DISTRIBUTION OF VALUE ADDED AMONG CULTURED FISH VALUE CHAIN ACTORS FOR SUSTAINABLE LIVELIHOODS IN SOUTHWESTERN NIGERIA

BY

***[1]Olagunju, F.I, [2]Dairo, D.A, [3]Tojola, S.S and [4]Adio, F.T**

***[1,2,3] Department of Agricultural Economics, Ladoke Akintola University of Technology, Ogbomoso. [4]Department of Extension, Ministry of Agriculture and Rural Development [2]**

Abstract

This study examined value chain mapping and the distribution of value added among actors in the catfish value chain in Southwestern Nigeria. With the aid of a questionnaire and interview schedule, a multi-stage sampling procedure was employed to select 360 participants, comprising 52 input suppliers, 85 producers, 83 processors, 86 marketers, and 54 consumers. Data were analyzed using descriptive statistics, value chain mapping, net income analysis, value-added share models, and Analysis of Variance (ANOVA). Findings revealed that the primary actors in the chain were input suppliers, producers, processors, marketers, and consumers, while research, financial services, and legislative activities were provided by support actors. The total value added within the system was estimated at ₦10,180/kg, with respective value-added shares of 6.8%, 19.4%, 34.5%, and 39.2% for input suppliers, producers, processors, and marketers. These differences were statistically significant at the 5% level. This outcome indicates that marketers derive the greatest benefits from their activities, while producers receive relatively limited returns despite their central role in sustaining the chain. The study recommends interventions that enhance producers' capacity to capture greater value through improved bargaining power, cooperative organization, contract farming schemes, and direct market linkages. Such measures would not only improve producers' livelihoods but also foster inclusiveness, resilience, and sustainability in Nigeria's aquaculture sector.

Keywords: actors, catfish, value chain map, and value-added share

Introduction

The fisheries sub-sector in Nigeria plays a vital role in the national economy, providing opportunities for improved nutrition, income generation, and job creation, thereby contributing to wealth creation and food security at both household and national levels. Fish remains the most affordable and widely consumed source of animal protein in Nigeria, accounting for over 40% of total protein intake. At the national level, the fisheries sub-sector contributes about 5% to agricultural GDP and 1.24% to overall GDP (FAO, 2021; Agoro et. al., 2025). In addition, the sector has significant potential to drive inclusive and sustainable employment, particularly for women and youth engaged in aquaculture, processing, and marketing along the fish value chain.

Fish is one of the most extensively traded food commodities globally, and Nigeria is a key participant in this trade as both a major importer and consumer. In recent decades, the fisheries sector has become increasingly integrated into global markets, transforming how fish is produced, processed, marketed, and distributed. What once operated largely through fragmented national and regional value chains has evolved into participation in international networks. For Nigeria, this shift underscores the strategic importance of fisheries for food security, employment, and poverty reduction. Yet, the continued role of national and subnational sub-chains highlights the need for policies that not only enhance Nigeria's competitiveness in global fish markets but also strengthen local value addition, ensure equitable participation of small-scale actors, and promote sustainable resource management (FAO, 208)

The expansion of aquaculture in Nigeria has become increasingly important in addressing the persistent gap between the nation's rising demand for fish and the limited domestic supply. According to the Food and Agriculture Organization (FAO, 2020), fish farming is now widely recognized as a viable strategy for reducing Nigeria's heavy dependence on imports and for meeting national consumption requirements. Nevertheless, small-scale fish farmers continue to face significant challenges, particularly in value addition, processing, and market access, which constrain their ability to enhance incomes and improve livelihoods. Weak market linkages, inadequate cold-chain and processing infrastructure, and limited access to credit and market information further exacerbate these constraints. The connection between catfish production and consumption involves various groups of economic agents. For example, catfish farming is carried out by producers, while the harvested catfish is either processed or marketed through different channels by other actors. Many economic activities occur along the value chain before the product reaches the final consumer. According to Bradley *et. al.,* (2020), the way these different economic agents respond to market forces may not be uniform. This suggests that price changes at the upstream level (such as production) may lead to different reactions at the downstream level (such as wholesale or retail), and vice versa.

A study by the Federal Department of Fisheries (FMARD, 2020) suggests that Nigeria's fisheries and aquaculture value chains support over 1.4 million jobs nationwide, encompassing roles across capture fishing, aquaculture, processing, and marketing sectors. Specifically, FAO (2021) and World Fish (2018) report that approximately 1,477,651 individuals are currently engaged in fishing-related activities in Nigeria. The majority of these opportunities are informal and include unskilled or semi-skilled tasks, such as pond excavation, fingerling harvesting, sorting, processing, and market vending. Although often categorized as casual piecework, these roles are integral to supporting rural livelihoods and the growth of small-scale aquaculture. Looking ahead, global projections by World Fish (2017) indicate that aquaculture has the potential to generate up to 76 million jobs by 2050, with developing countries—including Nigeria—likely to capture a significant share of these employment opportunities. This underscores the sector's capacity for expansion and its strategic importance for rural and youth employment in the coming decades.

Despite substantial investments by the Nigerian government—through initiatives such as the Agricultural Transformation Agenda, the National Aquaculture Strategy, and more recent interventions like the FISH4ACP catfish programme—alongside support from NGOs and development partners, the experiences of small-scale actors in Nigeria's fish value chains remain poorly understood. Performance among smallholder fish farmers has remained weak, with persistent structural challenges such as low productivity, high input costs, inadequate value addition, weak market linkages, and limited access to credit and technology. While government and donor report increasingly acknowledge these constraints, systematic academic research examining the realities of small-scale farmers within Nigeria's fish value chains remains limited. This neglect is particularly concerning, given Nigeria's heavy dependence on fish imports despite its vast aquaculture potential and repeated rounds of policy reforms. Addressing this research gap is therefore urgent, as it has direct implications for food security, poverty reduction, and the sustainability of the country's fisheries sector. Olukunle, (2023).

