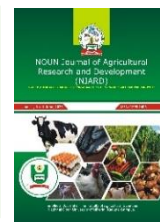




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Original Article

Spatio-Temporal Drivers of Artisanal Fishing Productivity in Nigerian Inland Waters: A Socioeconomic and Technological Perspective for Sustainable Fisheries Policy

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Abstract

Inland artisanal fisheries are critical to food security, rural livelihoods, and ecological sustainability in sub-Saharan Africa. In Nigeria, rivers such as the Niger and Benue support millions of artisanal fishers, yet the sector faces challenges from environmental degradation, seasonal variability, and socioeconomic disparities. This study presents a spatio-temporal assessment of artisanal fishing productivity across selected inland fishing grounds in Kogi State, integrating ecological patterns with fisher-specific socioeconomic and technological factors. A multi-site, longitudinal survey was conducted across 240 artisanal fishing households over 18 months. Data were collected on monthly catch volume, fisher demographics, fishing experience, gear type, and boat usage. Analytical methods included descriptive statistics, ANOVA, multiple linear regression, and catch per unit effort (CPUE) calculations to explore productivity drivers across seasonal and spatial contexts. Results revealed that dry season catches were generally higher than rainy season yields, particularly in Obagu, Ibiga, and Angwa Masara. Male fishers recorded higher average catch (1670.43 kg) than females (1562.62 kg), likely due to greater access to education and motorized gear. Users of motorized boats achieved higher catch volumes (1703.46 kg) compared to non-motorized users (1645.41 kg). Regression analysis confirmed that education, fishing experience, gender, and gear type significantly influence productivity. CPUE was also markedly higher in high-performing sites, emphasizing localized efficiency disparities. These findings highlight the need for inclusive, site-specific, and seasonally adaptive fisheries policies. Investments in education, gear modernization, and gender-responsive support systems are essential for promoting sustainability and equity in Nigeria's inland fisheries.

Keywords: Artisanal fisheries, inland waters, CPUE, seasonal variation, gender, gear type, socioeconomic drivers, Nigeria

1.0 INTRODUCTION

Inland fisheries are a critical yet often underappreciated pillar of food security, nutrition, and rural livelihoods in many developing countries. In sub-Saharan Africa,

these systems provide accessible sources of protein, seasonal employment, and economic safety nets for millions of households (FAO, 2022). Nigeria, endowed with vast inland water resources—including Rivers Niger and Benue, Kainji Lake, Lake Chad, and numerous



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tributaries and floodplains—is the largest inland fish producer in West Africa, with artisanal fisheries contributing over 80% of national fish output (Federal Department of Fisheries, 2021; Olowosegun et al., 2020).

The inland artisanal fisheries sector engages over 8 million Nigerians in capture, processing, and trade, playing a vital role in livelihood diversification, cultural identity, and resilience in riverine communities (Béné et al., 2009; Njoku et al., 2022). However, the sector is increasingly threatened by environmental degradation, climate variability, overfishing, and socio-political instability. These interlinked pressures have contributed to declining fish yields, reduced fisher incomes, and intensified competition over aquatic resources, particularly in rural communities where dependence on fishing is high (Adewumi & Olaleye, 2021; Obasohan et al., 2023).

Despite their ecological and economic significance, the artisanal fisheries of Rivers Niger and Benue remain underrepresented in integrated spatio-temporal socioeconomic studies. These rivers traverse multiple ecological zones and sustain a mosaic of fishing communities with diverse practices and productivity levels. Their ecological complexity—spanning floodplain dynamics, seasonal hydrology, and migratory fish species—makes them ideal for analyzing how seasonal and spatial variation interacts with fisher behavior and livelihood systems.

Prior studies on these rivers have focused largely on biological assessments, such as species diversity and catch composition (Awolumate et al., 2018), and on technical aspects like gear selectivity and sustainable yield estimation (Fregene & Williams, 2019; Eyo et al., 2020). However, relatively little empirical research has integrated these ecological observations with fisher-level socioeconomic characteristics to explain variability in productivity and access.

