



# ANALYSIS OF FISH FEED MARKET IN DELTA STATE



FUTA  
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LTD



## Foreword

Aquaculture is the fastest growing non-oil sector in the Niger Delta. Feed comprises more than 60 percent of the cost of raising farmed catfish, the dominant form of aquaculture in Nigeria. Field work around problems in the aquaculture sector consistently raises the issue of the “cost of feed being too high”, so there is demand to introduce solutions that can bring down the cost of feed. PIND and the Delta State Government met to discuss opportunities for stimulating growth of the sector throughout 2012. This study was developed by PIND with the Delta State Department of Fisheries, Delta State Ministry of Commerce and FUTA Business Development Company Ltd. In a meeting in October 2012 consensus was reached on the need to develop a deeper understanding of many issues concerning fish feed – where the demand really was, the comparative pricing of feed between the Niger Delta and the South West of Nigeria, who were the suppliers, and the main consumption patterns of feed by farmers. This latter involved developing a deeper understanding of the types of feed that farmers use, how they use them, where they buy or make them, and the in order to better inform the decision makers.

Following agreement on the terms of reference by the steering committee, FUTA Business Development Company, Ltd., was contracted to carry out the research. FUTA, working through State Department of Fisheries extension workers, interviewed more than three hundred farmers providing a wealth of basic data on the sector, completed in March 2013. Following an initial review by the PIND team, comprising of Sylvester Okoh, James Elekwachi, Misan Edema-Sillo and Shariful Islam; and a further review by the Steering committee led by Dara Akala; deeper analysis was required. The data provided from the field work was then analyzed much more deeply by Helene Kiremidjian and William Grant from DAI, resulting in this final draft.

This report provides significant insights into the consumption patterns of feed by small farmers in Delta State that demonstrate where the major opportunities for improvement in feed delivery, sales, and utilization by farmers can lead to significant increases in profitability for both farmers and the feed industry, while stimulating significant growth of this aquaculture sector. The participation of all members of the steering committee has been greatly appreciated.

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## **TABLE OF CONTENTS**

### **EXECUTIVE SUMMARY**

#### **SECTION ONE – STUDY PURPOSE AND METHODOLOGY**

- 1 Introduction
- 1.2 Terms of Reference and Scope of Work
- 1.3 Methodology
- 1.4 Structure of the Report

#### **SECTION TWO – INDUSTRY STRUCTURE**

#### **SECTION THREE – DEMAND ANALYSIS**

- 3.1 Demand for Fish in Nigeria and the Delta State
- 3.2 Demand for Fish Seeds
- 3.3 Profiles of Fish Farming Businesses

#### **SECTION FOUR – SUPPLY ANALYSIS**

- 4.1 Supplier characteristics
- 4.1 Feed Supply Chain Characteristics
- 4.2 Suppliers' Market Size, Market Penetration and Pricing Structure

#### **SECTION FIVE – FINDINGS AND RECOMMENDATIONS**

- 5.1 Findings
- 5.2 Recommendations

## MAIN FINDINGS/EXECUTIVE SUMMARY

This study on the catfish feed market in Delta State was carried out to get a better understanding of the supply and demand sides for feed, whether farmers were able to easily access feed and the range of factors affecting the overall cost of feed as an input into the production of catfish. During the period January – February 2013, enumerators from the Delta State department of fisheries surveyed 271 catfish farmers from four leading fish producing clusters in Delta State and interviewed a number of the major feed supply companies.

Three different types of fish feed are found in Nigeria: locally (Nigeria) manufactured fish feeds, local artisanal fish feeds made by small-scale feed millers or made “on-farm” by fish farmers, and imported fish feeds. Fish feeds can be floating or sinking (floating type is more efficient) and their size varies depending on the feeding period. The smallest size is less than 1mm and along with 2 mm feed is used for the starter period, followed by 4mm, 6mm and 9mm. The latter two sizes concentrate on the grow out phase when fish eat the largest volume of feed.

Best practice for feeding with the right quality feed should lead to a Feed Conversion Ratio (FCR) of about 1 or 1.2 kgs of feed to produce one kg of fish. So for a fish pond stocking 1000 fingerlings, the total amount of feed used should optimally not exceed 1.2 tons of quality feed. However, poor quality feed or inappropriate feeding patterns can lead to overfeeding of the fish at FCRs of up to 3:1.

### Findings on the Demand Side

- (1) Surveyed farmers in the Niger Delta tended to use more feeds than necessary in the first four and a half months of a fish growth period. This overfeeding represents a waste that raises the farmers’ costs, which can be reduced by improving farmers’ feeding practices. As farmers enter the middle of the fourth phase growth period (6mm feed), they use far less commercially manufactured feeds than recommended. On average, a farmer uses 33 % too much feed per pond during the first three phases of feeding (4.5 months) and uses only one third of the recommended manufactured feeds on the last two periods of feeding (2 months).
- (2) The modal fish farmer owns 2 ponds and stocks the ponds twice a year. But when looking at the larger population of farmers as a whole, they only stock their ponds 1.1 times per year, on average. Pond underutilization can be explained by several reasons: cash flow problems, poor access to markets and limited water availability in some areas.
- (3) Depending on the number of pond cycles observed by farmers per year, current demand for fish feeds in the Niger Delta State ranges from 4,192.890 (pond stocked once per year) to 8,385.780 tons of feed per year (ponds stocked twice per year) assuming the optimal feeding rate of 1.2:1. The survey team observed that this rule is rarely followed by farmers and that homemade feed can reach a 2.5:1 FCR.

- (4) By comparing farmer's consumption behaviors with the recommended feed use, we can estimate the untapped market potential in the Delta Niger. Using official statistics on the number of ponds in the Niger Delta State and the maximum pond utilization rate of twice per year, the untapped market potential<sup>1</sup> for commercial fish feeds in the Delta State ranges from 5,761.150 tons and 11,522.300 tons per year depending on the pond utilization rate. The untapped market is higher than current demand. Taking into account the untapped market potential, the total demand<sup>2</sup> for fish feeds, including manufactured, homemade fish and the amount of feeds they should have used, ranges from 9,940.54 and 19,881.08 tons of feeds, depending on the pond utilization rate.
- (5) All starter feed comes from imported sources, but grow out feed can be purchased from either imported, locally manufactured companies, or made by the farmers themselves. Almost two thirds of farmers make some of their own feed.
- (6) Coppens is the most widely used brand of fish feed (About 54.0 percent). The main reason for the wide of usage of this brand was the perceived quality of the feed, which is mostly used in the starter phase – all farmers use imported feeds as starter. Other types of feeds used include Multi-feed (17.4%), Zeigler (7.5%), Pira (6.0%), Durante (4.0%) and others (9.3%).
- (7) About 35.7% of the farmers used only floating feed while 62.1% used both floating and sinking feeds. Some farmers start their production cycle on imported floating feed and finish it off with local floating, gradual sinking or sinking feed.
- (8) The fish farmers bought fish feed from different sources, however, the most common sources were retailers (61.6%) and major dealers (30.5%) within the state, so farmers have ready access to commercial sources. Two thirds of farmers were able to source commercial feed within 5 km of their ponds.
- (9) About 30.4% of the farmers considered the price of the fish feed brand, quality and availability as the major factors in determining their choice of fish feed while 29.7% considered only quality.
- (10) Farmers prefer floating feed to sinking feed and floating feeds were used by a majority of farmers. Distributors and retailers noted that farmers procure more of the 4, 6 and 9 mm feed sizes regardless of the brand and 9 mm size is regarded as the finisher. But the survey results still showed that they purchase much less than they should if they were following a commercial best practice.
- (11) A number of factors affect the amount of feed farmers need to purchase (proper knowledge of feeding protocols) and their ability to purchase feed (access to finance to help with cash flow).

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<sup>1</sup> Untapped market potential is calculated by subtracting the amount of fish feeds used by farmers by the amount of fish feeds recommended per growth cycle.

<sup>2</sup> Total demand is calculated by adding the untapped market potential to the current demand.

## Findings on the Supply side

- (1) Common feeds with distributors in Delta State include Multifeed (Israel), Zeigler (USA,), Vital (Jos Nigeria), Makakoti (Ibadan, Nigeria), Sharp (China), Raanan, Coppens (Holland) and Pira, formerly Durante (Ibadan).
- (2) Most Nigerian feed manufacturers focus on the production of poultry feed, and only a small percentage of their capacity is used for fish feed.
- (3) There is a distributor/retailer network that is well established in the Delta State. Most of the distributors buy feed directly from the manufacturers while a few of them buy from the representatives of the manufacturers and importers in Nigeria. To make profits, distributors need to sell large amount of feeds as the margin per bag of feeds sold is thin. The distributors sell on the average between 15 and 20 metric tons of fish feed monthly. Daily sales range between 30 and 50 bags per brand.
- (4) Private companies that import feed from abroad are already using different pricing strategies to penetrate the Delta State and expand their market share for fish feed. This demonstrates a certain degree of market sophistication. We observe that Multifeeds' prices are cheaper than Coppens, the market leader. Vital feed, a feed manufactured in Nigeria, is aggressively marketing its new floating feed and is the cheapest.
- (5) The comparative analysis of feed prices across Lagos, Ondo and Delta States shows that retail prices for fish feeds for Vital Feed and Multifeeds were cheaper in the Delta State than in Ondo and Lagos States, in spite of increased transportation costs. This shows that fish feed is increasingly competitive in the Niger Delta and that suppliers are willing to carry additional costs to penetrate this market.
- (6) The analysis generally did not underline any gaps in feed supply in the Niger Delta State. Distributors and local manufacturers interviewed reported that they are able to meet all the demand for their products in Delta State. Only Vital Feed mentioned that transportation issues prevent them from adequately covering the Bayelsa State. Promoting public investment in transportation infrastructure can help better link supply with demand. Additionally, some manufacturers, such as Vital Feed, do not work at their full capacity.
- (7) Manufacturers are not all equal in terms of coping with demand fluctuations. The importer of Raanan feeds can increase its imports if demand increases while Vital Feed reported that it has difficulty answering to fluctuation in demand.
- (8) The intensity of client patronage varies by location. Patronage for Coppens was highest and cut across all LGAs. Zeigler had customers in Warri South, Uvwie and Isoko South while Vital enjoyed patronage in Ika South, Oshimili and Isoko South. Patronage for fish feed in Delta State comes from customers in Warri and its environ namely Ughelli, Sapele, Asaba, Agbor in Delta

State, Awka and Nnewi in Anambra State as well as Port-Harcourt in Rivers State. This demonstrates that firms are increasing their active marketing in the region.

- (9) Given the rapid growth in the production of catfish in Delta State over the past few years, the suppliers of feed appear to be finally realizing the size of the potential market and seem to be increasing their marketing activities to capture this market. Top Feeds, a local poultry feed manufacturer in Sapele, Delta State, has recently become aware of the size of the fish feed market and will be entering this market.

### Conclusions and Recommendations:

Over the past decade, the aquaculture industry has grown rapidly in Delta State, with a large expansion in the number of producers in the Delta State. With strong demand and few barriers to entry, many farmers entered the fish industry, most without the basic knowledge on good production practices. While supply was racing to keep up with demand, farmers were able to hide their inefficiency with then higher market prices. However, the market in Delta State is becoming saturated and competition is growing among farmers, forcing them to become more efficient producers. Farmers manage to produce table fish more efficiently, at lower cost, to bring down the price of fish. Feed is the single most important cost in total production cost for fish.

This study has shown that the cost of feed for fish farmers in Delta State is high, but is similar to prices in other parts of Nigeria. The study has also shown that many fish farmers overfeed their fish (up to 50%), causing extra cost, as well as leading to decreased water quality in the ponds, slowing the growth rate of the fish. The study has also found that there is a competitive supply of feed from commercial suppliers with good distribution networks, bringing most feeds to within 5 km of the fish ponds. The study has concluded that the total potential demand for feed is significantly greater than current supply and consumption, but has also noted that new feed suppliers are entering the market as they have become aware of the steady growth in the demand for feed. This improved understanding of the market for feed is leading to greater investment on the part of the feed manufacturers.

To improve the efficiency of farmer production and reduce the total cost of feed in the production of fish, several factors must be addressed:

- Farmers need to improve their production practices to understand proper feeding regimens so they can reduce the amount their spending on fish feeds and put their income to more productive use;
- A more efficient competitive market for feed supply needs to be promoted, characterized by continuous improvement in the quality of feed by the Nigerian manufacturers, increased efficiency in their distribution channels, and improved pricing strategies;
- Key market failures, such as access to market information by the feed suppliers and credit by the farmers, which have been slowing down the growth of a more dynamic and competitive feed market.

The following recommendations have been identified to upgrade the supply and demand of fish feed in Delta State:

Recommendation #1: Improve the effectiveness of Delta State aquaculture extension services to work with farmer groups, cooperatives and business associations to improve farmers' production practices leading to more efficient use of feed and increased productivity. Farmers need to be better informed on proper feeding regimens (both volume of feed and quality of feed), and understand the impact of feeding regimens on profitability to incentivize them to invest in using manufactured feeds of high quality.

Recommendation #2: The government should determine how to incentivize private sector investment in feed manufacturing to create greater competition and increased innovation in pricing and distribution networks in order to meet untapped demand for high quality fish feeds in the Delta State. Taking advantage of the fairly well developed network of manufacturers and distributors, the government should provide targeted incentives to stimulate private investment in fish feed production and manufacturing, which will then stimulate market incentives to compete more effectively.

Recommendation #3: The government could play a role in designing incentives to reduce lending risks from private banks to develop financial products that address the needs of aquaculture producers and processors. Findings revealed that very little credit comes from private banks and that no special facilities exist to support explicitly the development of the aquaculture sector in the Delta State (e.g. guarantee funds, special line of credit for production, etc.).

Recommendation #4: Investment should be made to promote activities that will increase the awareness of fish feed suppliers on the market opportunities that exist in the Delta State. The government could play a role in addressing this market failure (information) by investing in capturing additional market data and actively sharing this information with the private sector.

Recommendation #5: The government can play a greater catalyzing role between the fish farmers (as represented by their associations and cooperatives) and the private feed manufacturers to stimulate a win-win relationship between the two groups. Feed manufacturers have an incentive to promote efficient use of feed by fish farmers to ensure maximum competitiveness of the aquaculture sector in Delta State. The government can play an important role to stimulate the private sector to invest in improving fish farmer productivity, as well as helping them to develop more efficient distribution channels and to promote the adoption of the fish farming practices.

Recommendation #6: The state government should join in the effort to explore the development of alternative sources of protein (such as maggot meal) as substitutes for the very expensive imported fish meal. MARKETS II and PIND are already exploring the extension of this technology to Nigeria.