To assess the viability of fisheries value chains as an economic sector in Nigeria, it is important to examine demand and supply dynamics alongside the relative contributions of small- and large-scale operators. Fish is the most widely consumed animal protein in Nigeria, accounting for more than 40% of total animal protein intake (FAO, 2021). For low-income households, fish is a critical source of affordable and diverse nutrition, helping to mitigate malnutrition and strengthen food security. Rising prices of other animal protein sources, such as beef and poultry, have further reinforced the importance of fish as the primary, and often most accessible, protein alternative. However, domestic fish production—dominated by small-scale aquaculture and artisanal fisheries—falls significantly short of demand, resulting in an annual supply deficit of over 2 million tons that is bridged through imports (FMARD, 2020; World Fish, 2018).

National demand for fish in Nigeria is estimated at 3.6 million metric tons (MT) per year (FMARD, 2020). On the supply side, local production provides only about 1.1 million MT**,** while imports account for more than 2 million MT annually, representing over 50% of national fish consumption (FAO, 2021). Aquaculture has expanded steadily, contributing roughly 313,000 MT by 2018, while production from inland natural water bodies (artisanal fisheries) has remained relatively stagnant at around 750,000 MT despite an increase in the number of fishers and the use of more modern fishing gear (World Fish, 2018; FMARD, 2020). This stagnation suggests that capture fisheries are approaching their maximum sustainable yield, and that further growth in domestic fish supply will largely depend on scaling up aquaculture.

Aquaculture in Nigeria represents the most viable alternative for sustainably meeting the nation's growing demand for fish, especially as capture fisheries approach their production limits. Unlike natural fisheries, aquaculture has recorded steady expansion over the past two decades, with output increasing by more than 300% between 2000 and 2018 (FAO, 2021). This growth has been driven largely by the rise of commercial catfish and tilapia farms using both pond and cage systems. Large-scale operators have introduced improved technologies, higher-quality seed, and better feed, while also expanding input supply chains as well as wholesale and retail distribution networks. These developments have enabled the commercial aquaculture sector to play an increasingly important role in bridging Nigeria's fish supply deficit. However, small-scale farmers—who form the bulk of aquaculture producers—still face significant constraints in accessing quality inputs, finance, and markets, limiting their ability to contribute fully to closing the demand–supply gap.

In contrast, Nigeria's small-scale aquaculture subsector has not grown as much as the country's rising demand. It remains mostly underdeveloped and makes a relatively small contribution in both volume and monetary value to the fisheries market. Smallholder fish farmers, artisanal fishers, and traders in this segment mainly operate informally, producing for subsistence and selling within local communities and nearby urban markets (FAO, 2021). Studies show that the growth of this subsector is limited by little access to quality inputs like feed and fingerlings, insufficient technical knowledge, low adoption of better technologies, and poor access to finance and organized markets (FMARD, 2020; World Fish, 2018).

This study, therefore, investigates the structure of Nigeria's small-scale cultured fisheries value chains to identify their composition, opportunities for growth, and the critical challenges that must be addressed to enhance their contribution to national fish supply, food security, and rural livelihoods.

Methodology

A multi-stage sampling technique, comprising purposive, proportionate, and random sampling procedures, was adopted for the selection of respondents in the study. Primary data were collected using a questionnaire, alongside personal observations and key informant interviews, from the selected sample respondents in each state's purposively selected local government areas. From Lagos State: (Epe and Ibeju-Lekki LGAs), Ogun State: (Ijebu-ode and Ota LGAs), and Oyo State (Ikere and Moba). The sampling frame of 360 catfish actors consists of the list of catfish input suppliers, producers, processors (smoked catfish), marketers, and consumers was sought through the catfish actors' associations in the selected areas. The last stage involved a proportionate sampling of actors across the selected villages based on the number of actors collected from the various associations' sample frames. Random sampling techniques were employed to select actors across all the villages with the aid of Krejcie and Morgan's sample collection methods for easy determination of sample sizes. The total sample size of 360 actors comprises 52 input suppliers, 85 catfish producers, 83 catfish processors, 86 catfish marketers, and 54 consumers (obtained by using stratification) for the study. Data were analyzed using the value chain map and value share model. ANOVA was used to test the significant differences in the actors' value share. According to Coulibaly et. al (2010), the value added is the amount of value that each actor in the chain adds. It is the difference between the price the actor sells the value-added product and the price he pays for the raw material purchased from the preceding actor, i.e

$VA_i = P_1 - P_{-1}$ ……………………………………………………….(1)

Where
VAi = value added by each chain actor
i = input suppliers, producers, processors, and marketers
P_1 = price actor offered to sell valued product to the subsequent actor
P_{-1} = price of product purchased from the preceding actor.

Therefore,
$VA_{input\ supplier} = P_{fingerling} - P_{breedingstock}$ ……………………………………………(2)
$VA_{producer} = P_{harvested\ fish} - P_{fingerling}$ ……………………………………………(3)
$VA_{processor} = P_{proccesed\ fish} - P_{harvested\ fish}$ ……………………………………………(4)
$VA_{marketer} = P_{marketer\ fish} - P_{processed\ fish}$ ……………………………………………(5)

Hence, value share is the percentage share of an actor in the total value added in the value chain system. i.e

$$\%VA_i = \frac{VA_i}{\sum_{i=1}^{n} VA_i} \quad \text{……(6)}$$

All products that passed through the value chain were measured in kg to allow for easy comparison of the activity of the chain actors. The Analysis of Variance (ANOVA) was performed using compare the Scheffe test to compare the Analysis of Variance (ANOVA) multiple means. The ANOVA model is specified following Igwenagu et. al., 2020.

$$F = \frac{MSSB}{MSSW} = \frac{SSB/(k-1)}{SSW/(n-k)} \quad \text{……(7)}$$

TSS (total sum of squares) = SSW + SSB

$$SSW = \sum_{i=1}^{nj}[\sum_{j=1}^{n}(\overline{X_{\iota J}} - \bar{X}_J)^2] \quad \text{……(8)}$$

$$SB = \sum_{i=1}^{n}(\bar{X}_J - \bar{X})^2 \quad \text{……(9)}$$

Where,
$\overline{X\iota J}$ = ith value added of the chain actor j,
$\overline{XJ}$ = Mean value-added responding actors j
$\bar{X}$ = Grand mean value added of all actors,
SSB = Sum of squared deviations between the scores
SSW = Sum of squared deviations within the scores
n_j = Sample size of chain actors j
n = Sample size of chain actors in all categories,
K = Number of actors' categories
k-1 = Degrees of freedom for SSB (numerator),
n-k = Degrees of freedom for SSW (denominator)
F = Value by which the statistical significance of the mean differences was judged.

