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RESEARCH ARTICLE

Analysis of Fish Value Chain in Kebbi State, Nigeria

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ABSTRACT

The study was conducted to analyze the fish value chain in Kebbi State, Nigeria. Primary data were collected through a field survey using a semi-structured questionnaire designed in line with the purpose of the study. Data were analyzed using descriptive statistics, marketing margin, ordinary least square, multiple regression analysis, and net farm income. Both simple random and purposive sampling methods were used to select the respondents from different segments of the entire value chain. Forty fish farmers were randomly selected, and 30 traders and 20 processors were used across the state, thus, giving a total number of 90 sample size for the study. Results revealed that the main fish value chain actors are input suppliers, farmers, processors, and traders. They are involved in production, supply of inputs, fish distribution, marketing, and processing of fish products. Both fish farmers, processors, and traders realized profits of (₦52,261, ₦32,330, and ₦26,400, respectively). However, farmers realized more profit. The major constraints encountered by the fish value chain actors include the following; for fish farmers, the major constraints include the high cost of fish inputs (57.5%), the high cost of stable water supply (27.5%), and access to credit (15.0%). The major constraints affecting processors are the high cost of processing equipment (60.00%), unstable electricity supply (25.00%), and lack of access to credit facilities (15.00%) among others. The major constraints for fish traders are high transportation cost (46.67%), bad road networks (33.33%), and access to credit (20.00); it is recommended that the fish value change actors be provided with inputs of affordable prices and investments be made on production of feeds and fingerlings within the state.

Key words: Analysis, fish, Kebbi state, value chain

INTRODUCTION

According to Adedeji and Okocha (2011), Nigeria is the largest fish consumer in Africa and among the largest fish consumers in the world with over 1.5 million tons of fish consumed annually, yet, Nigeria imports over 900,000 metric tons of fish while its domestic catch is estimated at 450,000 metric tons/year.[1] Statistics available indicate that the growth in fish production is due to increased activities of aquaculture, and the need for aquaculture arose from the decrease in supply from ocean fisheries as a result of over-fishing, habitat destruction, and pollutions.

According to Graeme *et al*. (2011), a value chain is a sequence of related enterprises (operators) conducting activities (functions) so as to add value to a product from its primary production, through its processing and marketing to the final sale of the product to consumers.[6] The functions of each link in the chain involve sourcing inputs, making/producing, and then delivering/selling product to the next link in the chain.

Recent development of fish farming in Nigeria has been attributed to private investments and

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federal government interventions through the growth enhancement scheme of the agricultural transformation agenda under the leadership of former Minister of Agriculture and Rural Development, Dr. Akinwumi Adesina (Ekundayo, 2017).[4] Frameworks have recognized aquaculture as one of the flagship projects to spur inclusive economic development. Demand for fish is increasing rapidly, driven by population and income growth, increased awareness of the health benefits of fish consumption, and changes in lifestyle and consumer preferences[5] (Githukia *et al*., 2014; Obiero *et al*., 2019).[9]

A value chain is the entire series of activities and transactions needed to make a product and deliver it to consumers. It involves the different steps that constitute taking the example of fish from input suppliers, farming (aquaculture), processors, wholesalers, retailers, and distributors, until the products get to the final consumers. A value chain is a key concept that considers all the stakeholders that intervene and interact in food production and consumption. It shows the links between different activities and economic sectors.

The previous studies indicated that the demand for fish in Nigeria outstrips local production (Ozigbo *et al*., 2013;[3] Gona *et al*., 2018), which means that there is a large excess demand comparing total fish consumption and total fish production in the country.[10] Fish farming is the fastest growing agricultural sub-sector for the past 40 years – having been largely responsible for making more fish available, as catches from the open sea continue to dwindle as a result of over fishing, due to an increase in fish demand.

Data from the agricultural performance survey of the wet season (2017) in Nigeria have shown a serious decrease in fish production in Nigeria compared to the performance in 2016 with a national fish demand of about 2.1 million metric tons per annum and a domestic production estimated at about 800,000 metric tones.[2] Nigeria has a shortfall of about 1.3 million metric tons due to a drastic decrease in wild fish catch.

