water source contamination, disease outbreaks among fishermen and their families, and enduring disruptions to societal structures [11]. The escalating threat of flooding, propelled by the specter of climate change, portends even graver challenges ahead. Forecasts by Kirkpatrick JIM, et al. [12] and Sondermann M, et al. [13] paint a stark picture of escalating flood risks accompanying rising temperatures. To comprehensively address these challenges, researchers like Olufunmilayo M, et al. [14] have meticulously cataloged the attributes of flood events, crucial for assessing their influence on marine ecosystems and coastal communities.

Developing nations, in particular, are ill-equipped to tackle the menace of flooding, with limited flood protection measures exacerbating the toll of disasters. Instances abound, such as the devastating floods in India, Nepal, the Philippines, and Thailand, each leaving a trail of destruction in their wake [15,16]. In Nigeria, coastal communities, notably Delta State, grapple incessantly with the dual threats of flooding and shoreline erosion, wreaking havoc on farming and fishing activities [17]. As climate change continues unabated, the occurrence and magnitude of flooding are poised to escalate, with dire consequences for fishery-dependent communities. Declining fish catches, habitat erosion, and dwindling incomes are among the myriad challenges confronting fishermen [18]. The ripple effects extend beyond the aquatic industry, encompassing broader societal issues like food shortages, increased poverty, and compromised food security [19,20]. Against these existential threats, fish farmers in flood-prone areas have resorted to an array of adaptive strategies, from relocation to improved river management practices. Yet, the necessity for enhanced education on early warning systems and flood preparedness remains paramount, especially for vulnerable coastal communities [21]. Government intervention, bolstered by robust emergency preparedness mechanisms, is imperative to mitigate the effect of swamping on coastal livelihoods. However, a glaring gap persists in our understanding of flood risk quantification among fish farmers, underscoring the need for targeted research and policy interventions [19]. Only through concerted efforts can we hope to safeguard the means of support of coastal communities and mitigate the existential threat posed by flooding in the ages to come. The specific objectives are to:

- Identify the socio-economic characteristics of fish farmers
- determine the costs and earnings of fish farming before and after flooding
- ascertain the magnitude of flood occurrences
- evaluate the severity of flood risk on fish farming
- assess the propensity of quitting fish farming
- Determinants of the propensity to quit fish farming.
- identify flood management strategies

Materials and Method

Study Area

The research was conducted in the Delta North Agricultural Zone, situated within Delta State, Nigeria. A purposive and multistage sampling methods was use to choose the respondents. Initially, five local government areas were purposively chosen due to their high vulnerability to flood and active fish farming communities. These selected LGAs are Aniocha North and South, Oshimili North and South, and Ukwuani. Subsequently, 3 communities were arbitrarily picked from the selected LGAs, resulting in a total of 15 communities. From these communities, eight respondents were randomly chosen, totaling 120 farmers. Due to incomplete or inadequate information, four questionnaires had to be excluded, resulting in the use of 116 questionnaires. Primary data were gathered using structured questionnaires. Enumerators were also involved in collecting data to ensure comprehensive coverage. Descriptive statistics and inferential statistics were used to achieve the objectives.

Data Specification

The implicit form of the regression model is specified as

$$Y = \beta 0 + \beta 1X1 + \beta 2X2 + \beta 3X3 + \beta 4X4 + \beta 5X5 + \beta 6X6 + \beta 7X7 + \ldots + ei$$

Where:

Y=Flood severity risk (very severe=4, moderately severe=3, serious=2 and not severe=1)
X1 =mortality (number)
X2 =flood incidence (%)
X3 =insurance accessibility
X4 = incentive (yes=1,0' otherwise)
X5 =credit accessibility (yes=1, otherwise = 0)
X6 =income level (N)
X7=output level

Results and Discussion

Description of the Fish Farmers

Age Distribution of Respondents

The result of age distribution among respondents (Table 1) provides valuable acumens into the composition of the fish farming community, revealing a diverse range. With a mean age of 40 years serving as a central point around which age diversity clusters, the implications for the industry's future become apparent. Notably, the largest segment falls within the 31-40-year age group, suggesting significant representation in prime working years and the potential for new perspectives and innovative approaches. The substantial presence of respondents aged 41-50 indicates experienced individuals who could bridge generational gaps, facilitating knowledge transfer and ensuring industry continuity. Furthermore, participants over 50 demonstrate both diversity and commitment to the sector, either through adherence to traditional practices or adaptability to evolving methods. The average age of 40 unveils a relatively youthful population within the fish agribusiness community, reflecting active engagement and the potential for long-term impacts. These findings corroborates with Gbigbi TM [22] research, highlighting the consistency of demographic patterns within the sector. Understanding the age distribution within the fish farming community can guide policymakers in crafting targeted interventions and support mechanisms. Recognizing the significant representation of individuals in their prime working years could inform strategies to harness their productivity and innovation potential.

Educational Status

The educational status of respondents emerges as a pivotal factor influencing their aptitude for adopting advanced fish farming practices and strategies. The survey's findings delineate a diverse educational landscape within the fish farming community, with 5.2% reporting no formal education, an equivalent percentage having completed primary education, a substantial 56.9% possessing secondary education qualifications, and 32.8% attaining tertiary education. This array of educational backgrounds forms a critical lens through which to gauge the industry's capacity for embracing modern technologies and acquiring relevant skills. The segment of respondents with no formal education or primary education suggests the coexistence of individuals who may face challenges in accessing and assimilating complex information and modern farming techniques. The ascendency of respondents with secondary education qualifications, comprising 56.9% of the surveyed group, signifies a significant portion of the fish farming community with a foundational level of formal education. This demographic hold promises for the adoption of advanced practices and innovations, as secondary education typically equips individuals with basic literacy and numeracy skills, making them more receptive to new concepts and technologies. The 32.8% of respondents with tertiary education qualifications constitute a valuable cohort in the study location. Individuals with higher education backgrounds are likely to possess critical thinking skills, research acumen, and a capacity for innovation. Their presence indicates the potential for the fish farming sector to leverage advanced scientific knowledge and technology, leading to enhanced productivity, sustainability, and competitiveness.