RESULTS AND DISCUSSION

Socio-economic Characteristics of the Respondents

As shown in Table 1, respondents were predominantly middle-aged. The modal ages among input suppliers, producers, and consumers clustered around the late-40s (46–49 years), whereas processors and marketers skewed younger (30–37 years). This age profile mirrors recent evidence that upstream primary production is aging, while downstream agri-food activities (processing, trade, and marketing) increasingly attract younger entrants (FAO, 2025; BVAT & Penguin, 2024). In Nigeria and comparable settings, analysts likewise highlight a large youth cohort engaging more readily in off-farm and market-oriented agribusiness niches—often enabled by lower entry barriers and digital commerce—relative to on-farm production (Ikuemonisan et al., 2024; IFPRI, 2025). These patterns help explain the divergence observed in Table 1, in which downstream roles are younger on average than upstream ones, consistent with global calls to "replace an aging workforce" in primary agriculture while expanding youth opportunities off-farm (FAO, 2025).

Table 1: Profile of socioeconomic characteristics of cultured fish Actors by Age

Actors	Input Suppliers		Producers		Processors		Marketers		Consumers	
Age (yrs)	Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%
<=40	11	21	19	22	53	65	82	96	16	30
41-50	28	54	43	51	21	25	02	02	16	30
51-60	10	19	19	22	5	07	02	02	11	20
>60	03	6	04	5	02	03	00	00	11	20
Total	52	100	85	100	83	100	86	100	54	100
Mean	46.5		46.6		36.5		30.2		48.9	
SD	6.9		6.8		9.9		5.4		10.4	

Source: Field survey, 2025

The finding that cultured fish actors, input suppliers, producers, and consumers have relatively larger household sizes (6–10 persons) compared to processors and marketers (4–7 persons) suggests that aquaculture-related livelihood strategies are closely linked to household labor availability and dependency structures (Table 2). Larger household sizes among producers may imply greater reliance on family labor for pond management, input acquisition, and consumption needs, which can reduce production costs but also increase household consumption burdens (Twumasi et al., 2021; Omeje et al., 2020). In contrast, the relatively smaller household sizes among processors and marketers may indicate reduced household labor contributions, potentially necessitating hired labor, but also less consumption pressure on household income, allowing for greater flexibility in reinvesting profits (Nkeme et al., 2022; Omeje et al., 2023). This differentiation has implications for policy and development interventions: producers may benefit more from programs that enhance productivity and reduce household food insecurity, while processors and marketers may require improved access to credit and market infrastructure to scale operations sustainably (Adebanjo, 2024).

Table 2: Profile Distribution of the actors by Household Size

Actors	Input Suppliers		Producers		Processors		Marketers		Consumers	
Hhsz No	Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%
<=3	1	2	12	14	20	24	29	34	0	0
4-6	26	50	45	53	53	64	55	64	41	75
7-9	13	25	25	29	4	5	00	0	03	6
>9	12	23	3	4	4	5	09	2	10	19
Total	52	100	85	100	83	100	86		54	100
Mean	6.5		6.4		5.0		4.0		6.1	
SD	1.4		1.2		1.7		1.2		0.9	

Source: Field survey, 2025

The average years of experience varied across the cultured fish value chain. Table 3 showed that Input suppliers had 23 years, producers 22 years, processors 20 years, marketers 18 years, and consumers 27 years. Consumers showed the greatest variation in experience (SD = 11.2), while the other groups exhibited relatively consistent variability, with standard deviations narrowly ranging between 7.8 and 7.9. The relatively long experience among cultured fish consumers suggests a well-established and stable demand in the market. This high level of familiarity indicates that consumers are not only knowledgeable about the product but also consistent in their purchasing and eating habits. Such stability is essential for maintaining the value chain, as it offers dependable market signals to upstream participants such as producers, processors, and marketers. Additionally, consumers' deep-rooted familiarity with cultured fish may reflect longstanding dietary preferences, which could bolster market resilience against alternative protein sources. However, the high variability (SD = 11.2) points to a diverse consumer base, ranging from highly experienced buyers to newcomers, indicating opportunities for market growth, targeted promotions, and consumer education.

Table 3: Profile Distribution of the actors by Experience

Actors	Input Suppliers		Producers		Processors		Marketers		Consumers	
Exper (no)	Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%
<=10	6	12	13	15	13	16	15	17	00	0
11-20	11	20	21	25	31	37	37	43	08	15
21-30	30	58	41	48	27	32	24	30	12	22
>30	05	10	10	12	12	14	10	12	34	63
Total	52	100	85	100	83	100	86	100	54	100
Mean	23.2		22.2		19.5		17.7		26.8	
SD	7.8		7.9		7.9		7.8		11.2	

Source: Field survey, 2025

The average years of formal education among actors in the cultured fish value chain ranged from 11.9 to 12.4 years, which corresponds to the completion of senior secondary school (Table 4). This level of educational attainment suggests that most actors possess a moderate literacy foundation, sufficient for understanding basic production, marketing, and record-keeping practices. However, the absence of higher educational exposure may limit their ability to fully adopt advanced aquaculture technologies, engage effectively with digital platforms, or access complex financial and extension services. Consequently, while the current educational profile supports operational functionality within the value chain, it highlights the need for targeted capacity-building programs, vocational training, and simplified innovation transfer mechanisms to enhance productivity and market competitiveness.