## SECTION ONE – STUDY PURPOSE AND METHODOLOGY

### Introduction

Nigeria is a maritime country where fishing plays an important role in the national economy and fish is an important and popular component of the diet. Nigeria consumes over 1.5 million tons of fish annually. Fish constitutes approximately half the animal protein in the typical Nigerian's diet. Fish is supplied by a variety of sources including imports, domestic capture (i.e., fish caught from the various inland waters and coastal areas by artisanal fisher folks using boats and nets) and fish farming. Nigeria is a significant importer of frozen fish in Africa. Catfish is the predominant farmed fish in Nigeria and the fish farming sector is growing rapidly.

Small-scale fish-farming and artisanal fisheries make up about 80% of the fisheries sector, supplying roughly 82% of the country's domestic fish production. In the Niger Delta, the fish-farming sector is increasingly important with large numbers of new entrants over the last decade, particularly small-scale fish farmers.

In Delta State, and indeed the entire Niger Delta region, while artisanal fisheries is declining, aquaculture has witnessed rapid growth in the last 5 years due to a number of factors, including the low barrier to entry into the business, improving access to technologies, availability of fingerlings and feed, and technical advice. Research and analysis have shown that the single most important input in fish farming is good quality fish feed, which represents 60-70% of the cost of operations. Therefore, access to good quality fish feed which is affordable to small scale fish farmers is key to catalyzing growth within the aquaculture sector in Delta State.

In spite of the large numbers of fish farmers in the State, with large clusters in Asaba, Warri, Ughelli and Agbor, there is minimal production of good quality fish feed in the State. Farmers can source fish feed from imports and from Nigerian firms that manufacture feeds locally. A majority of farmers also self-formulate their feeds at home in inefficient conditions. This has made the fish farmers dependent on foreign manufactured fish feeds, or feed produced in other parts of Nigeria, which are imported into Delta State.

To address this undesirable situation, the State is considering intervening in the fish feed market as a component of its economic growth and employment creation agenda through an appropriate mix of fiscal policies and actions. A feasibility study of the fish feed mills was hence proposed to inform the decisions on the intervention necessary. The findings of the feasibility study will provide the State Government with facts and figures on which to base its decision on the kind of interventions to be made. However, the study has been structured into two phases with phase one being the analysis of the fish feed market in Delta State.

## 1.2 Terms of Reference and Scope of Work

The consultant is to lead a multi-disciplinary team to carry out a detailed techno-economic feasibility analysis and business planning for establishing fish feed mill(s) in Delta State. This will; be achieved in two phases. Phase One will focus on the analysis of the fish feed market in Delta State while Phase Two will be the feasibility study on the establishment of fish feed mills in the State.

The specific terms of reference for Phase One are:

1. Collect and analyse data to better understand the structure and size of the fish feed market in Delta State focusing on product types/brands, origin, distribution channels, prices and volumes sold per annum.
2. Carry out a quantitative survey of a sample of fish farmers from a range of different farming environments and practices; for gaining more detailed understanding of the farmers' buying behaviour (how and when they buy feeds) and drivers of decision making between purchased and farm-made feed and from these establish the level of demand.

### Methodology

#### Preliminary Meetings

Preliminary meetings were held among the various stakeholders (FUTA-BDC, PIND, and Delta State Ministry of Commerce and Ministry of Agriculture) to discuss and agree on number of issues such as: Survey instrument (questionnaire), time and duration of field survey, number of respondents, personnel to be used for questionnaire administration, study area, and so on.

#### Data Collection and Analysis

During a joint meeting of the representatives of the Delta State Ministry of Agriculture, PIND and BDC, the number of fish farmers on which questionnaires will be administered was fixed for 300. The distribution of fish farmers by Local Government Areas of Delta State provided by the State's Ministry of Agriculture served as the sampling frame. Five LGAs which are known to have fish farmers' clusters were selected for data collection. One hundred questionnaires were allocated equally across the LGAs while 200 were allocated proportionately to the number of farmers in each of the five LGAs. The allocation of the sample across the five LGAs, is presented in Table 1.

**Table 1: Distribution of the Sample of Fish Farmers**

Local Government Area	Equality	Proportion	Total
Ika South	20	5	25
Isoko South	20	10	30
Oshimili South	20	30	50
Uvwie	20	135	155
Warri South	20	20	40
<b>TOTAL</b>	100	200	300

The Extension Agents of the Delta State Ministry of Agriculture were requested to administer a structured questionnaire (See Appendix 1) to randomly selected fish farmers based on the distribution of the sample of fish farmers in Table 1. Only 281 completed questionnaires were returned. The distribution of the completed questionnaires is presented in Table 2

**Table 2: Distribution of Questionnaires Completed by Fish Farmers**

Local Government Areas	Number of Completed Questionnaires	Percentage
Warri South	29	10.3
Ika South	25	8.9
Uvwie	147	52.3
Oshimili	50	17.8
Isoko South	30	10.7
<b>Total</b>	<b>281</b>	<b>100</b>

In addition, Focus Group Discussions were held with fish farmers, fish feed distributors and marketers in some selected communities and fish farmers' clusters in Warri, Asaba and Oleh to complement the information gathered with the structured questionnaire. Data collected from the field were analyzed using descriptive statistics involving frequency table, percentages, mean, and standard deviation. In addition, the Focus Group Discussions held with fish farmers were analyzed and used to buttress the results obtained from the questionnaire administered on the fish farmers. The FGD carried out with fish feed marketers were later on complemented with interviews of the representatives of Vital Feeds and Rannan. The representative of Durante/Coppens said she will not be available for the interview. A three-page data collection instrument (See Appendix 2) was sent to her by email but there was no feedback in spite of the facilitation by PIND.

#### **Limitation of the methodology**

The State Extension Service has implemented the questionnaire with farmers. Farmers may have been more reluctant to answer certain questions because of the non-neutral aspect of extension agents. The extension agents selected the respondents by themselves rather than running a random sample. In addition, they have included in the sample farmers who were willing to talk, which may lead to an overestimation of the data (farmers may boost some answers to impress public agents).

Official statistics counts a total of 3,784 farmers in the Niger Delta State while the sample size of the survey varies between 277 and 271 (depending on the questions). Given the number of farmers in the Niger Delta, the sample size is small. In addition, the sample has not been randomly selected.

## **1.4 Structure of the Report**

This report is presented in five sections. Section One provides the goals of the study and the methodology used; Section Two provides some background information on the fish and fish feed industry; Section Three presents the demand side of the market assessment Section Four focuses on the supply side of the analysis; and the main findings and recommendations are presented in Section Five.

## SECTION TWO – INDUSTRY STRUCTURE

**Industry characteristics.** The Niger Delta region is made up of three ecological water systems, fresh water, brackish and marine waters – each of them has its own indigenous cultivable fish species. There is a high potential for aquaculture in these areas as depicted in Table 3 below. This study only focuses on the main cultivable species available in fresh water in the Niger Delta State – cat fish – whose characteristics are presented in Table 4.

**Table 3 – Potential Aquaculture Production in Niger Delta Region Types of Aquaculture**

Water Types	Production (mt/yr)
Fresh water aquaculture	500,000
Brackish water aquaculture	400,000
Marine aquaculture	300,000

Source: Study, July 2007<sup>3</sup>

**Fish seeds.** Fish seed species used by the farmers to stock the ponds are *clarias*, *heterobranchus* and the cross breed of the two known as *heteroclarias* or hybrid. Though farmers do know there are various species, they are not aware that there are different strains of *Clarias* but feel that all *Clarias* are Dutch *Clarias*. According to a recent study<sup>4</sup>, ninety percent (90%) of those interviewed are unable to differentiate between the three (3) varieties at the fingerling stage, so when purchasing fish seed, they are never truly certain which species they are getting.

Fish seed can be bought as fingerlings, post fingerlings or juveniles. The fingerlings are the cheapest but also the most delicate to handle and most difficult to care for. They are not recommended for first time fish farmers. For the earthen pond technology a lot of seed population loss is attributed to loss of fingerlings through pond leakages and fingerling mortality from infections and various stresses. Despite its associated handling difficulties, farmers who are skeptical of the services of fish seed breeders who may try to sell stunted fish as juveniles, prefer to buy fingerlings in order to be assured of the age of the fish seed<sup>5</sup>.

*Clarias* is the most common variety used among farmers in the Niger Delta State and is a fairly new technology in Nigeria. The feeds used need to be tailored to this variety specifically. Imported feeds are specifically designed for *Clarias*, but not for the *Heterobranchus* variety.

<sup>3</sup> "Brackish water aquaculture: a veritable tool for the empowerment of Niger Delta Communities"; Writers are from the African Regional Aquaculture Centre/Nigerian Institute for Oceanography and Marine Research, Port Harcourt, Nigeria and Department of Fisheries and Aquatic Environment Rivers State University of Science and Technology, Nkpolu, Port-Harcourt, Nigeria

<sup>4</sup> "Fish Feed Survey", May 2012, Elo ovuezirie, PIND project

<sup>5</sup> Ibid

**Table 4 – Characteristics of Cat fish in fresh water zone of Niger Delta State Species**

	Market value	Availability of seed/fry	Feeding habit	Potential yield
<b>Cat fish</b> <i>Clarias</i> <i>garipepinus</i> <i>Heterobranchus</i> <i>bidorsalis</i> <i>H. longifilllis</i>	Very good	All year round but inadequate	Omnivorous	Hardy with high culture potential.

Source: Same study

**Link between poultry and fish feed production.** The production of animal feeds in Nigeria is about 3.5 million tons annually<sup>6</sup>. Most of it is for poultry and a very small percentage of the total production is for fish feed. Poultry feed is exclusively produced locally (no import of poultry feed in Nigeria). In contrast, fish feed manufacturers are very limited in number in comparison to the number of fish farmers and, as such, the aquaculture industry is very reliant on the imports of quality fish feeds. Fish feed companies are just beginning to learn about the size of the local fish farming industry.

Given the dominance of the poultry sector in animal feeds, the fish feed industry can be volatile. If there is a sudden increase in price of poultry, demand will shift and will most likely lead to reorientation of feed manufacturers from the production of fish feed to poultry feed. However, there is an increasing recognition in the feed industry that fish farming is promising and feed manufacturers have started taking more risks to enter the fish feed market. Vital Feed produces both feed types and is present in Edo state and Akwa Ibom State. Top Feeds, a local manufacturer (Sapele, Delta state), who has historically concentrated exclusively on producing poultry feed is about to enter the fish feed market in the Niger Delta. The company is also building a new plant in Cross River state which should be commissioned in 2013.

At the production level, commercial farms involved in both poultry and fish production can make economies of scale by reducing the costs of inputs, such as fertilizer and feeds. Animal excreta can also be used as organic manure in fish ponds. The farmers who practice integrated poultry/fish farming often formulate both. Songhai Farms situated in the Tai Local Government Area of Rivers State have the capacity to produce both for their farms because they practice integrated farming, own feed mills and compound their own feed. Table 5 below describes the profile of integrated farms in Nigeria.

<sup>6</sup> Journal of Agriculture and Social Research (JASR) Vol. 11, No. 2, 2011, "Transforming aquaculture from subsistence to commercial level for sustainable development in Niger Delta region of Nigeria".

**Table 5 – Systems of Commercial Fish Farming in Nigeria**

Fish Farm Types	Characteristics
<b>Integrated Fish Farming</b>	In Nigeria integrated fish farming has been reported in many states of the federation in which 50% of fish farmers integrate, poultry, piggery or livestock with fish production, while integrated fish cum crop production is on the rise also in several states (AIFP, 2005). According to Asala (1994), the essence of integrated system is productivity of fish as to meet the challenges of food shortage and reducing the incidence of poverty in the country.
<b>Fish cum poultry farming</b>	Poultry cum fish farming is the integration of poultry animals like chicken, duck and geese with fish farming. The most common practice in Nigeria is fish cum chicken, which is widely practiced because of its profitability. Birds raised for egg (layers) or the one that are raised for meat (broilers) can be integrated with fish farming. This will reduce the cost of inputs, such as fertilizer and feed, so as to maximize profits (Akinrotimi <i>et al.</i> , 2005). The poultry houses can be constructed inside and raised over the pond or beside the pond as the case may be.
<b>Fish cum pig farming</b>	Pig farming is widely practiced across the southern and middle belt of Nigeria, offers the farmer a husbandry which is easier than chicken farming. It has good returns. The pig is a highly prolific animal and its combination with fish not only increase economic efficiency, but also increase its ecological efficacy as wastes residues, and left over from kitchen, aquatic plants are often used as pig food. The excreta in turn are used as organic manure in fish ponds (Ansa and Jiya, 2002).
<b>Fish Cum Crop Production</b>	This is the cultivation of agricultural crops (e.g. vegetables and arable crops like rice etc) and aquatic plants (like water spinach, water chestnut etc), with fish farming. The common practice in fish cum crop production in the country is in cultivation of fish with rice, and vegetables.

*Source:* Journal of Agriculture and Social Research (JASR) Vol. 11, No. 2, 2011

**Fish feeds.** The nutrients needed by fish from the natural environment are seasonal and may not occur in required proportion to meet the nutritional demand for cultured fishes, especially during their starter period. To compensate, farmers use supplementary feedings to ensure that fish gets the required nutrients. As human consumption for protein increased and the government invested in exploiting its water resources for fish farming, Nigeria became more reliant on pelleted feed for fish feeding. According to the literature, the combination of feed stuffs into a ration has more nutritional value than when ingredients are supplied separately.

Farmers use agricultural waste to formulate their feeds, including palm kernel cake, groundnut cake, millet/corn bran, wheat bran, blood meal, fish meal, soya bean meal. How fish are fed is as important as what fish are fed with. The feeding rates and frequency depends on stocking density, age and size of the fish, production function and pond ecology, which varies considering seasons. This also differs from one species to another. High protein diets (about 30-35%) are essential for fry/fingerlings and juveniles, , while adult fish requires less.

**Feed products.** The quality and quantity of feed affects water quality, which in turn affects fish health. The best feeds are water stable and are efficiently utilized by fish, so that the accumulation of waste in the pond or tank is minimized, and thus the impact on water quality, is minimized. In contrast, poor

quality feeds often start disintegrating on contact with water and are not well assimilated by fish, or may not even be consumed. Over feeding, causes large amounts of feed to remain in the water to disintegrate. This results in high waste accumulation and poor water quality.

The preferred fish feed is the foreign floating variety and the floatability characteristics are achieved by using an extruder which is expensive so few feed companies own it thereby giving rise to possible monopolistic tendencies by the companies. Foreign feeds have a higher proportion of protein than Nigerian produced feed, which gives better results in terms of table size fish at shorter time. The cost of protein source i.e. fish meals (imported) is very high. This is the case for Nigeria generally, including the Delta State. In general, locally produced feeds are cheaper than imported products. However, imported feeds have better floatability characteristics and higher protein percentage. Nigeria imports feed from USA (Ziegler brand), China (Sharp brand), Brazil (Pira brand), Netherlands (Coppens), Multifeed (Israel). Leaders in the region include Coppens and Multifeed (floating feeds). For the locally produced floating feed, Vital Feed Ltd is poised to becoming a strong brand. They are beginning to get back the confidence of the farmers because in the past their products were adjudged as not too desirable by the fish (and consequently for the farmers).