The prevalence of education among respondents aligns with observations from Gbigbi TM, et al. [23] research, which highlighted the active engagement of educated individuals in artisanal fishery in Nigeria. This correlation underscores the status of education in facilitating participation and advancement within the fisheries subsector. Educated individuals are better equipped to comprehend and implement best practices, navigate regulatory frameworks, and adapt to evolving market dynamics. The positive relationship between education and the prospective for technology adoption is a crucial consideration for policymakers and industry stakeholders.

Fishing Experience

The result unveils a diverse range of experiences within the surveyed group, with 36.2% of respondents indicating 1-5 years of fishing experience, 53.5% reporting 6-10 years, a modest 5.2% with 11-15 years, and an equal percentage with over 15 years of experience. The mean fishing experience was 7 years, suggesting a considerable profundity of knowledge and expertise among the fish farmers, contributing to an enhanced awareness of the intricacies of fish farming. The dominance of individuals with 6-10 years of fishing experience indicates a substantial presence of seasoned practitioners within the fish farming community. This accumulation of experience over a significant period suggests that a considerable portion of the farmers may have witnessed and adapted to changes in fishing practices, technology, and market dynamics, which are critical aspects of the evolving field of fish farming. The noteworthy proportion of respondents with 1-5 years of fishing experience also implies the inclusion of individuals relatively new to the field. This subgroup may bring fresh perspectives, enthusiasm, and an eagerness to adopt innovative fish farming techniques. Their presence highlights the possibilities for knowledge exchange within the fishing community, as experienced individuals may mentor those newer to the industry, fostering a collaborative and dynamic learning environment.

The small but notable percentage of respondents with over 15 years of fishing knowledge underscores the reality of a group with a wealth of knowledge and possibly a deep-rooted connection to traditional fish farming practices. Their prolonged engagement in the industry positions them as potential stewards of indigenous knowledge, offering insights that complement contemporary approaches to fish production. Seasoned fish farmers are likely to possess a deep understanding of ecological patterns, breeding cycles, disease management, and market dynamics. This reservoir of knowledge can be harnessed for the benefit of the entire fish farming community through targeted training programs, knowledge-sharing initiatives, and collaborative research endeavours.

Marital Status

The marital status of individuals is a potential factor that crisscrosses various facets of their lives, including economic activities. The result reveals a diverse range of marital statuses among the participants, with 53.5% reporting being married, 13.8% single, 12.1% divorced, and 20.7% widowed. The preeminence of married respondents in fish farming suggests a connection between marital status and involvement in this sector. This observation prompts an exploration of how the dynamics of marriage may influence or be influenced by fish farming activities. Marriage often entails shared responsibilities, and the decision to engage in fish agribusiness could be a strategic choice for couples seeking additional sources of income and livelihood enhancement. The study's findings resonate with Gbigbi TM [24] study on the oil spillage environment in Delta State, which identified a correlation between economic activities and household living standards. It implies that married individuals, constituting the mainstream of respondents, may view fish farming as a viable means to advance their households' economic well-being. For single individuals, involvement in fish farming might be driven by different issues, such as self-reliance and independence. Meanwhile, divorced or widowed individuals may engage in fish farming as avenue of financial recovery or a way to navigate life changes. The correlation between marital status and fish farming involvement also has implications for the societal fabric of communities. A thriving fish farming sector can contribute not only to individual households but also to the overall resilience and prosperity of the community. The shared benefits and constraints of fish farming may foster a sense of community cooperation and support, especially among married couples who are jointly invested in the success of their ventures [25].

Membership of Cooperative Society

The results reveal a significant aspect of the organizational structure within the fish farming community, shedding light on the affiliation level of fish farmers with cooperative societies. A substantial 60.3% of participants reported not being affiliated with any fish farming cooperative society, while 39.7% indicated their membership in various cooperative societies related to fish farming. The absence of affiliation with a cooperative society for a majority of respondents suggests a notable segment of fish farmers operates independently. This independence may stem from various factors, including individual preferences, lack of awareness about cooperative opportunities, or even reservations about the effectiveness of such organizations. Understanding the reasons behind this non-affiliation is crucial for developing strategies that encourage greater participation and collaborations within the fishing community.

On the flip side, almost 40% of respondents who are members of fish farmers' cooperative societies represent a more organized and interconnected segment of the industry. Cooperative societies have the capacity to serve as conduits for the exchange of knowledge, expertise, and resources among members. These organizations can facilitate collective decision-making, bulk purchasing of inputs, and joint marketing efforts, leading to increased productivity and profitability for the participating fish farmers. The influence of cooperative societies on knowledge dissemination within the fishing subsector cannot be overstated. These organizations provide a platform for members to share best practices, innovative techniques, and experiences. The collective wisdom amassed within cooperative societies can propel the overall improvement of fishing practices, addressing challenges and fostering continuous learning. Additionally, cooperative societies often collaborate with government agencies and NGOs, amplifying their capacity to access external resources, training programs, and market opportunities.

Gender of Respondents

The gender distribution among fish farmers in the survey provides valuable insights into the dynamics of participation. With 116 participants, the data highlights a notable gender disparity, with 81.0% of respondents identifying as male and 19.0% as female. This disparity prompts a deeper investigation of the reasons contributing to the skewed representation and its implications for the fishing industry. One significant aspect that emerges from the data is the predominance of males in fish farming. This could be attributed to various factors, including traditional gender roles, societal expectations, and the physical demands associated with the work. Historically, certain industries, including agriculture and fisheries, have been perceived as male-dominated, leading to limited female participation. The physically demanding nature of farming, which often involves tasks such as pond maintenance, net handling, and fish harvesting, may contribute to the observed gender distribution. It is crucial to recognize that

gender disparities in fish farming may not solely result from inherent differences in abilities or preferences between men and women. Societal norms, cultural expectations, and access to resources can significantly impact individuals' choices of occupation. Understanding this factor is indispensable for creating a more inclusive and equitable environment within the fish farming sector.

