A Report on

Aquaculture Value Chain Analysis in the Niger Delta

2011

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Executive Summary

The fisheries sector is one of the most important sectors in Nigeria, both from an economic and social standpoint. The Federal Department of Fisheries reports that in 2009, the sector contributed approximately US$ 1 billon to the country's GDP. The fisheries industry further supports almost 7 million people (directly and indirectly), and contributes to the livelihood, employment, and household food security of, especially, Nigeria's coastal communities, including the Niger Delta.

In the Niger Delta, the fisheries sector is of utmost importance to particularly small-scale or artisanal fish farmers. Small-scale fish-farming or artisanal fisheries make up about 80% of the fisheries sector, supplying roughly 82% of the country's domestic fish production.

The fisheries sector is composed primarily of two categories: capture fisheries and aquaculture. At present, capture fisheries make up the bulk of the domestic fish supply. For example, in 2009, Nigeria's domestic fish production reached approximately 780,704 metric tons, of which 80% was capture fisheries, and largely artisanal. However capture fisheries is a dwindling resource given a variety of factors, including environmental and behavioral such as overfishing and utilization of destructive fishing practices. In the Delta, the negative impact of oil and other industrial activities on aquatic ecosystem have also contributed to the decline of capture fisheries as a source of livelihood for many fisher-folks. Aquaculture contributes to the rest of the supply-base at 20% or 152,796 metric tons, mainly from pond culture.

With the decline in capture fisheries, and aquaculture meeting only about 7.6% of the country's current estimated fish demand of 2 million metric tons (annual), the shortfall is being addressed by imports. The country imports roughly 746,851 metric tons of frozen fish, and even then the overall demand has not yet been completely satisfied. Moreover, almost all imports are frozen and of species that are either exotic or high value. Nigeria imported close to US$900 million worth of fish in 2009, sourced from the EU, South America, South Pacific zone and African countries such as Mauritania and Senegal. In addition to frozen and fresh fish, Nigeria also imported approximately US$400 million worth of processed (dried) fish through Scandinavian suppliers.

The combination of Nigeria's large population with an annual growth rate of over 3 percent, high meat/poultry prices, and rising incomes are driving the demand for fish consumption. The demand for captured fish species is especially strong. However, with both marine and fresh water catches declining, local consumers are turning to farmed fish. The national preference is for the fresh indigenous African Mud Catfish (*Clarias gariepinus, Heterobranchus*, and their hybrid), Nigeria's fish of choice. Despite strong consumer demand for fresh local species, aquaculture production remains small, and has been unable to meaningfully tap the enormous opportunity that exists for Nigeria and the Delta's fish farmers.

The inability of the aquaculture sector to exploit growth opportunities rests on numerous constraints that hold back the sector, nationally and in the Delta as well. Lack of quality, cost-effective fish feed and shortage of quality, fast-growing fingerlings are two key factors that are imposing the biggest brake on the sector. The combined cost of feed and fingerlings contributes to as much as 65% of the cost of production. High cost of available inputs has served as a disincentive to aspiring small-scale producers, dissuading many from creating a stable demand for the inputs. On the other hand, high costs of inputs have resulted in high priced products, which have restrained the sector's growth opportunities despite a burgeoning demand for fish.

It is therefore no surprise that imports of frozen fish have increased by almost 20% per annum to meet demand at a price consumers seem willing to pay; domestic farmed fresh fish are retailed at prices as

much as 100% to 120% higher than imported frozen fish, while domestic capture fish are priced far higher, by almost 325%. Consequently, import of frozen fish is nearly as large as domestic production, and rising. Industry experts predict that imports will continue to rise, particularly since domestic production appears to be lagging. The need to escalate priority levels to address these two key input-sectors cannot be overstated.

In addition to feed and fingerling, there are other factors that add to expand cost of production of farmed fish. Many relate to production management or husbandry issues, which require targeted extension support and technical training to enable small-scale producers to break out of the current "low- input/low output" production system. The present average yield achieved by smallholders from mostly backyard ponds has contributed to smallholder uncertainty and conservative behavior given that their modest revenue stream discourages investment in innovative production solutions to take advantage of existing opportunities.

The prevailing marketing dynamics have not helped either. Because small-scale production yields are low, in many parts of the Delta, small-scale farmers have been unable to assemble sufficient volume to attract serious, stable buyers. Instead, small-scale fish-farmers generally rely on a multitude of roving wholesalers and traders, who are opportunistic and purchase with little regard for quality or long-term partnership.

The aquaculture fish value chain is fairly simple and short, with wholesalers and traders buying at the farm-gate and reselling either directly to restaurateurs or market women/"fish-mammies," who retail fresh or smoked fish directly to consumers in the county's various markets. While the consumer preference is for large fish at soup bars/joints and restaurants, the small and odd-sized fish also find a ready market with wholesaling market women who specialize in smoking fish. Domestic smoked fish demand in Nigeria is estimated to be as large as the fresh fish market, and increasing in markets far away from the coast. Smoked fish markets are generally controlled by fish market women or "smoker fish mammies," who by tradition, smoke fish and sell at a margin to mostly traders and retailers, and sometimes to consumers as well. Fish mammies are also active in capture fish value chain, where they engage in wholesaling smoked capture fish and in season, retailing fresh capture fish.

Given that marketing/trading and smoking fish require low investment and basic technology, both attract large numbers of participants. The atomistic nature of the sector and fragmented marketing carried out by a mass of mostly small to medium traders/wholesalers has challenged the sector. Challenges resulting from the structure of the industry involve not only the inability to consolidate sufficient volume, but also erosion of effective marketing strategies and prevention of the development of a common set of quality standards since everyone is off doing their own thing, without coordination, strategy or vision for the future. This has discouraged serious investment to grow the sector. The prevailing marketing channels though short is fragmented, for both fresh and smoked fish, and its fragmented nature has also undermined sector growth by contributing to increased risk and uncertainty, whether perceived or real, for the subsistence producers. Such that small-scale producers, despite strong consumer demand for fish, remain conservative and unwilling to invest and grow their production possibilities. Consequently, a large percentage of the participants remain small and semi-subsistent or if commercial, they remain stagnant. The fragmented marketing channels are another serious constraint inhibiting the aquaculture sector.

It is therefore imperative that alternative market-based options also be developed so that small-scale aquaculture can be repositioned to boost production, increase earnings, and encourage the maximization of this promising sector.

Vision for Growth

With demand for both fresh/live and smoked catfish strong and rising, our vision for growth, in the near-term, is to first assist in increasing cost-savings to help bring price down by 10% for consumers of both fresh and smoked fish. Given that the own-price elasticity of fish for Nigeria is estimated (2005) at -0.4891, a 10% decrease in price is expected to increase demand by about 4.89% or roughly 5% (rounded), which is equivalent to roughly 58,000 metric tons (based on 2005 total consumption of 1.19 million tons (see table 3).

As part of our vision for growth, commercial small-scale producers will be targeted for assistance to help them capture this increase versus it being met through increased imports. This will entail working with producers to assess areas for strategic improvement and efficiency gains to increase cost-savings, which can then be passed on to the consumers. Since the cost of feed alone takes up roughly about 60% of the cost of production, we will review options for lowering costs, while increasing productivity.

Secondly, our vision will address the issues of marketing with respect to forging stronger backward and forward linkages. We will promote business-to-business partnerships between and among players along the chain so that those with direct and indirect roles and responsibilities for efficient flow of product from production to sale are able to work interdependently to grow the sector.

The vision is premised on commercialization, which calls for strategies to be market-driven, anchored on sound business principles, and to ensure that small-scale producers are better integrated in value chains as partners, adding value and increasing value-chain efficiency.

For both the live/fresh and smoked fish channels, the vision is to increase competitiveness and consumer affordability and help link producers to not only reliable, ready markets through contracts but also to other equally important support structures such as fingerling suppliers, feed mills, technical/extension services etc. which are all necessary for commercial success. Our vision for growth requires that access to these support structures be as effortless as it is for those in poultry production, so that aquaculture too can proliferate and take-off like the poultry sector has done elsewhere in Africa.

Strategies for Value Chain Improvement

Many challenges exist throughout the value chain, which prevent the actualization of the vision. The following table addresses some key constraints restraining the aquaculture sector. The table also presents a list of strategies and approaches to quickly address the constraints challenging the sector. The implementation of all or some of the recommended changes or interventions can be carried out in situ or as separate ventures to take advantage of opportunities. Both approaches have the possibility of contributing significantly to value chain improvement, competitiveness and eventual sector growth.

Value Chain Functions	Table 1: Strategies for Value Chain Improvement
Production	• Increase Extension Services: There is need to train farmers on all aspects of fish production and management, from stocking to feeding to water quality management in order to increase productivity and volume.

1 ERS/USDA. International Evidence on Food Consumption Patterns across 144 countries. Using 2005 ICP data.

Value Chain Functions	Table 1: Strategies for Value Chain Improvement
	• Provide Training on Ponds: Fish farmers need assistance on pond location and management since pond culture is the most prevalent fish-farming method among smallholders. • Diversify Production into Cage/pen fishing: Cage/pen-fishing, which does not require either heavy capital investment or sophisticated technology, should be offered as option to smallholders too. • Increase Access to Finance: Access to credit for pond or cage/pen expansion, or input purchases should be considered for smallholders to increase fish supply. • Increase Access to Inputs such as Fingerlings, Fish Feed, and Supplies (cages and pens): The private sector should be encouraged to step in to provide these services. There is need to break the perception that "fingerling production" or "fish feed mills" requires heavy investment and complex technology. Concise business profiles with business plans using appropriate technology and indigenous materials (such as cassava) should be offered to the business community to help move these opportunities along. Absence of information and knowledge of best practices and appropriate technology have also contributed to hindering sector development and expansion.
Harvesting	• Provide Training on harvesting and post-harvesting practices such as proper handling of live fish, proper icing of fish if sold fresh, to proper handling to safeguard quality and food safety. • Provide Training on Business and Management Skills: Train fish-farmers and cooperatives to think & operate like a business, maintaining records and budgets for better cost-control. • Train on Quality Grading: Training on quality needs to include topics such as product segregation by quality and size, since pricing is determined by these characteristics. Further sizes differ for restaurants/pepper-soup bars and households. • Increase Linkages to Reliable Buyers: Promote and establish "partnerships"-- market linkages either directly with retail chains or through local commercial farms that supply these stores but are looking to increase their volume. Both channels offer smallholders the opportunity to slowly integrate into the formal live/fresh-fish value chain.
Consolidation	• Increase Consolidation Efficiency: Work with producers to help them understand the value of harvesting on schedule in order to achieve commercial volume at the producer level to control downstream costs. This can be also be supplemented with training on the importance of following a proper feeding regimen, using fish feed to achieve marketable fish size, and emphasizing the value of improving and maintaining quality to secure higher price. • Product Diversification: While pond-culture is the predominant form of aquaculture in Nigeria, cage-culture should also be considered as an approach to increasing the country's fish supply. Cage-culture uses fairly simple technology & lends itself well to the lifestyle of fisher folks.
Marketing	• Develop a Commercialization Strategy for Smallholder Aquaculture Industry: While support to improve production is critical, efforts to encourage "market-pull" are equally important. There is need to focus on building a strategy that enables smallholders to shift from subsistence livelihood to producing surpluses to meet market demand. For this to be successful, it will be important to help producers and their cooperatives or groups to understand that fish-farming is a business, and that business management and marketing are essential skills to profit financially. • Improve Transport/Hauling Material: Access better quality and type of packaging and hauling materials that are cost-effective such as insulated ice-coolers adapted for fresh fish, and easy to haul crates for live catfish and fingerling distribution. Quality packaging for smoked fish.

Value Chain Functions	Table 1: Strategies for Value Chain Improvement
	• Improve Market Orientation: To better understand consumers and competition; to better understand what competitors' strategies in pricing and distribution are; how good competing products are. Profitable trade can happen by understanding markets and market forces.

The Pilot Project

A proposed pilot project in Warri can pilot-test the concept and vision outlined above. Warri stands out as a pilot location in terms of suitability and "readiness" given its proximity to the Economic Development Center, the hub for all economic development activities under PIND. Secondly, and more importantly, Warri houses a large cooperative farm with 3,000 farmers and over 6,000 ponds, which could serve as the site for the pilot project.

The pilot project will work with the existing cooperative to target a group of small scale commercial farmers to first conduct a deeper diagnosis of all the key factors challenging producers on the input side. There is need to understand more clearly, both from a technical as well as a financial perspective, as to why feed costs are high, and why farmers are resorting to floating pelletized feed for bottom-feeders, which the mudfish clearly is. The pilot will also assess the reasons as to why feed is in short supply (or little used), and why feed mills that are currently producing for poultry and cattle are unable or unwilling to extend their production lines to cater to the growing aquaculture sector.

As with the feed sector, the pilot will carry out its assessments to ascertain the reasons leading to the current shortage and resulting high price of quality fingerlings. At present fingerlings/juveniles can cost as much as 6% to 10% of the farm-gate (wholesale) price for live fish. Understanding issues preventing smallholders from accessing fingerlings will also be addressed so that a clear and easy pathway can be established. The pilot will work with interested commercial hatcheries and fingerling nurseries to identify areas that can be improved. Linkages to small-scale commercial fish farmers will be encouraged and innovative approaches to fingerling distribution will be assessed.

The pilot project will also identify channels to link local agro-dealers with feed and fingerling suppliers to ensure access, closer to the ponds. Where there are no local agro-dealers, the pilot should assess the possibility of encouraging the establishment of one, either with existing poultry/animal feed manufacturers and fingerling suppliers or as a stand-alone business to supply feed for grow-out fish farmers. Nurseries, specializing in raising fingerlings/juveniles from fries procured from hatcheries, can be a valuable business to support the growth of grow-out farmers.