The key index for managing feeding regimes is the Feed Conversion Ratio (FCR). The FCR is defined as the number of kilograms of feed required to produce one kilogram of fish. Thus, the more efficient the feeding regime, the lower the FCR. The best farmers use only the best feeds available, and by doing so, make more profit, despite their higher cost. Such feeds offer farmers fast growth and low FCR. A good FCR ranges from 1.0:1 to 1.5:1, i.e., from 1.0 to 1.5 kg of feed is needed to produce 1 kg of fish. Some of the artisanal feeds made “on-farm”, however, give FCRs of 2:1 to 4:1 or higher and cost the farmer much more than they realize. In addition, by using the best fish fingerlings and fish feeds available, survival rates of 85-90% are possible, compared with survival rates of 40-60%<sup>7</sup>, using feeds made “on-farm”.

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<sup>7</sup> “Aquaculture Buyers Guide for Nigeria”, USAID Market Projects 2010

## SECTION THREE – DEMAND ANALYSIS

Fish feed demand is a derived demand. The strength of the demand for fish feed is contingent on the level of production of cultured fish in the state, which, in turn, is function of the demand for cultured fish in the state. The demand for cultured fish is a component of the total demand for fish in Nigeria and in Delta State. Price differentials between cultured fish from fish farms and wild fish from captured fisheries in inland waterways, high seas and imports will determine, among other factors, the component of the total demand for fish that will be captured by cultured fish.

From the foregoing, the demand for fish feed in Delta State will, in the first instance, be contingent on the number of fish farmers in the state, the number and sizes of their ponds, their production practices, especially the level of intensification of production. The production practices adopted by the farmers will, among others depend on their socio-economic characteristics, most important of which are their level of education, ownership and access to investment capital.

This section will first analyze current and potential demand for fish feed in the Niger Delta by comparing the recommended feeding schedule to grow fish with farmers' feed consumption behaviors and feeding practices using the survey results. The study will then analyze the profiles and characteristics of fish farming businesses in the Niger Delta to shed some light on consumption behaviors and market size.

### 3.1 Demand for fish in Nigeria and the Delta State

The aquaculture industry in Nigeria has grown tremendously in the past ten years with a reported production of farmed catfish of 143,207 MT (Federal Dept. of Fisheries, 2008) and will continue to do so with a projected growth rate of 20% growth per year. Growth is driven by several factors including population growth, increasing affordability as prices have come down, increasing demand from niche markets (e.g. hotels and restaurants) and a bigger awareness on necessary daily protein intake by Health institutions and multi-lateral agencies. Nigerians now appreciate the need to include protein sources (meat, fish, milk, etc.) in their daily diet for health reasons. Fish remains the cheapest source of protein in Nigeria. The growing health concerns on intake of red meat and its attendant issues, further deepens the need for fish production and intake. With its vast water resource (see Table 3) and 163km of coastal line, Delta State is suitable for fish farming. Fish is cultivated in either earthen ponds or artificial ponds e.g. tanks, concrete ponds and plastic ponds. In Delta State, while artisanal fishing is declining, aquaculture has witnessed rapid growth in the last 5 years due to a number of factors, including the low barrier to entry into the business.

The feed industry in Nigeria is developing gradually to meet the demands of Nigerian fish farmers. It started with imported feed and now major local (national) feed producers are developing improved and cheaper feed for the local industry. Prices are coming down and product quality is increasing. Farmers are getting access to feed, either imported, locally manufactured or farmer made, but challenges remain in terms of feed cost and quality.

Research and analysis have shown that the single most important input in fish farming is good quality fish feed, which represents 60-70% of the cost of operations. Major issues on cost include the cost of raw materials as there is an import duty on fish meal of 10%. The size of the market remains limited in comparison to poultry to allow economies of scale. There is a somewhat developed distribution network to farmers, but it is not yet as efficient as it could be.

Fish feed for the starter period (starter feeds for the first 2-10 weeks of production) are all imported as the technology needed to add the necessary proteins to feeds does not exist in Nigeria. Access to quality raw materials is limited as fish meal is expensive and little is imported. A scientific mixture will be needed to deliver the optimal Feed Conversion Ratio (FCR).

### 3.2 Demand for fish feeds

The demand for fish feed is a factor of several variables, some of which are quantitative, some of which qualitative. This section will look at the variables presented in Table 6 to estimate current versus untapped market potential.

**Table 6 – Summary of Variables Affecting the Demand for Feeds**

Variables	Characteristics	Status in the Niger Delta State
<b>Number of ponds stocked per year</b>	Depending on the size of business, farmers stock a different number of ponds per year.	The survey data shows that the average business owns 8 ponds (medium size) and that it stocks its ponds 1.1 times per year on average.
<b>Number of times a pond is stocked per year</b>	The utilization rate of pond by farmers varies depending on water availability, cash flow available, and revenue generated.	On average, the survey shows that farmers stock their ponds twice a year.
<b>Feed quality and conversion ratio</b>	High quality feed uses less feed for the same output.	Depending on the brand and type of feed (imported or locally manufactured), conversion ratios vary between 2.5:1 and 1.2:1. A good FCR ranges from 1.0:1 to 1.5:1, i.e., from 1.0 to 1.5 kg of feed is needed to produce 1 kg of fish. Some of the artisanal feeds made “on-farm” give FCRs of 2:1 to 4:1 or higher and cost the farmer much more than they realize.
<b>Knowledge by farmers on how much to feed and when to feed (growth cycle)</b>	Fish requires different amount of feeds at different stage of their growth cycle.	Farmers tend to use high quality starter feed, but waste a lot of it during the first three months. Farmers tend to replace manufactured feeds by self-compounded feeds in the last three months of the growth cycle
<b>Potential # of times that a pond can be stocked depending on water</b>	If water is not available, farmers will not be able to stock their pond immediately after the first harvest is done.	Water availability varies depending on ecological zones. Inland areas tend to be more seasonal because of lower rainfalls.

availability		
<b>Cash flow available to farmers to purchase the feed versus purchasing ingredients</b>	This is a factor of access to finance and to markets	Farmers have limited access to finance and to markets, which reduce their capacity to invest in their business and efficiently use their ponds.

Source: Authors

The cultured fish production capacity for the Delta State is depicted in Table 7. Official statistics from the 2010/2011 survey conducted by the Delta State Ministry of Agriculture shows that the total number of fish farmers and ponds was 3,784 and 8,270 respectively in 2011 (this number has certainly increased in the two years since this data was available, but it is a good starting point). The stocking capacity and annual output was estimated at 24,414 tons of table fish<sup>8</sup>. The potential fish feed demand for Delta State is a function of this production capacity. To estimate market demand, it is also important to take into account the growth cycle of fish as a fish needs a different amount and type of feed depending on their growth period (1mm, 2mm, 4mm, 6mm, and 9mm). This section will 1) analyze farmers' feed consumption behaviors by looking at a growth cycle and comparing a recommended feed schedule with current consumption patterns from surveyed farmers; 2) estimate current and untapped demand for manufactured feeds in the Niger Delta and look at patterns of pond stocking; 3) estimate feed waste and surplus based on survey results and 4) calculate efficiency gain in table fish production by applying good feeding practice.

**Table 7 – Distribution of Fish Farms in Delta State as at 2010/11**

S/N	L.G.A	No. of Farmers	Type of Ponds	No. of Ponds	Stocking Capacity	Output (Tons/ Annum)
1	Aniocha North	11	Concrete/Earthen	26	3,300	116
2	Aniocha South	43	Concrete/Earthen	243	214,600	205
3	Bomadi	35	Earthen	62	6,815	468
4	Burutu	49	Earthen	163	10,070	454
5	Ethiope East	57	Earthen/Concrete	253	117,500	736
6	Ethiope West	19	Earthen/Concrete	104		563
7	Ika Nort East	46	Concrete	151	86,500	409
8	Ika South	26	Concrete	73	7,200	397
9	Isoko North	43	Earthen/ Concrete	209	112,700	1,012
10	Isoko South	41	Earthen	129	61,800	1,531
11	Ndokwa East	50	Earthen	81	10,700	1,126
12	Ndokwa West	55	Earthen/Concrete	229	432,000	2,088
13	Okpe	46	Earthen/Concrete	173		468

<sup>8</sup> 2010/2011 Survey conducted by the Delta State Ministry of Agriculture

14	Oshimili North	46	Concrete	115	59,920	567
15	Oshimili South	132	Earthen/Concrete	634	245,000	1,679
16	Patani	22	Earthen	42		665
17	Sapele	81	Concrete/Earthen	360		696
18	Udu	52	Earthen/Concrete	122	68,000	648
19	Ughelli North	59	Earthen/Concrete	337		953
20	Ughelli South	30	Earthen/Concrete	144		1,009
21	Ukwuani	32	Concrete/Earthen	164		568
22	Uvwie	2,676	Earthen/Chikoko	4,304	360,500	4,016
23	Warri North	28	Earthen/Concrete	80		810
24	Warri South	81	Earthen/Concrete		144,500	1,980
25	Warri South West	24	Earthen/Concrete	72		1,250
	Total	3,784		8,270	1,941,105	24,414

Source: 2010/2011 Survey by the Delta State Ministry of Agriculture

**Farmers' consumption behaviors.** All farmers buy manufactured fish feed (2mm) at the starter stages, but as the fingerlings or post-fingerlings increase in age and size, the number of farmers buying manufactured feed decreases. By the 5th and 6th month, only a few are buying feed and significant proportions are substituting imported feed with homemade feed. According to experts, the ideal is to grow out a given fish from fingerling stage to table size with imported feed. The recommended volume is 66bags of 15 kg bags or approximately 1,000kg to grow out 1,000 fish. Limited working capital, however, prevents farmers from continuously buying commercial feed. After attaining a certain stage (past the first three-four months for *Clarias*, farmers believe that the crude protein level can be reduced and they use cheaper alternatives. Self-compounded feed is the cheapest with least crude protein percentage. Sinking feed is less efficient in that the feed dissolves faster in water and stays afloat for a shorter period than the floating feed.

According to experts interviewed, a typical growth cycle for the *Clarias* variety is as follow:

- 2kg of 1mm for 2 weeks
- 30kg of 2mm for 1.5/2 months
- 150kg of 4mm for 2 months
- 450kg of 6mm for 1month
- 570kg of 9mm for 1month

This estimate is based on an FCR projection of 1.2:1 feed to fish conversion ratio using floating feed and a stocking density of 1,000 fish seeds, assuming 1 cubic meter of water for 15 fingerlings/postfingerling. As we can see, fish eat different amounts of fish feeds at different periods of their growth cycle. Productivity is therefore not only a factor of feed quality, but also of farmers' good feeding practices.

The survey has assessed farmers' behaviors in terms of fish feeding consumption at different points of the fish growth cycle and taking into account the feed type used. The data shows that the growth cycle per pond is 6 months on average, which corroborates the proposed recommended schedule. A number

of assumptions have been made in order to interpret the data from the survey data and field consultations with experts (see Table 8 below).

**Table 8 – Surveyed Farmers’ Consumption Patterns**

<b>Growth Period (Feed Types Used)</b>	<b>2 weeks (2mm)</b>	<b>2 months (2mm)</b>	<b>2 months (4mm)</b>	<b>1 month (6mm)</b>	<b>1 month (9mm)</b>
<b>Number of farmers using purchased feed at this stage (sample size)</b>	271	271	267	239	197
<b>Average use of fish feed by farmers per pond (number of bag per week)</b>	0.7	0.7	1.3	2.2	1.9
<b>Conversion of number of bags used per week in kilos (1 bag = 15 kg)</b>	10.5	10.5	19.5	33	28.5
<b>Conversion of number of kilos of feed used per growth period (# of kilos by number of week in each growth period)</b>	21	84	156	132	114
<b>Recommended use of fish feeds</b>	2	30	150	450	570
<b>Assumptions:</b>					
* We assumed that the feed use by respondents follows the recommended schedule in terms of the length of the feeding period per growth stage. The survey shows that on average, each growth cycle is 6 month of length.					
**The survey shows that the average number of fish stocked per ponds is 1,971 fish seeds with an average of 22' x 45'm per pond – instead of 1,000 fish stock in the recommended schedule; the conversion ratio of surveyed farmers ranges from 1.2:1 (imported feeds) to 2.5:1 (home made feeds) so the FCR reflected in the survey data will be less efficient than the one used in the recommended feed schedule. These two factors explain in part why surveyed farmers used much more feed that recommended.					
*** The survey did not differentiate between 2mm and 1mm. Fish needs to be fed immediately so we assume that farmers used 2mm during the starting period (two weeks) during which they should have used 1mm feed. The 1mm type of feeding is currently too sophisticated and expensive for farmers in the Niger Delta.					
**** The number of kilo per bag per brand varies between 15 and 20 kilos; the team assumed that the standard bag size regardless of brand was 15 kg (slight underestimation of the feed used)					