Household Size

The investigation of household size among respondents provides a crucial standpoint on the support and labour available for fishing activities. The result reveals a spectrum of household sizes within the fish farming community, with 6.9% of respondents having 1-3 persons in their households, 55.2% with 4-6 persons, 36.2% having 7-9 persons, and a minor 1.7% with more than 9 persons. The average family size was 6 persons, signifying a substantial support base for fish farming endeavours, aligning with the discoveries of Gbigbi (2019) and offering valuable insights into the demographic characteristics of individuals engaged in the industry. The prevalence of households with 4-6 persons, constituting the majority at 55.2%, suggests a significant reservoir of potential labour and support for fish farming activities. The existence of households with 7-9 persons, accounting for 36.2% of respondents, further underscores the potential for a robust support system. Larger household sizes typically imply a greater capacity for shared responsibilities, which is advantageous for the labour-intensive nature of farming. The collective efforts of family members can support various aspects of aquatic farming, including pond maintenance, feeding, harvesting, and marketing, fostering a collaborative and sustainable approach to the industry. These larger households also present opportunities for collaborative efforts to increased productivity and economic returns in fish farming. The average family size of 6 persons aligns with Gbigbi's (2019) findings, suggesting that households engagement contribute effectively to the various facets of the fishing industry.

Variable	Frequency (%)	Mean/mode
Age (years)		
21-30	16(13.8)	40 years
31-40	44(37.9)	
41-50	34(29.3)	
Above 50	22(19.0)	
Educational attainment		
No formal schooling	6(5.2)	Secondary
Primary education	6(5.2)	
Secondary education	66(56.9)	
Tertiary education	38(32.8)	
Experience		
1-5 years	42(36.2)	7 years
6-10 years	62(53.5)	
11-15 years	6(5.2)	
Above 15 years	6(5.2)	
Marital standing		
Married	62(53.5)	Married
Single	16(13.8)	
Divorced	14(12.1)	
Widow	24(20.7)	
Co-operative membership		
Yes	46(39.7)	Yes
No	70(60.3)	
Gender		

Male	94(81.0)	Male
Female	22(19.0)	
Household size		
01-Mar	8(6.9)	6 person
04-Jun	64(53.2)	
07-Sep	42(36.2)	
Above 9	2(1.7)	
Income level (₦)		
Less than 100,000	4(3.5)	₦243,44.80k
100,000-200,000	56(48.3)	
100,001-300,000	26(22.4)	
300,001-500,000	10(8.6)	

Table 1: Socioeconomic Characteristics of fish farmers.

Costs and Revenues of Fish Farming

The study examined the cost and returns associated with fish farming before and after a flood event, utilizing a profit model outlined in Table 2. The results of this investigation unveiled a statistically significant disparity ($P < 0.05$) in both the cost and profit aspects of fishing before and after the flood. Before the flood, the cost of fingerlings was N21.72, while it rose significantly to N38.45 after the flood. The cost of feed also experienced a considerable increase, reaching N37612.07 after the flood, in stark contrast to the N 25103.45 before the flood. Fertilizer cost per bag stood at N2050.00 before the flood but escalated to N3253.45 after the flood. The price of lime increased from N 31206.90 before the flood to N3747.41 after the flood. The labour cost rose substantially after the flood, reaching N 45137.93, whereas it was N 31206.90 before the flood. Furthermore, the cost of pond construction significantly increased from N152017.24 before the flood to N 216586.21 after the flood. Transportation costs also surged from N 2933.43 before the flood to N 3700.86 after the flood, and the cost of drugs increased from N 2644.66 to N7870.69. The cost of water supply escalated from N2005.17 before the flood to N3743.10 after the flood. There was a noticeable disparity in fingerlings cost, with N4422.41 before the flood and N 3293.10 after the flood. Interestingly, the average unit price of fingerlings increased significantly from N 21.83 before the flood to N 74.66 after the flood.

Cost items	Before flood	After flood	Mean diff	Std Dev	t	Df	Sig.
Finger line cost	21.72	38.45	16.72	14.89	8.554	115	0
Feed cost	25103.45	37612.07	12508.62	7896.53	12.064	115	0
Fertilizer cost	2050	3253.45	1203.45	3359.86	2.728	115	0
Lime cost	2848.28	3747.41	899.14	706.52	9.692	115	0
Labour cost	31206.9	45137.93	13931.03	18690.33	5.676	115	0
Cost of pond construction	152017.24	216586.21	64568.97	58901.97	8.348	115	0
Cost of transportation	2933.45	3700.86	767.41	853.05	6.851	115	0
Cost of drugs	2644.66	7870.69	5226.03	3213.72	12.385	115	0
Cost of water supply	2005.17	3743.1	1737.93	1102.6	12.004	115	0
Fingerlings bought	6422.41	3293.1	1737.93	2266.85	12.004	115	0
Average unit price of fingerlings	21.83	74.66	52.83	19.14	21.022	115	0
Number of fish sold	6150	2737.76	3412.24	2062.17	12.602	115	0
Income level	133474.14	54181.9	79292.24	94609.83	6.383	115	0

Table 2: Cost and Revenue effect of flooding in fish farming.

The number of fish sold also exhibited a marked decrease, with 6150.00 fish sold before the flood compared to 2737.76 after the flood. In terms of income, the farmers realized N 133474.14 before the flood, which was substantially higher than N 54181.9 after the flood. Upon analyzing the cost-revenue relationship, it is evident that fish farmers were more profitable before the flood. This situation has implications for the fish catch output, which is expected to decrease, ultimately leading to reduced income for the fishermen and women in the industry.

Frequency of Flood Events Experienced Since 2014

Table 3 presents a comprehensive overview of the respondents' experiences with flooding since 2014. Notably, 43.1% of the surveyed individuals reported that they had encountered flooding four times during this period. An additional 27.6% had experienced flooding five times, making it clear that a significant portion of the fishing community faces recurring flood events. Furthermore, 20.7% of respondents noted that they had to contend with flooding three times, while 8.6% had experienced it twice since 2014. These statistics demonstrate that flooding is an ongoing issue in the study area. The mean frequency of flood occurrences among the respondents was four times. This recurring decimal emphasizes the regularity of flooding events, highlighting the potential discouragement it poses to fishing activities. The high frequency of flooding events, as showed by the mean of four times, has significant consequences for the fishing community. Recurrent flooding disrupts fishing activities, leading to financial losses and economic instability for the fishermen and their families. Furthermore, the challenges posed by frequent flooding events extend to the broader community, affecting food security and local economies. It is crucial to recognize that such recurring floods can discourage fishermen from pursuing their livelihoods, potentially leading to a decline in the fishing industry. Additionally, the disruption caused by flooding can damage fishing equipment and infrastructure, further exacerbating the economic challenges confronted by the fishing community. These findings underscore the need for comprehensive planning and adaptation measures to reduce the detrimental effects of frequent flooding on fishing activities.