Table 4: Profile Distribution of the actors by Education

Actors	Input Suppliers		Producers		Processors		Marketers		Consumers	
School (yrs)	Freq.	%	Freq	%	Freq.	%	Freq.	%	Freq.	%
<=6	4	8	8	9	00	0	1	1	00	0
7-9	9	17	14	16	14	17	19	22	11	20
10-12	26	50	41	48	55	66	38	44	32	60
>12	13	25	22	26	14	17	28	33	11	20
Total	52	100	85	100	83	100	86	100	54	100
Mean	11.9		11.9		12.0		12.4		12.0	
SD	2.95		2.95		2.98		2.99		2.98	

Source: Field survey, 2025

From Table 5, the gender distribution among cultured fish value-chain actors, coded as 1 = male and 0 = female, reveals a marked male predominance. This imbalance signals potential structural constraints impeding women's participation in the sector, such as limited access to resources, formal training, and decision-making opportunities (Adam et al., 2025; Williams et al., 2025). Comprehensive gender analysis in aquaculture has similarly documented women's concentration in informal, lower-remunerated roles such as post-harvest processing, marketing, and retail, while men dominate more profitable, capital-intensive segments like production and input supply (Adam et al., 2025; Elias et al., 2024).

This gender gap carries significant implications. First, the underrepresentation of women may constrain the sector's inclusivity, productivity, and resilience, as empowering women has been shown to enhance household nutrition, income diversification, and overall food security (Adam et al., 2023; Williams et al., 2025). Second, addressing these imbalances through gender-responsive interventions such as inclusive extension services, training tailored to women's needs, access to finance, and leadership development can strengthen both equity and efficiency within the value chain (Williams et al., 2025; FAO, 2022).

Table 5: Profile Distribution of the actors by Sex

Actors	Input Suppliers		Producers		Processors		Mark eters		Consu mers	
Sex (category)	Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%
Male	46	88.5	65	76.5	28	33.7	48	55.8	33	64.7
Female	06	11.5	20	23.5	55	66.3	38	44.2	18	35.3
Total	52	100.0	85	100.0	83	100.0	86	100.0	54	100.0
Mean	0.88		0.76		0.34		0.56		0.65	
SD	0.32		0.43		0.48		0.50		0.48	

Source: Field survey, 2025

The marital status of cultured fish actors, coded numerically as 1 = single (never married), 2 = married, 3 = separated, and 4 = widower/widow, produced mean values ranging from 1 to 4 across categories (Table 6). The distribution indicates that most participants were married, aligning with existing evidence that aquaculture and other agrarian livelihoods are often embedded within household structures, where marital unions provide access to shared labor, financial resources, and decision-making capacity (Omotayo & Akinyemi, 2022; Alhassan et al., 2023).

The implications of these findings are twofold. First, the dominance of married actors suggests that aquaculture development strategies must consider the household as a key unit of production, recognizing the role of spousal collaboration and family labor in sustaining the value chain (Ayanwuyi & Adeolu, 2021). However, such household structures may also reinforce gendered divisions of labor, limiting women's agency in decision-making (Elias et al., 2024). Second, the presence of separated and widowed actors highlights a vulnerable subgroup, as marital dissolution or widowhood often results in reduced access to productive assets, weaker social safety nets, and limited bargaining power within agrarian communities (Oladejo et al., 2020; FAO, 2022). Addressing these disparities requires inclusive aquaculture policies, social protection measures, and gender-responsive interventions that empower all categories of actors while safeguarding the resilience and sustainability of the sector.

Table 6: Profile Distribution of the actors by Marital status

Actors	Input Suppliers		Produ cers		Proce ssors		Marke ters		Consu mers	
MS (no)	Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%
single	00	00	00	00	26	31.3	18	20.9	00	00
married	16	30.7	12	14.1	20	24.1	21	24.4	35	64.8
Separate d	33	63.5	61	71.8	31	37.3	41	47.7	11	20.4
Widowe d	03	5.8	12	14.1	6	7.2	06	7.0	8	14.8
Total	52	100	85	100	83	100	86	100	54	100
Mean	2.75		3.00		2.21		2.41		2.90	
SD	0.56		0.53		0.97		0.89		0.59	

Source: Field survey, 2025

Value Chain Mapping and Functional Roles of Catfish Actors

The Value Chain Map of Catfish in the Southwest zone was illustrated in Figure 1. This shows the map of the overall catfish value chain, the segments, their interdependencies, and linkages in the study area.

Input Suppliers. The input dealers within the catfish aquaculture value chain primarily engaged in the provision of brood stock, formulated feeds, and production equipment to farmers (Fig.1). Beyond supplying materials, they often played advisory roles, particularly in guiding farmers on appropriate stocking densities and feed management practices, including feed quality and quantity. The majority of these suppliers in the study area were private individuals who relied largely on self-financing rather than institutional support. They were further categorized into wholesalers and retailers, distributing inputs to farmers at prevailing market prices under open-market conditions. Notably, input dealers did not benefit from government subsidies, and as a result, farmers purchased brood stock, feeds, and equipment at unsubsidized rates, which may have contributed to elevated production costs (Adeyemi & Olaoye, 2021; Kassali et al., 2022).

The implications of this structure are significant. First, the absence of subsidized inputs may limit small-scale farmers' competitiveness, as high input costs can constrain productivity and profitability (Bolarinwa et al., 2023). Second, reliance on private individuals as the dominant suppliers underscores the importance of strengthening private sector participation while also developing regulatory frameworks to ensure input quality, particularly for feeds and broodstock (Adewumi et al., 2020). Finally, the advisory role of suppliers highlights opportunities for integrating them into broader extension and knowledge-transfer systems, thereby improving farmers' technical efficiency and sustainability in the catfish value chain (Olaoye et al., 2021; FAO, 2022).

Producers. Catfish farmers constitute the most critical actors in the aquaculture value chain, comprising both hatchery operators and out-grower farmers (Fig. 1). The mean age of farmers in the study was 46.6 years, with 76.5% being male. A significant proportion (52%) employed artificial ponds or fibre cages for catfish production, while the majority operated on a small-scale basis (68%). Production cycles typically spanned six to eight months, during which catfish, under optimal management, attained an average market weight of 0.8 to 1 kilogram, consistent with earlier findings (Emokaro et al., 2010). Once harvested, the fish either passed through intermediaries in the marketing chain or were sold directly by the farmers.

The implications of these findings are notable. First, the relatively young and middle-aged demographic profile of farmers suggests potential for innovation adoption and long-term sectoral sustainability, provided adequate support systems are in place (Adeyemo et al., 2022). However, the predominance of small-scale enterprises highlights challenges of economies of scale, input access, and vulnerability to market shocks (Bolarinwa et al., 2023). Second, the widespread reliance on artificial ponds and fibre cages demonstrates flexibility in production systems, but also signals the need for infrastructure investment, biosecurity measures, and training to maximize efficiency (Olaoye et al., 2021; FAO, 2022). Finally, the reliance on intermediaries in marketing underscores the limited bargaining power of smallholders, reinforcing the need for producer cooperatives and improved market linkages to enhance profitability and value retention within farming communities (Adenegan et al., 2020; Kassali et al., 2022).