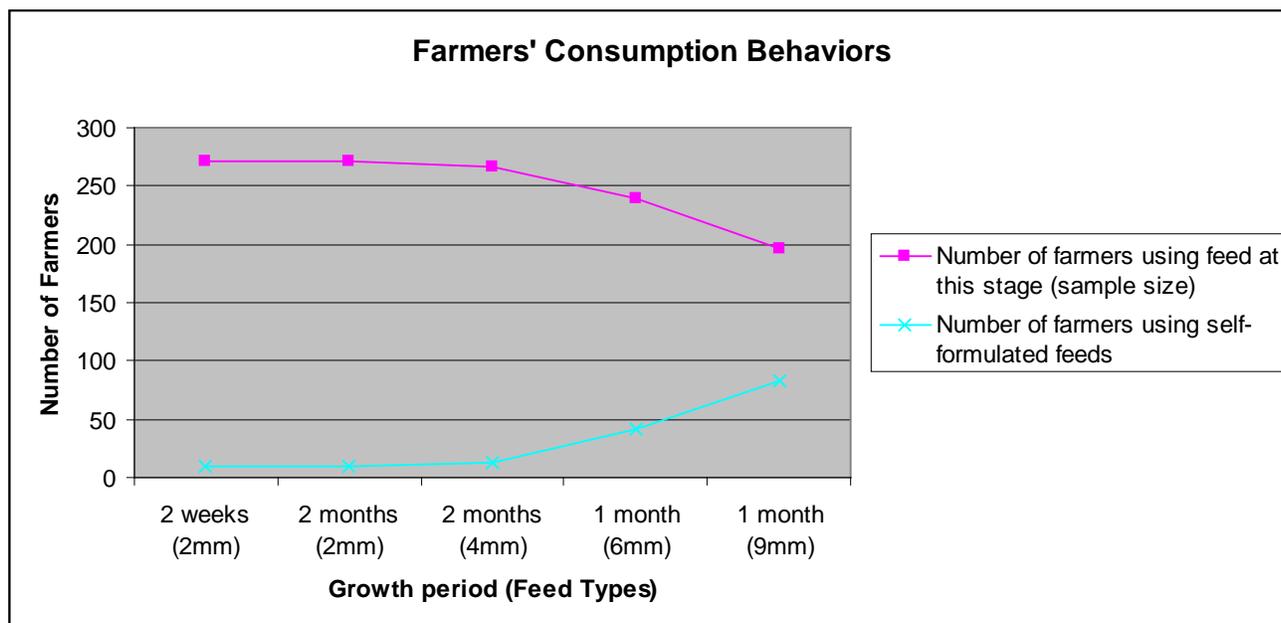
*Source: Authors*

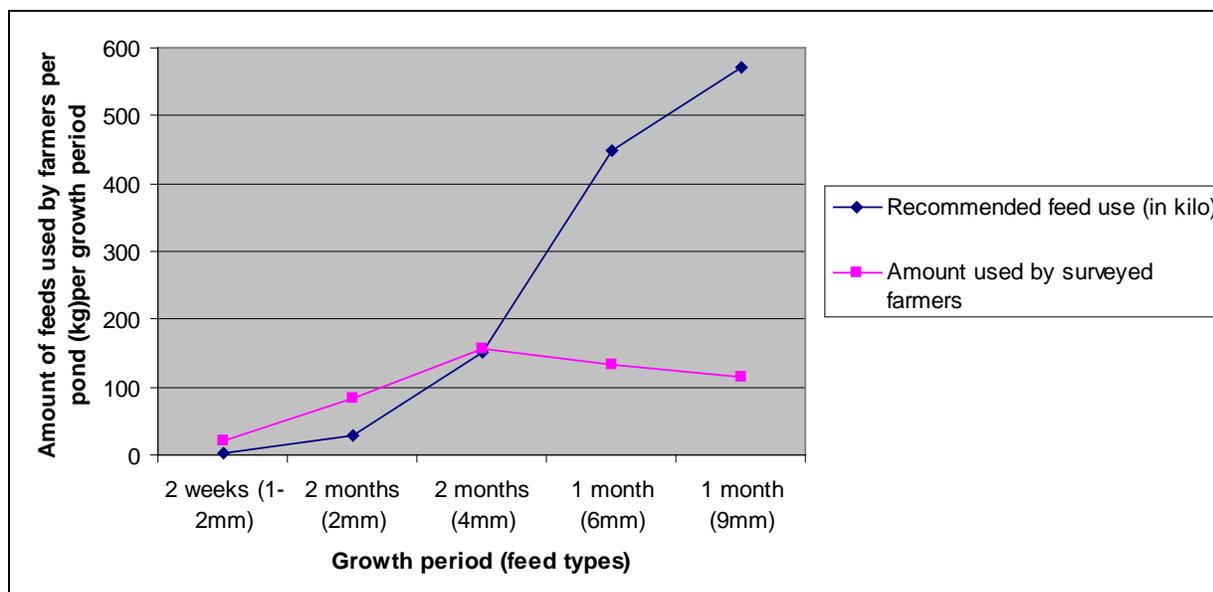
### Graph 1 – Farmers' Consumption Behaviors

Source: Authors

We can observe that as farmers move towards the end of the growth period, the number of farmers who reported consuming purchased feeds diminishes. Interviews with farmers showed that farmers tend to stop purchasing fish feed around the 5<sup>th</sup> and 6<sup>th</sup> months and start reverting to self-compounded feeds to finish the growth cycle. Graph 1 above shows the consumption behaviors of our surveyed farmers in terms of both purchased feeds and self-formulated ones, assuming that the respondents who stopped reporting their consumption of purchased feeds switched to using self-formulated feeds.

### Graph 2 – Recommended Feed Use Versus Surveyed Farmers Feed Use





Source: Authors

We can observe that surveyed farmers in the Niger Delta tend to use more feeds than necessary in the first four month and a half of the fish growth period. This represents a waste that should be reduced by improving farmers' feeding practices. As farmers enter the middle of the third growth period (4mm), we can observe that they use far less purchased feeds than recommended: farmers use around 3.5 times less 6mm feeds than recommended in Period 4 (132kg instead of 450kg recommended) and around 5 times less 9mm than recommended in Period 5 (114kg instead of 570kg recommended). This does not necessarily mean that farmers feed their fish less during the last two months, but that a majority of them relies on self-compounded feeds to feed their fish. The survey reveals that around 61.2% of farmers use self-compounded feeds so it is fair to assume that around 61.2% of farmers who stopped using imported/locally manufactured feeds do use self-compounded feeds to feed their fish. The amount of homemade feeds and their costs has not been calculated in the survey though it could provide a useful element to this analysis.

**Table 9 – Comparison of Recommended Feed Schedule and Practices by Surveyed Farmers**

Course of life of the productive fish pond	Recommended feed use	Amount used by farmers (from survey)
2 weeks (starter period)	2kg of 1mm	21kg of 2mm
2 months	30kg of 2mm	84kg of 2mm
1.5/2 month <sup>9</sup>	150kg of 4mm	156kg of 4mm
1 month	450kg of 6mm	132kg of 6mm
1 month	570kg of 9mm	114kg of 9mm

Source: Authors; PIND's experts

<sup>9</sup> We used two months for calculating the amount used by farmers (from the survey) during that period.

**Current demand for imported and locally manufactured feed.** Based on farmers' feed consumption behaviors identified previously, we will estimate current demand for manufactured feeds in the Niger Delta State by looking at the total number of ponds and the number of times a pond is stocked per year.

**Table 10 – Summary Statistics on Fish Farming Capacity in Delta State**

Statistics	Number of Ponds Owned per Farmer	Number of Ponds Stocked in 2012	Number of time a pond is stocked per year
<b>Mean</b>	7.68	9.17 <sup>10</sup>	2
<b>Mode</b>	2	4 <sup>11</sup>	2
<b>Minimum</b>	1	0.05	1
<b>Maximum</b>	57	60	9
<b>Standard Deviation</b>	8.95	9.29	-

*Source: Authors*

According to official data, we know that there are 8,270 ponds in the Niger Delta State. Not all ponds are used all at once – some of them are rented to other farmers while others remain unused because farmers lack the financial means to invest in them, or there is not enough water to use them in certain seasons. Before estimating current demand for feeds, it is important to understand how many times a pond is being stocked by farmers. This varies depending on the size of the fish farming business and its capacity to invest. As a rule the larger the business scale, the better the operational farming /production practices of the farmer. Typically, experts differentiate between small, medium and large size by following the table below:

**Table 11 – Fish Farming Businesses Sizes**

Business Scale	Ownership	Characteristics
<b>Small</b>	1-5 ponds	Farmers are their own manager and do not use much external labor. Grading and sorting are poorly done, if ever, as they do not have enough ponds to keep some aside from production for sorting/grading.
<b>Medium</b>	6-20 ponds	Business tends to perform sorting and grading, water change and use external labor.
<b>Large</b>	21- and above	Good management practices; put some ponds aside for sorting and grading; cash flow can be a challenge at that scale so farmers often rent some of their ponds to others.

*Source: Authors*

Looking at the mean and modal farmers tells us more about fish farmers production capacity (see Table 10 above). The modal fish farmer owns 2 ponds and stocks the ponds twice a year. But when looking at

<sup>10</sup> If production was optimal (stocked twice per year), the mean farmer would have stocked 16 ponds instead of 8 ponds.

<sup>11</sup> The mode for the number of ponds stocked in 2012 appears 54 times out of a 277 sample.

the larger population of farmers as a whole, farmers only stock their ponds 1.1 times per year, on average. In other words, the bigger the farm the fewer farmers stock their ponds. This highlights a large underutilization of ponds by farmers. Although in some cases, some medium and large businesses set aside several ponds for sorting and grading purposes, which is good production practice. Small businesses do not have enough ponds to implement this practice.

Pond underutilization can be explained by several reasons. First of all, farmers face a cash flow challenge as stocking a pond represents a fair investment involving buying the fingerlings, feeding the fishes, etc., which requires a certain level of capital. Data shows that farmers have limited access to financing. Farmers who own more than 20 ponds (large business) need a lot of capital to grow out the fish to table size after stocking. The working capital is a constraint especially in the event of losses sustained from the previous cycle(s). This can result in the scaling back of the number of stocked ponds in subsequent cycles. In such events, the owners resort to renting out of the ponds to bring in cash for the feeding of the growing fish in the present cycle. The most common reason why farmers do not utilize their ponds the most efficiently is mostly related to the cost of feeding the fish from the stocking size to table size. Financial problem is a challenge for businesses across all sizes.

Secondly, we know that farmers have difficulty accessing markets and often do not manage to sell their entire production, especially in the past couple of years as production. This is not because demand is low but because markets that are further away from production centers – and where demand is high – are hard to reach (outside of Warri). If farmers cannot sell all their production, they will most likely be reluctant to further invest in their business and expand. This has implication on market side. Facilitating farmers' access to market will increase their income and their willingness to invest in their business, thus improving pond utilization rate and increasing market size for feeds. If cash flow constraints are addressed, it is technically fairly easy for a farmer to start a new pond, meaning that farmers could have some flexibility in adjusting their production to increase in demand.

A third element that can explain the low pond utilization rate by certain businesses is the quality of water available. This depends on the location of the production as inland areas are more seasonal because less humid – than Warri, for instance. The market size depends on the number of times a pond can be stocked, which in turn depends on water availability (e.g. the Agbor area, where fish farmer population is low, faces water availability issues). Table 12 shows the number of production cycles operated by farmers by LGAs. We can observe that 58.7% of farmers who stock they ponds twice a year are located in the Uvwie LGA and that the less productive farmers are mostly found in the Oshimili South LGA.

**Table 12 – Number of Production Cycles Operated per Year by Location**

Number of cycles per year	Ika South	Isoko south	Oshimili South	Uvwie	Warri South	Total (count)	In %
1	3	7	14	7	3	34	12.3
2	19	22	10	135	23	229	82.7
3	2	1	3	4		10	3.6
More than 3 (from 3 to 9)			2		2	4	1.5
<b>Total</b>	24	30	49	146	28	277	100

Source: Survey

**Table 13 – Estimate of Current Demand for Purchased Feeds in the Delta State (annual basis)\***

	Period 1 - 2 weeks (2mm)	Period 2 - 2 months (2mm)	Period 3 - 2 months (4mm)	Period 4 - 1 month (6mm)	Period 5 - 1 month (9mm)
Number of kilos of feeds used per growth period <sup>12</sup>	21	84	156	132	114
Number of ponds	8,270				
Demand for feeds by all farmers (in kg per pond)	173,670	694,680	1,290,120	1,091,640	942,780
<b>Total estimated current demand for purchased feed in a growth cycle (in kilos per pond)</b>	<b>4,192,890</b>				
Number of times a pond is stocked per year	2				
<b>Total Current Demand per year (in kilos)</b> (using maximum pond utilization of twice a year)	<b>8,385,780</b>				
<i>* These calculations are an extrapolation of the amount of feed currently being purchased if we were to apply the statistics from the survey to the Delta State population using official statistics.</i>					

Source: Authors

Depending on how many times farmers are able to stock their ponds, current demand for fish feeds in the Niger Delta State ranges from **4,192.890 (pond stocked once per year) to 8,385.780 tons of feeds per year (ponds stocked twice per year).**

In financial terms, current demand is:

- At the cost of N5,400 per 15kg-bag (Coopens - Importer feeds), it gives a current market of between **N1.5billion and N3.1billion.**
- At the cost of N3,600 per 15kg-bag (Vitalfeeds - Locally manufactured), it gives a current market of between **N1billion and N2billion.**

<sup>12</sup> # of kilos is multiplied by the number of weeks in each growth period

**Untapped market potential.** Based on the previous analysis on estimated current demand for fish feeds, we can see that there is a large untapped market potential for fish feeds in the Niger Delta that can be estimated by looking at the difference between recommended fish feeds use and farmers' behaviors as highlighted by the survey. Before estimating this untapped demand potential, we will take a closer look at the data to estimate the amount of fish feeds wasted by farmers during the first three periods of the growth cycle and the amount of feeds unused for the remaining two periods (Table 14). On average, farmers waste 33 % of its feed per pond (79 kg) during the first three periods of feeding (4.5 months) due to overfeeding and uses 31% less manufactured feeds than recommended on the last two period of feeding (2 months).

**Table 14 – Estimated Waste and Surplus of Feeds Used by Surveyed Farmers in the Niger Delta\***

Growth Period (Feed Types Used)	1 weeks (2mm)	2 months (2mm)	2 months (4mm)	1 month (6mm)	1 month (9mm)
Feed Surplus (waste) used by farmers (per kilo per pond)	19	54	6		
Gaps in feeding from farmers				318	456
Number of ponds	8,270				
Total waste (feed surplus in kilos)	157,130	446,580	49,620		
Total untapped demand (feed gap in kilos)				2,629,860	3,771,120
Total waste (feed surplus in kilos)	653,330				
<i>* These calculations are an extrapolation of the amount of feed currently being purchased if we were to apply the statistics from the survey to the Delta State population using official statistics.</i>					

Source: Survey

Fish need to be fed continuously. Even if farmers stop buying manufactured feeds, they revert to a certain extent to self-compounded feeds. Conversations with farmers show that farmers tend to reduce the amount of feeds they give to their fish in the last two-three months of the growth cycle. The survey shows that 61.2% of farmers self-formulate some portion of their feed. Using this finding, we can estimate the amount of self-formulated feeds used by farmers that have replaced manufacturing feeds during the last two-three months. Out of the 6,400.9 tons of feeds unused by farmers, at least 3,917.35 tons of feeds have been self-formulated by farmers. The remaining 2,483.55 tons of feeds can give us an approximation of underfeeding during the last two-three months<sup>13</sup>.

<sup>13</sup> Because homemade feed leads to a poor FCR (from 2.5:1 to 4:1 according to industry experts), this is probably an underestimation of the amount of self-formulated fish feeds used by farmers during the last two months of the growth period.

**Table 15 – Estimated Untapped Market Potential for Fish Feeds in the Delta State**

Growth Period (Feed Types Used)	2 weeks (2mm)	2 months (2mm)	2 months (4mm)	1 month (6mm)	1 month (9mm)
Recommended use of fish feeds (in kilo per pond)	2	30	150	450	570
<b>Total Recommended Feed Use (in kilo per pond)</b>	<b>1,202</b>				
Farmers use of fish feeds (in kilo per pond)	21	84	156	132	114
<b>Estimated Current demand (in kilo)</b>	<b>507</b>				
Number of times a pond is stocked per year (on average)	2				
Number of ponds	8,270				
<b>Total Amount of Recommended Feeds (in kilo)</b>	<b>19,881,080</b>				
<b>Total Amount of Feeds Used by Farmers (in kilo)</b>	<b>8,385,780</b>				
<b>Estimated Net untapped demand (in kilos)</b> (using maximum pond utilization rate of twice per year)	<b>11,522,300</b>				
<i>* These calculations are an extrapolation of the amount of feed currently being purchased if we were to apply the statistics from the survey to the Delta State population using official statistics.</i>					

Using official statistics on the number of ponds in the Niger Delta State and the maximum pond utilization rate of twice per year, we can estimate the untapped market potential for fish feed (total recommended amount of feed use *minus* the amount of feed used by surveyed farmers) in the Niger Delta State at **11,522.300 tons per year** (see Table 15), which is significantly higher than current amounts purchased (5,761.150 tons per year if pond utilization of one per year).