Number of flood occurrences	Frequency	Percentage (%)	Mean occurrence
2	10	8.6	
3	24	20.7	4 times
4	50	43.1	
5	32	27.6	
Total	116	100	

Table 3: How many times have you experienced a flood in your fish farm since 2014.

Flood Risk Severity Level

In Table 4, we examined the severity of flood risk and its implications for various aspects of fish farming. This analysis involved categorizing different stages of risk linked with flooding and ranking them according to their severity and impact on farm revenue. The results of this investigation shed light on the considerable consequences that floods have on fish farm output and income. Our findings reveal that flood poses the most significant risk to fish farming, resulting in substantial losses in fish farm output and income. This is indicative of the vulnerability of the aquaculture industry to extreme weather events such as floods. Additionally, the third most significant risk during flooding is the outbreak of diseases in fish farms, with a mean severity rating of 3.4138. This underscores the multifaceted challenges faced by fish farmers during flood events, including disease management. The fourth risk identified is the propensity of fish farmers to quit the industry resulting from the catastrophic scenarios that unfold during the flood season. This reflects the psychological and economic toll that flooding can have on individuals involved in fish farming. The fifth risk relates to the mortality of fish, with a notable number of fish deaths occurring during floods. Another risk factor identified in our analysis is the fluctuation in fish prices before and after flood events. The instability in prices can have a cascading consequence on the economic sustainability of fish farmers, further compounding the challenges faced during floods. Last but not least, theft emerges as the seventh risk faced by fish farmers during flooding, as desperate circumstances can drive individuals to pilfer fish from flooded ponds as a means of survival. The striking variation in fish prices before and after flooding exacerbates the overall impact on fish farming, as it reflects the immense economic strain on farmers. The occurrence of the flood is shown to make life extremely difficult for the citizenry, with the pilfering of fish

from overflowing ponds becoming the only viable alternative for survival in dire circumstances. This, in turn, intensifies the decision of some fish farmers to quit the industry, leading to substantial financial losses. The flood risk severity index calculated in our study stands at 0.8227. This index signifies that a staggering 82% of the losses incurred by fish farmers can be directly attributed to flood events. This statistic underscores the immense and disproportionate toll that flooding takes on the fish farming sector both in terms of economic loss and the associated challenges that farmers must contend with. This highlights the urgency of implementing mitigation strategies and disaster preparedness measures to safeguard the aquaculture industry from the detrimental effects of floods and to ensure its long-term sustainability.

Variable	VS	MS	S	NS	Total	Mean	Rank
Output	90(77.6)	20(17.2)	2(1.7)	2(3.4)	428	3.69	1st
Income	98(84.5)	2(1.7)	14(12.1)	2(1.7)	428	3.69	1st
Fish price	22(19.0)	64(55.2)	24(20.7)	6(5.2)	334	2.879	6th
Mortality	80(69.0)	0(0)	20(17.2)	16(13.8)	376	3.241	5th
Quitting propensity	62(53.4)	36(31.0)	12(10.3)	6(5.2)	386	3.328	4th
Disease outbreak	78(67.2)	16(13.8)	14(12.1)	8(6.9)	396	3.414	3rd
Theft	34(29.3)	30(25.9)	46(39.7)	6(5.2)	324	2.793	7th

Table 4: Level of Flood Risk Severity.

Farmer's Propensity to Quit

The results reveal that a significant portion (60.3%) of fish farmers are inclined to quit their farming activities in the event of flooding. In contrast, 39.7% of respondents expressed their commitment to continue farming despite facing flood-related challenges. This highlights a crucial vulnerability within the fishing industry, with potentially severe consequences for food security of those dependent on this sector. These findings have several implications; the high proportion of fish farmers likely to quit during floods suggests a potential loss in income and economic instability within these communities. This underscores the importance of financial safety nets and risk mitigation strategies for the respondents. Fish is a major source of protein for many populations, particularly in regions where fish farming is prevalent. The inclination to quit farming during floods can lead to a shortage of fish products, impacting local food security. Identifying the factors that contribute to the propensity to quit farming during floods is critical. This knowledge can inform the advancement of resilience-building programs and support systems for the farmers, such as flood-resistant infrastructure, early warning systems, and financial resources access. These results emphasize the necessity for all-inclusive policies and regulations that address the unique challenges faced by the fisherfolks in flood-prone areas. The determination of 39.7% of respondents to continue fishing during floods provides hope for the industry's resilience. The outcome accentuate the vulnerability of fisherfolks to flooding and the urgent attention for interventions to ensure the safety of the fishing industry. By addressing these challenges, we can support the resilience of fisherfolks and enhance food security in regions heavily dependent on aquafarming.

Is Your Farm Insured?

The result showed that among the surveyed farmers; 12.1% had opted for farm insurance, representing a minority who have actively embraced risk mitigation through insurance coverage. About 87.9% remained without farm insurance, highlighting the widespread susceptibility of the majority to flooding-induced financial uncertainties. The results of this study hold several important implications: The overwhelming lack of farm insurance among the surveyed farmers signifies a significant economic vulnerability. In the event of flooding disasters, 87.9% of uninsured farmers are at risk of severe financial losses, potentially jeopardizing their livelihoods and agricultural sustainability. The low adoption rate of farm insurance may reflect a need for improved awareness and education regarding the profits of such coverage. Understanding farmers' perceptions of risk and their decision-making processes is vital for crafting effective risk management approaches. Policymakers should consider promoting incentives for farm insurance adoption, such as subsidies, favorable terms, or educational campaigns. Insurance providers could tailor their products to better meet the specific needs and constraints of agricultural communities, making insurance more accessible and appealing to farmers. Enhancing farm insurance adoption can contribute to greater agricultural resilience in the face of flooding disasters. Communities with higher insurance coverage are better positioned to recover and rebuild after such events, reducing the overall impact on the agricultural

sector and society at large. This study opens avenues for further research into the underlying factors influencing farmers' decisions to insure their farms.

Did You Receive Any Incentive?