As a result of climate change, rivers are gradually drying up, leading to low fish catch; the population is increasing, leading to more demand for fish and its associated by-products, the price of fish is also escalating due to shortage of fish supply telling that if fish must be made available in the future, and then the need to look in the direction of fish value chain cannot be overemphasized.

Despite the fact that Kebbi State is endowed with rivers such as River Rima with tributaries of river Niger that cut through Yauri, Shanga, and Ngaski, fish is still expensive due to the supply-demand gap. A study conducted in the state by (Ayuba *et al*., 2018) indicated that the state manifested a rapid growth in the number of fish farms, fishers, and fish traders; however, there is also a slow or lack of growth in fish farm input segments (local hatcheries and feed mills) and a small reduction in fish processors (drying and smoking). The study also observed that fish farmers in Kebbi state may be getting their raw materials (fingerlings) from outside the state, which may have a resultant effect on the overall fish production value. To bridge the fish, supply-demand gap is the basis for this study. To raise strategies for improved availability/supply of fish production is due to increased activities of aquaculture, and the need for aquaculture arose from the decrease in supply.

If the fishery sub-sector must develop in Nigeria generally and Kebbi state particularly, there is the need to assess the performance from the value chain perspective. According to Zamora (2016), value chain analysis is an effective way to examine the interaction among different players in a given industry.[11] If these interactions among different players are carefully assessed, information obtained are likely to assist in revealing areas of intervention by policymakers. By studying the underlying value chain for fish, the study hopes to provide a signal that will serve as a guide to policymakers, researchers, major stakeholders, and prospective investors on the factors that influence how well or how badly the chain works and suggest areas for future research and possible interventions. Fish value chain study of this nature hopes to provide a means of assessing the entire actors to provide information that can serve as strategies for the improvement of fish supply and developing the entire fishery industry. It is on this premise that this study hopes to provide answers to the following research questions;

i. Where is the source of fingerlings and feeds to the fish farmers?
ii. Who are the fish value chain actors in the study area?
iii. What is the value added to fish value chain in the study area?

iv. What are the factors influencing profitability among fish farmers?
v. What are the constraints to the identified fish value chain actors?

Concept of Value Chain

The concept of value chain as first described by Porter (1985) is a process from producers to final consumers of products or services. A value chain is defined as the full range of processes that are required to bring a product from its conception to its end use (Kaplinsky and Morris, 2003).[7] It encompasses all the stages from inputs suppliers, farmers, processors, traders, wholesalers, retailers, distributors, and/or transporters up to the final consumers. Value chain focuses on analyzing actors, structures, and dynamics of value chains, focusing particularly on the typologies of various actors and the activities, linkages, and relations between them (Zamora, 2016).

METHODOLOGY

Study Area

The study was carried out in Kebbi State, Nigeria. Kebbi state is in the northwestern part of the country. The state lies between latitude 10°c8' N and 13°15' N and longitude 3°3' E and 60°2' E, covering a total land area of about 36,129 square kilometers. The state has boundaries with Sokoto state to the north and east, Niger state to the south in Nigeria and it shares an international border with the Republic of Benin to the west. Kebbi was formed out of Sokoto state on August 27, 1991, by the regime of General Ibrahim BadamasiBabangida. Its capital is in Birnin Kebbi. Its major towns include Birnin Kebbi, Argungu, Yauri, and Zuru. Kebbi state is made up of 21 local government areas, four emirate councils (Gwandu, Argungu, Yauri, and Zuru), and 35 districts. The state has a population of 3,351,831 (National Population Commission, 2006) according to the 2006 census.[8] Projecting this population to the year 2020 at a 3% growth rate reveals the population as 4,351,067. Over two-thirds of the population are engaged in agricultural production, mainly arable crop alongside cash crops with livestock production.

Data Collection

Data for the study were collected through a field survey with the use of a semi-structured survey questionnaire designed in line with the purpose of the study and interview of key informants at both local government areas and villages across the main fish clusters (areas) in the state. Data collection was on the source of fingerlings and feeds, the different actors of the fish value chain and their various activities, costs, returns, and the constraints encountered along the various value chain actors among others.