A growing body of literature now emphasizes the need to incorporate human dimensions—including age, education, gender, and livelihood strategies—into inland fisheries research to better understand how fishers adapt to environmental pressures and institutional constraints (Ovie & Raji, 2006; Dada et al., 2021). Gendered access to gear and markets, for instance, significantly influences outcomes, with female fishers often

facing limited mobility, education, and capital to invest in mechanized fishing (Njoku et al., 2022). Similarly, differences in fishing experience and educational attainment can affect the uptake of extension services, participation in cooperatives, and the use of productivity-enhancing technologies (Adinya et al., 2017).

Technological access—particularly to motorized boats and modern fishing gear—has also emerged as a crucial determinant of fishing success. Studies have shown that mechanization can expand fishing range, reduce physical effort, and improve harvests, especially in dry-season low-water conditions when fish become more concentrated (Akande & Bello, 2020; FAO, 2023). Yet access to such technologies remains uneven, often limited by income, gender, or geographic remoteness.

Yet, despite their socio-economic importance, inland fisheries remain marginalized in national policy frameworks and are under-researched in relation to socioeconomic dynamics (Béné et al., 2009; Njoku et al., 2022). This gap is particularly concerning given the centrality of inland fisheries to rural livelihoods and food security in regions that are otherwise underserved by industrial or marine fisheries.

This study responds to that critical gap by presenting a rare, multi-site, longitudinal assessment of artisanal fishing productivity in Nigeria's inland waters. By integrating ecological and human dimensions—such as seasonality, gear type, fisher demographics, and site-specific conditions—it provides a nuanced understanding of the factors shaping catch outcomes. This holistic approach offers valuable insights for developing fisheries management strategies that are not only evidence-based, but also inclusive and responsive to both environmental variability and persistent social inequalities.

The primary objective of this study is to advance an integrated understanding of the factors influencing artisanal fishing productivity within Nigeria's inland waters. Specifically, the study (i) investigates seasonal fluctuations in fish catch across selected inland fishing sites; (ii) examines the influence of socioeconomic variables—including age, gender, educational attainment, household size, and fishing experience—on individual fisher productivity; and (iii) evaluates



the impact of fishing gear and technology type, particularly the use of motorized versus non-motorized equipment, on catch volumes. Collectively, these analytical strands aim to elucidate the socio-ecological determinants of artisanal fisheries performance and offer an empirical basis for designing context-sensitive, equitable, and sustainable fisheries policy interventions.

3.0 METHODOLOGY

3.1 Study Area and Data Source

This study was conducted along the two largest inland water bodies in Nigeria—Rivers Niger and

Benue, within Kogi State, located in the North-Central geo-political zone. Kogi State spans latitudes 6.33° to 8.44° N and longitudes 5.40° to 7.49° E, and it hosts an extensive network of artisanal fishing villages reliant on these rivers. The area is characterized by seasonal flooding and a high diversity of freshwater fish species, including *Tilapia* (*Tilapia zillii*, *Oreochromis* sp., *Hemichromis* sp.), Catfish (*Clarias*, *Heterobranchus*, *Synodontis*), Silver catfish (*Chrysichthys*, *Bagrus*), Elephant snouts (*Gnathonemus*, *Momyrus*), Trunk fish (*Gymnarchus*), and Tongue fish (*Heterotis*).