The findings revealed a significant disparity in the distribution of government incentives among the surveyed population. A substantial majority (72.4%) reported that they had never benefited from any form of government incentives. In contrast, a minority (27.6%) acknowledged having received incentives from the government. These results have several implications, shedding light on potential constraints and opportunities in the government's incentive distribution system. The overwhelming majority of individuals never receiving government incentives suggests that there may be an issue of inequitable access. This raises questions about whether the incentives are reaching those who need them most or if barriers are preventing certain groups from accessing these benefits. The relatively low percentage of individuals receiving government incentives highlights the need for policymakers to evaluate the effectiveness of these programs. These findings could influence decisions about resource allocation within the government. If a significant portion of incentives goes unused or unclaimed, it may be an opportunity to reallocate resources to more effective programs or channels of distribution. The distribution of government incentives can significantly impact the social and economic well-being of citizens. These results emphasize the importance of ensuring that incentive programs are designed to reach those who would benefit most, thereby contributing to overall societal welfare. The gap between those who receive incentives and those who do not underscore the need for awareness campaigns and outreach efforts. It may be beneficial for the government to explore strategies for informing eligible individuals about the availability of incentives and the application process. In a nutshell, the lopsided distribution of government incentives as revealed by this study calls for a deeper examination of the policy's effectiveness, access, and overall impact. Addressing these implications can lead to more equitable and efficient government incentive programs, ultimately benefitting a larger portion of the population.

Did you have Access to Credit?

The result showed that a significant majority of the respondents, approximately 63.8%, faced a formidable challenge owing to credit inaccessibility, hindering their ability to enhance and expand their farming operations. Conversely, a smaller proportion, only 36.2% of fish farmers, reported having access to credit resources aimed at bolstering their farm enterprises, implying there is a potential for improved income and livelihoods. However, these findings underscore the pressing need for interventions and policy measures that can bridge this stark divide in accessing financial resources among fish farmers. The fact that nearly two-thirds of fish farmers lack access to credit highlights a critical issue of financial exclusion within the industry. Strategies to improve credit access could lead to increased production and, subsequently, greater food security. Limited access to credit may impede fish farmers' ability to invest in improved equipment, better quality fish feed, or expanded production. As a result, this may hinder the overall productivity of the aquaculture sector. Given that fish farming is often concentrated in hinterland, improving credit accessibility can also have wider rural development implications. Access to credit can enable fish farmers to invest in sustainable and innovative farming practices. Increased income and livelihood opportunities for fish farmers can stimulate economic growth in rural communities, which can be crucial for poverty reduction and overall development. This may include the utilization of environmentally friendly technologies, responsible aquaculture practices, and reduced reliance on harmful inputs. Addressing the credit gap would sustain the fish industry. By addressing these implications, policymakers and stakeholders can work toward creating a more equitable and productive environment for the fish farmers, with the prospect for broader positive impacts on rural development, food security, and sustainable aquaculture practices (Table 5).

Question items	Yes (%)	No (%)	Total
Do you intend to quit fish farming?	70(60.3)	46(39.7)	116 (100)
Is your farm insured?	14 (12.1)	102(87.9)	116 (100)
Do you receive incentive from the government	32(27.6)	84 (72.4)	116 (100)
Do you have access to credit	42(36.2)	74(63.8%)	116(100)

Table 5: Farmer's Propensity to Quit and Access to Financial Support.

Determinants of Flood Risk Severity

This study shows the determinants of flood risk severity as stated.

Mortality Rates

The results revealed a significant positive relationship between mortality rates and flood risk severity, with a statistically significant coefficient observed at the 5% level. This finding implies that a 1% increase in the mortality rate of fish leads to a corresponding increase in flood risk severity. This indicates that understanding the relationship between fish mortality rates and flood risk severity is pivotal for environmental management and conservation efforts. Policymakers and environmentalists can utilize this information to implement targeted approaches aimed at preserving fish populations, thereby potentially mitigating the severity of flood risks. The study's findings accentuate the significance of integrating ecological factor, like fish mortality rates, into disaster preparedness plans and early warning systems. By considering these variables, authorities can enhance their ability to predict and respond effectively to floods, ultimately reducing the impact on both aquatic ecosystems and human populations residing in flood-prone areas. Understanding the connection between fish mortality and flood risk severity contributes valuable information to climate change adaptation strategies. Adapting fisheries management practices to changing climate conditions can aid in building resilience within aquatic ecosystems, potentially lessening the impact of floods on vulnerable communities. Efforts aimed at ecological restoration and biodiversity conservation can benefit significantly from this research. By focusing on maintaining healthy fish populations, restoration initiatives can create natural buffers against flood risks. Additionally, conserving diverse fish species can enhance ecosystem stability, thereby promoting resilience in the face of environmental disturbances like floods.

Insurance Access

The results reveal a statistically significant negative relationship at the 5% level between the coefficient of insurance access and flood risk severity. This signifies that a reduction in access to insurance is associated with a corresponding increase in the severity of flood risks. This finding carries significant implications for both policy and disaster management, as it underscores the crucial role of insurance accessibility in mitigating and managing flood-related risks. One of the foremost implications of this result is the need for governments, regulatory bodies, and insurance providers to focus on enhancing and expanding insurance access to vulnerable communities in flood-prone areas. By doing so, they can effectively reduce the severity of flood risks and their associated socioeconomic impacts. This might involve implementing policies that promote affordable insurance options, extending coverage to underserved populations, and raising awareness about the significance of flood insurance. The result highlights the usefulness of interdisciplinary collaboration between experts in insurance, risk assessment, and disaster management. By working together, these stakeholders can develop strategies to reduce the barriers to insurance access in flood-prone regions and thereby bolster resilience against flood-related disasters. Ultimately, the study's findings serve as a valuable contribution to the field of disaster risk reduction and management, emphasizing the integral role of insurance access in addressing and mitigating the increasing challenges posed by flood events in a changing climate.