Sampling Procedure and Sample Size

Both simple random and purposive sampling methods were used to select the respondents from different segments of the entire value chain. Forty fish farmers were sampled from Yauri, Bagudo, Birnin Kebbi, and Argungu, 30 fish traders were randomly selected across the state, while 20 processors were used. Thus, giving a total number of 90 fish farmers and fish processor as sample size for the study.

Analytical Techniques

Descriptive statistics was used to achieve objective 1 and 5 while net farm income (NFI), marketing costs, and gross margin were used to achieve objective 3. Functional analysis was used to achieve objective 2. NFI analysis was used to achieve part of objective 3 and ordinary least squares multiple regression analysis was used to achieve objective 4 in the study.

The Functional Analysis Model

The functional analysis is a tool of analysis that was used to ascertain objective 2 in the study. The functional analysis shows;

a. The principal functions in the chain,
b. The agent (or agent of the agent) carrying out the functions and
c. The principal product of the chain (the various forms into which it is transformed throughout the chain).

$$\text{Marketing margin} = \frac{\text{Selling price} - \text{production cost}}{\text{Selling price}}$$

NFI Model

NFI = Total revenue (TR)-total cost (TC) where;
TR= Total monetary value of fish output in naira
TC= Total expenses (costs) incurred in fish production
NFI= Difference between TR and TC of production.

Ordinary Least Square Multiple Regression Analysis Model

Ordinary least squares multiple regression analysis was used to evaluate factors affecting the profitability of fish farming in the study area.
The model is presentenced as follows;

$$Y = b_0 + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + b_7X_7 + b_8X_8 + U$$

Where;
Y = Amount of profit realized (₦) X1 = Price of fish in the market, (₦) X2 = Cost of fingerlings (₦), X3 = Cost of feeds (₦) X4= Capital (₦), X5 = Experience in fish farming (years), X6 = Distance to the market (km) X7 = Transportation cost (₦), X8 = Quantity of fish harvested (kg), U = error term, b1−b8 = coefficients estimated. Different forms of the econometric model were estimated to arrive at the best fit for this study. They include double log, semi-log, and exponential functions.

RESULTS AND DISCUSSION

Results in Table 1 revealed that the majority of the fish farmers source their fingerlings through purchase from outside the state (67.5%). About 15.0% source their fingerlings by purchasing from standard hatcheries within the state. About 10% source their fingerlings by obtaining from the wild/rivers, that is from those who are into fishing while 7.5% source their fingerlings through breeding locally. The implication of the findings is that since the majority of source fingerlings are from outside the state, it is likely that those fingerlings will be accessed at a very high cost unlike if they were available within the state.
Results in Table 2 revealed that the majority (72.5%) of the fish farms source their feeds through purchase from traders and are produced outside the state. While 15.0% source their feeds locally from homegrown ingredients such as fish bones, wheat offal, and groundnut cake. Moreover, 12.5% source their feeds by relying on manure/fertilizer to form phytoplankton and zooplankton for the fish to consume. The implication of this is that since the majority of the fish farmers depend on the purchase of feeds from traders and these feeds are not produced in the state, it means that there is a tendency for these feeds to get to the state at ridiculous prices, thus making the farmers to obtain them at a very high cost increasing their cost of production.

Input Suppliers

The first value chain actor is the input suppliers who play an important role in the value chain by providing the needed inputs required by the fish farmers for production. These input suppliers include dealers in fish inputs, veterinary research stations involved in the production of drugs and vaccines, fingerlings producers, feed producers, and producers of fishing equipment's such as nets and fish gear.

Table 1: Distribution of fish farmers according to source of fingerlings

Source of fingerlings	Frequency	Percentage
Purchase from standard hatcheries in the state	6	15.0
Purchase from outside the state	27	67.5
Obtain from the wild/rivers	4	10.0
Breed locally	3	7.5
Total	40	100.0

Source: Field survey data, 2022

Table 2: Distribution of fish farmers according to source of feeds

Source of feeds	Frequency	Percentage
Locally produced from home grown ingredients	6	15.0
Rely on manure/fertilizer to form phytoplankton and zooplankton	5	12.5
Purchase feeds from traders and are produced outside the State	29	72.5
Total	40	100.0

Source: Field survey data, 2022

Fish Farmers

The second value chain actor is the farmers rearing fish, and the fish produced is set for the next stage for further processing. The smallholder fish farms produce fish that are made affordable to the consumers or the processors such as restaurant owners, serving as eateries, fish roasters, fryers, and/or fish traders.