Processors. Processors represent a critical segment of the catfish value chain, primarily engaged in adding value by transforming fresh catfish into processed products (Fig. 1). In the study area, fish processing has evolved into an emerging industry that provides livelihood opportunities for unemployed youths and retired individuals. The majority of processors (66.3%) were female, with an average age of 36.5 years, underscoring the gendered dimension of value addition in aquaculture. Smoked catfish constituted the dominant product, with 73% of processors involved in smoking activities due to strong consumer preference and high market demand. Processing was predominantly small-scale, with 87% of actors handling between 10 kg and 20 kg of fish daily. The industry is characterized by relatively low entry barriers, as minimal start-up capital is required, which explains its rapid expansion and increasing participation (George et al., 2021; Olalekan et al., 2023).

The implications of these findings are significant. First, the dominance of women in the processing node reinforces the role of aquaculture in enhancing female employment and income diversification, consistent with broader evidence on gendered participation in fish value chains (Elias et al., 2024). However, women processors often face structural barriers such as limited access to credit, modern smoking technologies, and storage facilities, which constrain profitability and product quality (FAO, 2022; Nwosu et al., 2021). Second, the strong market demand for smoked catfish highlights an opportunity to scale up processing capacity and improve food safety standards, given concerns about traditional smoking methods and environmental health (Adeyeye et al., 2022). Finally, the low capital requirement and expanding participation suggest that the processing segment can serve as a pathway for poverty reduction and entrepreneurship development, provided there is investment in training, technology, and market linkages (Alhassan et al., 2023; Bolarinwa et al., 2023).

Marketers. Marketing constitutes a critical node in the catfish value chain, facilitating the distribution of processed and fresh fish products to end-users (Fig. 1). In the study area, approximately 55.8% of marketers were male, indicating a modest gender imbalance in favor of men. The marketing portfolio comprised fillets (10%), whole smoked catfish (75%), and fresh fish (38%), highlighting consumer preference for smoked products, which command stronger market demand. Distribution occurred across diverse outlets, including roadside stands (48%), public and private offices (26%), restaurants and hotels (14%), supermarkets (20%), and open markets (58%). Most marketers (78%) operated at the retail level, reflecting the relatively low capital requirements and accessibility of small-scale trading in the aquaculture sector (Oluwasanya et al., 2022; Ayinde et al., 2023).

The implications of these findings are noteworthy. First, the dominance of retail operations underscores the importance of micro-entrepreneurship in sustaining livelihoods and reducing entry barriers in fish marketing (FAO, 2022; Bolarinwa et al., 2023). However, reliance on small-scale marketing may limit economies of scale, thereby constraining profitability and the ability to access formal markets such as supermarkets and export channels (Obiero et al., 2021). Second, the wide range of selling outlets reflects the versatility of catfish products and their adaptability to both formal and informal markets, offering opportunities to expand value chain integration through improved logistics and cold-chain systems (Alhassan et al., 2023). Finally, the gendered nature of marketing highlights the need for inclusive interventions that enhance women's participation by improving access to credit, training, and digital platforms, which are increasingly transforming agri-food trade (Elias et al., 2024; Olalekan et al., 2023).

Consumers. The study revealed that catfish consumption was concentrated in urban centers, where 70% of consumers resided (Fig. 1). This concentration is attributable to the clustering of hotels, restaurants, and food service establishments in cities and semi-urban areas, which increases demand (Obiero et al., 2021). Consumers primarily sourced catfish from commodity markets (10%), retail shops (15%), direct farmer-to-consumer contacts (30%), offices (20%), and roadside vendors (25%), reflecting a diverse set of distribution channels. Household income data indicated that approximately 66.7% of consumers earned between ₦30,000 and ₦80,000 per month, while 33.3% earn between ₦120,000 and ₦450,000 per month, with an average monthly income of ₦50,833 and ₦ 239,722, respectively, with a mean household size of seven and five members. Given this relatively large household size and modest income levels, affordability emerged as a challenge. At an average retail price of ₦8,500 per kilogram of catfish (prices vary due to the size of the fish, delivery options, and specific vendor promotions), it was not readily accessible to all households. Consumption patterns further revealed that 25% of households reported weekly consumption of 1 kg of catfish, while only 15.3% consumed 2 kg weekly.

The lower-income group has larger households and much lower per capita income; therefore, their purchasing power is limited. Spending on non-essentials, quality inputs, or premium catfish products and suppliers might be restricted. The higher income group, with fewer members and significantly higher per-person income, can afford higher-quality, better-packaged or processed products, more frequent purchases, or more expensive types of catfish.

The findings demonstrate substantial heterogeneity among households in terms of income and household size. With two-thirds of households in a constrained income bracket (₦30,000–₦80,000) and relatively large sizes, any interventions in the catfish value-chain (or food/protein supply) must consider the limited per-capita purchasing power in this majority group. Conversely, the smaller, wealthier segment (earning ₦120,000 - ₦450,000) represents a niche for higher-margin products, improved quality, and value-added services. The concentration of demand in urban centers underscores the potential of aquaculture to meet the protein needs of rapidly urbanizing populations, consistent with broader trends in sub-Saharan Africa (FAO, 2022; Oladimeji et al., 2023). However, the affordability gap, driven by rising input costs and limited subsidies, highlights a structural constraint to ensuring equitable access to fish protein for low-income households (Adeoye et al., 2021). The dominance of informal retail outlets such as roadside vendors and open markets suggests that interventions to strengthen food safety, quality assurance, and cold-chain infrastructure could significantly improve consumer trust and public health outcomes (Adeyeye et al., 2022; Olanrewaju et al., 2024). Finally, the relatively low per capita consumption reflects an untapped growth opportunity. Expanding access through targeted subsidies, consumer credit schemes, and investments in efficient distribution networks could enhance nutrition security while simultaneously driving aquaculture sector growth (Bolarinwa et al., 2023; Elias et al., 2024).