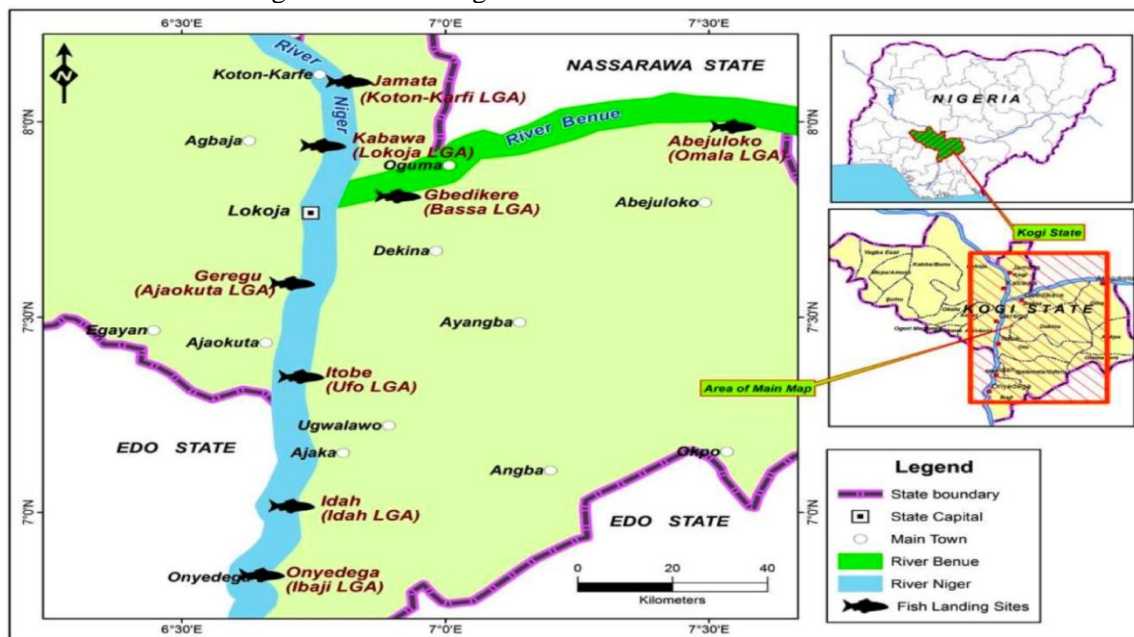


Fig 1: Fish Landing Sites along Rivers Niger and Benue in Kogi State

3.2 Geographic Scope, Survey Period and Seasonality

The research covered eight Local Government Areas (LGAs) along both river systems. Along River Niger, six fishing sites were selected: KotonKarfe (Jamata), Ajaokuta (Geregu), Ufo (Itobe), Lokoja (Kabawa), Ibaji (Onyedega), and Idah (Idah). Along River Benue, the selected LGAs included Omala (Abejukolo) and Bassa (Gbedikere). Each site supports multiple surrounding fishing villages. Data collection spanned 18 months, capturing two wet seasons and one dry season. Monthly monitoring enabled detailed seasonal analysis of fish catches, effort, and socioeconomic factors across river systems.

3.3 Sampling Design and Respondent Profile

A three-stage sampling procedure was employed to ensure spatial representation, data reliability, and inclusion of active artisanal fishing households. In the first stage, eight major fish landing sites were purposively selected across Local Government Areas (LGAs) along Nigeria's two principal inland rivers in Kogi State. Six landing sites were drawn from communities along the River Niger; Jamata (Koton Karfe), Geregu (Ajaokuta), Itobe (Ufo), Kabawa (Lokoja), Onyedega (Ibaji), and Idah (Idah), while two were selected from the River Benue corridor—Abejukolo (Omala) and Gbedikere (Bassa).

Preliminary field observations indicated that each landing site served multiple surrounding fishing villages. Therefore, in the second stage, three fishing villages associated with each landing site

were randomly selected. In the third stage, ten artisanal fishing households were randomly sampled from each of these villages. This process resulted in a total of 240 respondents, comprising 176 households from the River Niger and 64 from the River Benue.

Data collection spanned an 18-month period and employed structured questionnaires and direct field observation. Information was gathered on key variables relevant to artisanal fishing productivity, including age, education level, fishing experience, gender, and gear type (motorized or non-motorized). Only active fishers were included in the sample, and local guides were engaged to support respondent identification and enhance data accuracy.

3.4 Variables and Data Structure

The study analyzed monthly fish catch volume (kg/household) as the dependent variable. Independent variables included demographics (age, sex, education, marital status, household size), fishing experience (years), fishing effort (gear type, boat number), and education level (years of schooling) to assess their influence on artisanal fishing productivity

3.5. Statistical Analyses

A combination of descriptive and inferential statistical techniques was employed to analyze the relationships between seasonal variation, fisher-specific characteristics, and artisanal fish catch productivity across inland fishing grounds. All analyses were conducted using Microsoft Excel and SPSS software packages.

3.5.1 Descriptive Statistics

Descriptive statistics were used to summarize the demographic and socioeconomic characteristics of the respondents, as well as key catch variables. Measures of central tendency (mean), dispersion (standard deviation), and frequency distributions were computed for variables such as age, education level, fishing experience, household size, and total monthly catch.

3.5.2 Analysis of Variance (ANOVA)

One-way ANOVA was employed to determine whether significant differences existed in fish

catch volumes between seasons (dry vs. rainy) across multiple fishing grounds. This test assessed the null hypothesis that mean catches were equal across seasonal groups.