Fish Traders

At the third stage, trading of both fresh fish and dry/smoked fish takes place and the value chain actors are the traders. Fish traders purchase fish from individual farmers and sell it to processors or wholesaler. The fresh fish is sold to consumers or restaurant owners or processors such as fish smokers, dryers, roasters, restaurant owners or supermarket for processing in the form of freezing.

Table 3: Actors in the fish value chain and their functions

Value chain actors	Stage of the value chain	Functions	Agents	Output
Input suppliers dealer	Input supply	Production of input	Research institution	Fingerlings Feeds Farm tools Vaccine Drugs
Farmers-production trade (fish)		Rearing of fish marketing	Smallholder fish farmers Fish traders	Fresh fish Fresh fish, delivered to restaurants/ traders/ processors
Processors	Processing	Roasting Frying Sun drying Restaurants as food eateries		Village/city producers Restaurant owners
Traders	Marketing	Trade Transportation		Wholesalers and retail traders
Transportation Distributors				Roasted/ smoked fish Fried fish Processed fish feeds Stored fish in freezers Fresh fish, smoked fish, dry fish.

Source: Field survey data 2022

Processors of Fish Products

Result in Table 3 revealed the fourth stage of the fish value chain. This group is involved in frying, sun drying, freezing, and roasting of fish. They are also found in restaurants where food is sold and are also involved in selling fish products in freezers.

Results of cost and returns analysis in Table 4 reveals that the average total variable cost was ₦137,600. This shows the amount of money spent by the farmers in the study area for purchase of variable cost items like cost of labor, fingerlings, transportation, cost of feeds, water, medication. Results in Table 4 revealed the depreciation on fixed cost items of the farmers during production like cost of pond, cost of fishing gear/net, cost of tank/basin, cost of jerry cans. This account for ₦3007 while ₦140,607 was the TC and TR of ₦192,868 was realized from fish produced, fish consumed and fish

Table 4: Average cost and returns analysis of fish farming in Kebbi state

Variable	Average cost (₦)	Total (₦)	Percentage
Revenue			
TR	192,868	7,714,720	
Revenue from fish sold	183,868	7,354,720	
Revenue from fish consumed	9000	360,000	
Variable cost			
Cost of labor	18,000	720,000	12.80
Cost of fingerlings	32,000	1,280,000	22.76
Cost of medication	9,600	384,000	6.82
Cost of feeds	55,000	2,200,000	39.12
Cost of water	14,000	560,000	9.96
Cost of transportation	9,000	360,000	6.40
TVC	137,600	5,504,000	97.86
Fixed cost			
Depreciation on pond	314	12,560	0.23
Depreciation on fishing gear/Net	81	3,240	0.05
Depreciation on tank/basin	156	6,240	0.11
Depreciation on jerry cans	65	2,600	0.05
Depreciation on loan	2,200	88,000	1.56
Depreciation on buckets	95	3,800	0.06
Depreciation on broom	28	1,120	0.02
Depreciation on rake	45	1,800	0.04
Depreciation on knife	23	920	0.02
TFC	3007	120,280	2.14
TC=(TVC+TFC)	140,607	5,624,280	100.00
Net income=TR−TC	52,261	2,414,440	

Source: Field survey data, 2022 TR: Total revenue, TVC: Total variable cost, TFC: total fixed cost, TC: Total cost

sold. Net income of ₦52,261 was realized as profit suggesting that fish farming business is profitable in the study area.