Support Actors. Collaborations between farmers and support actors in the catfish value chain can be broadly categorized into four domains: financial services, technical advisory support, information and knowledge dissemination, and legislative frameworks (Fig.1). In Nigeria, government institutions remain the primary actors in aquaculture legislation and regulatory enforcement, particularly through national and state-level ministries (FAO, 2022). Technological innovations, including improved fish handling equipment, modern feeding practices, and efficient smoking techniques, have largely been introduced through training programs provided by the Fisheries and Aquaculture Departments of the Federal and State Ministries of Agriculture and Natural Resources (George et al., 2021; Olanrewaju et al., 2024).

First, the reliance on government-led legislative instruments underscores the importance of coherent policy environments for aquaculture expansion. However, over-centralization may limit responsiveness to local challenges, suggesting the need for participatory governance that integrates private sector and farmer associations into decision-making (Bolarinwa et al., 2023). Second, the role of training and knowledge dissemination highlights the value of extension services and capacity-building programs in improving efficiency, product quality, and compliance with food safety standards (Alhassan et al., 2023; Omitoyin et al., 2020). Third, the absence of structured financial support mechanisms from government institutions creates barriers to entry for smallholder farmers, who often rely on informal credit, thereby restricting scalability and profitability (Olalekan et al., 2023). Strengthening public–private partnerships to deliver integrated support across finance, technology, and training could therefore accelerate the sector's contribution to food security, job creation, and poverty alleviation (Elias et al., 2024; World Bank, 2022).

Estimate of the actors' value-added share in the catfish value chain

This section assesses the costs and returns associated with actors along the catfish value chain to evaluate and compare the net value added by each actor. The value added by an actor is determined by the price differential between the value-added product sold to the next actor in the chain and the price of the primary product obtained from the preceding actor. For example, the producers' value addition is measured by the price difference between catfish sold to processors and the fingerlings purchased from input suppliers. This reflects transformation, place, and time value added through the specific activities of the actors in the chain (Coulibaly et al., 2010). Furthermore, the value-added share represents the proportion of total value added that accrues to each actor within the value chain system. In addition, the value-added share represents the percentage of an actor's contribution to the total value added in the value chain system.

The result of the value added of the actors (input suppliers, producer, processors, and marketers) in catfish value chains is presented in Table 1. For input suppliers, value addition is measured as the price differential between the unit cost of brooded fingerlings procured and the unit price at which they are sold to producers. In this case, the input suppliers purchased brooded fingerlings at ₦2,112.50/kg and sold them to producers at ₦2,812.50/kg, resulting in a value addition of ₦700/kg. Given a total quantity of 34,850.42 kg supplied, the aggregate value added by the input suppliers amounted to ₦24,395,294.00. This trend corroborates Trienekens (2011), who opined that the vertical dimension of network structure reflects the flow of products and services from the primary producer up to the end-consumer.

For producers, value addition is determined by the price margin between inputs and outputs along the value chain. Specifically, producers purchased fingerlings from input suppliers at ₦2,900/kg and sold the matured catfish to processors at ₦4,800/kg, yielding a unit value added of ₦1,900/kg. Based on a total sales volume of 1,681.23 kg of catfish, the aggregate value added by producers amounted to ₦3,194,337. For processors, the value added is derived from the price differential between the processed catfish sold to marketers or consumers at ₦8,400/kg and the fresh catfish purchased from producers at ₦4,850/kg, resulting in a margin of ₦3,550/kg. Given a total sales volume of 1,261.85 kg, the processors generated a total value added of ₦4,479,567.50.

For marketers, value added is calculated as the price difference between the marketed catfish sold to consumers at ₦12,580/kg and the purchase price of fresh catfish from processors and producers at ₦8,550/kg, yielding ₦4,030/kg. With a total sales volume of 702.81 kg, this amounted to a total value added of ₦2,832,324.30. Overall, the catfish value chain recorded a cumulative value addition of ₦10,180/kg. The distribution of value added across actors was 6.8% for input suppliers, 19.4% for producers, 34.5% for processors, and 39.2% for marketers.

Figure 2 illustrates the price flow and value-added distribution among actors in the catfish value chain. The unit cost of brooding fingerlings by input suppliers was ₦2,112.50/kg, which was subsequently sold to producers at ₦2,812.50/kg. Producers sold the matured catfish to processors at ₦4,800/kg, while processors sold the processed catfish to marketers at ₦8,400/kg. Finally, marketers sold to end consumers at ₦12,580/kg. From this price flow, the estimated value added by input suppliers, producers, processors, and marketers was ₦700/kg, ₦1,900/kg, ₦3,550/kg, and ₦4,030/kg, respectively, culminating in a total value addition of ₦10,180/kg across the catfish value chain. The distribution of value-added share was 6.8% for input suppliers, 19.4% for producers, 34.5% for processors, and 39.2% for marketers.

This pattern implies that value-added shares increase progressively along the chain, from input suppliers with the lowest share to marketers with the highest. Marketers, in particular, contribute significantly by creating place, time, and possession utilities, thereby addressing the "what, where, when, and how" of consumer purchases. Their role extends beyond sales to include gathering insights on consumer behavior and purchase decisions, positioning them as critical actors in shaping the structure and performance of the catfish value chain.

The hypothesis testing, which posited that there are no significant differences in value added among catfish value chain actors in Southwest Nigeria, was conducted using Analysis of Variance (ANOVA). The results are presented in Tables 8 and 9. As shown in Table 8, the F-calculated value (318.32) exceeded the F-tabulated value (2.60) at the 5% significance level with degrees of freedom (3, 302). Consequently, the null hypothesis of no significant difference in value added among the actors was rejected, and the alternative hypothesis was accepted. To identify the sources of the observed differences, a multiple comparison post-hoc test (Scheffé test) was employed. Before this, Bartlett's test of equality of error variances yielded a chi-square value of 390.4404 ($p < 0.000$), confirming that the assumption of homogeneity of variance was not violated, as shown in Table 8.