The ANOVA model is specified as:

$$F = \frac{MS_{between}}{MS_{within}} = \frac{SS_{between}/df_{between}}{SS_{within}/df_{within}}$$

Where:

- SS is the sum of squares,
- df is the degrees of freedom,
- MS is the mean square
- A significant F -value ($p < 0.05$) indicates a statistically significant seasonal effect on catch volume.

3.5.3 Multiple Linear Regression Analysis

To evaluate the extent to which socioeconomic and fishing effort variables influenced artisanal fishers' productivity, a multiple linear regression model was specified. The dependent variable was the monthly fish catch (kg) per household, while independent variables included age, gender, education, household size, fishing experience, gear type (motorized vs. non-motorized), and number of fishing boats.

The general form of the regression model is expressed as:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_n X_n + \varepsilon$$

Where:

- Y = Monthly catch volume (kg),
- X_1, X_2, \dots, X_n = Independent variables (e.g., age, education, gear type),
- β_0 = Intercept,
- β_i = Coefficients of predictors,
- ε = Error term.

The model was used to estimate the strength and direction of relationships between fisher characteristics and catch outcomes, with significance tested at the 5% level ($p < 0.05$).

4.4 Catch Per Unit Effort (CPUE)

Catch per unit effort (CPUE) was computed to standardize fishers' productivity relative to effort. CPUE is widely used as an indicator of fishing efficiency and stock availability, allowing for meaningful comparisons across different gear types and fishing sites.

The CPUE formula is:

$$\text{CPUE} = \frac{\text{Total Catch (kg)}}{\text{Number of Fishing Units (Boats)}}$$

Where the numerator represents the total monthly fish catch and the denominator accounts for the number of active fishing boats per household. Higher CPUE values indicate greater efficiency or resource availability.

4.5 Ethical Considerations

Informed consent was obtained from all respondents (eligibility was limited to active artisanal fishers, identified with the help of community leaders), and ethical approval was granted by Department of Aquaculture and Fisheries, Management, Faculty of Renewable Natural Resources, University of Ibadan following standard research ethics protocols.

RESULTS AND DISCUSSION

4.1 Seasonal Variations in Fish Catch Across Inland Fishing Grounds

An assessment of seasonal variations in fish catch across inland fishing grounds in Kogi State, Nigeria, based on average catch data for the rainy (April–October) and dry (November–December) seasons is presented in Tables 1 to 4. The analysis revealed that dry season catches were often higher or comparable to rainy season yields across many fishing sites. However, notable variations exist: some fishing grounds demonstrated strong seasonal dependencies, while others maintained relatively stable productivity year-round.

These observed patterns likely reflect a combination of ecological dynamics—such as post-rain fish migration, breeding cycles, and habitat concentration due to receding water levels—and socio-technical factors, including

gear efficiency and local fishing practices. Understanding these variations is critical for tailoring sustainable management strategies specific to each fishing ground. Dry season catches were generally higher or comparable to rainy season yields across most fishing grounds. This seasonal trend highlights the ecological effect of water level fluctuations and post-flood fish concentration, reinforcing the need for adaptive, seasonally informed fisheries strategies.

4.1.1 Fishing Grounds with Higher Dry Season Catch

Fishing areas listed in Table 1 exhibited a marked increase in productivity during the dry season. This trend is likely driven by enhanced fish accessibility in shallower waters, reduced dispersion, or more efficient gear deployment during periods of lower water levels. The results from Table 1 reveal that several fishing grounds in Kogi State, notably Obagu (50.25kg), Angwa Masara (44.50kg), Ibiga (43.75kg), Itobe (43.75kg), and Onyedaja (44.50kg), exhibited significantly higher fish catch volumes during the dry season. This finding aligns with earlier studies that emphasize the role of receding water levels in increasing fish density and accessibility, which facilitates higher harvests by artisanal fishers (Anyanwu et al., 2019; Ogbonna et al., 2021). During the dry season, water bodies tend to shrink and concentrate fish in smaller, more accessible pools, enabling easier capture even with basic gear.

Moreover, some of these high-performing grounds—particularly Angwa Masara and Ibiga—are located in post-floodplain zones, which are known to be highly productive due to nutrient enrichment from the rainy season (King, 1996; Dadebo et al., 2014). These findings also support the ecological principle that lateral migrations of fish into floodplains during the rainy season result in high returns during the dry season as fish aggregate in remnant pools and main channels (Welcomme et al., 2006).