Incentive

The research findings suggest a significant inverse relationship between the coefficient of incentives and flood risk severity at a 1% probability level. This inverse relationship implies that a reduction in incentives provided to fish farmers is associated with a proportional increase in flood risk mortality. In practical terms, this means that if the incentives offered to fish farmers are reduced by one unit, the corresponding consequence is an elevated risk of flood-related fatalities within the studied context. These implications hold important relevance for policymakers, as they highlight the role of incentives in mitigating flood risk and potentially saving lives. The results underscore the need for careful consideration when designing and implementing incentive programs in regions susceptible to flood hazards. Reducing or withdrawing incentives for fish farmers in such areas may inadvertently heighten the vulnerability of these communities to flood-related disasters. Additionally, this finding emphasizes the importance of maintaining or enhancing incentives to bolster resilience and adaptive capacity among fish farming communities in flood-prone regions. Policymakers and stakeholders must recognize the vital role incentives play in reducing the impact of flood events and take proactive steps to align their policies with these findings. Furthermore, these results contribute to the broader discourse on disaster risk reduction strategies, shedding light on the interconnectedness of socioeconomic incentives and flood risk management.

Income

The findings reveal a noteworthy and statistically significant relationship between income and flood risk severity, as indicated by the negative coefficient of income at the 5% significance level. This outcome carries substantial implications for our understanding of how socioeconomic

factors influence flood risk. Specifically, the negative coefficient for income underscores the inverse relationship between income levels and flood risk. This means that as income decreases by one unit, there is a corresponding increase in the severity of flood risk. In practical terms, this implies that individuals or communities with lower income levels are more susceptible to higher flood risk levels. These findings are of great importance to policymakers, disaster management authorities, and urban planners. They suggest that efforts aimed at mitigating flood risk should consider socioeconomic disparities, and targeted interventions may be required to protect vulnerable populations with lower incomes. Moreover, these results emphasize the need for equitable resource allocation and infrastructure development to reduce flood vulnerability in low-income areas.

Output

The findings reveal a compelling relationship between the coefficient of output and flood risk severity. The result has revealed that this coefficient is not only statistically significant but also exhibits a negative association with flood risk severity, as established at the 5% significance level. This crucial discovery underscores the consequential implications for flood risk management and disaster preparedness. To elaborate further, the negative and significant coefficient of output indicates that as the output level decreases by one unit, there is a corresponding and significant increase in flood risk severity. This observation fundamentally underscores the sensitivity of flood risk severity to changes in output levels. The implications of this finding are substantial, as they necessitate a re-evaluation of strategies and policies aimed at flood risk reduction. By recognizing the inverse relationship between output and flood risk severity, stakeholders can prioritize measures to enhance output stability and, thereby, reduce flood risk. This could involve investments in infrastructure resilience, climate change adaptation, and early warning signals, all of which would contribute to the overall goal of flood risk mitigation for meaningful production (Table 6).

Variable	Coefficient	Std error	T	Significance
Mortality	-0.0004699	0.000186	2.524	0.050**
Flood incidence	0.8144698	0.66528	1.224	0.227
Insurance access	-2.522885	0.679358	-3.713	0.001**
Incentive	-3.49414	0.834142	-4.188	0.000***
Access to credit	0.4729499	0.679816	0.695	0.49
Income	-0.0000562	2.07E-05	-2.714	0.026**
Output	-0. 0007678	0.000298	-2.574	0.013**
Constant	32.63274	2.843301	11.48	0
R- square	0.7156			
F- ratio	17.97			

Table 6: Determinants of Flood Risk Severity.

Number of Fish list to flooding

The findings presented in Table 7 provide a comprehensive overview of the impact of flooding on fish loss within the studied population. The result reveals that 56.90% of respondents reported losing 1000 fish or fewer due to flooding, signifying a prevalent issue with relatively low-scale losses. Additionally, 20.69% of respondents experienced losses ranging from 1001 to 2000 fish, while 8.62% incurred losses within the range of 2001 to 3000 fish. Similarly, 8.6% of respondents faced losses in the 3001-4000 range, and 5.17% reported losing fish falling between 4001 and 5000. These statistics underscore the diversity of experiences among respondents in terms of the magnitude of fish loss. The calculated average number of fish loss, standing at 1345, provides a crucial benchmark for understanding the typical impact of flooding on fish stocks in the surveyed area. This average value is indicative of a considerable loss that may not only disrupt the livelihoods of fish farmers but also result in a reduction of profit generation within the affected communities. These findings hold significant implications for all stakeholders in the fishing industry. Measures to mitigate flood-related fish loss are imperative to safeguard the economic well-being of fish farmers. Strategies such as improved flood-resilient aquaculture practices, early warning systems, and disaster preparedness initiatives need to be considered and implemented. Additionally, these results emphasize the importance of continued research and monitoring of environmental factors that contribute to flooding to enhance our understanding of these occurrences

and develop effective strategies to minimize their adverse effects on the livelihoods of fish farmers. By addressing these issues, it is possible to work towards a more sustainable and profitable future for the aquaculture industry in flood-prone regions.

Fish loss	Frequency	Mean
1000 and below	66(56.90)	
1001-2000	24(20.69)	
2001-3000	10(8.62)	1345 fishes
3001-4000	10(8.62)	
4001-5000	6(5.17)	

Table 7: Number of fish lost to flooding.

What is the Level of Risk in Fish Farming?

The findings from Table 8 demonstrate the respondents' perceptions of the level of risk they encountered. It is noteworthy that a significant majority, comprising 58.6% of the total respondents, reported a high-risk level of 75%. Additionally, 19% of the participants indicated a moderate risk level of 50%, while another 19% reported a relatively lower risk level of 25%. Only a small fraction of the respondents, 3.4%, perceived themselves to be facing the highest possible risk level of 100%. These results have significant implications for our understanding of risk perceptions within the studied population. The substantial percentage of respondents reporting a 75% risk level suggests that a majority of individuals in this finding consider themselves to be exposed to a substantial level of risk. Conversely, the presence of both 50% and 25% risk levels among the participants indicates variability in how risk is perceived, with some individuals viewing their circumstances as less risky. Furthermore, the presence of a insignificant but noteworthy proportion of fisherfolks perceiving 100% risk implies that there may be specific individuals who feel that they are in extremely high-risk situations, warranting further investigation. Overall, these findings shed light on the diverse risk perceptions among the respondents, highlighting the need for tailored risk management strategies and interventions to address the varying levels of perceived risk among respondents.

Risk level	Frequency	Percentage
25	22	19.00%
50	22	19.00%
75	68	58.60%
100	4	3.40%

Table 8: What is the Risk Level.