Taking into account the untapped market potential, the total demand for fish feeds, including manufactured, home-made fish and the amount of feeds they should have used, is therefore ranging from **9,940.54 and 19,881.08 tons of feeds**, depending on the pond utilization rate.

In financial terms, estimated total demand (current and untapped market) is:

- At the cost of N5,400 per 15kg-bag (Coopens - Importer feeds), it gives a current market of between **N3.6billion and N7.2billion**.
- At the cost of N3,600 per 15kg-bag (Vitalfeeds - Locally manufactured), it gives a current market of between **N2.4billion and N4.8billion**.

**Efficiency gain in table fish production.** As farmers learn how to use fish feeds more efficiently, their FCR will improve – in other words, farmers will be able to produce more table fishes with lesser fish feeds. To estimate the gap in table fish production, and, as such, the foregone revenue for farmers, we

have compared what table fish production would be using a highly efficient FCR (1.2:1) and what it would be using an inefficient one (2.5:1), holding the feed use constant.

**Table 16 – Feed Use and Table Fish production Efficiency**

Scenarios	Feed used	Table fish production
Efficient FCR (1.2:1)	19,881.08	16,567.57
Inefficient FCR (2.5:1)	19,881.08	7,952.43
<b>Gap</b>		<b>8,615.14</b>

*Source: Authors*

As farmers use better feeds and improve their knowledge of how to feed, they will reduce the amount of feed that is needed and speed up the time to grow the fish so they can get the fish to market sooner (if there is sufficient market to absorb them). If the amount of feed used remains constant, an improved FCR will lead to an increase in table fish production of **8,615.14 tons of fish per year** in the Niger Delta State. Farmers are not fully aware of the impact of this waste on their table fish production and bottom line. If we assume that a pond can stock 1,000 feed seeds on average, an additional 8,615 ponds will be needed, which represents a doubling of current capacity in the Niger Delta State (see Table 16).

**Feed industry growth.** This analysis corresponds to a snapshot in time. The fish industry in the Niger Delta State has grown tremendously from 2002, where only a few farmers were entering the fish business, to the 3,784 active farmers in the industry today in the Niger Delta. If we were to work with farmers to increase their utilization rate of ponds, we can see that there is an important market potential that feed suppliers can tap into.

### 3.2 Profiles of Fish Farming Businesses

We have seen that demand for fish feed in Delta State is, in the first instance, contingent on the number of fish farmers in the state, the number and sizes of their ponds, their production practices, especially the level of intensification of production. The production practices adopted by the farmers are depended on their socio-economic characteristics, most important of which are their level of education, ownership and access to investment capital. This part of the demand analysis will look at some of the main economic and social characteristics of farmers to try to shed some light on our findings on market size and untapped market potential.

**Gender.** Fish production in Delta State is dominated by male owned business (see Table 17). Men accounted for 72.5% of total respondents interviewed in the study (against 27.5% of female). Pond ownership structure also reflects than dominance. Regardless of gender, the majority of businesses surveyed (56%) were small businesses (less than 5 ponds), 37.5% were medium size enterprises (between 6-21 ponds) and 18% were large businesses (more than 21 ponds). Men dominate pond ownership across business sizes, especially in the large and medium categories. Women are highly concentrated in small businesses (64.5% of female respondents). Men and women observe the same distribution patterns across business size: smaller sample as businesses increase in size.

Table 17 – Pond ownership by business size and gender

Pond ownership	Small (1-5 ponds)		Medium (6-20 ponds)		Large (More than 21 ponds)		Total
	Count	%	Count	%	Count	%	
Male	106	59.4	80	67	15	83.3	201
Female	49	41.6	24	23	3	16.7	76
Grand Total	155	100	104	100	18	100	277
Male (as a % of total males)		52.7		39.8		7.5	100
Female (as a % of total females)		64.5		31.6		3.9	100
Business size (in %)		56		37.5		6.5	100

**Demographics.** The fish farming industry attracts mostly farmers in the working age as it is a fairly labor intensive industry. Respondents were on average about 43 years – and range from 19 (minimum age) and 78 years old (maximum age). Around 73% of farmers fell within the 25-54 age group, while only 5.1% of farmers were below 25 years old. Almost all farmers were literate (97.5%) and only 2.5% of fish farmers had no formal education. This suggests that respondents in the area are well knowledgeable and can conveniently acquire the technical skills required for fish farming.

**Access to inputs and input quality.** The kind of fish mostly stocked was fingerlings followed by post-fingerlings. Reasons for this can be attributed to the availability and cost of fingerlings compared to the other types of fish seed. The fingerlings are cheaper compared with post-fingerlings and juveniles, when properly managed; a farmer can easily raise them to post-fingerlings and juveniles at a good cost.

Clarias was the major species of fish stocked by fish farmers in Delta State. As much as 80.2% of the farmers claimed that they stock Clarias. Farmers believe that Clarias has some advantages over Heterobranchus and Tilapia. About 76.2% of the fish farmers obtained fish seed from private farms in Delta State. The quality of the fish seed was the major factor farmers consider in buying fish seed from these private sources. Since the feed conversion efficiency and hence profitability can be greatly affected by the quality of the fish seed, it is important that fish farmers obtain their seeds from sources with trusted quality fish seeds.

As for feed, about 35.7% of the farmers used only floating feed while 62.1% used both floating and sinking feeds. Only 2.2% of the farmers claimed they used only sinking feed. This underscores the importance attached to floating feed. As mentioned previously, the use of floating feeds lead to a better FCR as floating feed remains more time on the water surface than sinking feeds, which allows a better assimilation by fishes.

**Access to knowledge.** A majority (85.4%) of the farmers had access to fish feed market information through various means ranging from fellow fish farmers, extension officers, to newspapers, among others. Around 14.6 % of farmers reported having a lack of access to information because of a limited number of extension agents and poor road network in their locations. As shown in Table 18, the highest

concentration of farmers without access to market information is in Oshimili South (17 out of 265 out of respondents) and the highest concentration while farmers have the best access to information in Uvwie (125 out of 265 respondents).

**Table 18 – Access to Market Information by LGAs**

	Ika South	Isoko South	Oshimili South	Uvwie	Warri South	Total
Access to market information	17	28	29	125	28	227
No access to market information	8	0	17	12	1	38
% of farmers with access to market information (out of total with access to market information)	7.5	12.3	12.8	55	12.3	100
% of farmers without access to market information (out of total without access to market information)	21	0	44.7	31.6	2.6	100
<b>Total (count)</b>	<b>25</b>	<b>28</b>	<b>46</b>	<b>137</b>	<b>29</b>	<b>265</b>

Source: Survey

The five major sources of fish feed market information identified by the farmers are the media, extension officers, newspapers, family and friends; and fellow fish farmers. It was discovered that most fish farmers obtained information through their fellow fish farmers, while very few of them got information through extension officers. This is an indication that the impact of extension agents was not being felt as expected in respect of providing information on fish feed to the fish farmers. Fish feed requirements are a major input into fish farming; adequate information on how to feed fish (what and when) is critical to the fish farmers' operations and performance.

A significant percentage of the fish farmers (71.4 percent) had access to extension service either through farm visit of the extension officers or through general meetings organized by the extension agents. In spite of the access by a significant percentage of the farmers, the claimed not to have received much support through the extension agents. Lack of access by 28.6 percent of the farmers might be due to the inaccessibility of their locations and/or unavailability of extension agents in their locations. Since fish farming is knowledge driven, every fish farmer in Delta State should have access to adequate extension services so that the farmer could obtain information on the latest technologies and remain competitive in fish farming business.

**Access to feed markets.** Two thirds of the farmers are less than five km from their source of feed. The average distance from fish farm to fish feed market in the surveyed areas is 6.5 km, with minimum and maximum distance of 0.1 and 125.0 km, respectively. Although the average distance is small, looking at the minimum and maximum distance between locations shows high variations in the distance from fish farm to fish feed market between LGAs. Table 19 shows that the most disadvantaged LGA in terms of accessibility to fish feed retail outlets is Ika South LGA with 58.3% of farmers being 20km and above from the nearest retail outlets for fish feed. Uvwie and Warri South LGAs had the best accessibility to outlets for fish feed.

**Table 19 – Distance between Fish Farmers and Source of Fish Feed (Percent)**

LGA	Less than 2 Km	2 - 4.99 Km	5 - 9.99 Km	10 - 19.99 Km	20 Km and above
Warri South	13.8	62.1	13.8	10.3	0.0
Ika South	0.0	8.3	4.2	29.2	58.3
Uvwie	49.0	42.1	2.1	6.9	0.0
Oshimili	15.2	15.2	17.4	52.2	0.0
Isoko South	23.3	26.7	10.0	36.7	3.3
<b>% distance of the total</b>	32.5	35.0	6.9	20.1	5.5

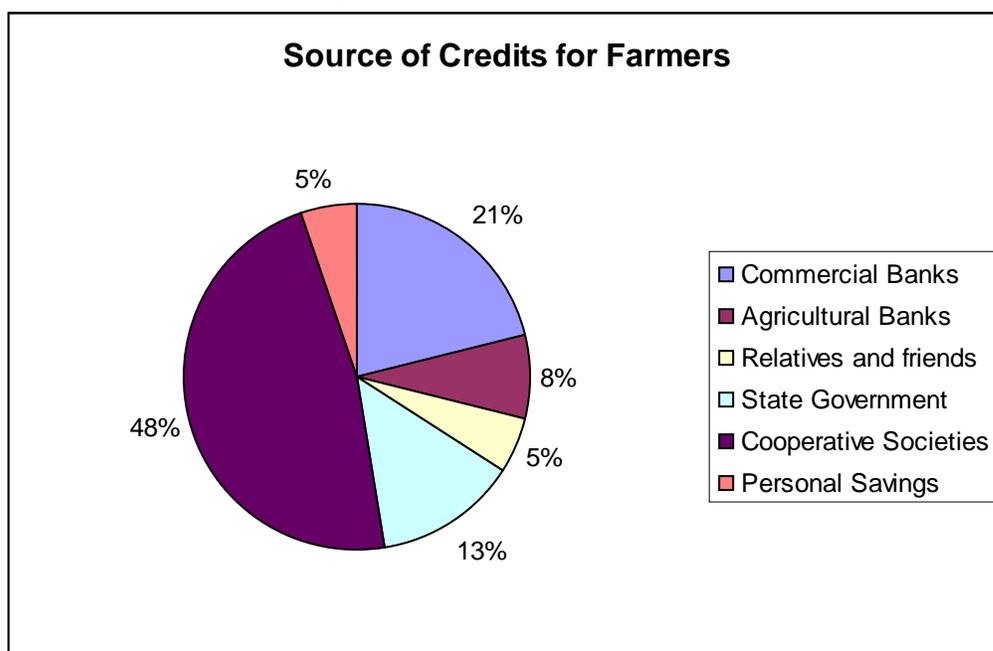
Source: Survey

The overall average distance from fish farm to fish feed market of 6.5km suggests that on the average, fish farmers travel short distances to buy fish feed. This is an indication that fish feed is readily available to the farmers.

**Access to credit.** It was revealed that only a small percentage of farmers had access to credit. This finding suggests that sufficient credit facilities were not made available to fish farmers in the state. It is therefore very important to take cognizance of this finding and appropriate steps should be taken to improve access to credit facilities for fish farmers. This may in turn boost fish production and significantly increase the protein intake in the state.

Findings revealed that cooperatives account for the highest source of credit to fish farmers in the state. This suggests that very little credit facility come from private banks and that no special facilities exist to support the development of the aquaculture sector in the Delta State (e.g. guarantee funds, special line of credit for production, etc.). Diagram 1 below shows the different sources of credits for farmers (in percentage).

Diagram 1 – Source of Credit for Farmers



*Source: Authors*

## SECTION FOUR – SUPPLY ANALYSIS

This section analyzes the supply side of the fish feed industry in the Niger Delta State. It starts by looking at the characteristics of the feed suppliers, then presents the structure of the fish feed supply chain in the Delta State and then analyzes suppliers' market size, penetration and pricing structure.

### 4.1 Supplier characteristics

There are three types of fish feed suppliers in Nigeria:

- 1) **Locally Manufactured Fish Feeds.** There are four major producers of fish feeds in Nigeria, namely CHI, Grand Cereals for Vital Feeds, Tempo Feed Mill for Freshline Feeds and Durante.
- 2) **Local Artisanal Fish Feeds** made by small-scale feed millers or made “on-farm” by fish farmers. There are many locally produced, artisanal small-scale feed millers producing some fish feeds as well as many fish farmers who produce their own fish feeds on the farm. Most of these feeds are only available in the areas where they are produced. Common suppliers of artisanal, small-scale feed millers' feeds include: MOSAB, Ideal Fish Feeds, Aqua Visa Feeds, Megatimex, UNIFACO, Aqua Plus, High Yield, Jib Feeds, Darrell Feeds, etc<sup>14</sup>. These companies offer compounding services (tolling) to farmers willing to self-formulate their feeds.
- 3) **Imported Fish Feeds.** There are about one dozen fish feeds imported from abroad into Nigeria. Imported feeds are all high quality floating feeds in general. Note, most quality fish feeds come in several pellet sizes as they are tailored to feed different sizes of fish. Small fish require high protein (50% CP) and tiny pellets. Most imported fish feeds only include the larger size pellets. The smaller size pellets are very expensive, but the high quality of these feeds jump-starts the young larvae and fry into fast growth. Many fish farmers start feeding the small size pelleted feeds during the first 4-8 weeks of growth, then switch to the lower cost feeds<sup>15</sup>. Companies in Nigeria include: MOSAB, Idea Fish Feeds, Aqua Visa Feeds, Megatimex, UNIFACO, Aqua Plus, High Yield, Darell Feeds, and Jib Feeds.

**Table 20 – Summary of Main Fish Feed Suppliers in Nigeria**

Fish feed suppliers	Brand	Fish feed types	Pellet sizes	Present in Niger Delta
<i>Locally manufactured</i>				
<b>CHI</b>		Floating	4 mm, 6 mm, and 8 mm	-
<b>Grand Cereals</b>	Vital Feeds	Floating	4 mm, 6 mm, and 8 mm	X
<b>Tempo Feed Mill</b>	Freshline Feeds	Floating	4 mm, 6 mm, and 8 mm	-
<b>Durante</b>	Durante	Sinking	4 mm, 6 mm, and 8 mm	X
<b>Makakoti</b>				X

<sup>14</sup> USAID's "Aquaculture Buyer's Guide, October 2010

<sup>15</sup> Ibid.