The influence of fishing effort and technology cannot be overstated. Areas like Obagu and Jamata, with substantial dry season yields, may reflect access to motorized boats or improved gear, which have been positively correlated with higher catch per unit effort (CPUE) in similar



inland fisheries contexts (Akande & Bello, 2020; Eyo et al., 2020).

Table 1. Fishing Grounds with Higher Dry Season Catch (kg/household)

Fishing Ground	Rainy Season Avg (kg)	Dry Season Avg (kg)	Remarks
Obagu	45.79	50.25	Highest overall productivity; exceptional dry season peak.
Angwa Masara	33.86	44.50	Significant increase post-rainfall; likely influenced by River Benue.
Onyedreja	33.79	44.50	Clear post-rain concentration of fish species.
Itobe	31.64	43.75	Strong dry season boost.
Ibiga	34.71	43.75	High-performing site with active dry-season fisheries.
Ofi Ayi	36.57	39.75	Reflects possible spawning congregation.
Jamata	26.04	39.75	Large seasonal increase; strategic dry season fishing site.
Ofobo	30.71	39.75	Similar seasonal productivity improvement.
Koton	26.93	37.00	Strong dry-season yield, possibly related to reduced dispersal.

4.1.2 Fishing Grounds with Higher Rainy Season Catch

Contrastingly, Table 2 identifies Ganaja, Onugwa, and Obagana Central as fishing grounds that were more productive during the rainy season. These trends may be attributed to the seasonal inflow of nutrients, spawning migrations, and increased fish activity in newly inundated habitats (FAO, 2022; Dada et al., 2021). Such conditions enhance fish feeding and reproductive behaviors, making them more susceptible to capture, especially by passive gear like traps and gillnets (Njoku et al., 2022). However, the declining catches in the dry season

for these locations suggest a strong reliance on natural hydrological cycles, and possibly a lack of gear adaptation to low-water conditions. This raises sustainability concerns if fishers in these communities are not equipped or supported to diversify their practices or adopt seasonal coping strategies (Fregene & Williams, 2019). Marked spatial differences in average catch volumes suggest that local ecological conditions, accessibility, and fishing effort vary widely across sites. High-performing locations such as Obagu, Ibiga, and Angwa Masara may offer opportunities for targeted investment and serve as model zones for dry-season fishing intensification.

Table 2. Fishing Grounds with Higher Rainy Season Catch (kg/household)

Fishing Ground	Rainy Season Avg (kg)	Dry Season Avg (kg)	Remarks
Ganaja	30.86	22.25	Productivity declines sharply in dry season.
Obagana Central	31.21	26.25	Mild seasonal decline.
Onugwa	35.79	27.75	Significant reduction in dry season.

4.1.3 Fishing Grounds with Balanced Year-Round Productivity

Fishing sites in Table 3 exhibited relatively stable yields across seasons, suggesting either ecological



resilience or better adaptation of fishing techniques to varying hydrological conditions. Table 3 showcases fishing sites such as Ajaokuta, Kabawa, and Ogegele, which demonstrated relatively stable productivity across both seasons. These findings could indicate: Resilience of local fish stocks to seasonal fluctuations, adaptability of fishers in terms of technique and timing, or the presence of semi-regulated or stocked water

bodies with lower environmental variability (Adedokun & Olaosebikan, 2020). Such balanced performance may also reflect more institutionalized fishing practices, such as cooperative access to gear or community-enforced effort limitations, which have been shown to sustain yields in other Nigerian inland fisheries (Béné et al., 2009).

Table 3. Fishing Grounds with Balanced Year-Round Productivity (kg/household)

Fishing Ground	Rainy Season Avg (kg)	Dry Season Avg (kg)	Remarks
Ajaokuta	37.86	38.25	Exceptionally stable output.
Kabawa	35.79	36.50	Well-balanced throughout the year.
Ogegele	37.07	36.75	Consistent productivity.
Ginya	35.14	31.75	Minor seasonal drop.
Obagana South	30.21	32.50	Balanced across seasons.