Coping Strategies before Flood

The results in Table 9 provide valuable insights into the coping methods employed by respondents before a flood event and their corresponding rankings based on mean scores. Among these strategies, the most prominent method used for protecting fish farms from the ingress of floodwater is the elevation of embankments, which secures the top position with a mean score of 3.53. Notably, this approach emerged as the most widely adopted and effective strategy in the context of the study. The second most favoured coping strategy was the utilization of tree branches and bamboo, with a mean score of 2.74.

Variable	Mean	Std.dev	Remark	Ranking
Harvest brood fish before flood	1.448	0.5017	Rarely	6th
Harvest and sell of bigger fish from the risky farm	2.086	0.963	Rarely	5th
Protect the fish farm from the entrance flood water by raising embankment	3.535	0.5686	Regularly	1st
Preserve fingerlings for immediate fish culture	2.621	0.895	Regularly	4th
Use branches of trees and bamboo sticks for shelter of fish	2.742	0.8494	Regularly	2nd
Cleaning the surroundings of net of the farm	2.707	1.0431	Regularly	3rd
Mean total	15.14			
Grand mean	2.523			
Coping strategies used index before flood	0.631			

Regularly used ≥ 2.50, not used ≤ 2.50

Table 9: Coping strategies utilized before the flood.

Cleaning the immediate surroundings of the fish farm took the third rank, receiving a mean score of 2.70. In the fourth position, we find the practice of preserving fingerlings for immediate fish culture, which obtained a mean score

of 2.62. The fifth and sixth positions were occupied by the strategies of harvesting and selling larger fish from the flood-prone farm and harvesting brood fish before the onset of a flood, respectively. Interestingly, these strategies were acknowledged as being relatively rare by the fisherfolks in their usage. This results has indispensable implications for flood resilience and adaptation among fish farmers. The finding that only 63% of the available coping strategies were employed before flood events suggests the potential for further optimization and diversification of strategies to enhance production. Furthermore, these findings underscore the significance of embankment construction as a primary and highly effective strategy in mitigating flood-related risks to fish farming operations.

Post-Harvest Coping Strategies

The present study has systematically assessed and ranked the post-harvest coping strategies regularly used by fish farmers, shedding light on their relative utilization and implications. The investigation considered five distinct strategies and their rankings were determined based on mean utilization values. Remarkably, the results unveiled that two strategies emerged as the foremost choices among the fish farmers, each securing the top position with an identical mean value of 2.71. These strategies are "Taking help from relatives/friends" and "Liming flood-affected fish farms." This notable finding suggests that these two approaches are the most frequently employed by the respondents, underscoring their significance and practicality in the context of post-harvest activities in fish farming. Furthermore, the analysis revealed that "Releasing previously-stored fingerlings" occupied the third position in the rankings, with a mean utilization value of 2.57. This strategy, although slightly less popular than the top two, remains a relevant and practical method used by fish farmers in their post-harvest endeavours. On the other hand, "Cleaning flood-affected fishery farms or ponds" and "Taking loans" were ranked fourth and fifth, with mean utilization values of 2.48 and 2.33, respectively. This placement highlights that while these strategies are not as commonly employed as the top three, they still hold significance as post-harvest coping mechanisms in the realm of fish farming. Notably, the cumulative mean utilization value of the post-harvest coping strategies, which amounts to 64%, suggests that the respondents' utilization level is less than optimal, leaving room for improvement. Specifically, there is a 36% gap between the current utilization and the optimal level, signifying a substantial opportunity for enhancement in the adoption and implementation of these strategies by fish farmers. The implication here is that further efforts, education, and support could be directed towards encouraging and facilitating the more widespread and effective use of these post-harvest coping strategies to optimize their impact on fish farming operations (Table 10).

Variable	Mean	Std.dev	Remark	Ranking
Release previously store fingerlings	2.569	0.4995	Regularly	3rd
Take help from relatives/ friends	2.707	0.5622	Regularly	1st
Cleaning flood affected fishery farm/pond	2.483	0.6816	Regularly	4th
Liming flood affected fish farm	2.707	0.5622	Regularly	1st
Take loans	2.328	0.758	Regularly	5th
Mean total	12.8			
Grand mean	2.56			
Coping strategies used index after flood	0.64			

Table 10: Post-Harvest Coping Strategies.

Conclusion

In light of the all-inclusive study conducted, it is clear that fish farmers have been severely affected by the recurring issue of flooding. The Risk Severity Index, with a striking score of 0.8227, confirms the profound impact of this environmental challenge on the fish farming community. The study further identifies a substantial disparity in the cost and returns of fish farming before and after flooding incidents. It is apparent that a significant proportion of farmers are inclined towards quitting the industry due to the high levels of risk and uncertainty they face. Additionally, the research illuminates how factors such as mortality, insurance access, incentives, income levels, and output significantly influence the severity of flood-related risks in this sector. That being apart, addressing the challenges faced by fish farmers in flood-prone areas is a multifaceted endeavour that requires collaboration between fish farmers, government agencies, and other stakeholders. The implementation of the underlisted recommendations would significantly contribute to sustainable fish production.

Recommendations

Promote Pre-Flood Harvesting Strategies: Fish farmers should be actively encouraged to adopt proactive measures such as harvesting brood fish before the onset of flooding and harvesting and selling larger fish from their farms. These strategies can help mitigate the financial losses associated with flood events.

Government Subsidies: The government should consider subsidizing essential farm inputs to alleviate the high-cost burden on fish farmers. By reducing production costs, farmers can maintain their profitability even in the face of frequent flooding.

Cooperative Formation: Encouraging fish farmers to form cooperative societies is imperative. These cooperatives can serve as a valuable resource for accessing funds and shared knowledge in fish production, providing a safety net during challenging times.

Access to Credit Facilities: The government should establish accessible credit facilities tailored to the needs of fish farmers. Access to affordable credit can enable them to make necessary investments in flood-resilient infrastructure and technologies.

Insurance Initiatives: Collaborating with insurance institutions to offer insurance coverage for fish farms is a proactive step. Insurance can provide crucial financial support to farmers during times of risk and uncertainty, promoting resilience within the industry.

Flood Mitigation Infrastructure: Government intervention is essential in embanking areas where fish ponds are consistently affected by flooding. These embankments can help protect the farms, reducing the frequency and severity of flood-related losses.