<i>Imported fish feed</i>				
<b>Coppens (Holland)</b>	Coppens	Floating	0.2 mm, 0.3 mm, 0.5 mm, 0.8 mm, 1.2 mm, 1.5 mm, 2 mm, 3 mm, 4.5 mm, 6 mm, 8 mm.	X
<b>Sharp (China),</b>				X
<b>Raanan Feed</b>				X
<b>Multifeed (Israel)</b>			0.2mm, 0.6mm, 1.1mm, 1.4mm, 2mm, 3mm, 4mm, 6mm, and 9 mm	X
<b>Zeigler (USA,)</b>			Mael, park one, park two, 1.5mm, 2mm,3mm ,4mm, 5mm, 6.5mm, 8mm and 9.5mm sizes	X

Source: Authors, USAID's "Aquaculture Buyer's Guide, October 2010

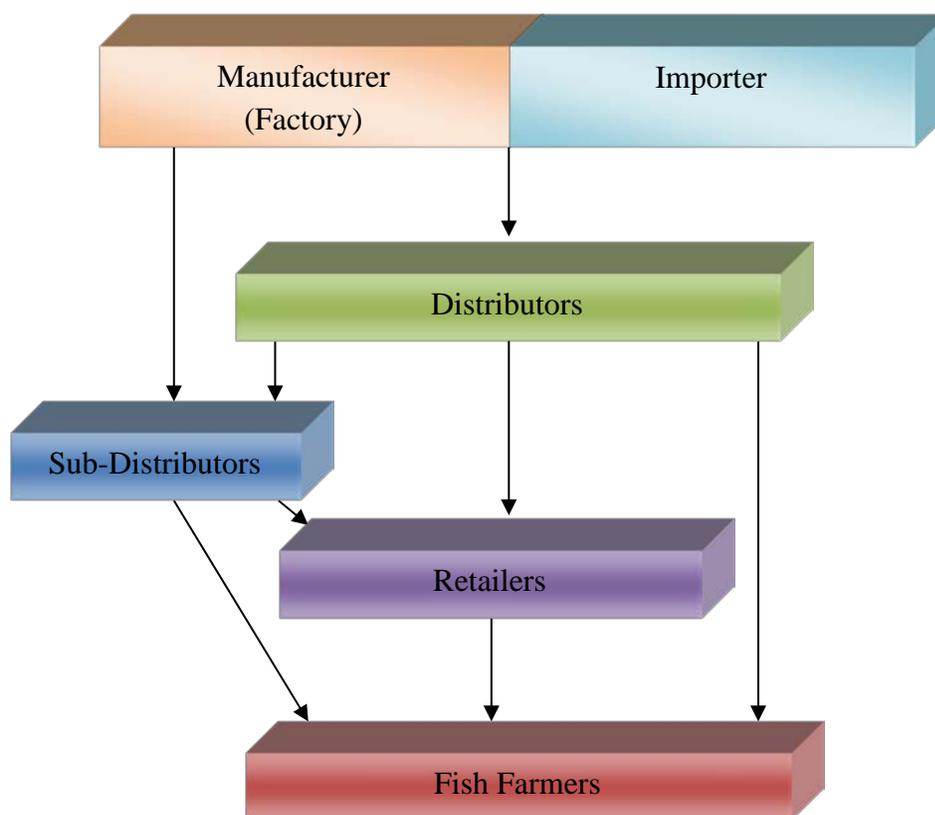
Common feeds available for sale in Delta State include Multifeed (Israel), Zeigler (USA), Vital Feed (Jos Nigeria), Makakoti (Ibadan, Nigeria), Sharp (China), Raanan, Coppens (Holland) and Pira former Durante (Ibadan). Table X details the main fish feed suppliers present in Nigeria by category (see Table 20).

## 4.2 Feed Supply Chain Structure

**Manufacturers.** Generally, manufacturers reported that they were able to meet all the demand for their products in Delta State. According to Vital Feeds, the only state in the Niger Delta it is unable to cover adequately is Bayelsa and this is due to transportation challenge. Furthermore, some manufacturers do not work at full capacity. For example, Vital Feeds reported that its factory is not operating at its installed capacity due to fluctuations in market demand. This fluctuation is due to the rainy and dry seasons. Since fish farming is water based, during rainy season many fish farmers stock their ponds and production is at its highest during the months of May to October. Thus demand for fish feeds is highest during that period, while it is low between the months of November to April during which time most of the earthen ponds dry up and the concrete ponds become short of water. Fluctuations in production are also due to scarcity of feed raw materials and this reduces the level of production that can be achieved.

**Distributors.** These brands of feeds have distributors in Delta State. Most of the distributors buy feed directly from the manufacturers while a few of them buy from the representatives of the manufacturers in Nigeria. The distribution channel for fish feed in Delta State is presented below.

Figure 1 – Distribution Channel of Fish Feed in Delta State



Source: Authors

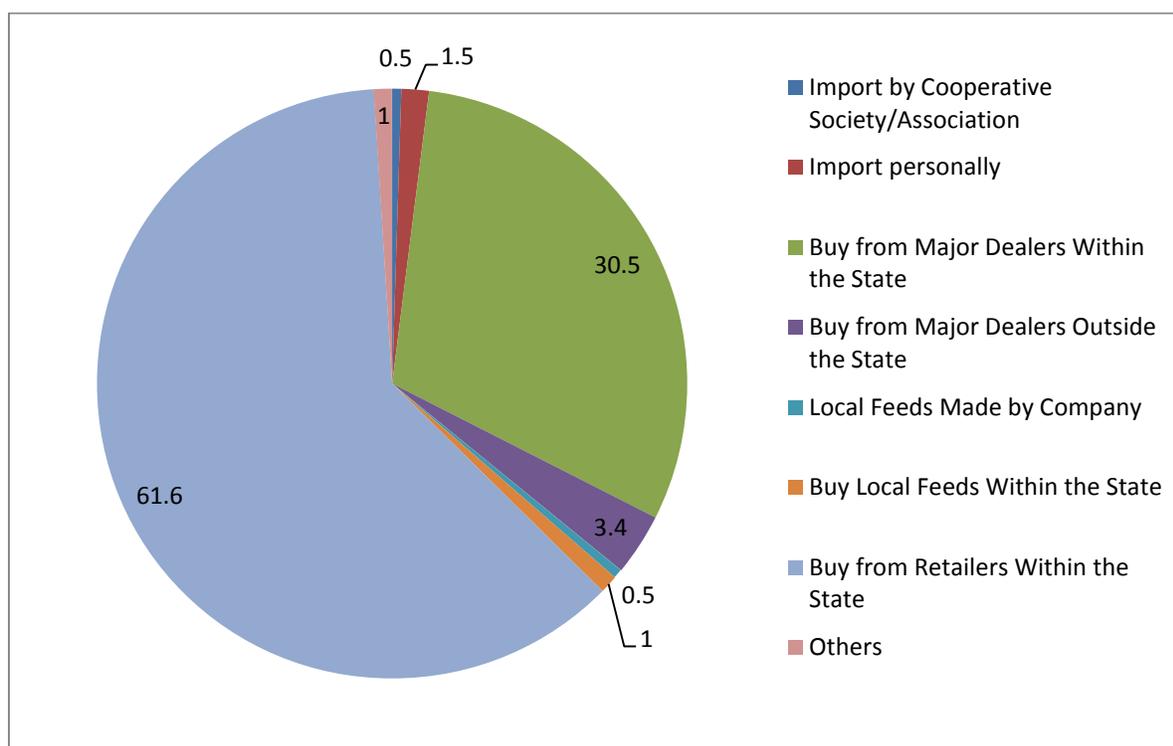
Distributors/retailers' margins for fish feed are low so distributors/retailers need to place large orders to remain profitable – for which a large amount of upfront capital is needed. Raising enough capital often represents a challenge for distributors. Distributors sell on the average between 15 and 20 metric tons of fish feed monthly. Daily sales range between 30 and 50 bags per brand.

Interviews with distributors revealed that manufacturers have a tendency to prevent entry of new distributors in the sector to ensure price stability, quality control and a stable feedback mechanism for the manufacturers and the farmers for the feed. The most important barrier, however, is capital. Distributors must procure large quantities of feeds at a time, which necessitate large amount of capital to be provided upfront.

- **Vital Feed.** For Vital Feeds, the distributor is expected to procure 15 tons of feed at a time; Vital feeds then delivers the feed in the distributor's store. The company has six distributors in Delta state and ten in Edo state.
- **Raanan Feed.** The importer of Raanan Feed claimed it has five distributors in Delta, one in Rivers, three in Edo and one in Imo State.

**Retailers.** The fish farmers bought fish feed from different sources, however, the most common sources were retailers (61.6%) and major dealers (30.5%) within the state. This suggests that farmers prefer to buy from sources close to them to reduce the cost of transportation. The majority of the farmers use less than 5 bags of feed per week. This was because most of them operate on a small scale level. This can be explained by the fact that most fish farms are small businesses and that farmers lack the necessary cash flow to buy large quantities of feeds at once. Unless farmers get together to purchase feeds, the nearby retailers will continue to be their main source of feed supply even if the price is slightly higher from this source. On the other hand, local retailer can also be a way to address storage and transportation concern if a larger quantity of feeds gets purchased at once.

**Diagram 2 – Source of Feed in the Niger Delta (in %)**



Source: Survey

**Financing.** Distributors and retailers did not receive credit facilities from the manufacturers and they do not sell on credit to their clients. Some of the distributors who tried sales on credit to their customers experienced high default by their clients (retailers).

### 4.3 Suppliers' Market Share, Market Penetration and Pricing Structure

**Suppliers' market shares.** Table 21 below presents fish feed suppliers that are active in the Delta State (by market share in %). We can see that the top 6 brands that capture the larger market share are dominated by foreign manufactured, except in the case of Pira (former Durante) that now operates in Nigeria as a local firm. The most common brand of fish feed used in the Niger Delta was Coppens (54.5% of surveyed farmers), followed by Multi-feed (17.4%), Zeigler (7.5%), Pira (6.0%), Durante (4.0%) and sharp (3.6%). The main reason for farmers' preference for Coppens was attributed to the perceived quality of the feed. Coppens is, indeed, the leader in small size fish feed, especially for the starter period. We can also observe that Vital Feed is the cheapest local manufacturer in Niger Delta.

**Table 21 – Suppliers’ Market Share in Niger Delta**

	Types	Frequency	Percent	Retailer Prices (N)
1	Coppens	151	54.0	5,600
2	Multi Feed	49	17.4	4,300
3	Zeigler	21	7.5	5,600
4	Pira	17	6.0	-
5	Durante	11	4.0	-
6	Sharp	10	3.6	-
7	Ranaan	7	2.5	-
8	Vital Feed	6	2.1	3,600
9	Aqua Feed	2	0.7	-
10	Local Feed	1	0.4	-
11	Le-quosant	1	0.4	-
12	Makakwhite	1	0.4	-
	<b>Total</b>	<b>277</b>	<b>100</b>	<b>-</b>

*Source: Survey*

Reasons considered by farmers in deciding which brand to purchase were price, availability and (floating/sinking) attributes. About 30.4% of the farmers considered the price of the fish feed brand, quality and availability as the major factors in determining their choice of fish feed while 29.7% considered only quality. About 22.8% of the farmers considered price and quality. Floating feeds also dominate the market in Delta State. Distributors and retailers reported that farmers prefer floating feeds to sinking feeds and that many of the farmers used this type compared to the sinking locally made feed. Farmers also procure more of the 4, 6 and 9 mm feed sizes regardless of the brand and 9mm size is regarded as the finisher. The demand by the farmers is related to the feeding regime of the fish as the fish eat more when they are above two months old and that is the time bigger mm sizes are used. The 1mm and lower sizes of feeds are not in high demand because the high protein ingredients needed to be produced highly increase the price.

The survey shows that most fish farmers (71.3%) change the type of feed used at different stages of production. The major reason identified for this measure is to reduce cost of feeding and to enhance weight gain. The farmers believed that feed constitute the greater percentage of the cost incurred in fish production. As the market analysis shows, some farmers start their production cycle on imported floating feed and finish it off with local floating or sinking feed. Some of them use self-formulated feed to finish off their fish.

**Products’ market penetration in Niger Delta State.** Market penetration of brands varies from one location to the other. Table 22 shows the relative strength of the various brands of feeds by LGA. Patronage for fish feed in Delta State comes from customers located in Warri and its neighborhood, namely Ughelli, Sapele, Asaba, Agbor in Delta State, Awka and Nnewi in Anambra State as well as Port-Harcourt in Rivers State.

Coppens has captured about 53.7% of the fish feed market in the State and shows a strong client patronage that cut across all LGAs. Durante was not common in Warri area, but commonly found in and around Asaba. Sharp and Pira are said to be of equal demand in Warri axis. Zeigler had customers in Warri South, Uvwie and Isoko South while Vital enjoyed patronage in Ika South, Oshimili and Isoko South.

**Table 22 – Distribution Fish Feed Brand Patronage by Local Government Areas (in %)**

LGA	Zeigler	Pira	Vital Feed	Multi Feed	Coppens	Durante	others
Warri South	6.9	0	0	3.4	82.8	0	6.9
Ika South	0	0	12.0	36.0	52.0	0	0
Uvwie	12.2	8.8	0	16.3	50.3	0	12.2
Oshimili	0	8.0	4.0	26.0	36.0	22.0	4.0
Isoko South	3.3	0	3.3	6.7	73.3	0	13.3
<b>Total</b>	<b>7.5</b>	<b>6.0</b>	<b>2.1</b>	<b>17.4</b>	<b>53.7</b>	<b>3.9</b>	<b>9.3</b>

According to distributors, Vital Feed has a high patronage from clients not only because it is cheaper than other brands, but also because it enhances high weight gain for the fish, which is an advantage for farmers as they sell by weight. The company, however, still has a low market penetration (2.1%). This shows overall that there is room for all feed manufacturers to increase their sales and reach more location by building up their distribution systems and better marketing their feed. The understanding of the size of the fish feed market in Delta state by manufacturers remains weak.

**Feed Pricing.** Distributors claimed that there are seasonal price fluctuations with changes at three months interval. Distributors reported a margin of ₦150 per bag of feed. They also noted that price changes from the manufacturers were not frequent. However, local charges such as import duties, port taxes and other tokens (official and non-official) usually lead to increases in local market price of the feeds at times.

The result of a survey of the retail prices of fish feeds in Ondo, Lagos and Delta States is presented in Table 23. The table shows that the prices of fish feeds are overall comparable across the three states with some slight differences. Vital feeds were cheaper in Delta State than in Ondo and Lagos States while Coppens feeds were more expensive in Delta State than in Ondo and Lagos States. Multifeed products were cheaper in Delta than Ondo State while Zeigler feeds were more expensive in Delta than in Lagos State. It is observed that the imported feed were cheaper in Lagos State than in Delta State. This must be due to nearness to the port of entry of these feeds into Nigeria. In the case of Vital Feed and Multifeed, prices were cheaper in the Delta State than in Ondo and Lagos states. This finding shows that fish feed development in the Niger Delta is getting commercially-driven and that some suppliers are willing to carry additional costs to penetrate this market.