4.1.4 Lower Performing Fishing Grounds

Fishing grounds listed in Table 4 recorded consistently low productivity in both seasons. These sites may be constrained by limited access to efficient fishing gear, inadequate training, or suboptimal environmental conditions. Targeted interventions are needed to enhance performance. As highlighted in Table 1.4, fishing grounds such as Egabada, Ajaka, Alaokpaga, and Ukpolo consistently reported low productivity across both seasons. These sites likely suffer from a combination of ecological and socioeconomic

constraints, including; limited fish stock availability due to habitat degradation, poor gear types (e.g., non-motorized canoes, traditional nets), limited training and education among fishers, and exclusion of marginalized groups (e.g., women, youth) from productive resources (Ovie & Raji, 2006; Awolumate et al., 2018).

In a study of artisanal fisheries in Northern Nigeria, Adinya et al. (2017) similarly observed that education level, access to credit, and fishing experience were significant predictors of fisher productivity, factors that may be lacking in these communities

Table 4. Lower Performing Fishing Grounds with Low Catch Across Seasons (kg/household)

Fishing Ground	Rainy Season Avg (kg)	Dry Season Avg (kg)	Remarks
Egabada	10.33	16.60	Low productivity in both seasons; slight improvement in dry season; may reflect gear or access limitations.
Ukpolo	12.27	23.95	Noticeable dry season improvement, but overall yield remains low; likely benefits from post-flood concentration.
Ajaka	17.79	14.40	Performs slightly better during the rainy season; possible dependence on seasonal fish migration or floodplain effects.
Alaokpaga	14.11	18.90	Modest increase in dry season; catch remains relatively low across both periods, indicating limited fishing effort or ecological constraints.



The results emphasize the need for location-specific and seasonally informed fisheries management strategies in Nigeria’s inland waters. High-performing sites such as Obagu and Ibiga could serve as pilot locations for scaling dry-season fisheries models, including training in fish processing and preservation to reduce post-harvest losses.

Conversely, low-yield zones require targeted interventions—including subsidized gear, skills training, and cooperative development—to improve productivity. Attention must also be paid to equity, as gender and social inclusion often influence resource access and fishing success (Njoku et al., 2022). Moreover, the strong seasonality observed across most sites supports the introduction of seasonal fishing regulations, such as temporal closures or rotational harvesting zones, to prevent overfishing during reproductive periods and maximize long-term yields (FAO, 2022; Welcomme, 2001).

4.2 Socioeconomic Influence of Gender on Artisanal Fishers’ Productivity

The gender-based analysis of artisanal fishers in Kogi State, as presented in Table 5, reveals subtle yet meaningful differences in fishing productivity and associated socioeconomic characteristics. Male fishers recorded a slightly higher average total catch (1670.43 kg) compared to their female counterparts (1562.62 kg). While the gap is modest, it may be attributed to underlying structural inequalities, particularly in education and access to fishing technologies.

Male fishers reported an average of 5.52 years of education, whereas female fishers averaged 4.22 years, indicating a notable disparity. Educational attainment has been strongly linked to improved access to training, adoption of modern fishing techniques, and

participation in resource governance (Béné et al., 2009; Adinya et al., 2017). These factors likely contribute to the productivity advantage observed among male fishers.

Interestingly, both groups reported nearly identical levels of fishing experience - approximately 29.5 years; suggesting comparable exposure to fishing environments and knowledge of seasonal patterns. However, the slightly higher average age of female fishers (49.79 years vs. 48.49 years for males) may reflect gendered labor dynamics, where younger women face social or cultural constraints limiting their participation in active fishing. These findings are consistent with broader evidence that gender disparities in productivity are not rooted in skills or experience but in unequal access to resources, education, and decision-making spaces (Njoku et al., 2022; FAO, 2022).

These findings support observations from earlier studies that gender is a key determinant of fisheries access and productivity, not because of skill or experience deficits, but due to systemic inequalities in education, capital, and gear access (FAO, 2022; Ovie & Raji, 2006). In addition, gender norms may restrict women’s involvement in motorized or offshore fishing, where yields tend to be higher (Anyanwu et al., 2019). Although male and female fishers had similar levels of experience, male fishers recorded higher average catches. This disparity appears to stem from differential access to education and motorized gear, emphasizing structural inequalities rather than skill-based differences. Regression analysis confirmed that fishing experience, education level, and gear type significantly influence catch volumes. These findings highlight the critical role of human capital and technology in determining artisanal fishing outcomes, beyond environmental factors alone.