Results for the cost and returns analysis in Table 5 reveal that the average total variable cost was ₦72,050 indicating the amount of money spent by the processors for the cost of labor, cost of fish purchased, cost of firewood, cost of oil, cost of spices, cost of salt, cost of packaging materials, cost of transportation, and cost of water. Results from Table 5 further revealed the fixed cost items for processing consisting of depreciation of table/benches, depreciation on buckets, depreciation on jerry can depreciation on show glass, depreciation on building/shop, depreciation on the frying pan, tray, and knife. This accounts for ₦1,815 as fixed cost. While ₦73,865 was the TC and revenue of ₦105,295 was realized as TR. The net income of ₦32,330 was realized as profit suggesting that fish processing is profitable in the study area.

The cost and returns analysis in Table 6 reveals that the total trading cost used by the traders was ₦11,3300. This showed the amount of money spent by the actors for the purchase of variable cost items which are the cost of fish, cost of loading, cost of offloading, cost of transportation, and tax/commission. The TR generated was ₦139,700 with a net income of ₦26,400. This implies that fish trading is profitable in the study area.

Comparing the results in Tables 4-6, that is, comparing the level of profit realized by different actors (farmers, processors, and traders), the results revealed that farmers realized an average profit of ₦52,261, while processors realized an average profit of ₦32,330 and traders realized an average profit of ₦26,400. This suggests that all three actors were profitable in their different value chain activities.

Farmers realized more profit, then processors, and lastly traders. The multiple regression results of factors affecting the profitability of fish farmers in Kebbi state are presented in Table 7. The results showed that semi-log was chosen as the lead equation based on conformity with a priori expectation, magnitude of coefficient, overall significance of the functional form (F-statistics), as well as the explanatory power of the variables (R^2adjusted) included in the model. The F-value is statistically significant at a 1% level which implies that the dependent variable (Y) is the profit realized by the fish farmers. The R^2 value was 0.79 which indicates that 79% of the total observed variation in fish farming profitability was explained by the variables included in the model, while 21% of the variation was due to error. The F-ratio 11.88 was significant at 1% indicating goodness-of-fit of the model.

Table 5: Average cost and returns analysis of fish processing in Kebbi state

Variable	Average cost (₦)	Total cost (₦)	Percentage
Variable cost			
Cost of labour	12,200	244,000	16.52
Cost of fish purchased	28,700	574,000	38.85
Cost of firewood	5,500	110,000	7.45
Cost of oil	9,000	180,000	12.18
Cost of spices	1,100	22,000	1.48
Cost of salt	400	8000	0.55
Cost of package materials	750	15,000	1.02
Cost of transportation	9,000	180,000	12.18
Cost of water	5,400	18,000	7.32
Total variable cost	72,050	150,040	97.55
Fixed cost			
Depreciation on table/benches	310	6,200	0.42
Depreciation on buckets	120	2,400	0.16
Depreciation on jerry cans	180	3,600	0.24
Depreciation show glass	380	7,600	0.51
Depreciation on building/shop	560	11,200	0.76
Depreciation on knives	70	1,400	0.09
Depreciation on frying pan	110	2,200	0.15
Deprecation on tray	85	1,700	0.12
Total fixed cost	1815	36,300	2.45
TC	73,865	1,477,300	100.00
TR	105,295	2,105,900	
Net income (TR-TC)	32,330	646,600	

Source: Field survey data, 2022 TR: Total revenue, TC: Total cost

Table 6: Average cost and returns analysis of fish trading in Kebbi state

Variable	Average cost (₦)	Total cost (₦)	Percentage
Cost of fish	98,000	2,940,000	86.49
Cost of loading	2,000	60,000	1.76
Cost of offloading	2,200	66,000	1.95
Cost of transportation	8,600	258,000	7.59
Tax/commission cost	2,500	75,000	2.21
TTC	113,300		100.00
TR	139,700		
Net income (TR-TTC)	26,400		

Source: Field survey data, 2022 TTC: Total Trading Cost, TR: Total Revenue

Results indicated that the price of fish in the market, experience in fish farming, and quantity of fish harvested were significant positively at a 1% level of probability, respectively (1.550, 3.721, and 2.487), suggesting that any increase in these variables will have a corresponding positive influence on the profit realized by fish farmers. While cost of fingerlings, cost of feeds, and distance to the market were significant negatively at 1, 5, and 5%, respectively (−1.312, −3.04, −1.565), suggesting that any increase in the cost of these variables will lead to a corresponding decrease in the amount of profit realized by the fish farmers.