**Table 23 – Retail Prices of Fish Feed in Ondo, Lagos and Delta States**

Brand	Ondo State			Lagos State			Delta State		
	Size (mm)			Size (mm)			Size (mm)		
	Less than 1.8	2	3 - 9	Less than 1.8	2	3 - 9	Less than 1.8	2	3 - 9
Vital		4,100	4,100		4,000	4,000		3,600	3,600
Coppens	13,500	5,333	4,967	12,750	5,100	5,100		5,600	5,600
Multifeed		4,500	4,500					4,300	4,300
Durante (S)	17,000	5,850	5,375						
Durante (E)		4,500	4,500						
Optimal		4,300	4,300						
Zeigler					4,500	4,500		5,600	5,600
Aqua					4,900	4,900			

An indication of the Vital Feeds' pricing structure from the manufacturer through the distributor to the retailer and farmer is presented in Table 24. The table shows that the distributors sell the feeds at ₦3,850 to retailers while retailers sell the feeds to farmers at ₦3,800. This is possible because of the structure of Vital Feed's distribution network, which is broken down into major dealers, sub dealers and farmer users. Depending on the category of distributors, Vital Feed provides a percentage discount of the recommended factory-retailer price allowing the end user to buy feed at ₦ 3800 – distributors can get the feed at between N3600-3750 from the factory and still sell it to farmers at the competitive price of N3800-3850 depending on the location.

Compared to the retail prices of Vital Feed in Table23, the retailers of Vital Feed in Lagos and Ondo States were selling above the recommended retail price while the retailers in Delta State were selling below the recommended retail price. This is only possible if there is a sales promotion in Delta State that allows distributors access to the vital feeds at lower than the recommended prices. Interaction with the Regional Office of Vital Feed revealed that the company realized at a particular point in time that its sales in the Niger Delta were going down while sales in the Lagos area were going up because retailers were going to buy the feeds in Lagos and bringing them to the Niger Delta. The company has taken steps to adjust prices and reverse the trend.

**Table 24 – Pricing Structure of Vital Feed**

Type	Recommended Factory-Retailer Price	Less 14%or13% Discount	Recommended Distributors Price to Retailers/Farmers	Actual Retail Price to Farmers
2mm	4,350	3,741	4,000	
4 mm	4,200	3,612	3,850	3800
6 mm	4,200	3,612	3,850	3800
9 mm	4,200	3,612	3,850	3800

Source: Regional office of Vital Feeds

The Regional Office of Vital Feeds indicated that the 2mm feed has more protein than the bigger sizes hence it is costlier. However, the sales of the 4mm-9mm sizes were higher.

**Homemade feeds.** The survey indicated that a majority (61.2%) of farmers formulate some of their feed by themselves. The major ingredients/materials used in compounding fish feed are : fish meal, soya cake, soya half cut, bone meal ,maize, wheat offals, lysine, methione, groundnut cake/oil. Fish feed formulation is by trial and error method using indigenous knowledge. No training was given to the fish farmers on feed formulation.

## SECTION 5 – FINDINGS AND RECOMMENDATIONS

Over the past decade, there has been rapid expansion of the number of producers in the Delta State, showing that the fish industry is growing rapidly. A lot of farmers entered the fish industry without the basic knowledge on good production practices and are fairly inefficient. Competition has grown among farmers. The nearby markets are becoming saturated as most farmers concentrate on selling in Warri where ecological conditions are good (yearly availability of water, etc.). Farmers have difficulty reaching out markets outside of this zone. It is important that farmers manage to produce table fish more efficiently and bring table fish's price down. The majority of the production costs come from fish feeds. To reduce feed costs, the issue at stake is not to reduce the price of fish feeds, but to improve farmers' production practices so farmers can reduce their spending on fish feeds and put their income to more productive use. Key market failures, such as accessing market information and credit, also need to be addressed.

### 5.1 Findings

Finding #1 – There is enough quality fish feeds available for purchase by farmers in the Delta State. The demand analysis showed that farmers tend to stop buying purchased feeds (whether imported or manufactured locally) during the last two months of a growth cycle and revert to self-formulated feed from home. Around 50% of fish feed consumption is supplied commercially and approximately 2/3 of farmers make their own feed. In general, farmers revert to homemade feeds to lower their cost as they do not have enough working capital to buy manufactured feeds during the entire growth circle.

Finding #2 – Farmers do not know how to use fish feed properly to maximize their output. The analysis of farmers' feeding practices over a production cycle highlighted that farmers in the Niger Delta tend to use more feeds than necessary in the first four and a half months of a fish growth period. This represents a waste that can be reduced by improving farmers' feeding practices. Farmers spend too much money on fish feeds than recommended. As farmers enter the middle of the third growth period (4mm), however, they start using far less imported feeds than recommended and substitute commercial feeds by homemade feeds. This has a negative impact on their table fish production and reduces their productivity. Not only farmers are not aware of the impact of this practice on their bottom line, but the main reason they engage in that behavior is to reduce their expenses as they lack the financial means to further invest in their business and continue buying manufactured fish.

Finding #3 – There has been an increasing supply of fish feeds into the Delta State, both of imported and Nigerian manufactured feeds. A Nigerian company like Vital Feed is aggressively growing into the fish feed market by proposing a new floating feed product at a cheaper price than competitors. In addition, Top Feeds, a local manufacturer, who has historically concentrated exclusively on producing poultry feed, is about to enter the fish feed market in the Niger Delta.

Finding #4 – Suppliers should be able to adjust to an increase in demand for fish feed by farmers in the Delta State. As farmers improve their knowledge of good feeding practices (high quality and right amount of feeds at each growth stage), they will reduce the amount of self-formulated feeds they use and increase their consumption of commercial feeds. As they learn when and how much to feed their

fish, farmers will also reduce their feed wastes. Overall, the demand analysis showed that if farmers were to follow recommended feeding practices, a large untapped market potential would unfold. Do suppliers have enough capacity to meet growing demand in the Delta State? Generally, manufacturers reported that they were able to meet current demand for their products in Delta State. The supply analysis also shows that fish feed suppliers produce primarily poultry feed. Since fish feed represents only a small percentage of their feed manufacturing, a doubling of the demand of fish feed will not require a massive readjustment of their production capacity.

Finding #5 – The market for fish feed, which is a function of supply and demand, is still very immature. On the one hand, farmers do not understand the value proposition of the fish industry and the profit that they would make if there were applying best production practices. On the other hand, fish feed companies do not have a full understanding of the fish feed market potential in the Delta State. They sell their products through their respective network of distributors and retailers, but do not fully invest in marketing. If suppliers were aware of the large amount of homemade feeds produced by farmers, they would try to compete.

## 5.2 Recommendations

Recommendation #1: Work with farmer groups, cooperatives and business associations to improve farmers' production practices and become more productive. This survey and other recent activities have shown that farmers are probably using twice as much feed as they should. If they improve their production practices, their conversion ratio will drastically improve. Farmers need to be more informed on the real effect of their feeding behaviors in monetary terms to incentivize them to purchase higher quality and more efficient manufactured feeds. Additional research should focus on demonstrating the savings done by continued feeding of imported feeds even in the later phase of the growth period. Demonstration plots should be made to convince farmers to change behaviors.

Recommendation #2: The government should stimulate private sector investment in local manufacturing in order to meet untapped demand for high quality fish feeds in the Delta State. Since there is a fairly well developed network of manufacturers and distributors, the government should provide targeted incentives to stimulate private investment in fish feed production and manufacturing and stimulate the market actors to invest and innovate. Current suppliers could expand their market share or new players could enter the market. The study shows that private companies that import feeds from abroad are already using different pricing strategies to penetrate the Delta State market and expand their market share for fish feeds. This demonstrates a gradually increasing level of market sophistication.

The comparative analysis of feed prices across Lagos, Ondo and Delta States shows that retail prices for fish feeds for Vital Feed and Multifeeds were cheaper in the Delta State than in Ondo and Lagos States, in spite of increased transportation costs. Prices for Coppens and Ziegler, however, were more expensive. This shows that fish feed is getting increasingly competitive in the Niger Delta and that some suppliers (e.g. Vital Feed and Multifeeds) are willing to carry additional costs to penetrate this market. Any public investment in fish feed milling risks to crowd out private investment and innovation in the sector by market actors with proven experience and will likely distort the market for fish feed.

If Delta State proceeds with carrying out a full feasibility design for feed mills it will need to consider the following issues:

- a. Clarify the location of the feed mills so as to be next to the best markets
- b. The volume of feed that is required by type and quality
- c. The price for any feed to be competitive
- d. The packaging and branding of the feed (size of packages to be sold)
- e. Timing of the sales of feed.

Recommendation #3: The government should play a role in designing incentives to reduce lending risks from private banks to develop financial products that address the needs of aquaculture producers and processors. Findings revealed that very little credit facility comes from private banks and that no special facilities exist to support the development of the aquaculture sector in the Delta State (e.g. guarantee funds, special line of credit for production, etc.).

Recommendation #4: Investment should be made to increase the awareness of fish feed suppliers on the market opportunities that exist in the Delta State. The government could play a role in addressing this market failure by investing in generating additional market data and developing a system to disseminate data to suppliers.

Recommendation #5: The state government should join in the effort to explore the development of alternative sources of protein (such as maggot meal) as a substitute for the very expensive imported fish meal. MARKETS II and PIND are already exploring the extension of this technology to Nigeria.

## ANNEX 1: FEED DEMAND QUESTIONNAIRE

**THE FEDERAL UNIVERSITY OF TECHNOLOGY, AKURE**  
**Business Development Company (FUTA-BDC)**  
**and**  
**FOUNDATION FOR PARTNERSHIP INITIATIVES IN THE NIGER DELTA (PIND)**

### Analysis of Fish Feeds Market in Delta State

Dear respondent,

The Federal University of Technology Akure in collaboration with the Foundation for Partnership Initiatives in the Niger Delta (PIND) is currently working on a market analysis of fish feeds in Delta State. We seek your contribution to this work by providing some information on your feed purchasing behaviour. Please, be assured that all information requested from you is strictly for research purpose. We therefore solicit your voluntary participation in this study.

Thank you.

### FUTA-BDC & PIND

#### Section 1: Socioeconomic Characteristics of the Fish Farmer:

1.1	<b>Local Government Area :</b>	
1.2	<b>Community/Location:</b>	
1.3	Farmer identification	
	Name of Farmer	
	Telephone Number	
	Sex	1. Male 2.Female
1.4	Age	.....years
1.5	Level of education	1. No formal education 2.Primary education 3.Junior secondary education 4.Senior secondary education 5.Tertiary education 6.Others: Adult literacy, vocational etc
1.6	Fish farming experience?	.....years
1.7	Are you a member of any fish Producers'/Farmers' association?	1.Yes 2. No
1.8	Do you belong to any cooperative society?	1. Yes 2. No
1.9	Do you have access to extension services?	1.Yes 2.No
1.10	Have you ever received advisory/training services on fish feed formulation techniques?	1.Yes 2.No
1.11	Do you formulate local fish feeds yourself?	1.Yes 2.No
1.12	Do you have access to fish feed market information?	1.Yes 2.No
1.13	If yes, how do you get the fish feed market information?	1.Through media ( <i>Radio &amp; TV</i> ) 2. Through Extension officers

	<i>(multiple responses possible)</i>	3. Newspapers 4. Family and friends 5. Fellow fish farmers 6. Others (specify)
1.14	Do you have access to credit?	1. Yes 2. No
1.15	If yes, what is your source of credit?  <i>(multiple responses possible)</i>	1. Banks 2. Agricultural banks 3. Relatives and friends 4. Esusu/Contributions 5. State Government 6. Cooperative Societies 7. Money lenders 8. Personal savings 9. Others, specify
1.16	If you have access to credit, how much did you receive in 2012?	₦
1.17	Irrespective of the ownership of the land/pond, is this fish enterprise your own?	1. Yes 2. No
1.18	If No, who is the owner of the fish enterprise?	1. Family 2. Partnership business 3. Cooperative societies 4. Others (specify)
1.19	What is the distance of your fish farm to nearest fish feed market	.....km
1.20	Do you use both imported feeds and local feeds in your production?	1. Yes 2. No
	How many ponds do you have on your farm (s)?	
	How many ponds did you stock in 2012?	Production cycle 1 ..... Production cycle 2 .....
	What is the average pond size?	.....ft x ft
	What kind of fish seed do you stock?	.....Fingerlings ..... post-fingerlings ..... Juveniles
	How many fish seeds do you stock per pond?	..... Fingerlings..... post-fingerlings ..... Juveniles
	What species of fish do you stock?	Clarias ..... Heterobranchus ..... Tilapia ..... Others, (specify) .....
	If you stock more than one specie per pond, what is the ratio of the species to each other?	.....
	What is the source(s) of your fish seed?	Private farms in Delta State Government farm in Delta State Private farm in other State Product of my own farm Others, (specify)
	Why do you patronize the source for fish seed?	
	What is the price per fish seed?	₦..... Juveniles ...₦ ..... post-fingerlings ₦.....Fingerlings
	How many production cycles do you operate per year?	.....