Table 9 presents the results of the post-hoc test, labeled multiple comparisons, which highlight the statistical significance of differences between groups. The mean difference analysis revealed significant variations among the catfish value chain actors. Specifically, the mean difference between marketers and processors was ₦479.651 ($p < 0.000$), indicating that marketers' net value addition was significantly higher than that of processors at the 5% significance level. Similarly, producers' net value addition was found to be significantly higher than that of input suppliers, with a mean difference of ₦1,650 ($p < 0.000$), also significant at the 5% level.

The post-hoc analysis revealed marked disparities in value addition across the catfish value chain. Marketers' net value added was significantly higher than that of input suppliers by ₦3,329.63 ($p < 0.000$) and higher than producers by ₦2,129.65 ($p < 0.000$). Likewise, producers' net value added exceeded that of input suppliers by ₦1,199.98 ($p < 0.000$), while processors recorded significantly higher net value added than input suppliers by ₦2,849.98 ($p < 0.000$). These findings confirm that net value added differs significantly across all nodes of the chain, with marketers capturing the highest share.

This unequal distribution underscores the need for interventions to reduce structural imbalances in value appropriation. Strengthening the bargaining power of producers and processors through cooperatives, contract farming arrangements, and improved access to reliable markets could help enhance their share of value added (Donovan et al., 2015; Markelova et al., 2009). Furthermore, policies that promote innovation in processing, access to finance, and investment in infrastructure, particularly cold chain systems and efficient logistics, would improve efficiency and competitiveness across the chain (FAO, 2020; Kaplinsky & Morris, 2001). A more equitable distribution of value among actors not only enhances rural livelihoods but also stimulates aquaculture investment and supports inclusive growth in Nigeria's fisheries sector (World Bank, 2017; Trienekens, 2011).

Conclusion and recommendations

Within the catfish value chain, each actor contributes to the cumulative value addition as fingerlings progress from the input supplies to the consumption nodes. This underscores the critical roles played by input suppliers, producers, processors, marketers, and supporting actors. Nevertheless, significant disparities exist in value added among the actors in Southwest Nigeria. The distribution of value-added shares reveals a progressive increase along the chain, with input suppliers contributing the least and marketers capturing the highest share. Notably, producers who constitute the most fundamental primary actors recorded disproportionately low value-added shares, while marketers appropriated the largest portion.

This outcome indicates that marketers derive the greatest benefits from their activities, while producers receive relatively limited returns despite their central role in sustaining the chain. This imbalance calls for interventions that enhance producers' capacity to capture greater value, such as through improved bargaining power, cooperative organization, contract farming schemes, and direct market linkages. Furthermore, policies that strengthen processing infrastructure, facilitate access to finance, and promote consumer-oriented product development could help align value addition with consumer preferences, while ensuring more equitable benefit distribution across the chain. Such measures would not only improve producers' livelihoods but also foster inclusiveness, resilience, and sustainability in Nigeria's aquaculture sector.

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APPENDICES

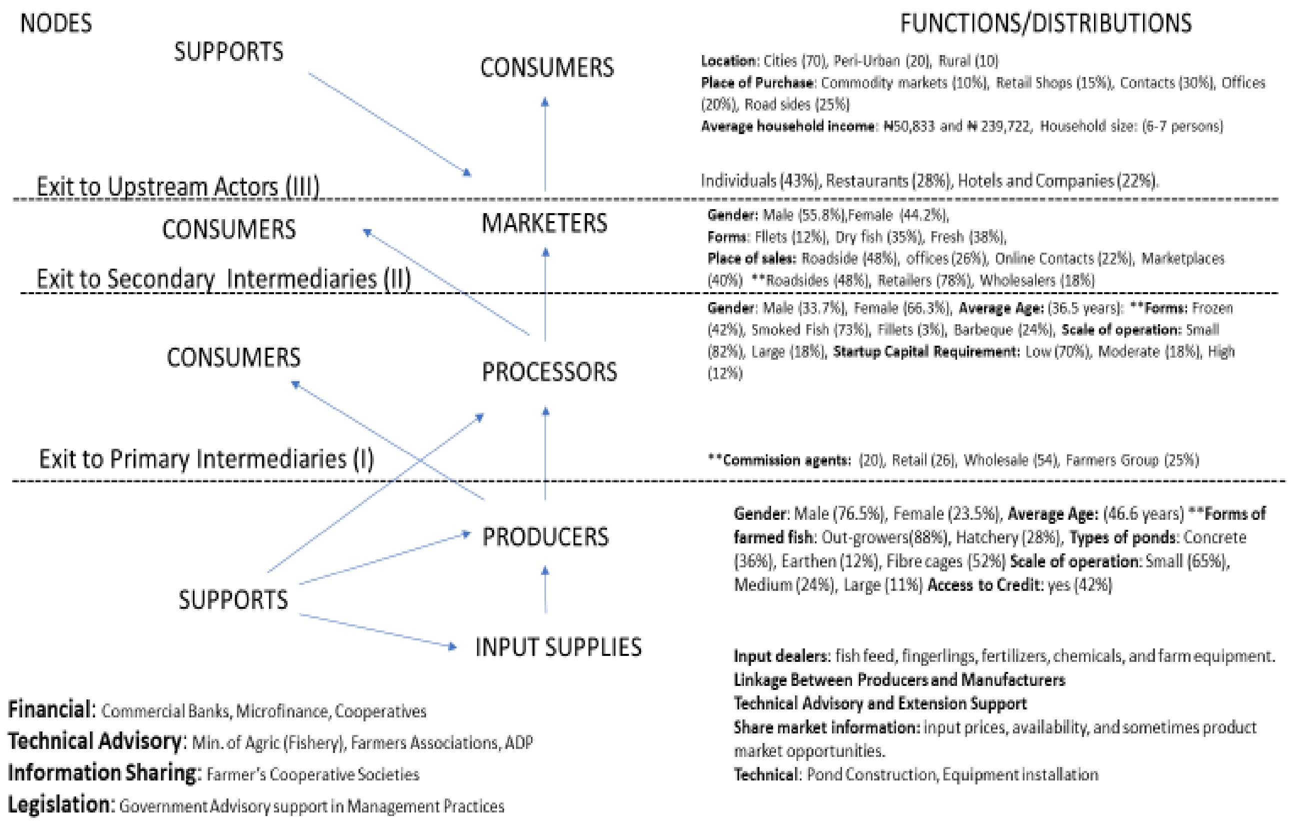

Fig. 1: Catfish value chain Map in Southwestern Nigeria.
Source: Field survey, 2025
**Multiple Responses.