Results presented in Table 8 revealed that the most pressing constraint affecting the fish farmer are high cost of fishing inputs (57.5%), the second most pressing constraint is the high cost of stable water supply (27.5%), while access to credit was also reported by (15.0%). This suggests that if there is any intervention that should be provided to fish farmers, it should be on how to enable them to secure these inputs at moderate prices to enhance their profitability.

Table 7: Estimates of factors affecting the profitability of fish farmers in Kebbi state

Variables	Exponential	Semi log	Double log
Constant	2124.16	7.150	1.235
	(2216)**	(7.114)***	(0.443)
Price of fish in the market	(2.195)** 0.981	(3.795)*** 1.550	(1.912)** 1.003
Cost of fingerling	(1.635)	(4.210)***	(2.150)**
	−1.008	−1.312	−2.108
Cost of feeds	(2.012)**	(2.226)**	(1.135)
	−11.018	−3.041	−3.011
Capital	(−0.437)	(−0.309)	(0.226)
	0.001	2.130	0.116
Experience in fish farming	(1.911) * 1.155	(3.165)*** 3.721	(1.901)* 1.014
Distance to the market	(2.121) ** −4.011	(2.235)** −1.565	(1.907)* 1.553
Transportation cost	(−1.142)	(−0.014)	(0.184)
	0.002	2.130	−0.228
Quantity of fish harvested	(3.215)*** 5.413	(4.770)*** 2.487	(3.916)*** 2.319
R^2	0.61	0.79	0.66
R- adjusted	0.59	0.77	0.64
F- ratio	13.877***	11.881***	12.429***

Source: Field survey data, 2022. (*)=coefficients that are significant at 10%, (**)=coefficients that are significant at 5%, (***)=coefficients that are significant at 1% Figures in parenthesis are the *t*-values

Results presented in Table 9 revealed that the most important problem facing fish traders is high transportation cost (46.67%). The next problem is bad road network's (33.33%). While 20% of the traders reported accessing credit as a major constraint. This implies that, if fish traders are to benefit from their business, there is the need for road network's to be made accessible, especially linking villages/markets where fish is sourced for distribution to the place where consumers reside.

Results in Table 10 revealed the constraints associated with fish processors in the study area in the magnitude of prevalence. Results showed that 60% of the processors reported the high cost of processing equipment's as major constraint, 25% of the processors reported unstable electricity supply, and 15% reported a lack of access to credit. For processors to be able to overcome their challenges, there is a need for intervention on subsidizing processing equipment's, proving stable and affordable electricity supply, and providing support in the form of credit.

Table 8: Distribution of fish farmers according to constraints encountered

Constraints	Frequency	Percentage
High cost of fishing inputs	23	57.5
High cost of stable water supply	11	27.5
Access to credit	6	15.0
Total	40	100.0

Source: Field survey, 2022

Table 9: Distribution of fish traders according to constraints encountered

Constraints	Frequency	Percentage
Bad road network's	10	33.33
Access to credit	6	20.00
High transportation cost	14	46.67
Total	30	100.00

Source: Field survey, 2022

Table 10: Distribution of fish processors according to constraints encountered

Constraints	Frequency	Percentage
Unstable electricity supply	5	25.00
High cost of processing equipment's	12	60.00
Lack of access to credit	3	15.00
Total	20	100.00

Source: Field Survey 2022

CONCLUSION

Based on the findings of this study, it is concluded that the main fish value chain actors are input suppliers, farmers, processors, and traders. They are involved in the supply and production of inputs, distribution, marketing, and processing of fish products. Both fish farmers, processors, and traders realized profit of (₦52, 261, ₦32, 330, and ₦26, 400 respectively); however, farmers realized more profit.

The major constraints encountered by the fish value chain actors include the following; for fish farmers, the major constraints include; high cost of fish inputs, high cost of stable water supply, and access to credit. The major constraints affecting processors are high cost of processing equipment, unstable electricity supply, and lack of access to credit facilities among others. The major constraints for fish traders are high transportation cost, bad road networks, and access to credit.

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