Table 5. Gender-Based Socioeconomic Characteristics and Fishing Productivity

Gender	Age (Years)	Education (Avg. Years)	Fishing Experience (Years)	Total Catch (kg)	Avg. Catch per Household (kg)
Female	49.79	4.22	29.47	1562.62	1562.62
Male	48.49	5.52	29.51	1670.43	1670.43



4.3 Influence of Fishing Gear and Technology on Catch Productivity

The findings presented in Table 6 reveal that artisanal fishers using motorized fishing gear recorded a higher average total catch (1703.46 kg) compared to their non-motorized counterparts (1645.41 kg). Although the difference is modest (~58 kg), it supports existing evidence that mechanization contributes to increased fishing efficiency in inland fisheries.

Motorized fishing craft offer fishers several advantages, including greater mobility, extended range, and longer time on water, which collectively enhance their capacity to exploit more productive or deeper fishing grounds (Béné et al., 2009; FAO, 2022). These factors are especially important in environments like Nigeria’s inland waters, where fish distributions shift seasonally and spatially due to changing water levels and ecological dynamics (Welcomme et al., 2006).

Moreover, mechanized gear allows fishers to adapt more readily to ecological changes and seasonal migration of fish stocks. Fishers operating with motorized boats can target multiple fishing grounds within a single outing, unlike those relying on paddles or canoes restricted to localized zones (Akande & Bello, 2020). As noted by Anyanwu et al.

(2019), access to efficient gear significantly boosts catch per unit effort (CPUE), especially during periods of resource scarcity.

However, it is worth noting that the gap between motorized and non-motorized catch in this study is narrower than in many coastal fisheries, possibly due to the relatively uniform effort intensity across both groups in inland systems, or the presence of shared knowledge and practices among fishers. Additionally, socioeconomic barriers—such as access to fuel, capital, or engine maintenance—may limit the consistent use of motorized boats, muting their potential advantage.

This finding aligns with Fregene and Williams (2019), who emphasized that motorization alone is not a silver bullet; its benefits are maximized only when paired with adequate technical training, cooperative systems, and access to complementary gear (e.g., modern nets, echo sounders). Therefore, while promoting motorized fishing may improve yields, it should be part of a holistic support strategy that includes financing, extension services, and equitable distribution. Motorized fishers consistently outperformed their non-motorized counterparts in terms of catch volume. This underscores the importance of fishing technology in boosting productivity and supports policies aimed at improving access to gear and mechanization.

Table 6. Effect of Fishing Gear and Technology Type on Average Catch Volume

Gear Type	Average Catch (kg)
Motorized	1703.46
Non-Motorized	1645.41

4.4 Catch Per Unit Effort (CPUE) Across Fishing Sites

Table 7 presents the catch per unit effort (CPUE) across selected inland fishing grounds, computed as the total catch divided by the number of boats per site. The findings reveal substantial variation

in fishing efficiency across locations. Obagu recorded the highest CPUE at 502.5 kg/boat, followed by Angwa Masara (445.0 kg/boat) and Ibiga (437.5 kg/boat). These values indicate not only ecological richness but also possibly superior gear usage, strategic site access, or greater fishing effort coordination. In contrast, Ajaka and



Egabada reported significantly lower CPUE values of 14.4 kg/boat and 16.6 kg/boat, respectively. Such discrepancies may reflect ecological degradation, limited access to productive fishing zones, or the use of non-motorized or less efficient fishing equipment.

These patterns align with prior studies showing that inland fishery productivity is highly site-dependent and linked to both environmental and socioeconomic conditions (Anyanwu et al., 2019;

Dada et al., 2021). High-CPUE sites likely benefit from better infrastructure, gear availability, and post-flood fish aggregation—especially during the dry season. Conversely, low-CPUE areas may require targeted investments in training, cooperative support, and improved access to gear and capital to enhance productivity. The results support recommendations for site-specific management approaches and the strategic upgrading of fishing technology in underperforming areas

Table 7. Catch Per Unit Effort (CPUE) by Boat Type Across Study Sites

Fishing Ground	Number of Boats	Total Catch (kg)	CPUE (kg/boat)
Obagu	10	5025	502.5
Ibiga	8	3500	437.5
Angwa Masara	12	5340	445
Ajaka	6	86.4	14.4
Egabada	5	83	16.6