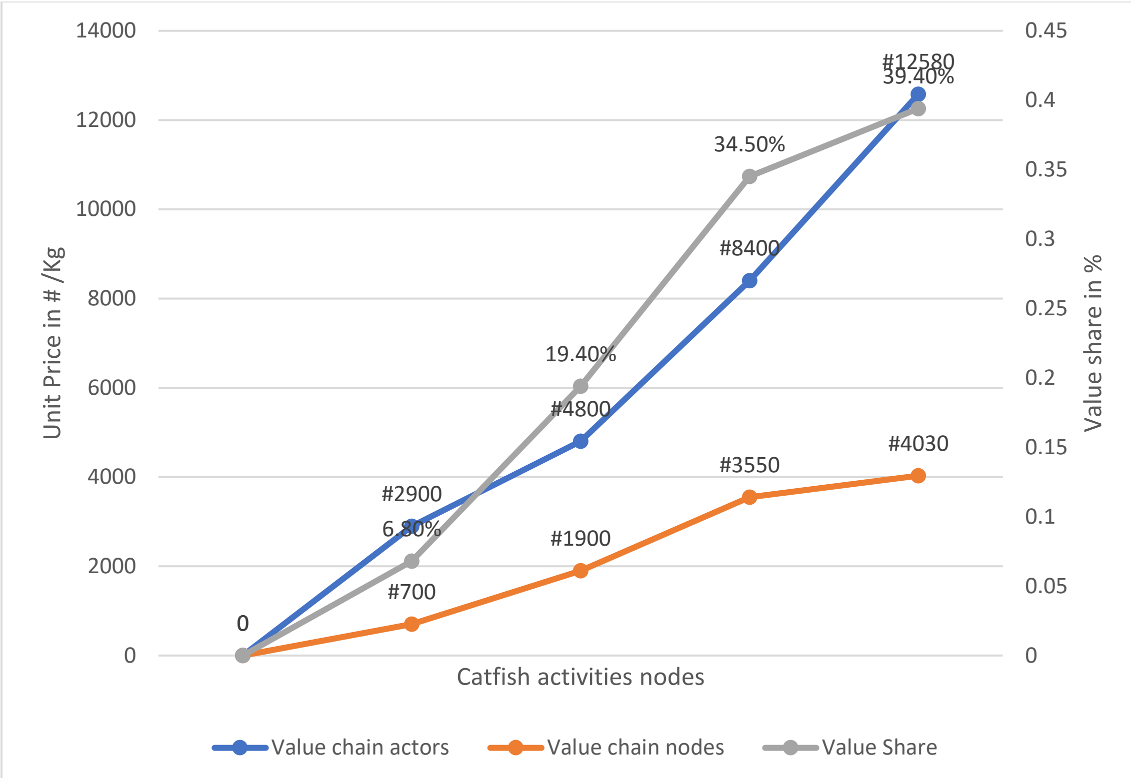

Figure 2: Price flow and value-added share of the catfish value chain
Source: Field survey, 2025

Table 7: Estimate of the actors' value-added share in catfish value chain

	Input SSlier			**Producer**	
Items	**Qty**	**Value (₦)**	**Items**	**Qty**	**Value (₦)**
Fingerling brooded *(Pfp)	36,210.68 (2112.5)	76,495,061.50	Fingerling stocked*(Pfs)	1,843.00 (2,900)	5,344,700
Fingerling sold*(Pfs)	34,850.42 (2812.5)	98,016,806.24	Catfish sold (Pcs)	1681.23 (4,800)	8,069,904
Value added (Vai)= Pfs-Pfp		700.00	Value added (Vap)= Pcs-Pfs		1,900.00
Total value added	34,850.42 (700)	24,395,294.00	Total value added	1681.23 (1,900)	3,194,337
Value added share (Vs)=Va/CVA		6.8%	Value added share (Vsp)=Va/CVA		19.4%
	Processor			**Marketer**	
Items	**Qty**	**Value (₦)**	**Items**	**Qty**	**Value (₦)**
Harvested Fish (Phf)	1,625 (4,850)	7,881,250.00	*Catfish bought (Pfs)	823.74 (8,550)	7,042,977.0
Qty Marketed (Ppf)	1261.85 (8,400)	10,599,540.00	Catfish sold (Pcs)	702.81 (12,580)	8,841,349.8
Value Added (Vapr)=Phf-Ppf		3,550.00	Value added (Vam)=Pfs–Pcs		4,030.00
Total value added	1,261.85 (3,550)	4,479,567.50	Total value added	702.81 (4,030)	2,832,324.30
Value added share (Vspr)=Va/CVA		34.5%	Value added share (Vsm)=Va/CVA		39.2%

Source: Field Survey, 2025 *Catfish bought represents average quantity of wholesale and retail marketers;
CVA= ∑ (Vai + Vap + Vapr + Vam) = ₦10,180/Kg; 1 fingerling = 6.25g
All measurements are done on the unit of price per kg;
Figures in parentheses are the unit prices of the respective items.

Table 8: Analysis of variance

Source	SS	df	MS	F	Prob > F
Between groups	473865203	3	157955068	318.32	0.0000
Within groups	149857919	302	496218.273		
Total	623723121	305	2044993.84		

Source: Computed from ANOVA

Bartlett's equal-variances test: $chi^2(3) = 390.4404$

$Prob>chi^2 = 0.000$

Table 9: Comparison of Value Added by Actors (Scheffe)

Actors	Input suppliers	Producers	Processors
Producers	1199.98 (0.000)**		
Processors	2849.98 (0.000) **	1650 (0.000) **	
Marketers	3329.63 (0.000) **	2129.65 (0.000) **	479.651 (0.000) **

Source: Computed from ANOVA
Figures in parentheses are the P-values
**= Significant @5%
Breusch–Pagan/Cook–Weisberg test for heteroskedasticity
$chi^2(1) = 0.00$
$Prob > chi^2 = 0.9989$