To ensure that small-scale production of live and smoked fish sufficiently deliver gains from enterprise and trade, there is need to conduct a rigorous cost analysis. While many existing fish-farmers say that aquaculture is profitable, it is not clear how they calculate and arrive at their profits. In many instances, smallholders fail to pay for their own labor and investment, assuming that what they draw in (revenue) is all profit. Consequently, many find themselves struggling financially and working long hours despite their "profitable" businesses.

There is also need to determine clearly the number of production cycles that can be achieved per pond per year to arrive at a reasonable income threshold. Along the same lines, it is also important to identify sources of fast-growing varieties for both fingerlings and improved feed. There is need to link with

IITA/Ibadan to tap the institution's knowledge and research outputs that are already being commercialized in certain parts of the country. For example, IITA developed a pelletizing machine to produce cassava-based fish feed (pellets). These machines utilize both cold or steam process to produce soft, hard and floating pellets. Since the technology uses local materials, the cost of the entire package (extruder, steam boiler and dryer) required to produce fish feed is designed to be affordable for small-scale entrepreneurs.

The promise of the sector lies not just in expanding grow-out activities as enterprises, but also other essential businesses within the value chain. The potential business options and opportunities mentioned above not only address constraints but in the process also help improve value chain efficiency. These business/enterprise opportunities can be either stand-alone activities or integrated to produce affordable and quality inputs/products or services. Local production of these inputs has the potential to not only boost fish production but also encourage local employment especially for women and the youth. Given the country's significant unmet demand for fresh and smoked fish, the following opportunities and business prospects in this sector appear all the more promising and commercially viable:

- **Hatcheries** – to produce fries and fingerlings to partially meet the deficit prevalent in the country and the Delta.
- **Fry/ Fingerling Nurseries and Distribution** – to produce and make available quality fingerlings and juveniles targeting grow-out farmers on a timely basis.
- **Feed Production and Distribution** – cassava-based fish feed production and distribution since cassava-based feed (developed by IITA/Ibadan) is a lower-cost alternative to imported feed. Feed can be either floating or sinking feed, although the mudfish does not require the more expensive floating feed given that they are bottom-feeders. Lower-cost options further improve their cost of production for fish farmers given that fish feed alone can take up as much as 60% to 65% of the cost.
- **Fisheries Supplies** – the small-scale aquaculture sector supply chain struggles due to the absence of simple but key factors which, if available, could improve efficiency of the chain and value of the product. Simple items such as insulated fish containers for shipping live fish, or containers that are able to transport live fingerlings across great distances without increasing fingerling mortality are important for business success and profitability. For smoked fish, appropriately priced technologies such as solar dryers as well as packaging machines will assist in expanding product lines targeting different segments of the market.
- **Private Extension Services** – in the absence of government funded quality extension services, technical service providers manage their extension services business, providing technical assistance and training to small-scale fish farmers for a fee.

All the above enterprise options are suitable for small-scale commercial production and favorable to women and youth. All opportunities, as mentioned, however, need to be further developed in more depth, and will require formal financial analysis or business planning to assess how best to maximize returns for small-scale producers. If launched properly, these enterprises will not only provide the needed services and products but could also attract more players, further stimulating the sector. The pilot will further determine the most attractive market segments for small scale commercial farmers, as well as the fish-size preferred by the segments (whether live or smoked) in order to better target consumers and deliver products quickly to increase "market pull" and enterprise profits.

The pilot project will address weaknesses in information about available services by developing a directory of suppliers covering feed, fingerlings, extension service providers, equipment suppliers, veterinarians, financing institutions, as well as fish farms. This directory, along with the lessons learned, will be shared with those active in the sector through information sharing meetings.

Appropriate Technology

Strategies to increase competitiveness will also require improving technical efficiency of current production practices and technologies. PIND's Appropriate Technology Centre will be linked to evaluate those technologies that are presently available and to review options for developing additional ones to meet the need of the sector such as covered/enclosed solar driers and smokers to produce hygienic, healthy products, diversifying into utilization of better packaging materials made of environmentally friendly materials, reviewing opportunities that tap technologies offered by domestic manufacturers that can provide cost-effective alternatives to expand product lines and reach more market segments, and the IITA developed pelletizing machine which is used to produce cassava-based fish feed (pellets).

Introduction

The Foundation for Partnership Initiatives in the Niger Delta (PIND) identified fisheries as a value chain that had growth potential and also could provide employment for people in the Niger Delta (including women and youths). The process of value chain identification was based on studies carried out by the New Nigerian Foundation (NNF) on behalf of PIND during which several value chains were selected. A workshop was then held and some value chains were selected; the fisheries value chain was one of the few selected by the team.

Fisheries in Nigeria

Nigeria's fisheries sector is made up of capture fisheries and aquaculture. Capture fisheries encompasses both marine and inland fisheries. Available fish statistics indicate that overall fish production from captured fisheries has increased by roughly 57% over the years, from 320,955 metric tons in 1995 to 504,227 metric tons in 2007. A noticeable increase was observed in 2006, resulting in catches amounting to 518,537 metric tons.

Aquaculture, on the other hand, increased considerably, by almost 430%, albeit from a small base of 16,119 metric tons in 1995 to 85,087 metric tons in 2007. In 2009, domestic aquaculture production boomed further, providing 152,796 metric tons of fish, mostly catfish using flow through and water re-circulatory culture systems.

This rising trend in aquaculture continues to show promise of further rapid expansion given the state of decline of capture fisheries in Nigeria. Nigerian marine sector has been on the downward slope for a number of years, most markedly in the industrial shipping sector, where the numbers of fishing trawlers and boats have reduced significantly. Artisanal fishing within the inland waterways also show signs of decline since the river systems are now over-exploited due to obnoxious capture fishing methods which include the use of undersized nets, chemicals, dynamites and destructions of nursery grounds. Nigeria's river system cannot therefore sustain any serious agri-business in capture fisheries to meet the burgeoning fish demand of the country's growing populace. Consequently, aquaculture has been rapidly expanding to meet the demand shortfall caused by capture fisheries. Based on this, the research team decided to focus on aquaculture as one of the key value chains for study.

Niger Delta Fisheries

The Niger Delta area contains many rivers, seas and creeks, which provide a strong pattern of marine and inland fish capture. However, given the seasonal nature of capture fisheries, combined with the negative impact of oil and other industrial activities on the aquatic ecosystem in the Delta, fishermen in the area have had to seek other employment, outside the fisheries sector to sustain their livelihood.

Figure 1: An adult african mud catfish (*clarias gariepinus*)

The continuing depletion of fish stock in and around the Niger Delta and declining profitability in the stagnant capture fisheries sector makes it an imperative to promote aquaculture, especially in the coastal areas. Widespread adoption of aquaculture has the promise to generate significant quantities of table fish on a sustainable basis and provide jobs.

Catfish and Tilapia

Catfish production is the single-most important aquaculture practice in the Niger Delta area. Ninety percent (90%) of fish farming or aquaculture in the Niger Delta in particular and Nigeria in general, is focused on catfish production. Another 4% are into Tilapia production. Given the intense interest in catfish production, this research is therefore focused on farmed African Mud catfish (*Clarias gariepinus, Heterobranchus and their hybrid*) production - the catfish of choice in Nigeria.

The Niger Delta's strength in farmed African mud catfish lies in the fact that*:*

- The fish is already being farmed extensively and production is increasing
- It is indigenous to, and occurs all over, Nigeria
- It is very tasty, hardy with strong market demand and high growth potential

Methodology

Secondary Data Collection and Review

As part of the study, a review of literature and past research on fisheries was conducted. Some useful data was obtained from various sources, including the Department of Fisheries in the Federal Ministry of Agriculture and Rural Development, and the Market Research on Catfish project funded by USAID. Additional donor program reports also provided key information to inform this study. That said, the information available largely focused on the country as a whole; few carried information specific to the Delta area production or marketing of aquaculture.

Key Informant Interviews

Key informant interviews were organized in three states: Rivers, Bayelsa and Delta States. The objective of the interviews was to get a better understanding of the value chain linkages and dynamics between and among various actors within the chain in the region. Interviews were carried out with farmers, hatchery operators, hoteliers, market women, researchers, and Government officials with oversight of agriculture departments. All provided information that proved to be very useful, providing a lot of insight into the aquaculture value chain in the Delta Region. A list of some of the key informants and fish farms we visited and met with is provided in the annex.

Survey

In addition to interviews and farm visits, we also conducted a brief survey of retailers (mainly market and caterers) and consumers to better understand the market for aquaculture fish. Three separate questionnaires were designed for:

- Market Women
- Catering Services (hotels, bars, restaurants, soup joints, fast food retail outlets, etc).
- Consumers of fish

The essence of the survey was to understand the markets for fish and also to have an idea of the consumption pattern of consumers of fish. In the questionnaires, consumption of three categories of fish was examined (i.e. captured fish, cultured fish and imported frozen fish). In addition, questions on preference for smoked and fresh fish were put forward. The questions also covered purchase and

preference for fish over meat (or meat over fish) and the reasons behind such preference. Copies of the questionnaires are included in the annex.

The Validation Workshop

A validation workshop on the aquaculture value chain was held on the 21st of July 2011 at Cyprian Hotel, Warri. The aim of the workshop was for the participants to validate the findings from the study.

The workshop brought more clarity on issues concerning production and marketing and provided added information. It also helped to not only identify constraints along the value chain, but to proffer solutions in the form of sustainable market driven intervention (with clear-cut activities), designed to address these constraints.

Key Findings

- Aquaculture in Nigeria is expanding rapidly, from 16,119 metric ton in 1995 to 25,720 metric tons in year 2000 and 85,087 metric tons in 2007. It further increased to 152, 796 metric tons in 2009.
- Aquaculture has great potential for growth and for employment in the Niger Delta region.
- Catfish is the major product from aquaculture and accounts for over 90% of fish cultivation.
- Smoking is used to add value to the fish and also serves as a means of preservation.
- Sale of fresh versus smoked fish is at a 1: 1 ratio, with more smoked fish leaving the Delta and more fresh fish consumed internally.
- Hatchery farm establishment is increasing by about 50% annually in the Delta.
- About 60% of the cost of production is accounted for by feed purchase.
- The demand for fish is increasing at an annual rate of 3% and current demand nation- wide is about 2 million tons while present supply is about 1.5 million tons.
- There is room for growth for aquaculture through increased fish and fingerlings production.
- Production of fish could be increased and cost of production driven down by addressing the cost of imported feed and encouraging production of local feed in the country.
- There is poor linkage between actors in the value chain.
- Extension services are inadequate especially in hatchery farming. There is the need to create awareness on good parent/brood stock identification.
- There is the need for regulation and standardization in fish production.

The End Markets

Fish accounts for about half of the daily protein intake in the typical Nigerian diet constituting over 25gm. National consumption of fish is currently over one million tonnes (about 1.5 million tons), with a wholesale value of about US $1 billion per year (Federal Department of Fisheries, 2009). Both value and volume are expected to rise in tandem with the increase in population.

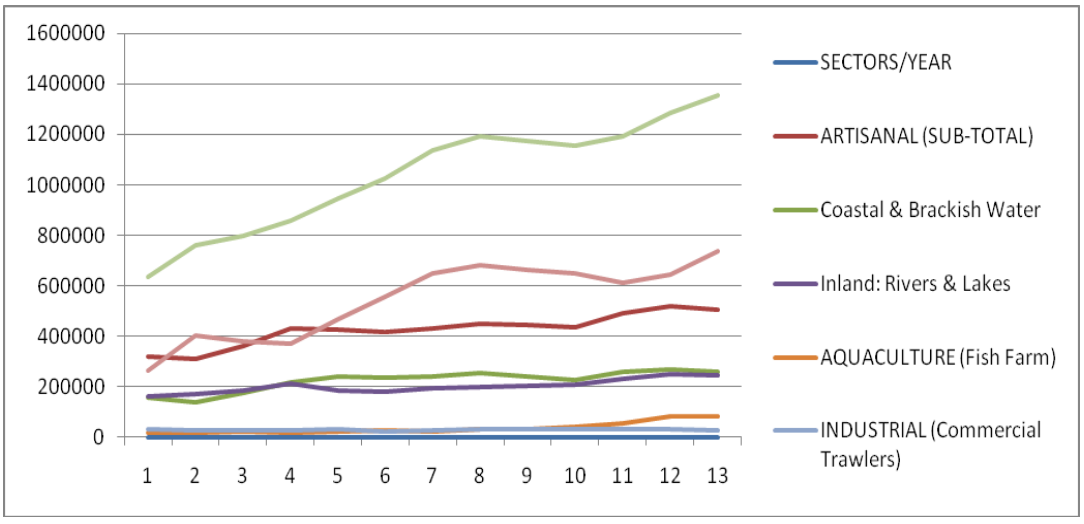
Table 2: Fish Consumption Data for Nigeria

S/NO	SECTORS/YEAR	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
1	ARTISANAL (SUB-TOTAL)	320,955	309,200	360,220	433,069	426,786	418,069	433,537	450,965	446,203	434,830	490,594	518,537	504,227
	Coastal & Brackish Water	159,201	138,274	175,126	219,073	239,228	236,801	239,311	253,063	241,823	227,523	259,831	269,878	260,099
	Inland: Rivers & Lakes	161,754	170,926	185,094	213,996	187,558	181,268	194,226	197,902	204,380	207,307	230,763	248,659	244,128
2	AQUACULTURE (Fish Farm)	16,619	19,490	25,265	20,458	21,738	25,720	24,398	30,664	30,677	43,950	56,355	84,533	85,087
3	INDUSTRIAL (Commercial Trawlers)	33,479	27,244	27,703	29,955	31,139	23,308	28,378	30,091	33,882	30,421	32,595	33,778	26,193
4	DISTANT WATER	266,448	403,273	382,442	373,044	466,840	557,884	648,197	681,152	663,180	648,033	611,520	646,484	739,666
	GRAND TOTAL	637,501	759,207	795,630	856,526	946,503	1,024,981	1,134,510	1,192,872	1,173,942	1,157,234	1,191,064	1,283,332	1,355,173

Source: Federal Department of Fisheries

For Nigeria, the total demand for fish is estimated at about 2 million metric tons annually. However supply remains only at roughly 1.5 million tons. Nigeria's annual fish supply comes from both domestic

Figure 2: Fish consumption data for various sectors



production as well as imports. Imports meet close to 50% (746,851 tons) of the country's total fish consumption. Domestic fish production provides the other 50%, with 780,704 tons produced annually. Of the domestic production, capture fisheries contribute to roughly 80% (627,908 tons) of the total domestic fish supply, while aquaculture meets the rest, at 152,796 tons.