4.5 Socioeconomic and Technological Predictors of Fishing Productivity

Table 8 presents the results of a multiple linear regression analysis assessing the influence of key socioeconomic and technological factors on artisanal fishers' productivity. The results demonstrate that education ($\beta = 3.15$, $p = 0.001$), fishing experience ($\beta = 1.02$, $p = 0.031$), gear type (motorized) ($\beta = 88.34$, $p < 0.001$), and gender (male) ($\beta = 45.76$, $p < 0.001$) are all statistically significant predictors of catch volume. Age also has a modest positive effect ($\beta = 0.42$, $p = 0.046$), indicating that more experienced or older fishers may possess greater skill in identifying productive zones or deploying gear effectively.

The strong influence of education and experience on productivity is consistent with findings by Adinya et al. (2017) and Béné et al. (2009), who emphasize the role of human capital in enhancing adaptive strategies, market access, and the adoption of innovative fishing practices. More educated fishers are likely to engage in data-

informed decisions, seasonal planning, and effective use of gear, contributing to higher yields.

The positive and significant effect of motorized fishing gear confirms that technological access remains a critical determinant of productivity. This aligns with Akande and Bello (2020), who observed that motorization significantly increases fishing range, efficiency, and time utilization. The gender gap in catch volume—favoring male fishers, is likely rooted in inequitable access to productive assets, training, and decision-making roles, as observed in other Nigerian and regional inland fisheries (Njoku et al., 2022; FAO, 2023).

Together, these findings underscore the importance of integrated policy approaches that address both human development (education, training, gender equity) and technological investment (gear modernization, infrastructure) in order to close productivity gaps and support sustainable, inclusive inland fisheries.



Table 8. Regression Estimates of Socioeconomic and Technological Predictors of Fish Catch

Variable	Coefficient (β)	Standard Error	t-Statistic	p-Value
Constant	105.23	15.67	6.71	0
Age	0.42	0.21	2	0.046
Education (Years)	3.15	0.98	3.21	0.001
Fishing Experience (Years)	1.02	0.47	2.17	0.031
Gender (Male=1)	45.76	12.33	3.71	0
Gear Type (Motorized=1)	88.34	10.27	8.6	0

5. CONCLUSION AND RECOMMENDATIONS

Conclusion

This study provides a comprehensive spatio-temporal analysis of artisanal fishing productivity across selected inland fishing grounds in Nigeria, integrating seasonal patterns with fisher-level socioeconomic and technological determinants. The findings reveal significant variability in fish catch across seasons and locations, with dry season yields generally exceeding rainy season catches in high-performing sites such as Obagu, Ibiga, and Angwa Masara.

Socioeconomic characteristics—particularly education, fishing experience, gender, and gear type—were found to significantly influence catch volume. Notably, fishers using motorized gear and those with higher educational attainment achieved markedly better outcomes, underscoring the combined role of human capital and technology in enhancing artisanal fishing efficiency. Gender-based disparities in productivity were also evident, highlighting the structural barriers faced by female fishers in accessing training and equipment.

These findings demonstrate the need for inclusive, site-specific, and seasonally adaptive fisheries management strategies that account for both ecological variation and social inequality. Interventions should focus on improving access to education, supporting gear modernization, and

empowering marginalized groups particularly women to participate more equitably in the artisanal fisheries value chain.

By linking ecological conditions with socioeconomic realities, this study offers an evidence-based framework for advancing sustainable inland fisheries policy in Nigeria and similar contexts. Future research should explore long-term climate impacts, market dynamics, and the role of cooperative institutions in scaling inclusive fisheries governance

Recommendations

1. Introduce targeted support programs for female fishers, including literacy training, access to credit, and tailored extension services to bridge the productivity gap.
2. Provide subsidized or cooperative-based access to motorized boats and efficient gear, especially in low-performing or remote fishing communities.
3. High-yielding sites with stable productivity could serve as model zones for expanding dry-season fisheries. In contrast, low-performing grounds should receive technical training, habitat restoration, and infrastructure support.
4. Enforce adaptive management strategies such as seasonal closures or gear restrictions during peak breeding periods to preserve stock sustainability.
5. Establish a regular monitoring framework that integrates socio-economic and



ecological indicators to guide fisheries governance and adaptive policy formulation.

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