What is the length of each cycle?	.....Months
What is the average weight of your table fish at the end of the cycle	.....Kg
What type of feed do you give to your fish?	Sinking ..... Floating ..... Sinking and Floating .....
What kind of feed do you give to your fish?	Branded..... Self-formulated .....
What quantity of feed did you use in 2012?	... 2mm ...4mm ...6mm ...9mm Branded Floating (bags) ... 2mm ...4mm ...6mm ...9mm Branded Sinking (bags) ... 2mm ...4mm ...6mm ...9mm Self- formulated Floating (bags) ... 2mm ...4mm ...6mm ...9mm.Self- formulated Sinking (bags)

## Section 2: Information on Fish Feeds Purchase Behaviour

### Purchasing pattern:

2.1	What brands do you buy?	Source of feed	Qty (No of Bags per Week)	Unit Price (₦/bag)
	<b>Feed type 1: (2mm)</b>			
	Brand 1:.....	1.Import by cooperative society/Association		
		2.Import personally		
		3. Buy from major dealers within the State		
		4. Buy from major dealers outside the State		
		5. Local feeds made by company		
		6. Buy local feeds within the State		
		7. Buy local feeds outside the State		
		8. Buy from retailers within the State		
		9. Others (specify)		
	Brand 2:.....	1.Import by cooperative society/Association		
		2.Import personally		
		3. Buy from major dealers within the State		
		4. Buy from major dealers outside the State		
		5. Local feeds made by company		
		6. Buy local feeds within the State		
		7. Buy local feeds outside the State		
		8. Buy from retailers within the State		

		9. Others (specify)		
	<b>Feed type 2: (4 mm)</b>			
	Brand 1:.....	1.Import by cooperative society/Association		
		2.Import personally		
		3. Buy from major dealers within the State		
		4. Buy from major dealers outside the State		
		5. Local feeds made by company		
		6. Buy local feeds within the State		
		7. Buy local feeds outside the State		
		8. Buy from retailers within the State		
		9. Others (specify)		
	Brand 2:.....	1.Import by cooperative society/Association		
		2.Import personally		
		3. Buy from major dealers within the State		
		4. Buy from major dealers outside the State		
		5. Local feeds made by company		
		6. Buy local feeds within the State		
		7. Buy local feeds outside the State		
		8. Buy from retailers within the State		
		9. Others (specify)		
	<b>Feed type 3: (6 mm)</b>			
	Brand 1:.....	1.Import by cooperative society/Association		

		2.Import personally		
		3. Buy from major dealers within the State		
		4. Buy from major dealers outside the State		
		5. Local feeds made by company		
		6. Buy local feeds within the State		
		7. Buy local feeds outside the State		
		8. Buy from retailers within the State		
		9. Others (specify)		
	Brand 2:.....	1.Import by cooperative society/Association		
		2.Import personally		
		3. Buy from major dealers within the State		
		4. Buy from major dealers outside the State		
		5. Local feeds made by company		
		6. Buy local feeds within the State		
		7. Buy local feeds outside the State		
		8. Buy from retailers within the State		
		9. Others (specify)		
	<b>Feed type 4: (9 mm)</b>			
	Brand 1:.....	1.Import by cooperative society/Association		
		2.Import personally		
		3. Buy from major dealers within the State		
		4. Buy from major dealers outside the State		

		5. Local feeds made by company		
		6. Buy local feeds within the State		
		7. Buy local feeds outside the State		
		8. Buy from retailers within the State		
		9. Others (specify)		
	Brand 2:.....	1.Import by cooperative society/Association		
		2.Import personally		
		3. Buy from major dealers within the State		
		4. Buy from major dealers outside the State		
		5. Local feeds made by company		
		6. Buy local feeds within the State		
		7. Buy local feeds outside the State		
		8. Buy from retailers within the State		
		9. Others (specify)		

2.2	How often do you buy fish feeds?	1.Weekly 2. Fortnightly 3. Monthly 4.Others (specify)
-----	----------------------------------	--

2.3	In which months do you buy more fish feed?	
	In which months do you buy less fish feed?	
	How do you buy your fish feeds?	Bulk Purchase.....

	<i>(multiple responses possible)</i>	Paying In Advance .... Credit Purchase ..... Retail Purchase ..... Others (specify)
--	--------------------------------------	--

### Farmers' Perceptions about Fish Feeds:

2.4	Are you satisfied with the current price of fish feeds in market?	1.Yes    2.No
	Are you satisfied with the level of availability of fish feeds in market?	1.Yes    2.No
	Are you satisfied with your access to quality fish feeds in market?	1.Yes    2.No
2.5	What factors do you consider in purchasing a brand of fish feed? <i>(Multiple responses possible)</i>	1. Price 2. Quality 3. Availability 4. Credit sales 5. Others (specify)
2.6	Do you change your fish feed at different stages in the production cycle?	1. Yes 2. No
2.7	If yes, what kind of change?  <i>(Multiple responses possible)</i>	1. Imported to local brand 2. Imported to self compounded 3. Local brand to self compounded 4. Others (specify)
2.8	Why do you change your feed type? <i>(Multiple responses possible)</i>	1. To reduce cost 2. To increase weight gain 3. Others (specify)

## ANNEX 2: QUESTIONNAIRE FOR MANUFACTURERS OF FISH FEEDS IN NIGERIA

**THE FEDERAL UNIVERSITY OF TECHNOLOGY AKURE**

**Business Development Company (FUTA-BDC)**

**and**

**FOUNDATION FOR PARTNERSHIP INITIATIVES IN THE NIGER DELTA (PIND)**

Dear Sir,

The Federal University of Technology Akure in Collaboration with the Foundation for Partnership Initiatives in the Niger Delta (PIND) is currently carrying out a study on the fish feed market in Delta State. This is at the instance of Delta State Government which desires to boost fish production in the state and provide various forms of support to fish farmers in the state.

1. What is the name of the brand of fish feed produced?.....
2. What is the installed production capacity of the factory/annum? .....
3. What is the Current Production capacity/annum?.....
4. If current production capacity is less than installed capacity  
why?.....  
.....  
.....  
.....
5. Are all your materials sourced locally? Yes.....No.....
6. If no which ones are imported?.....

No	
1	
2	
3	
4	
5	

7. What are the current prices of the types of fish feed produced?

	Type	Factory price	Recommended Distributors price	Recommended Retail price
1.	0.5			
2.	0.7			
3.	0.8			
4.	1			
5.	1.8			
6.	2			
7.	3			
8.	4			
9.	4.5			
10.	6			
11.	8			
12.	9			

8. What were the factory prices for 6-9mm feed in the last five years?

Year	Factory (Naira/metric tonne)	Recommended Distributors price (Naira/metric tonne)	Recommended Retail price (Naira/metric tonne)
2012			
2011			
2010			
2009			
2008			

9. How many distributors do you have in the Niger Delta Region

No	States	
1.	Delta	
2.	Abia	
3.	Rivers	
4.	Cross rivers	
5.	Balyesa	
6.	Edo	
7.	Imo	

10. Kindly rank the demand for fish feed in the following states. (starting with 1 for the highest and 7 for the lowest in demand)

No	States	Rank
1.	Rivers	
2.	Abia	
3.	Delta	
4.	Cross rivers	
5.	Balyesa	
6.	Edo	
7.	Imo	

11. Are you able to meet the demands for your fish feed in the following states?

No	States	Yes/No
1.	Rivers	
2.	Abia	
3.	Delta	
4.	Cross rivers	
5.	Balyesa	
6.	Edo	
7.	Imo	

12. What then are the estimates of your sales to the following states in the year 2012?

No	States	Metric tonnes
1.	Rivers	
2.	Abia	
3.	Delta	
4.	Cross rivers	
5.	Balyesa	
6.	Edo	
7.	Imo	

13. What were your volumes of sales in Delta State in the last five years?

Year	Metric Tonne
2012	
2011	
2010	

2009	
2008	

14. Which channels do you use to get your fish feed to farmers?

.....

.....

.....

.....

15. What periods of the year do you have low or high sales and why?

.....

.....

.....

.....

16. What are your expansion plans for Delta State and the Niger Delta in the next five years?

.....

.....

.....

.....

17. Will your company be willing to go into partnership with the Delta State Government in setting up fish feed mill in the State?.....Yes /No.....

18. If yes how do you think the partnership should be structured?

.....

.....

.....

.....

.....

## ANNEX 3 – SUMMARY OF FOCUS GROUP DISCUSSION FOR FISH FARMERS ON THE CHALLENGES OF FISH FEED IN FISH FARMING IN DELTA STATE

1. Fish farming is profitable but the high cost of the imported fish feeds and lack of marketing opportunities for their harvest have being a challenge to profitability in the business.
2. More men are involved in fish farming than women.
3. The experience of participants ranged from 2 to 20 years with a mean of about 7 years.
4. Majority depend on imported fish feeds while less than half of participants compound their own feed.
5. Though there was no indication that fish feeds are scarce, imported fish feed have higher demand during the rainy season as those who compound are hindered from drying their feeds.
6. Fish feed is bought on cash and carry basis.
7. All lack knowledge of fish feed formulation, so formulations done is by trial and error while majority lack knowledge on determination of fish feed quantity.
8. Extension visit is very low and linkage between then is virtually non existence.
9. Type of fish feed bought is dependent on availability, price and perception of weight gain to be achieved from the feed.
10. Coppens is the most expensive fish feed (N5,600) and perceived to be of best quality while Vital is the cheapest (N3,600) and perceived to give the highest weight gain.
11. Fish pond sizes vary as well as the type of enclosure used. Most of the participants used earthen ponds. Ponds were either 25by50ft or 20by40ft and 6by8/10ft. These held between 1,000-1,500 fishes and 500 fishes respectively.
12. Number of ponds ranged from 2 to 34
13. Contrary to report generated by the questionnaire, fish farmers do not patronize commercial banks. They depend more on their cooperatives and personal savings.
14. Major challenges of fish farmers include
  - i. High cost of fish feed

- ii. Lack of finance to fund the business
  - iii. Exploitation by middle men
  - iv. No storage facilities
  - v. Limited processing avenues
  - vi. No organized market outlets
  - vii. No organized cooperative societies
  - viii. Lack of record keeping practice
  - ix. Lack of fish feeding techniques
15. Expected intervention from government/ NGO's
- i. Financial assistance
  - ii. Capacity building by organizing seminars and training on the importance of record keeping, fish feeding techniques, stocking density, operations of cooperatives and cooperative marketing
  - iii. Provision of organized market outlets
  - iv. Provision of modern processing equipment to add value to fish
  - v. Enlightened and experienced farmers in the various fishing clusters should be co-opted as animateurs to disseminate knowledge on fish farming
  - vi. Ensure guaranteed fish prices
  - vii. Lower fish feed prices by at least 40%
  - viii. Such feeds should have the following qualities
    - i. Floating
    - ii. Inviting aroma
    - iii. Various sizes for various sizes of fish
    - iv. High protein content
    - v. Formulation for starter, grower ad finisher

## ANNEX 4 – ILLUSTRATIONS



**Picture 1: Members of FGD discussion at Warri, Delta State**



**Picture 2: PIND demonstration plot at Warri, Delta State.**

## ANNEXE 5 – SUMMARY TABLE OF SOCIO-ECONOMIC CHARACTERISTICS OF FISH FARMERS (1)

<b>Gender</b>	<b>Frequency</b>	<b>Percent</b>
Male	203	72.5
Female	77	27.5
Total	280	100.0
<b>Age</b>	<b>Frequency</b>	<b>Percent</b>
Less Than 25	12	5.1
25 – 34	60	25.6
35 – 44	62	26.5
45 – 54	49	20.9
55 and above	51	21.8
Total	234	100.0
Mean = 43.3; Minimum = 19.00; Maximum = 78.00		
<b>Level of Education</b>	<b>Frequency</b>	<b>Percent</b>
No Formal education	7	2.5
Primary Education	23	8.3
Junior secondary Education	2	.7
Senior Secondary Education	70	25.3
Tertiary Education	169	61.0
Others: Adult literacy, Vocational etc	6	2.2
Total	277	100.0
<b>Member of Fish Producers Association</b>	<b>Frequency</b>	<b>Percent</b>
Yes	147	52.5
No	133	47.5
Total	280	100.0
<b>Cooperative Society Participation</b>	<b>Frequency</b>	<b>Percent</b>
Yes	170	60.7
No	110	39.3
Total	280	100.0
<b>Access to Extension Services</b>	<b>Frequency</b>	<b>Percent</b>
Yes	195	71.4
No	78	28.6
Total	273	100.0

## ANNEX 6 – SUMMARY TABLE OF SOCIO-ECONOMIC CHARACTERISTICS OF FISH FARMERS (2)

<b>Formulation of Own Feed</b>	<b>Frequency</b>	<b>Percent</b>
Yes	170	61.2
No	108	38.8
Total	278	100.0
<b>Access to Fish Feed Market Information</b>	<b>Frequency</b>	<b>Percent</b>
Yes	240	85.4
No	41	14.6
Total	281	100.0
<b>Source of Fish Feed Market Information</b>	<b>Frequency</b>	<b>Percent</b>
Through Media (Radio & TV)	19	7.7
Through Extension Officers	29	11.7
Newspapers	13	5.3
Family and Friends	16	6.5
Fellow Fish Farmers	155	62.7
Others	15	6.1
Total	247	100.0
<b>Access to Credit</b>	<b>Frequency</b>	<b>Percent</b>
Yes	51	18.7
No	222	81.3
Total	273	100.0
<b>Source of Credit</b>	<b>Frequency</b>	<b>Percent</b>
Commercial Banks	8	21.1
Agricultural Banks	3	7.9
Relatives and friends	2	5.3
State Government	5	13.2
Cooperative Societies	18	47.4
Personal Savings	2	5.3
Total	38	100.0
<b>Ownership of Fish Farming Enterprise</b>	<b>Frequency</b>	<b>Percent</b>
Yes	262	97.0
No	8	3.0
Total	270	100.0

## ANNEX 7 – SUMMARY TABLE OF FISH FARMING CHARACTERISTICS

<b>Distance of Fish Farm to Fish Feed Market</b>	<b>Frequency</b>	<b>Percent</b>
Less than 2 km	89	32.5
2 - 4.99 km	96	35.0
5 - 9.99 km	19	6.9
10 - 19.99 km	55	20.1
20 km and above	15	5.5
Total	274	100.0
<i>Mean = 6.5 km; Minimum = 0.1 km; Maximum = 125.0 km.</i>		
<b>Use of Local and Imported Feed</b>	<b>Frequency</b>	<b>Percent</b>
Yes	208	75.1
No	69	24.9
Total	277	100.0
<b>Number of Ponds Owned</b>	<b>Frequency</b>	<b>Percent</b>
Less than 5	143	51.4
5 – 9	63	22.7
10 – 19	48	17.3
20 – 49	20	7.2
50 and above	4	1.4
Total	278	100.0
<b>Kind of Fish Stocked</b>	<b>Frequency</b>	<b>Percent</b>
Fingerlings	129	46.0
Post-Fingerlings	107	38.1
Juvenile	45	16.0
Total	281	100.0
<b>Species of Fish Stocked</b>	<b>Frequency</b>	<b>Percent</b>
Clarias	225	80.2
Heterobranchus	25	8.9
Tilapia	4	1.4
Others	27	9.6
Total	281	100.0
<b>Source of Fish Seed</b>	<b>Frequency</b>	<b>Percent</b>
Private Farms in Delta State	209	76.3
Government Farm in Delta State	3	1.1
Private Farm in other State	11	4.0
Product from my Own Farm	39	14.2
Others	12	4.4
Total	274	100.0
<b>Reason for Patronizing the Source of Fish Seed</b>	<b>Frequency</b>	<b>Percent</b>
Personal/Family Relationships	11	4.2

Easy Access/Convenience	13	5.0
Quality	213	81.3
Availability	25	9.5
Total	262	100.0
<b>Type of Feed</b>	<b>Frequency</b>	<b>Percent</b>
Sinking	6	2.2
Floating	100	35.7
Both	174	62.1
Total	280	100.0
<b>Kind of Feed</b>	<b>Frequency</b>	<b>Percent</b>
Branded	106	38.9
Self-Formulated	5	1.8
Both	161	59.2
Total	272	100.0

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The PIND Foundation works to establish and encourage innovative multi-stakeholder partnerships that support programs and activities, which empower communities to achieve a peaceful and enabling environment for equitable economic growth in the Niger Delta.

PIND Foundation's activities and interventions are targeted at creating employment and increasing net income of the pro-poor and disadvantaged in the 9 states of the Niger Delta.