With the decline in capture fisheries, and aquaculture meeting only about 7.6% of the country's current total fish demand, the shortfall is being addressed by imports. However, as mentioned earlier, the demand for fish is far from being satisfied, either through imports or domestic production. The state of affairs in the fisheries sector calls for expanded supply, opening opportunities for domestic production to rise up and meet the challenge of Nigeria's growing desire for fish.

Figure 3: Artisanal fishing - 1995-2007

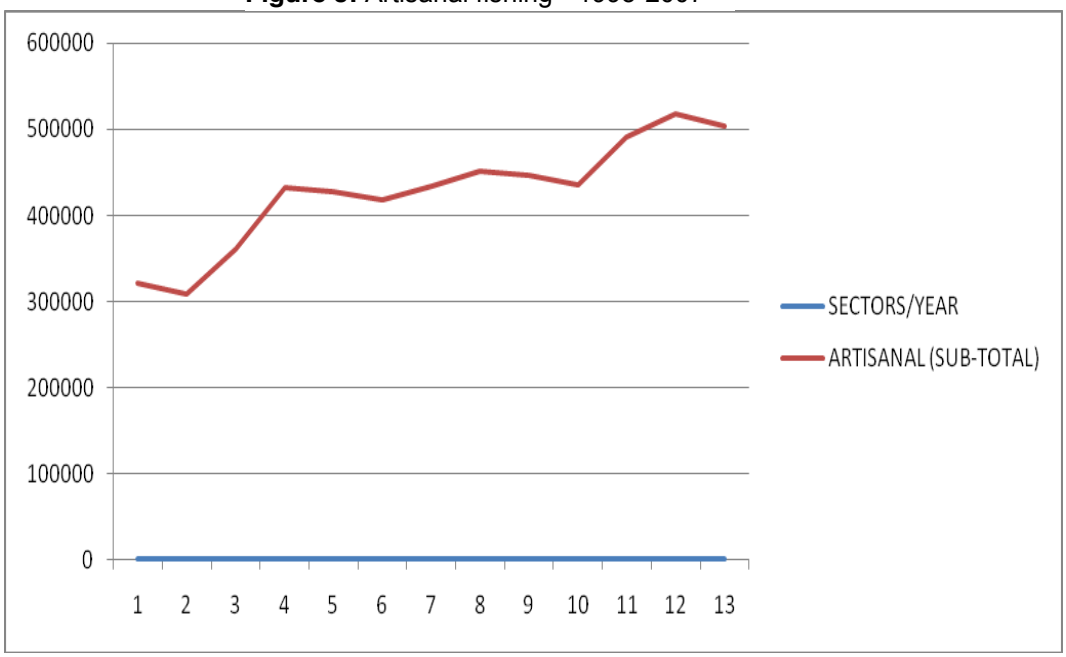


Figure 4: Aquaculture - 1995-2007

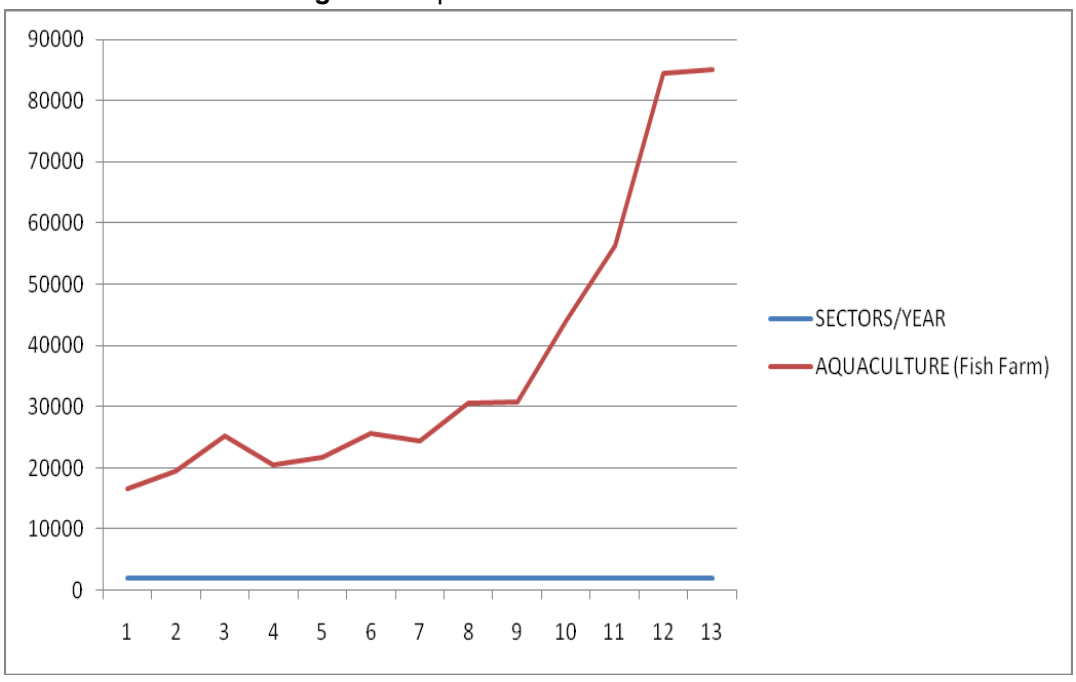


Table 3: Fish Production Statistics for 2009

Type of Fish Production	Quantity (Metric Ton)	Value ($)	Value (Naira)
Captured Fish	627,908	1,663,945	249,591,675
Aquaculture Production	152,796	492,890	73,933,500
Total Production in Nigeria	780,704	2,156,835	323,525,175
Imported	746,851	766,669,000	115,000,350,000
Total Consumption for 2009	**1,527,555**	**768,825,835**	**115,323,875,175**

A recent survey reinforces the rising numbers favoring fish in Nigeria. Of the 71 persons interviewed, 78.9% or 56 people preferred fish to meat; 15.5% said they preferred meat over fish. Four people or 5.6% surveyed said they had no preference. Many of the respondents cited reasons such as health, taste and nutritional values influencing their preferences. However, the high cost of fish, especially marine/fresh water captured fish, has caused people to turn to meat, which in the Niger Delta, is a strong competitor of fish.

From a pricing perspective too, the window of opportunity for domestic aquaculture is growing. For example, while many prefer fish to meat, the preference is for fresh fish and not frozen fish. While price of frozen fish (a large percentage of which are imported) is usually the lowest (depending on the type of fish), those that can afford to veer away from frozen fish, do so for various reasons. Many in Nigeria believe that frozen fish have preservatives that are unhealthful, and that prolonged storage and transportation affect quality, especially from a taste aspect. Such beliefs and perceptions about frozen imports favor domestic aquaculture production.

Presently, with increased production of farmed catfish, the prices have fallen to comparable levels to that of meat. Consequently, consumption of farmed catfish has increased accordingly.

Table 4: Price Comparison between Meat and Fish

S/NO	CULTURED CATFISH	MEAT	CAPTURED	FROZEN FISH
Retail Price/Kg In Naira	700 - 1000	700 – 1000	1500 – 2000	350 - 450
Wholesale Price	500 – 550	N/A	800 – 1200	200 -250

The Niger Delta consumers access their fish from various channels and markets. Generally, table fish in the Delta is sold through four principal markets:

1. Fresh Fish Market for farmed and capture fish
2. Smoked Fish Market
3. Frozen Fish Market
4. Export Market (mainly smoked fish)

The Fresh Fish Market

Fresh fish demand in the Delta is high as it is key in the preparation of native dishes. Given the high demand, most of the fresh fish produced in the region is consumed within the region. Imports from other parts of Nigeria, such as Lagos and Ogun states also supplement the demand for fresh fish.

A recent survey conducted in three states (Baylesa, Delta and Rivers) of the Niger Delta showed that preference for captured fresh fish is higher than farmed fish. However because of seasonal availability and cost of fresh captured fish, consumers feel forced to buy farmed fish. Survey results indicate as many as 35% prefer fresh captured fish, as opposed to 15% who consume farmed fish. Even fewer (8%) purchased imported fish. A total of 17% of those that were surveyed said they purchased all categories of fish, and 14% said they purchased both captured and farmed/cultured, while 7% indicated they purchased captured and imported fresh fish.

As indicated earlier, the preference among most consumers in the Niger Delta is for fresh African Mud catfish. It should be noted that fresh catfish has to be sold live if customers are to buy it. This restriction does not apply to Tilapia and other types of fish, but they have to be sold almost immediately or else stored in ice. Since catfish is hardy and resilient, it can survive for quite a few days as long as it is preserved in water, and the water is changed daily. Fresh catfish for pepper soup in certain restaurants and bars is becoming very popular and people pay as much as N3,000 to N4,000 for a single catfish (depending on the size) in some bars (referred to as “point and kill”).

The survey indicated that of the 28 retail outlets (hotel, restaurants, fast food shops, local restaurants, bars, etc) for fresh fish in the Niger Delta, 25 sold catfish. Of these 25, 21 outlets or 84% of the outlets sold farmed or cultured catfish in addition to the captured variety. Only one outlet was found to sell fresh Tilapia pointing to the Delta’s overwhelming preference for catfish despite its higher price.

Price for captured catfish is higher than farmed/cultured catfish. The farm-gate wholesale price for fresh catfish is usually around N500 per Kg, while for retailers the price ranges from N550 to N650 per kg. Wholesalers are usually those buyers, who purchase between 100 to 200 kgs regularly (weekly) and directly from the fish farms. Farmed/cultured catfish is then retailed in the market at N800 to N1,000 per Kg. Restaurants, fast food retail outlets and hotels, etc. pay more to buy directly from fish farmers and select the best out of the lot. The need for quality and assurance costs them more than the wholesalers, but caterers find it cheaper than buying from other wholesalers or market women. Institutional buyers usually pay higher rates, ranging from N600 to N800/kg at the farm gate for choice and quality.

Table 5: Ratio of the Three Categories of Fish Sold at Retail Outlets

S/NO	RETAIL OUTLET TYPE	CATEGORIES						
		NATURAL CAPTURED FISH		CULTURED FISH		IMPORTED FROZEN FISH		TOTAL NUMBER OF RETAIL OUTLETS SURVEYED
		Rated Scores	Percent	Rated Scores	Percent	Rated Scores	Percent	
1	Combined (Hotels, Fast Foods, Restaurants/bars/Bukas	30	23.4%	53	41.4%	45	35.2%	28
2	Hotels only	15	53.57 %	7	25%	6	21.4%	5
3	Fast Food Sales Outlets	8	17.4%	16	34.8%	22	47.8%	10
4	Restaurant/Bars/Bukas	7	13.7%	30	58.8%	14	27.5%	13

Table 6: Preference for Fish Categories from Consumer Survey

NUMBER OF CONSUMERS	CATEGORIES					
	NATURAL CAPTURED FISH		CULTURED FISH		IMPORTED FROZEN FISH	
	Rated Scores	Percent	Rated Scores	Percent	Rated Scores	Percent
71	172	44.44	114	29.46	101	26.10

Table 7: Preference Ranking Among Fish Categories

S/NO	NUMBER OF CONSUMERS	CATEGORIES					
		NATURAL CAPTURED FISH		CULTURED FISH		IMPORTED FROZEN FISH	
		Rated Scores	Percent	Rated Scores	Percent	Rated Scores	Percent
1	71	172	44.44	114	29.46	101	26.10

Smoked Fish Market

The demand for smoked fish is fast expanding and at present, the sale of smoked fish is equal to that of fresh fish. That said, the potential for smoked fish is large given the demand for well preserved and packaged smoked fish from other parts of the country. The smokers, who purchase fish from farms

purposely for smoking, usually pay slightly less (about N450/kg on the average) since they mix large sized fish with those that are small and rejected by fresh fish vendors. The retail price of smoked fish is not based on the weight as smoked fish weighs less than the fresh fish from which it is derived. Smoked fish is priced at roughly between N1,200 – N1,500. Smoked fish markets are strongest in Lagos and some of the south eastern states.