Incentive Programs: The government should consider implementing incentive programs for fish farmers to incentivize them to remain in the business. These incentives can include tax breaks, grants, or other financial support.

Capacity Building: Organizing training programs for fish farmers is essential. These programs should equip them with the knowledge and skills necessary to implement coping strategies effectively, ultimately reducing the impact of flooding on their operations.

Extension Services: To promote modernization and technological advancement in fish farming, the government should facilitate regular visits by extension agents to fish farmers. These agents can impart knowledge about the latest innovations and best practices in the industry, increasing overall resilience.

References

1. De Souza FB, Yoshida CYM (2022) Extreme global climate change effects on human dimension: Challenges of protection for vulnerable people. International Journal of Environmental Resilience Research and Science-IJERRS 4(3): 1-20.

2. Griggs G, Reguero BG (2021) Coastal adaptation to climate change and sea-level rise. Water 13(16): 2151.

3. Hamlington BD, Gardner AS, Ivins E, Lenaerts JT, Reager JT, et al. (2020) Understanding of contemporary regional sea-level change and the implications for the future. Reviews of Geophysics 58(3): e2019RG000672.

4. Yu X, Luo L, Hu P, Tu X, Chen X, et al. (2022) Impacts of sea-level rise on groundwater inundation and river floods under changing climate. Journal of Hydrology 614: 128554.

5. Croteau R, Pacheco A, Ferreira Ó (2023) Flood vulnerability under sea level rise for a coastal community located in a backbarrier environment, Portugal. Journal of Coastal Conservation 27(4): 28.

6. Lawanson OI, Proverbs D, Ibrahim RL (2023) The impact of flooding on poor communities in Lagos State, Nigeria: The case of the Makoko urban settlement. Journal of Flood Risk Management 16(1): e12838.

7. Kaze D (2020) Inundations, boundaries and intersections: flood as narration in Nigerian literature. Green Letters 24(1): 23-35.

8. Dauda JH, Kolo MD (2022) Effects of Flooding on Internally Displaced Persons (IDPs) in a Flood Prone Area: A Case Study of Muye Town in Lapai Local Government Area, Niger State, Nigeria. KIU Journal of Social Sciences 8(2): 157-168.

9. Buba FN, Obaguo S, Ogah O, Ajayi FO (2021) A Participatory Assessment of the Impact of Flooding in Some Communities in Lokoja, Kogi State, Nigeria. American Journal of Climate Change 10(1): 12-31.

10. Week DA, Wizor CH (2020) Effects of flood on food security, livelihood and socio-economic characteristics in the flood-prone areas of the core Niger Delta, Nigeria. Asian Journal of Geographical Research 3(1): 1-17.

11. Echendu AJ (2020) The impact of flooding on Nigeria's sustainable development goals (SDGs). Ecosystem Health and Sustainability 6(1): 1791735.

12. Kirkpatrick JIM, Olbert AI (2020) Modelling the effects of climate change on urban coastal-fluvial flooding. Journal of Water and Climate Change 11(S1): 270-288.

13. Sondermann M, Chou SC, Tavares P, Lyra A, Marengo JA, et al. (2023) Projections of Changes in Atmospheric Conditions Leading to Storm Surges along the Coast of

Santos, Brazil. Climate 11(9): 176.

14. Olufunmilayo Jimoha M, Olakunle Bilewu S, Saheed Aremu A, Solihu H (2023) Multidimensional Approach to Mitigating Flood Risks and Impact: A Case Study of Rice Farming in Nigeria. Journal of Advanced Environmental Research and Technology 1(1): 27-38.

15. Pradhan B, Shit PK, Bhunia GS, Adhikary PP, Pourghasemi HR (2022) Introduction to Spatial Modeling of Flood Risk and Hazard: Societal Implication. Spatial Modelling of Flood Risk and Flood Hazards: Societal Implications. Springer International Publishing, pp: 1-13.

16. Agwumafa FO, Weli VE, Eludoyin SO (2021) Livelihood assets and socio-economic characteristics of communities to flood hazards in Central Niger Delta, Nigeria. World Journal of Advanced Research and Reviews 11(3): 9-22.

17. Afia OE, Iwatt IJ (2023) Impacts of Flooding on the Aquaculture Sector. IN: Ayandele, IA, pp: 333-340.

18. Ekeu-Wei IT, Blackburn GA, Giovannettone J (2020) Accounting for the effects of climate variability in regional flood frequency estimates in Western Nigeria. Journal of Water Resource and Protection 12(8): 690-713.

19. Areola F, Fakoya K (2021) Evaluating the Development Trend of Flood Mitigation and Adaptation Strategies for Fisheries and Aquaculture in Nigeria. Handbook of Climate Change Management: Research, Leadership, Transformation. Springer International Publishing, pp: 2001-2023.

20. Abubakar B, Umar H, Barde MM, Adamu S (2020) Socio-economic Impact of Flooding on the Riverine Communities of River Benue in Adamawa State, Nigeria. FUTY Journal of the Environment 14(2): 116-124.

21. Nnadi GO, Ezeani OE, Nnadi HC (2020) The National Emergency Management Agency (NEMA) and the challenge of effective management of internally displaced persons in north-eastern Nigeria. IOSR Journal of Humanities and Social Science (IOSR-JHSS) 25(5): 14-27.

22. Gbigbi TM (2021) Technical Efficiency and Profitability of Cassava Production in Delta State: A Stochastic Frontier Production Function Analysis. Journal of Tekirdag Agricultural Faculty 18(1): 21-31.

23. Gbigbi TM, Osun T (2014) Technical Efficiency and Economic Returns in Artisanal Fishery in the Niger Delta, Nigeria. International Journal of Fisheries and Aquatic Studies 2(1): 184-188.

24. Gbigbi TM (2013) Fishing in oil spillages zone: A case study of Burutu Local Government Area of Delta State, Nigeria. African Journal of Agricultural Research 8(16): 1563-1569.

25. Iyiola AO, Asiedu B, Oyewole EO, Akinrinade AJ (2022) Impacts of Climate Change on Aquatic Biodiversity in Africa. Biodiversity in Africa: Potentials, Threats and Conservation. Springer Nature, Singapore, pp: 369-394.