Imported Frozen Fish

Imported frozen fish accounts for about half of the consumed fish in Nigeria. The consumption of imported frozen fish is most prevalent in the upland areas where captured fresh fish is not readily available. In coastal cities of the Niger Delta, such as Warri, Port Harcourt, and Yenagoa, the demand is highest for fresh fish rather than imported frozen fish. Given the availability of captured and farmed fish, the market for imported frozen fish is relatively smaller than upland areas. That said, the demand for fish is rising and domestic production has been unable to satisfy it. Consequently, frozen fish is imported from countries such as Sweden, Norway, Mauritania and Senegal. Once the imported frozen fish lands in either Lagos or Port Harcourt, it is stored in cold rooms. From there, wholesalers buy and transport to other cities, from where they are sold to market women. Wholesalers buy the fishes at N250 – N500 per kg depending on the type of fish. It is retailed at N350 – N650 per kg. Major buyers of imported frozen fish include fast food restaurants, where they are sold with continental dishes. The local dishes are sold either with meat of captured or cultured catfish.

The Export Market

There is potential for export of smoked fish from the Delta to other parts of Nigeria and to other countries. However, the requirements for export to most western countries are so stringent that most exporters fail to comply. A few studies report that there is a small export of fish (fillets) at Ebughu, near Oron in Akwa Ibom State to other countries. But this is small scale and does not account for a significant portion of the market. Most of the fish leaving the Delta is taken to other parts of the country as smoked fish.

The Value Chain Map

The value chain map presents a visual depiction of the various functions involved in the production of fish up to the consumption by the end markets, and the various actors who deliver those functions and the linkages between those enterprises.

The various functions in the aquaculture value chain include:

Inputs

Feed

The major inputs for cultured/farmed fish are feeds, medicines, fertilizers and other materials used in constructing and maintaining the ponds like water, labor, nets, etc. Feed accounts for about 60% to 65% of the total cost of production for fish in a cultured environment.

Feed Considerations

Catfish (*Clarias, heterobranchus* and the hybrid) is a very suitable fish species for the development of fish farming in Nigeria, due to its hardiness, tolerance, fast growth rate, ease of reproduction and ability to derive atmospheric oxygen. However, Clarias is a carnivore fish; its nutritional requirements are high and expensive. The availability of affordable, quality catfish feed is an issue in Nigeria and needs to be addressed.

Feed Availability in Nigeria

There are basically 3 types of feed available to fish farmers in the Niger Delta and the country as a whole:

- **Imported Feeds -** These are extruded floating feeds high in protein and fat, made available to catfish growers at a retail price of N300/kg to N350/kg (usually in 15kg bags at N4,500 to N5,000). This is considered an extremely high price. The high price is partly due to the high cost of ingredients and the high cost of marine transportation from the country of manufacture to Nigeria. In order to reduce the cost of fish production, there is need to reduce transportation cost of feed. However, given the very high quality of imported feed, the demand exists in Nigeria. Imported feed are said to have high feed conversion ratios (FCR), yielding 1 kg of fish for 0.9 to 1.4 Kg of feed (FCR of 1:09 – 1:1.4). The most popular imported fish feed are Coppens and Multifeed.

- **Local Feeds -** These are produced by local manufacturers in Nigeria. The feeds are based mostly on ingredients obtained locally and sold at the retail price of N160-180/ kg (usually in 20kg bags at about N360/bag). Fish meal (which is imported) and blood meal are usually used to provide animal protein in the fish feed. About 72% of all fishmeal in Nigeria is imported and this makes up about 30% of fish feed. The high cost of importation of the fishmeal is responsible for the high cost of feed in the country. There are a few feed manufacturers in Nigeria, based primarily in Lagos, including CHI, UAC, etc. Presently, the combined annual production of fish-feed in the country is estimated at about 600 – 700 tons.

- **Homemade Feeds** - These are feeds produced by catfish farmers themselves, involving home based operations with simple and mostly inadequate facilities. They have minimal access to quality feed ingredients, finance, storage facilities etc. As feed plants, their

operations appear below the minimum economic size. Some farmers believe that their "home-made" feed contains enough protein for the fish. The major difficulty is in purchasing extrusion machines which could make the feed float. The advantage of floating feed is that the fish could easily spot the feed and pick them up, even though the Clarias gariepinus is a bottom-feeder. However, farmers think surface-feeding implies that fish are feeding properly, which they interpret as an indication of the good fish health. The farmers who make some of their own feed complained about the high cost of pelletizing and drying machines. The perception that sinking pellets can be a source of pond pollution is quite prevalent.

Feed Manufacturing

Feed manufacturing is a separate value chain in itself. A feed manufacturing plant consists of typical machines, bins, silos, pelletizers, extruders, and dryers etc, representing significant capital requirement. The economic viability of the plant is conditioned by the ability to purchase and store raw materials cost-effectively, and the ability to effectively deliver and distribute the feeds. The minimum economic size is in the range of 6,000 tons and above per year. Under special country/market conditions, the minimum economic size could be lower (say, 3,000 ton/year).

Our investigation revealed that there is no such large scale feed manufacturer in Nigeria. Catfish feeds are produced locally in Nigeria by 3-5 medium size plants (CHI, Fishline, Durante), with capacities in the range of hundreds of tons/year and many (hundreds) of Nano & Micro feed producers, who operate home mixer operations to produce their own feed, some with aspirations to sell to others.

Hatcheries

Given the rise in aquaculture across the country, demand for fingerlings is also growing rapidly. In the Niger Delta, especially medium and large-scale fish farmers are responding to the expanding demand by engaging in fingerling production.

Most of the fingerling producers used to buy fingerlings/juveniles from outside the Delta (from Lagos and Ibadan), but now grow theirs and sell the excess. Also, a lot of standalone hatcheries have also emerged. In Rivers State for example, there are about 260 such standalone hatcheries with 60 of them being medium scale modern hatcheries. The major problem with marketing of the fingerlings is that, most out-growers are not aware of the existence of these hatcheries. The hatcheries in turn are not linked to small-scale grow-out farmers, who are the most likely people to buy their fingerlings. This leads to the belief that supply of fingerlings outweighs the demand. Our study reveals that some grow-out farmers still buy fingerlings from Lagos, while hatcheries nearby in the Delta are complaining about low patronage. There are a number of hatcheries presently operational in the Niger Delta and these provide more than 90% of the fingerlings/ juveniles required by grow-out fish producers. The hatcheries come in two categories:

Integrated Systems

Some farmers who are grow-out fish producers also have hatcheries within their farms and produce their own fingerlings/juveniles and sell the excess to other grow-out fish farmers who need them. Most of these farmers are either medium scale or large scale commercial farmers. It is estimated that up to 60% of the fingerlings used by grow-out farmers come from these hatcheries.

Stand Alone Hatcheries

Stand alone hatcheries which are not part of an integrated system also have sprung up due to rising demand for fingerlings in the Niger Delta. Rivers State is believed to have the largest number of these hatcheries in the Delta with about 200 small hatcheries and 60 medium scale modern hatcheries.

- **Small Scale Hatcheries** - The small scale hatcheries are those that are established with the very basic facilities, producing between 20,000 – 30,000 fingerlings/juveniles per cycle.
- **Medium Scale Modern Hatcheries** - Medium scale hatcheries have modern facilities and produce between 50,000 to 100,000 fingerlings per cycle.

For the market to function efficiently there is need to link hatcheries and grow–out farmers. This was especially emphasized during the validation workshop held in Warri. Prices of fingerlings/juveniles are as follows:

- Fingerling (5g, 4 weeks old) - N10 to N15
- In between (Post Fingerlings) - N 30 to N40
- Juvenile (10 g, 6 weeks old) - N50

Types of Hatcheries

Indoor Hatcheries

This is usually the complete unit of fish breeding system constructed in a housed area for fish breeding. It consists of concrete tanks with a network of water distribution system usually perforated to allow splashing for oxygen aeration when in use. Other components may include rooms for storage of work materials or tools, table usually for the spawning activity, dissecting of male fish, stripping of female fish and bowls, syringes, beakers, spoons, etc, that are usually used during breeding sessions.

Outdoor Hatcheries

This is mostly characterized by the sample materials as in the indoor hatchery but only differs in the facilities being outdoors and uncovered.

Simple Hatcheries

This could be in the form of the normal water bath or aluminum troughs for the production of fingerlings. There also may use electric aerators where affordable but this is not mandatory.

Complex Hatcheries

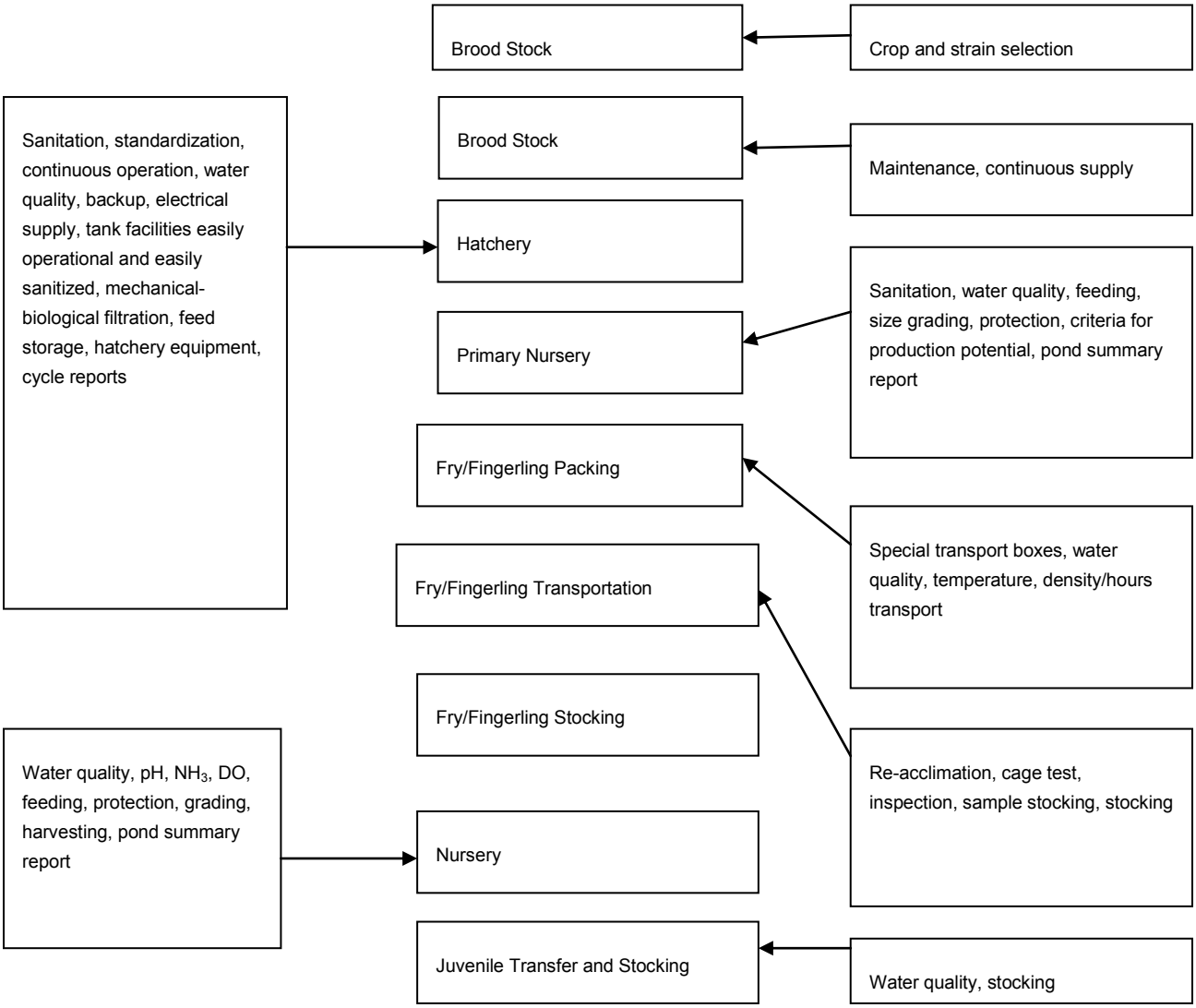
This kind of hatchery is usually more organized, with flow through water systems and equipped with a laboratory facility. Water quality parameters equipment and tools are usually in use here with very high number of technical instruments installed to monitor hatching of eggs, feeding and sanitation of the hatchery chambers of tanks. Table 9 presents an estimate of construction costs and investments

required to establish a complex hatchery. The table illustrates the range equipment and staff required to operate a complex hatchery in the first year for example.

Table 8: Construction Estimate for a Hectare of Hatchery Complex (1st Yr)

A)		**Hatchery Capital Costs**	
	1	Excavation of Land 10ft x 50ft for 2 nursery ponds2 (by hand)	N250,000
		(by machine cost is N400,000)	
	2	Hatchery block Plus Concrete Tanks	N650,000
B)		**Hatchery Variable Costs**	
	1	Hatchery Materials	
		- Brood stock fish	N280,000
		(50 males @ N4,000 each and 100 females @ N800 each	
		- Hormone 10 bottles @ N15,000 each	N150,000
		- Accessories (Plastic drums, bowls, basins, baskets,	N150,000
		wheel barrows, machetes and fittings)	
	2	Nursery Pond Input / Materials	
		- Water Pump	N200,000
		- Nettings	N40,000
		- Feeds	N100,000
		- Lime	N20,000
		- Poultry Manure	N60,000
		- Fingerlings Net	N50,000
	3	Running Expenses	
		- Salaries for 5 Staff @ 12,000 x 12 mths.	N720,000
		- Fuel, maintenance, electric bills. Etc	N150,000
	4	Bore hole plus Over Head Water Storage Tank	N450,000
		GRAND TOTAL COSTS =	N3,270,000

Figure 5: Best practice value chain production



Source: Final Report, Catfish Farming Industry Supply Chain Development Programme, June 2008, MSME Nigeria

Steps in Producing Fingerlings in the Hatchery

1) In fingerlings production, you need a good brood stock male and female from two different ponds of at least 8 months to 1 year old.
2) To start, inject the female and separate it in a different pond for 10 hours to enable the formed egg to come freely from the fish's belly.
3) Open the belly of the male fish and bring out the sperm sack.
4) Cut a hole inside the sack to release the fluid and mix it with a normal saline.
5) Press out the eggs from the female and put it in a bowl and mix the fluid that had previously mixed with the normal saline with the eggs.
6) Set the carcaban inside the hatchery tank filled with water.
7) Spread the egg mix inside the hatchery tank but let it land on the carcaban not on the flow of the tank.
8) Keep the eggs inside the tank for 24 hours. The eggs will automatically start the hatching process. After about 3 hours into the hatching process, turn the carcabans upside down and leave them for another 3 hours, making sure to stir up the carcaban kits very well.
9) Lastly, the remaining eggs in the tank that have not been hatched need to be siphoned.

Production (Grow-Out Fish Farmers)

The Niger Delta is home to three categories of grow-out fish farmers. As illustrated in table 9 below, the categories differ by production capacity, production output, and annual income earned. The categories of grow-out fish farmers are also different from each other based on the production system they utilize and prefer. For example, small scale farmers overwhelmingly use the green-water/earthen pond system compared to the flow through system operated by large scale farmers.

Table 9: Output Based on Water Area and System Used

S/NO		**Small Scale Farmers**			**Medium Scale Farmers**		**Large Scale Farmers**	
	Ton/year							
	Production capacity (ton/year)	5	20	40	80	120	240	480
	Production/week (kg/week)	104	500	750	1750	2,500	5,000	10,000
	Total income (Naira/year)	2 million	8 million	16 million	32 million	48 million	96 million	192 million
1	Earthen pond system(green water)							
	Water area (Ha)	0.12	0.5	0.9	1.9	2.6	5.5	10.7
	Total area(Ha)	0.16	0.6	1.2	2.5	3.4	7.1	13.9
	Make up(m^3/day) water	29	110	220	458	635	1318	2563
	Labor	1	5	9	15	16	18	19
2	Recirculatory System (RAS)							
	Water area (Ha)	0.01	0.03	0.07	0.20	0.26	0.46	0.78
	Total area(Ha)	0.02	0.07	0.13	0.40	0.51	0.91	1.52
	Make up(m^3/day) water	6	23	46	91	137	274	549
	Labor	1	4	5	8	13	16	19

3	Flow Through System							
	Make up(m^3/day) water	*46*	*184*	*369*	*737*	*1106*	*2212*	*4424*

Source: Final Report, Catfish Farming Industry Supply Chain Development Programme, June 2008, MSME Nigeria.

Small Scale Farmers (Household Growers)

These are farmers who mainly buy fingerlings or juveniles and grow them until ready for sale. They have no brooders nor grow their own fingerlings. Most of them have a single or few ponds (usually within their residential compounds) and produce at small scale for personal consumption and sell the excess. Some commercial farmers start like this and then grow to become commercial farmers. These farmers usually buy 250-500 fingerlings and then grow them. This type of small-scale farmer makes up about 80% of total number of producers. They usually produce about 100 Kgs (0 .1 tons) per month. Small scale commercial farms also exist and they produce between 0.4 – 5 tons/month and have about 3,000 – 5,000 fish under management.

Medium Scale Commercial Farmers (Also Have Hatcheries)

These produce mainly to sell to consumers through wholesalers and usually have fairly large farms. Most of those that were visited had their own hatcheries and have brooding stock and facilities for artificial insemination. They also employ workers and persons knowledgeable in fisheries to run the farms. The output of these farms are between 5 – 10 tons per month and have about 5,000 – 20,000 fish under management.

Large Scale Commercial Farms

These are similar to the medium scale farmers except for the process sophistication and output, which is above 10 ton per month. Large scale farmers also employ a lot more people than the smaller operations and earn more revenue per year, ranging from 96 million to 192 million.

Production Methods

Fish farming practices and methods differ by farm size. The most prevalent fish-farming practice in the Niger Delta is pond culture, simply because, as mentioned earlier, 80% of aquaculture is practiced by small-scale grow-out fish farmers. In addition to pond culture, there are others that are being practiced:

Pond Culture

This involves raising fish in earthen ponds which are not raised from the earth but dug out in the ground. With the earthen ponds, water does not have to be changed daily and output is usually good as it is closest to the natural habitat of the fish and contains a lot of micro-organisms, which the fish feed on. The approach to maintaining ponds differ by where they are located:

- If the pond is in the upland area where the floor of the pond does not reach the water table, other sources of water have to be used (like water pumps), to fill the ponds.

- In areas where the floor of the pond is permanently below the water table (like parts of Bayelsa, Delta and Rivers States), water is retained in the ponds throughout the year and there is no need to fill the pond with water.
- Tidal brackish water swamps are where the water covers the mangrove flats in the high tide and recedes in low tide. A well constructed pond would utilize the tidal water. When the water fills the pond, the sluice gates are locked and the water is trapped and the water can be drained off during low tide using exhaust valves.

Cage Culture

Cage culture occurs when fish are raised in cages that are lowered into a body of water. For successful cage culture, a suitable site should be selected. The shelter should not be exposed to wind or currents from the sea. In some areas the direction of the tidal current reverses daily. In such places, the feeding of the fish should be timed with stationery periods, when the current is about to reverse its course.

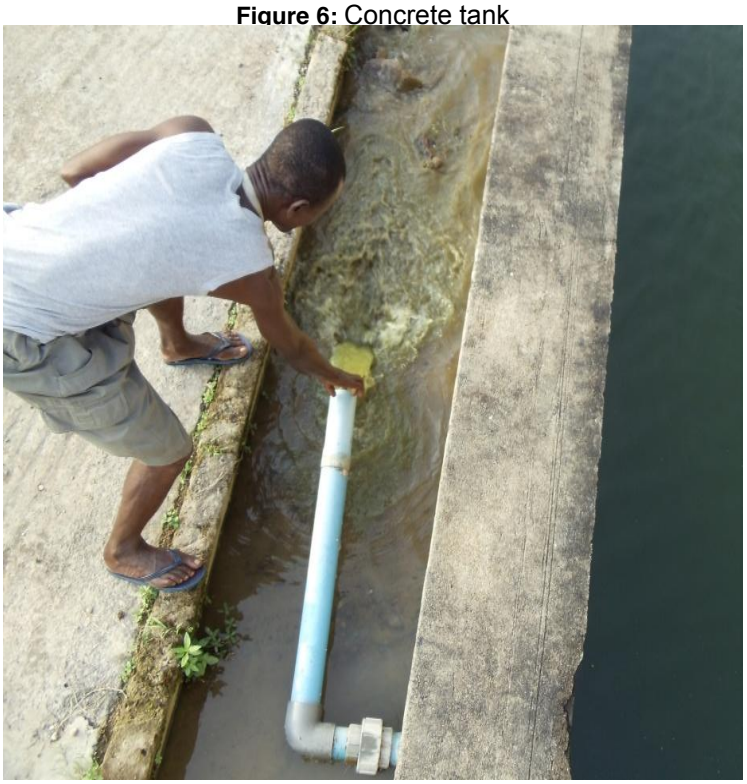
Pen Culture

Pen culture occurs when raising fish in an enclosed area of a body of water. The area should be sheltered from violent waves and the floor should be level with firm soil. The materials used for fencing the pen include bamboo, plastics, nylon netting and aluminum meshes. The poles which support the fencing are driven into the floor. The stocking rate is between 20 to 25 fish per cubic meter. For intensive farming, supplementary feeds are applied to support the high density of fish population. Feeding is usually done during stationery or at the slowest moment of the current.

Fish Culture in Tanks

Fish culture in tanks is the practice of rearing fish in tanks made of different materials. The most common are made of concrete but other materials like plastic, wood and fiber glass are also used. Before filling the tank with water, a layer of humus soil is placed at the bottom of the tank. The tank is constructed in such a way that it slopes slightly to one side and a level control pipe is installed at the deeper end. When the level of water is above the gauge line, the water flows into the vertical pipe and drains away.

Figure 6: Concrete tank



Borrow-Pits Culture

In states like Bayelsa, Rivers, Delta and Cross River and other coastal states, fish can be raised in borrow-pits in swampy areas. These fish ponds retain water even in the dry seasons. These pits are converted to ponds by making bunds above the flood levels and stocking the fish.

Flow-through System

A flow-through system is the practice of raising fish in tanks (concrete, fiber or other materials) where there is a continuous flow of water and outflow of the used/waste water. There must be an abundance of water and most farms where this is the practice have bore-holes and water tanks with generators. Flow-through system of culturing fish is practiced in an environment where there is an abundant supply of good quality water continuously streaming into the pond. As the water increases in the pond, it removes the waste and uneaten feed through a controlled outlet valve.

Water Recirculation System

Water from the tanks are treated and recycled for use. This system allows for mass production of fish where there is limited or poor quality of source water. It is highly technical and capital intensive.

Wholesalers

These are traders who buy fish at the farm gate in large quantities and resell to retailers such as market women, retail outlets (such as restaurants, bukas, fast food retails shops, etc) or other smaller distributors. The wholesalers or market mammies buy about 100 – 200kg weekly (and even more) at a farm-gate price of about N500/kg and N650 – N700/kg for catfish. There are some wholesalers who buy fresh fish at the farm-gate for smoking. Wholesalers interested in buying for smoking fish are not selective in terms of sizes and so get a better price of about N450/kg. The transportation of the fish to major fish markets is carried out by wholesalers.

There are different reasons why fish is smoked in Nigeria. First, it meets the need to preserve excess fish while adding value. Smoking fish also helps expand the market for fish, enabling distant consumers to easily access fish and add variety to the local dishes. Several studies indicate that some market women specialize in selling only smoked (dried) fish. A popular dry fish market exists around Patani in Delta State and Sagbama area in Bayelsa State. Both are situated along the East-West road. These market women buy most of their fish from fish ponds close to them and then smoke them prior to selling. They smoke captured fish as well. The price of smoked fish is usually higher than those of fresh fish.

Market Women

The market women play a very crucial role in the entire value chain. They buy from the wholesalers and sell at the local markets. It is because of their hard work and entrepreneurism that live fish are transported across great distances and hardship to markets where consumers and caterers buy from.

Caterers

As already stated, market women are major retailers of fish (both fresh and smoked); however there are other retailers of fish apart from the market women. Modern restaurants, local restaurants (Bukas), Bars/Pepper Soup Joints and fast food companies are some of the major retailers of fish. These retail outlets sell fish in cooked form (either fresh or smoked fish).

It was observed that a large market exists for sale of fish through these outlets especially the Bukas and pepper soup joints, where fish is placed in pepper soup with beer. These bars/pepper soup joints make more sales of beer when they sell them with fresh catfish.

The Value Chain Map

Figure 7 below presents a visual description of the flow of products, and maps the players and their roles in moving the products from production to final sale.

Description by Channel

The channels are defined by technology and whether the fish has been processed or not. The two identified channels are:

Fresh Fish Channel

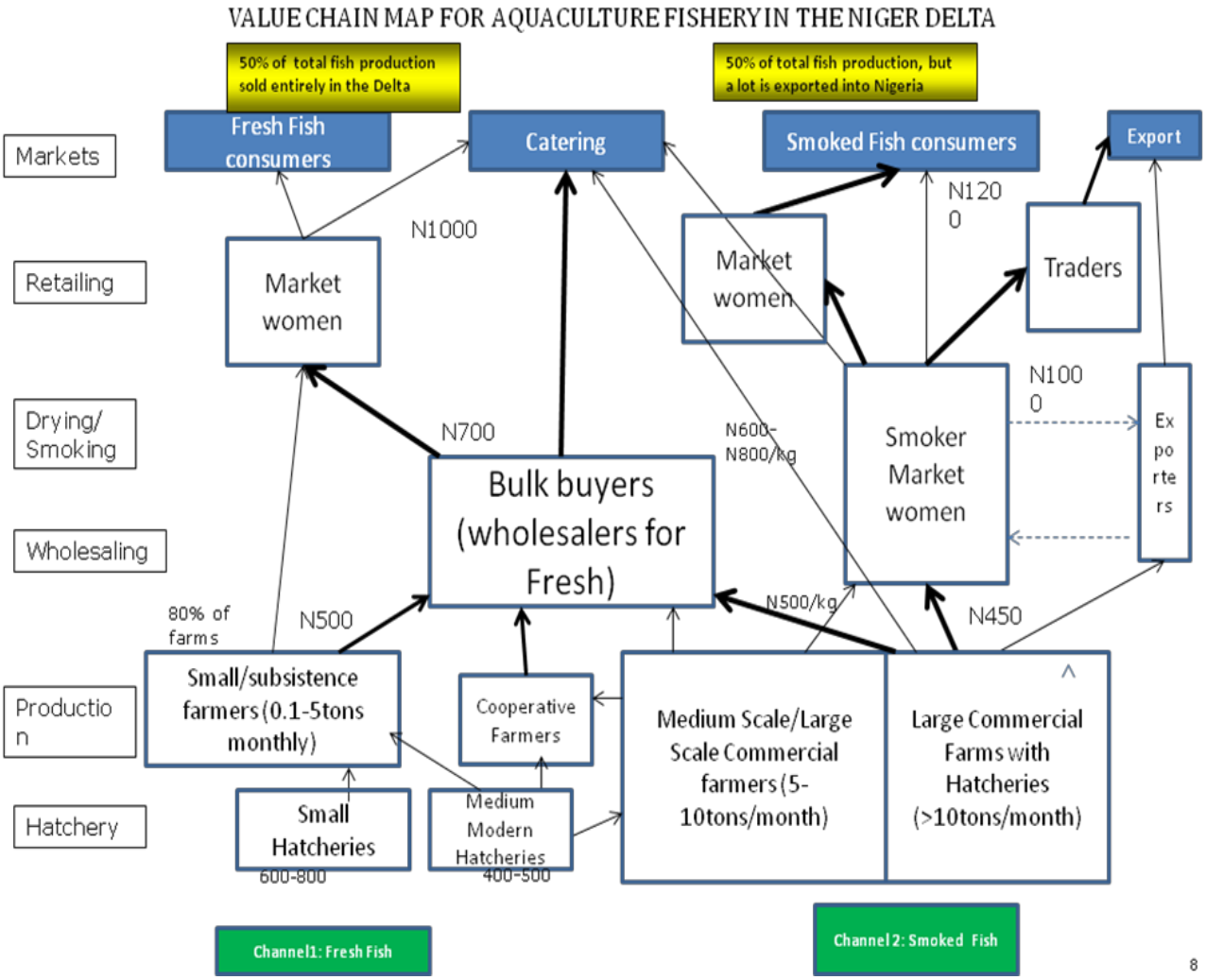
The fresh fish channel is mainly dominated by catfish; however there is a market for other cultured/farmed fishes, especially Tilapia. The hatcheries, both integrated and standalone, provide fingerlings/juveniles to the grow-out farmers. All categories of farmers (small scale, medium scale and large scale) then sell to bulk buyers or fresh fish wholesalers. These then sell to market women and also to catering houses (restaurant, hotels, bukas, etc), who in turn sell to consumers.

Smoked Fish Channel

The smoked fish channel for farmed/cultured fish is flourishing. Although many fish mongers smoke fish as a means of preservation, smoking also adds value to the fish. Most consumers use smoked fish in the cooking of soups and other local dishes to enhance the taste of the foods. From our studies the sale of smoked fish competes with that of fresh fish by a ratio of 1:1. The fish mongers who smoke fish usually are not very selective of fish at the farm gates and therefore usually receive a better price than their other counterparts, who specialize only in fresh fish sales. A kg of fresh fish at the farm gate in the Niger Delta usually costs about N500, but the buyers of smokers get theirs for an average of N450 per kg. After smoking such fish, it can fetch as much as N800 per kg as opposed to fresh, which sell for about N650 to N700.

The map starts with the hatcheries, where fingerlings/juveniles are produced and then sent to the grow-out farmers, who then grow the fish and sell to wholesalers who specialize in smoking fish. Market women smoke the fish and then sell to other market women and catering houses (restaurants, hotels, etc). The market women or “mammies” then sell to consumers. Also, the smoker market women wholesalers sell smoked fish to traders who export them out of the Delta to other parts of the country. At times, certain exporters purchase large amount of fish from farmers and then employ the services of these smoker market women to smoke the batch of fish for them, before selling them outside the Delta.

Figure 7: Value chain map for aquaculture fishery in the niger delta



Points of Leverage

The main point of leverage in the value chain, those points where working with discrete actors will allow us to reach large numbers of actors in the value chain in the Niger Delta, is the producer associations.

Producer Associations

Producer co-operatives are a very good point of intervention. By coming together, farmers could bring to the relevant authorities the problems they encounter in production and sale of their products. They could obtain credit facilities and share knowledge of better farm management practices.

Producer associations can assist in delivering effective services to their members and help articulate their demands for policy and institutional change. Effective member services may include: (i) helping set standards and disseminate knowledge; (ii) creating networks to strengthen business linkages and improve distribution channels (for example by developing mechanisms for large buyers and end users such as the fast food chains to contact farmers directly or through the association); and (iii) providing information on input and output prices and trends in major markets. Policy advocacy may be specific to the industry, including issues such as formalizing standards and accreditation systems or address wider investment climate issues such as access to finance, infrastructure, addressing administrative barriers and so on. At present, there are farming associations in the Niger Delta such as the Catfish Association of Nigeria (CAFAN) which has branches nationwide.

Supporting Organizations and Regulatory Framework

Support Organizations

Over the years, Nigeria's fisheries sector has had support and technical assistance from a string of donors, NGOs and government agencies. The facilitative role espoused by many has helped at the community level for producer mobilization and group formation, for example. The following list illustrates the range of organizations that have supported the sector in one way or the other:

- Ministries of Agriculture (state and federal)
- African Regional Aquaculture Centre (ARAC) Port-Harcourt
- Rivers State Sustainable Development Agency (RSSDA) Port-Harcourt
- Youth Empowerment Through Agriculture (YETA)
- Farmers Support Program (FSP) Delta
- Agricultural Development Program (ADP)
- Nigerian Institute of Oceanography Lagos
- International Fund for Agricultural Development (IFAD)
- Organization for Food and Agricultural Development in Africa (OFADA)
- National Institute for Fresh water Fisheries Research (NIFFR)
- Agric Research Council of Nigeria (ARCN)

Privately Owned

There are a number of service providers who support the sector to fill a void in needs by the private participants in the value chain with respect to productivity, access to technology, husbandry, pond construction and farm management. Some examples include:

- Flourishing Aquaculture Company (Consultancy, training and extension service provider)
- Aquaton Konsults Nig. Company (Consultancy, training and extension service provider)
- Wealth Agro (Marketers of fish feed, medications and supplements)

Regulatory Framework

The regulation of standards in the fish production industry is generally weak especially in the production of fingerlings/juveniles. There is need to register hatcheries and monitor their production activities. Most of the hatcheries in the Delta operate below minimum required standards and their products are mainly "raunts," which can lead to poor fish yields. Also the processing of fish needs to be regulated so that minimum health standards can be maintained. If standards were adhered to and compliance was strong, smoked fish and fresh fish fillets would be able to qualify for export from the Delta to foreign countries. Increased export can provide a major boost to the industry.

As stated earlier, the Government could also reduce taxes on imported fish meal to make quality fish-feed more affordable to grow-out farmers.

Value Chain Dynamics

Trends and Drivers

Trends

- Small household and small scale commercial fish farms constitute about 80% of the total number of farms. These farms are increasing rapidly at a rate of 20% annually. A large number of households maintain backyard fish ponds to produce fish for their families and sell the surplus in the market
- There is an increasing demand for cultured/farmed fish, from 16,619 metric tons in 1995 to 85,087 metric ton in 2007 and 152,796 in 2009 (an increase of 9,726 tons a year 0r 58% increase from 1995)
- Number of medium/large farmers are also increasing
- The number of hatcheries in the Niger Delta increased by about 50% in two years.
- Imported fish is increasing at 20% per annum

Drivers

- Nigeria's annual population growth rate of over 3 percent
- Demand for catfish is high and is increasing
- Fish farmers say that they are profitable (about 50% profit when farms are properly managed)
- Easy to set up farms especially at the small scale level
- Less expensive than other protein (capture and meat)
- Rising average household income
- Sharp drop in supply of low-cost pacific pelagic fish from Chile, Peru etc. formerly Nigeria's major suppliers

Fresh catfish, as a relatively high-priced, semi-luxury product, is likely to have strongly positive price elasticity. Reductions in price will lead to significant increases in demand and potential sales. With own price elasticity of -0.489 for Nigeria, a 10% reduction in fish price is expected to increase demand by 4.89%. The income elasticity of demand for fish is estimated at 0.667, which translates to an increase of 6.67% for every 10% increase in income.

The market for cultured/farmed fresh fish is very large both locally and internationally. There is an increasing demand for cultured fresh fish due to the destruction of natural aquatic lives by oil exploration and other industrial activities, which has led to high cost and scarcity of captured fresh fish. Some people prefer cultured fish because they believe it is free from pollution and chemicals. The relative low cost of cultured fish is also an added advantage.

Farmed fish fetch a lower price than captured fish. The size of cultured fish that sell for N700, can fetch N2,500 if it were captured fish. Given the price difference, cultured fish is much more affordable and more easily available for the average consumer.

The increase in the numbers of eateries in the Niger Delta like "Point and Kill" joints, fast foods restaurants and hotels have greatly increased the demand for cultured fresh fish. Actors in the value chain agree that the demand for their products is much higher than they can supply. Catfish is the most preferred of all the cultured fish and 90% of fish farmers culture Catfish for reasons such as: 1) It is hardy 2) It can survive in little water 3) It grows fast 4) It can grow to a large size 4) It is in high demand by consumers etc. Another fish that is also being cultured is Tilapia but it's only a few farmers that are into

tilapia production because many of them complain that it is not hardy and it does not grow very big. Some tilapia fish farmers also complain that the demand is not as high as Catfish but the export potential of Tilapia is higher than catfish in terms of fresh fish. Fresh fish is in high demand generally in the country and especially in the Niger delta and the cultured fresh fish is gaining high popularity in the country as a whole. Fish farmers have not being able to meet this high demand.

At present, the export potential for fresh cultured fish is not yet developed due to a lack of preservation equipment on the part of fish farmers and exporters. They lack the equipment needed to process and preserve the fish before export.

Vision for Growth

Production

The vision for growth is to increase the production of fish to respond to market demand. Since the demand for fish currently is about 2 million metric tons while the production of fish is about 1.5 million metric tons (a short fall of about 25%), there is room to increase market share for domestic fish-farmers. Market share for aquaculture can be increased not just from the deficit created by high demand but also from imports (import substitution) and capture fisheries given that fresh catch in Nigeria is priced high, nearly 325% over imported frozen fish and almost twice more than domestic live fish. It is therefore safe to project that aquaculture can address the shortfall in fish supply.

That said, our vision for growth in the near-term is to first assist in increasing cost-savings to help bring down prices by 10% for consumers of both fresh and smoked fish. Since the price elasticity of fish for Nigeria is estimated (2005) at -0.489[2], a 10% decrease in price is expected to increase demand by about 4.89% or roughly 5% (rounded), which is equivalent to roughly 58,000 metric tons (based on 2005 total consumption of 1.19 million tons (see table 3).

The vision for growth will emphasize targeting commercial small-scale producers for assistance in order to help them capture the increase in demand (as a result of decreasing price) versus it being met through increased imports. This will entail working with producers to assess areas for strategic improvement and efficiency gains to increase cost-savings, which can then be passed on to the consumers. Since the cost of feed and fingerlings alone takes up roughly about 60% to 65% of the cost of production, we will review options for lowering costs, while increasing productivity.

Quality Feed and Fingerlings

Improving access to quality fingerlings, feed, and all aspects of production knowledge using commercially driven service providers, can result in the overall growth of the value chain. Improving access means making available better quality fingerlings and locally produced feed at a competitive price for farmers.

Strategies to increase cost savings with both fingerling and feed production will be reviewed. For fingerlings, cost savings approaches will involve utilizing quality fingerlings from good parentage, reflected by high growth rate, implying higher FCR and shorter pond-stay and more cycles of production per pond per year. For feed, cost savings can be achieved by using proper, technically sound feed, and not necessarily more expensive feed. Since catfish are generally bottom-feeders, they do not require the more expensive floating pellets. Furthermore, looking to IITA/Ibadan researched and produced cassava-based catfish feed can also be a cost-saving approach. Linkages to poultry and animal feed manufacturers will also be established to assess the possibility of adding fish-feed as a new product line to address market demand.

Our vision will also address the issues of marketing with respect to forging stronger backward and forward linkages, for example we will look to linking hatcheries with fingerling nurseries, who in turn be linked to grow-out farmers. There is need to help strengthen Nigeria's input supply base so that competitively priced inputs are made available for downstream economic activities such as grow-out farming. As part of the vision, input suppliers, extension service providers, packaging and transport businesses will be

[2] ERS/USDA. International Evidence on Food Consumption Patterns across 144 countries. Using 2005 ICP data.

encouraged to come together to form business-to-business partnerships so that all become an integral part of a value chain and see each other as partners versus simply suppliers.

Our vision for growth will support those structures and address issues to make access to inputs and services central to fish farming, be as effortless as it is for those in poultry production, so that aquaculture too can proliferate and take-off like the poultry sector has done in many other countries in Africa and Asia.

Increased Smoked Fish Production

In addition to live fish, our vision is to contribute to the increase in the export of smoked fish from the Delta area to other parts of the country. As with live/fresh fish, we aim to increase production of smoked fish through cost-savings and quality improvement. The passing on of cost savings to consumers should reduce price, and since fish is a normal good, a reduction in price by 10% should see an increase in consumption by at nearly 5%, given the overall own-price elasticity of fish for Nigeria.

As aquaculture production increases, concerns emerge at the prospect of higher than normal environmental impact or waste water/discharge, particularly when feed is used. Even though fish waste is organic and composed of nutrients good for aquatic organisms, sometimes high-intensity operations have the possibility of negatively impacting the environment. There are best practices documented and applied world-wide. For example, using re-circulating systems, farms using poly-culture techniques, and proper siting of facilities are some examples of environmental management. A popular approach to waste-water management is to direct the waste-water to fertilize adjoining vegetable gardens, as an additional source of income. This combination of fish and vegetables production has worked successfully in many countries in Africa and Asia. We hope to address this issue as well.

Major Opportunities for Economic Growth

Increased Production

- **Production of Fingerlings and Juveniles -** Improved quality and production of fingerlings/juveniles can result in better quality fish, higher survival rates of fingerlings and also increased fish production for the markets. There is presently a shortage of quality fingerlings in the Delta, which has resulted in bringing fingerlings from Lagos and Ibadan at much higher costs.

- **Better Feed -** Feed produced in Nigeria cannot meet the demand of farmers. There is also the issue of the quality of feed. By improving quality and quantity of feed produced locally, there can be an increase in the quantity and quality of fish produced. Improving quality of feed and fingerlings will reduce the price of fish and increase the demand for fish.

- **Better Pond Management -** Apart from feed, pond management is a major factor in the quality and quantity of fish produced. Through proper maintenance of the pond (stocking, water management, provision of drugs, etc), fish production can increase and become more profitable. Losses are incurred by farmers who do not know how to properly manage their farms.

Processing

- **Technology Improvements -** With improvements in the techniques and technologies used in the smoking and processing of fish, export markets outside the shores of Nigeria could open up. Also, smoked fish can last longer and can be transported across greater distances.

Table 10 below presents some of the constraints and challenges to growth as perceived by the industry to have held the sector back. The table identifies some key bottlenecks that hinder productivity and profitability in order to intervene in the most critical leverage points that can yield high performance and positive change.

Table 10: Constraints to Growth

Constraints to Growth	Intervention	Activities to address the constraints
1. High cost of imported feed	Encourage increased production of locally produced feed	• Facilitating feed manufacturers and financial institutions to work together so that feed manufactures can acquire extruder machines and other related machines for feed production locally • Removal or reduction of import duty on imported fish meal • Removal or reduction of import duty on foreign feeds by Government in order to reduce the prices. • Facilitate local feed manufacturers to create awareness among fish farmers that sinking feed is as good as floating feed • Encourage local feed manufacturers to use locally available components in the making of feed • Encourage feed manufacturers to improve the quality of feed produced locally • Encourage feed producers and farmers to hold regular interactive forums
2. Quality parent/brood stock in short supply and preponderance of low quality parent / brood stock	Capacity building on production of quality parent/brood stock	• Teach hatchery operators how to identify and produce quality brood stock using extension services providers • Facilitate loan facilities from financial institutions through farmers associations to provide loans to hatchery owners to improve facilities
	Capacity building on identifying quality brood stock	• Teach hatchery operators how to identify and produce quality brood stock using extension • Use of fliers and pamphlets to inform hatcheries operators on how to identify quality Parent/brood stock • Identify farmers who produce quality brood stock and involve them in the campaign

Table 11 suggests a select list of strategies and approaches to address some of the constraints and challenges listed above in table 10 and identified by industry representatives during the interviews held with them.

Table 11: Strategies for Value Chain Improvement

Value Chain Functions	Strategies for Value Chain Improvement
Production	• Increase Extension Services: There is need to train farmers on all aspects of fish production and management, from stocking to feeding to water quality management in order to increase productivity and volume. • Provide Training on Pond: Fish farmers need assistance on pond location and management since pond culture is the most prevalent fish-farming method among smallholders. • Diversify Production into Cage/pen fishing: Cage/pen-fishing, which does not require either heavy capital investment or sophisticated technology, should be offered as option to smallholders too. • Increase Access to Finance: Access to credit for pond or cage/pen expansion, or input purchases should be considered for smallholders to increase fish supply. • Increase Access to Inputs such as Fingerlings, Fish Feed, and Supplies (cages and pens): The private sector should be encouraged to step in to provide these services. There is need to break the perception that "fingerling production" or "fish feed mills" require heavy investment and complex technology. Concise business profiles with business plans using appropriate technology and indigenous materials (such as cassava) should be offered to the business community to help move these opportunities along. Absence of information and knowledge of best practices and appropriate technology have also contributed to hindering sector development and expansion.
Harvesting	• Provide Training on harvesting and post-harvesting practices such as proper handling of live fish, proper icing of fish if sold fresh, to proper handling to safeguard quality and food safety. • Provide Training on Business and Management Skills: Train fish-farmers and cooperative to think & operate like a business, maintaining records and budgets for better costs-control. • Train on Quality Grading: Training on quality needs to include topics such as product segregation by quality and size, since pricing is determined by these characteristics. Further sizes differ for restaurants/pepper-soup bars and households. • Increase Linkages to Reliable Buyers: Promote and establish "partnerships"-- market linkages either directly with retail chains or through local commercial farms that supply these stores but are looking to increase their volume. Both channels offer smallholders the opportunity to slowly integrate into the formal live/fresh-fish value chain.
Consolidation	• Increase Consolidation Efficiency: Work with producers to help them understand the value of harvesting on schedule in order to achieve commercial volume at the producer level to control downstream costs. This can be also be supplemented with training on the importance of following a proper feeding regimen, using fish feed to achieve marketable fish size, and emphasizing the value of improving and maintaining quality to secure higher price. • Product Diversification: While pond-culture is the predominant form of aquaculture in Nigeria, cage-culture should also be considered as an approach to increasing the country's fish supply. Cage-culture uses fairly simple technology & lends itself well to the lifestyle of fisher folks.
Marketing	• Develop a Commercialization Strategy for Smallholder Aquaculture Industry: While support to improve production is critical, efforts to encourage "market-pull" are equally important. There is need to focus on building a strategy that enables smallholders to shift from subsistence livelihood to producing surpluses to meet market demand. For this to be successful, it will be important to help producers and their cooperatives or groups to understand that fish-farming is a business, and that business management and marketing are essential skills to profit financially.

Value Chain Functions	Strategies for Value Chain Improvement
	• Improve Transport/Hauling Material: Access better quality and type of packaging and hauling materials that are cost-effective such as insulated ice-coolers adapted for fresh fish, and easy to haul crates for live catfish and fingerling distribution. Quality packaging for smoked fish. • Improve Market Orientation: To better understand consumers and competition; to better understand what competitors' strategies in pricing and distribution are; how good competing products are. Profitable trade can happen with understanding of markets and market forces.

Activities to Address Market Constraints

Certain constraints affecting the aquaculture value chain have been identified with likely interventions to deal with them. However, further analysis has to be carried out to be able to better understand these issues and design specific interventions. While awaiting further analysis of the systemic constraints, and likely interventions, a pilot project should be designed to implement some of the recommended activities before the main projects/programs is kicked-off.

The identified constraints are:

1) High cost of imported feed
2) Quality parent/brood stock in short supply and preponderance of low quality parent/brood stock
3) Poor infrastructural facilities within hatcheries and grow-out farms

The first constraint, high cost of imported feed, has direct effect on the aquaculture value chain but is not actually a part of the chain. Although feed production is an important input in the aquaculture value chain, it is also a separate value chain by itself. Due to its importance but high cost, some farmers have become involved in feed production. So designing a pilot project that would address major aspects of feed production would not be feasible. As a result, we will address other constraints that have more direct implications. For example, there is need to address the short supply of quality parent/broad stock. However, in the final project and interventions designed, the issues concerning the quality of locally produced feed (from feed producers and fish farmers) and the high cost of imported feed, have to be addressed.

The Pilot Project

It is recommended that a pilot project be located in Warri working with fish farmers in a large cooperative farm (Ifoma farms) with 3,000 farmers and over 6,000 ponds to gather more information on the nature of the market failures around the constraints and on the development and testing of market driven solutions to those constraints. Warri has the advantage of being close to the Economic Development Center which is the hub for all economic development activities of PIND. The farm provides an excellent testing ground to look more closely at the production economics, market constraints surrounding supply of services (within the context of a viable market within a concentrated cluster of producers).

Interventions within the Pilot Project

Quality fingerlings/juveniles are the first requirements to get quality table sized fish. The quality of the fingerlings on the other hand depends on the parent/broad stock and feeding, amongst others. Our proposed interventions would therefore provide capacity for fish farmers (grow-outs producers and hatchery owners), to be able to:

- Produce quality parent/brood stock, and easily identify quality parent/brood stock;
- Analyze and address the market around the supply of feed;
- Address issues around the supply of services to the pond farmers, including husbandry training, pond advisory services;
- Address the challenges that producers are facing when they interact with the large buyers
- Generate greater understanding of the processing techniques and marketing relations in the smoked fish channel
- Access to credit facilities

The program will develop links to the other parts of the PIND program, including the Appropriate Technology Centre (ATC), the capacity building program, and based on the above identified areas for

interventions, the pilot project would focus on facilitating the delivery of the needed services within the sector by the actors and service providers supporting the value chain.

Developing the Commercial Supply of Feed

Feed is the single most important cost involved in fish culture, equal to more than 50% of the cost of production. The program will address both the supply and demand sides of the market for fish feed. It will delve into greater depth on the challenges facing the feed producers and the awareness and understanding of the value of different qualities of feed to the producers.

Capacity Building for Hatchery Owners to Produce Quality Parent/Brood Stock

This component of the program will identify service providers who can work with hatchery owners to provide capacity building for them on proper breeding and management of brood stock. It is possible to encourage the feed producers to participate in such a scheme, since this will involve improving feeding regimens and farm management. Also, the increase in the number and quality of the fingerlings resulting from improved quality brood stock would cause a greater demand for feed.

Capacity Building on Identification of Quality Parent/Brood Stock

The process of selecting proper breeders is necessary for raising quality juveniles. For instance to pick a mature female fish for spawning requires proper identification. Usually gravid fish has a protruded abdomen. If the abdomen is gently pressed, eggs ooze out of the fish. If the eggs are greenish and transparent, the eggs are just ripe. If brownish, the eggs are over ripe. If however, eggs do not come out easily but come mixed with blood, then the eggs are not ripe. Both over ripe and unripe eggs cannot be fertilized and therefore the females bearing them should not be used. For the male fish, the level of maturity is checked by pressing the gonad region of the fish. If water shoots out then the fish is mature for breeding. For Clarias and Heterobrancus, a male fish of over 2 years is considered mature for breeding.

The quality of juveniles produced are dependent on the parent/brood stock, therefore capacity building on how to identify the right breeders and how to do the process of artificial insemination will be very important.

Like that of capacity building to raise brood stock, hatchery owners should be knowledgeable enough to know how to identify quality breeders when purchasing them, when they are ready for breeding, and how to carry out the artificial insemination procedure. The capacity building component would not only cover fish farmers but also extension services providers.

Best Practice Training for Private and Public Sector Service Providers to the Fisheries Sector

The pilot will develop a greater understanding of the gap in the supply of advisory services to the sectors, and address the capacity constraints on the part of the providers, as well as the demand constraints to purchase the services. This will involve the conduct of a comprehensive and targeted practical demonstration of best practices and training of private service providers and extension services personnel in the federal and state ministries and agencies, department of fisheries, Agric Development Programs (ADP) etc. The objective is to strengthen their service and support delivery capacities by familiarizing

them with best practices skills and competencies in fish farming. It will also expose them to knowledge on fish diseases and control. The extension services personnel can then constitute the largest group involved in farming practices knowledge transfer to thousands of local fish farmers.

There are other actors in the value chain that provide support services such as some consulting firms (which undertake trainings on farm management), in the Niger Delta. These organizations have been doing a good job and could be involved in this scheme. If the farmers see the need for improved brood stock then they will be willing to pay a fee to enhance their capacity.

Improving Links to the Financial System

Designing a targeted program for bank staff is necessary to inform them of the peculiarities of the industry and the potential that exist in funding fish farmers and hatchery owners. This type of support will help increase their skills to understand the necessary ingredients for supporting the aquaculture sector. In turn, these will minimize the existing challenge that fish-farming operators face in getting banks to work with the industry.

Overall, the pilot project will concentrate mainly on capacity building of the farmers, the financial institutions and the service providers, so as to provide funds for increased production and also to ensure that these funds are properly utilized.

Roles and Responsibilities of the Producer Associations

The target of the pilot includes a large association of fish producers. The program should analyze their structure, the services they provide and the effectiveness of their management of the marketing functions. The associations can provide or facilitate a wealth of services to their members and it is necessary to understand what is needed, what they are doing, what they could be doing.

Challenges within the Smoking Channel

The project needs to greatly increase its understanding of the operations in the smoked fish channel: the relations between the smokers and the producers, the efficiency of the production technologies, and the relations of the smokers with the traders who purchase fish to take out of the Niger Delta. This is extremely important given the strong “export” growth potential from this channel.

Links to other PIND Programs – the Appropriate Technology Centre

Strategies to increase competitiveness will require improving technical efficiency of current production practices and technologies. Making available affordable appropriate technologies such as moving from pond to cages for live fish, utilizing covered/enclosed solar driers and smokers to produce hygienic, healthy products will be important. Adopting packaging materials made of environmentally friendly materials or reviewing opportunities that tap technologies offered by domestic manufacturers can provide cost-effective alternatives to expand product lines and market reach are good examples. Linking the ATC to the IITA to develop improved cassava-based fish feed pelletizing machines. These machines utilize both cold or steam process to produce soft, hard and floating pellets. Since the technology uses local materials, the cost of the entire package (extruder, steam boiler and dryer) required to produce fish feed

is designed to be affordable for small-scale entrepreneurs. In this vein, we will work closely with the Appropriate Technology Centre to evaluate those that are presently available and to review options for developing additional ones to meet the need of the sector.

Appendix

List of individuals and organizations the team met with during the study:

- David Farms, Eneka Port Harcourt
- Felaso Farms No. 500 East West Road, Port Harcourt
- Ada-eze Farms LTD Achalla Ibusa , Managing Director
- Shalom Fish Farm Asaba, Managing Director
- Nwachukwu Fish Farm Asaba, Managing Director
- Director of Center, African Regional Aquaculture Center (ARAC) of the Nigerian Institute for Oceanography and Marine Research
- Desk Officer for Fisheries, Federal Ministry of Agriculture, Federal Secretariat, Port Harcourt
- Managing Director, Chinyere Restaurant, Asaba
- Smoked fish sellers at Patani and Sagbama along East-west Raod
- Market women at Creek Road Market, Port Harcourt
- Mark Women at Macaver market, Warri
- General Manager, Pinnacle Aqua Systems Company Limited
- Rivers State Sustainable Development Agency Office, Head of Aquaculture and Livestock
- Clock Tower Hotel, GRA Stage 2, Food and Beverages Manager
- Rivers State Ministry of Agriculture, Fisheries department
- Delta State Ministry of Agriculture and Natural Resources Asaba, Director of Fisheries Department
- Fishery officer Fisheries Department, Delta State Ministry of Agriculture and Natural Resources Asaba
- Delta State Agricultural Development Programme (ADP), Ibusa, Chief Fishery Officer.
- International Fund for Agricultural Development/Community Based Natural Resource Management Programme (IFAD/CBNRMP) Ibusa, Delta State programme officer for IFAD programmes.
- National Bureau of Statistics Asaba
- Delta State FADAMA III Coordination Office Asaba, State project coordinator.
- fish broker, Mr. Adefarakan Anthony who buys fingerlings/juveniles and sells
- Kennedy's Fish Farm Asaba, Managing Director
- Ogboogonogo market Asaba , fish market retailers
- Cable market Asaba, fish market retailers
- Visit to Obiora Farms LTD Asaba and interview with the Manager of the Farm Mrs. M.O. Esezobor.
- Aquaton Konsults Nig. Company Asaba, Managing Director
- Wealth Agro Services, Manager
- Chinyere restaurant Asaba, Managing Director
- Achievers fish farm Ugboroke, Managing Director.
- Noregha Hotels Ekpan, Food and Beverage Manager
- Little Paradise Homes and Suites, Warri, purchase /Stock Control Officer
- Mekaval Hotel and Suites Warri, Food and Beverage Manager
- Visit to Promise Restaurant Ughelli, Managing Director

Table A-1: Fish Farms Visited

S/NO	**NAME OF FARM**	**ADDRESS**	**STATE**
1	David Farms	Eneka	Rivers State
2	Pinnacle Aqua System	East_West Road, Port Harcourt	Rivers State
3	Achievers Farms	Igbogene, Yenagoa	Bayelsa State
4	A household farm at Yenagoa	No. 7 Greenvilla Road, Yenagoa	Bayelsa State
5	Risco Arimson Nigeria Limited	Greenvilla Road, Yenagoa	Bayelsa State
6	Personal household farm owned by Mr. Eric Bibowei	Along Tombia Road, Okutukutu, Yenagoa	Bayelsa State
7	Blessed Fish-Farm Consulting Services	No. 50 Old Azikoro Road by Mountain of Fire Ministries, Yenagoa	Bayelsa
8	Ufuoma Farms	NNPC Housing complex Road Ekpan Road, Warri	Delta
9	Kennedy Fish Farm	Asaba	Delta
10	Obiora Farms Limited, Asaba	Asaba	Delta
11	Shalom Fish Farm	Asaba	Delta
12	Ada-eze Farms LTD Achalla Ibusa	Asaba	Delta
13	Nwachukwu Fish Farm Asaba	Asaba	Delta

Table A-2: Fish Production Statistics for 2009

TYPE OF FISH PRODUCTION	**QUANTITY (METRIC TONNES)**	**VALUE ($)**	**VALUE (NAIRA)**
CAPTURED FISH	627,908.00	1,663,944.50	249,591,674.50
AQUACULTURE PROCDUCTION	152,796.00	492,890.00	73,933,500.00
TOTAL PRODUCTION WITHIN NIGERIA	780,704.00	2,156,834.50	323,525,174.50
IMPORTED	746,851.00	766,669,000.00	115,000,350,000.00

TOTAL CONSUMPTION FOR 2009	1,527,555.00	768,825,834.50	115,323,875,174.50

A-3: List of Farmed and Farmable Fish Types

CURRENTLY CULTURED AT COMMERCIAL LEVEL (90%)		
S/NO	BOTANICAL NAME	COMMON NAME
1	Clarias Gariepinus	African Catfish (table size 4-6m)
2	Heterobranchus spp H. longifilis (farmed in Warri and Sapele) H. bidorsalis (farmed in Bayelsa)	African Catfish (table size 8-12m)
3	Hybrid of Clarias Gariepinus and H. longifilis/ H. bidorsalis	
CULTURED AT COMMERCIAL LEVEL (8%)		
4	Oreochinomis Miloticus Tilapia Guineansis Sarotherodon Melanotheron	Nile Tilapia (table size 10m) –fresh water Guinea Tilapia – brackish water Black chin Tilapia
CULTURED AT SUBSISTENCE LEVEL (2%)		
5	Parachana Obscura	African Snakehead
6	Heterotis Miloticus	Slap water
7	Gymnarchus Miloticus	
CULTURABLE POTENTIAL IN BRAKISH WATER		
8	Tarpon Atlanticus	Atlantic Tarpon
9	Mugil Cephalus Liza Grandisquanis Liza Falcipinnis	Mullets

Table A-4: Fish Landing by States and Year for 2008

	AMOUNT IN NAIRA
Abia	82,000.00
Akwa Ibom	42,468,750.00
Bayelsa	13,630,760.00
Cross River	6,553,000.00
Delta	13,518,025.00
Edo	7,803,075.00
Imo	689,404.50
Ondo	12,830,088.00
Rivers	33,004,347.50
TOTAL	130,579,450.00

Footnote:
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10/15/2010 9:00

SOURCE:

Federal Department of Fisheries

Contact:
nconyeri@yahoo.com

Unit:
Naira

Matrix:
159SFI095

Table A-5: Artisanal Fish Production (Capture Fisheries) in the Niger Delta for 2007

S/NO.	STATES	ARTISANAL FISH PRODUCTION IN TONS
1	Abia	216
2	Akwa Ibom	92,043
3	Bayelsa	25,470
4	Cross River	13,775
5	Delta	26,539
6	Edo	15,621
7	Imo	2,110
8	Ondo	22,686
9	Rivers	52,903
	Total	251,363

Table A-6: Fish Production in Nigeria for 2007 (Federal Department of Fisheries)

S/NO	SECTOR	PRODUCTION IN TONS	PERCENTAGE
1	Artisanal Fishing	504,227	83.02%
2	*Industrial (Commercial Trawlers)	18,040	2.97%
	Sub-total (Captured Fishery)	522,267	86%
2	Aquaculture	85,087	14%
	Total	607,354	100%

*Fish alone without shrimp

FISHERIES VALUE CHAIN ANALYSIS EXERCISE

SURVEY QUESTIONNAIRE FOR CONSUMERS OF FISH

SECTION 1: Demographics Questionnaire no…….

1. City……..
2. State……

SECTION 2:

1. Do you eat fish?.....If yes how often?.....
2. Which one do you prefer, meat or fish?.....
3. What is the reason for your preference?
   .....
   .....
   .....
   .....
4. Which of these categories of fish do you normally buy? (please tick all that applies)
   a. Imported frozen fish
   b. Natural captured fish (from rivers and seas)
   c. Aquaculture fish (from fish farms)
5. What is the reason why you choose to buy that category of fish?
   ……
   ……
   ……
   ……
   ……
   ……
6. Please list in order of preference the category of fish you like (imported frozen fish, captured fish or aquaculture fish)
   ……
   ……
   ……
   ……
7. If you had more money to spend on fish, what category of fish would you prefer?
   ……
   ……
   ……..
8. Do you prefer smoked or fresh fish? Why?
   ……
   ……
   ……
   ……
   ……

9. Which do you buy more often, fresh or smoked fish?
   ……
   ……
   ……
10. Which one of these do you prefer: capture catfish or aquaculture catfish? Why?
   ……
   ……
   ……
   ……
11. Amongst the aquaculture fishes which one do you buy the most?
   i) Catfish
   ii) Tilapia
   iii) Others

12. If you don't eat catfish, what are the reasons?
   ……
   ……
   ……
   ……
   ……
   ……
13. For catfish which one do you prefer and buy most, fresh or smoked catfish?
   ……
   ……
   ……
   ……
   ……
   ……
   ……

14. If prices of fish drops would you buy more fish and what type of fish would you buy?
   ……
   ……
   ……
   ……
15. If your earnings increase are you likely to buy more aquaculture fish or other categories of fish? If yes what type: fresh or smoked? Catfish, Tilapia or others?
   ……
   ……
   ……
   ……
   ……
   ……
16. What are your views on the prices of fish? Are they affordable?.....
   .....
   .....
17. What could be done to make the prices affordable?.....
   .....
   .....
   .....

FISHERIES VALUE CHAIN ANALYSIS EXERCISE

SURVEY QUESTIONNAIRE FOR RETAILERS (FAST FOOD RETAIL OUTLETS, LOCAL RESTAURANTS (BUKAS, RESTAURANTS, PEPPER SOUP JOINTS).

SECTION 1: Demographics Questionnaire no…….

2) City……..
3) State……

SECTION 2:

4) Name of Food Sales Outlet
……
5) Type of Food Sales Outlet
……
6) Address……
……
7) City……
……
8) State……
……

SECTION 3:

1) Where do you usually get your fresh fish?

……
……
……

2) Which of these categories of fish do you normally buy and sell? (please tick all that applies)
   a) Imported frozen fish
   b) Natural captured fish (from rivers and seas)
   c) Aquaculture fish (from fish farms)

3) Which of the above listed fish do people buy most? Please rank them in order of preference with 3 being the highest and 0 the lowest. Put 0 if they don't buy that type of fish.
   a) Imported frozen fish…….
   b) Natural captured fish (from rivers and seas)…….
   c) Aquaculture fish (from fish farms)……

4) Why do they prefer that kind of fish?.....
.....
.....
.....

5) If you do buy and sell fresh fish please provide the following information

S/NO.	FRESH FISH TYPE	ORIGIN	CAPTURED/ CULTURED	QUANTITY (WEEKLY)	AVAILABILITY	PURCHASE PRICE	SELLING PRICE
	Catfish						
	Tilapia						
	Others						

6) If you do buy and sell smoked fish please provide the following information

S/NO.	SMOKED FISH TYPE	ORIGIN	CAPTURED/ CULTURED	QUANTITY (WEEKLY)	AVAILABILITY	PURCHASE PRICE	SELLING PRICE
	Catfish						
	Tilapia						
	Others						

7) Between smoked fish and fresh fish which one do customers prefer and why?
……
……
……
……

8) What quantity of smoked fish do you normally buy and sell from these type of farmed fish (aquaculture fish)
   a) Catfish…….
   b) Tilapia……
   c) Others……..

9) What quantity of fresh fish do you normally buy and sell from these type of farmed fish (aquaculture fish)
   a) Catfish…….
   b) Tilapia……
   c) Others……..

10) What are your thoughts concerning cultured fish, frozen fish, marine fish (taste, price and availability)
   a) Taste……
   ……
   b) Price……
   ……

c) Availability……
……
……

11) What can be done to provide better quality fish to you and your consumers
……
……
……
……
……
……

12) Do you have enough fish presently to satisfy your customers demands?.....

13) If no how much more fish do you require?
.....
.....
.....

14) What problems do you encounter in the purchase, preparation and sale of fish?
……
……
……
……
……
……

15) How can these problems be solved?
……
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…….....

FISHERIES VALUE CHAIN ANALYSIS EXERCISE

SURVEY QUESTIONNAIRE FOR FISH WHOLESALERS AND MARKET WOMEN.

SECTION 1: Demographics Questionnaire No. …….

1) NAME OF MARKET/LOCATION
   ……
2) ADDRESS……
   …….
3) CITY……
   ……..
4) STATE……
   ……

SECTION 2:

5) Where do you usually get your fresh fish?

   ……
   ……
   ……

6) Which of these categories of fish do you normally buy and sell? (please tick all that applies)
   a) Imported frozen fish
   b) Natural captured fish (from rivers and seas)
   c) Aquaculture fish (from fish farms)

7) Which of the above listed fish do people buy most? (Please rank them in order of preference with 3 being the highest and 0 the lowest. Put 0 if they don't buy that type of fish.)
   a) Imported frozen fish…….
   b) Natural captured fish (from rivers and seas)…….
   c) Aquaculture fish (from fish farms)……

8) Why do they prefer that kind of fish?
   .....
   .....
9) If you do buy and sell fresh fish please provide the following information

S/NO.	FRESH FISH TYPE	ORIGIN	CAPTURED/ CULTURED	QUANTITY (WEEKLY)	AVAILABILITY	PURCHASE PRICE	SELLIN G PRICE
	Catfish						
	Tilapia						
	Others						

10) If you do buy and sell smoked fish please provide the following information

S/NO.	SMOKED FISH TYPE	ORIGIN	CAPTURED/ CULTURED	QUANTITY (WEEKLY)	AVAILABILITY	PURCHASE PRICE	SELLING PRICE
	Catfish						
	Tilapia						
	Others						

11) Between smoked fish and fresh fish which one do customers prefer? Explain why?
……
……..

12) What are your thoughts concerning cultured fish, frozen fish, marine fish (taste, price and availability)
   a) Taste……
   ……
   b) Price……
   ……
   c) Availability……
   ……

13) What can be done to provide better quality fish to you and your consumers
……
……
……

14) Do you have enough fish presently to satisfy your customers' demands? Discuss
.....

15) If no how much more fish do you require? (Try and collect quantitative amount like percentage, weight, etc)
.....
.....

16) What problems do you encounter in the purchase and sale of fish?
Purchase:……
……
Sales:……
……..

17) How can these problems be solved?
……
……
……

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