

THE VALUE CHAIN OF FARMED AFRICAN CATFISH IN UGANDA

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ABSTRACT

Catfish farming has increased over the past decade in Uganda. In order for this emerging industry to be sustainable, systematic production and marketing are essential. This paper discusses the existing catfish farming industry in Uganda and its value chains. Analysis is done to answer questions on the industry structure, value chains, value distribution and how relationships among actors have influenced profitability. It further draws from the experience of established Icelandic producers to suggest value creation changes that can improve profitability in catfish farming value chains in Uganda. The main findings indicate lack of cooperation in the domestic value chain that has led to vulnerability of farmers though the chain has potential for higher income. Cooperation and governance in the regional export value chain has improved its performance in the industry with farmers having better bargaining power and price control. The paper concludes that, due to size, cooperation among actors in the domestic value chain is a must to improve profitability while consistence in supply of quality and quantity will improve competitiveness of the regional export value chain.

INTRODUCTION

The fishing industry in Uganda has been established, on five major freshwater bodies, around the harvest of three most locally available fish species that provide 80% of total landings i.e. Nile perch, tilapia and catfish (FAO-Fishstat 2009). The fisheries sector in Uganda grew from 0.5 million USD to 140 million USD in the period from 1998 to 2008 (ABP 2009). Trade in the fisheries sector accounted for 2.5% of the total national GDP in 2009 and 90% of the fish exports were attributed to Nile perch (Fulgencio 2009). The fisheries sector provides employment directly or indirectly to over 1 million Ugandans (Fulgencio 2009).

However the situation since early 2000s has been changing for the worse in capture fisheries (Kabahenda and Hüsken 2009). There was a 46% drop in revenues from fish exports in the period 2006 to 2009 from 141 million USD in 2006 to 75.6 million USD in 2009 due to decreasing export volumes (Hammerle *et al.* 2010).

Aquaculture has attracted interest and investment from both the private sector and public institutions in the country (UIA 2005). It has grown in the past 10 years from less than 5000 tonnes a year in 2002 to over 50,000 tonnes in 2008 and catfish accounts for two thirds of the production (FAO-Fishstat 2009). However the sector suffers from an uncoordinated marketing system (Hammerle *et al.* 2010).

The necessity for a value chain study on an important species like the African catfish is evident from the obligations and plans by the Uganda government to the international trade partners and the local population. For example, the UN, which Uganda is part of, clearly states through its FAO constitution Article 1(d) the pertinent need to improve processing, marketing and distribution of food and agricultural products (FAO 1945). This goal is central to both the Strategic Framework 2000-2015 and 2010-2019 of the UN-FAO (FAO 1999; FAO 2010a). Similarly the Uganda National Aquaculture Development Strategy (2008) has a third principle to address aquaculture as a profitable investment and enhanced marketing efforts have been cited to be critical (Wathum and Rutaisire 2008). Farmers and participants along the entire value chain are important actors in all the above efforts.

It is therefore necessary to study the catfish farmer's share in the value chain. Most Ugandan commercial fish farmers have been in the business for less than 5 years (USAID-FISH 2009). The viability or profitability for these long term investments and the industry as a whole will to a large extent be determined by the way business activities are carried out.

With this background, the purpose of the study is to answer the question “What value creation changes should African catfish farmers in Uganda adopt to improve sales, cost performance and margins?”

Specifically, the study has the following objectives;

- First, determine the main actors, distribution channels and relationships in marketing African catfish products.
- Second, analyse the different value chains for African catfish products, their relative value distributions and their effects on farmers.
- Third, determine the product needs of value chain customers to suggest key success factors that can improve profitability of African catfish farming in Uganda.

To achieve the objectives above, the following framework is used in this study.

The first part of the project looks at the Ugandan aquaculture industry and gives an overview of the industry and its competitiveness by global standards. The attractiveness of the industry is analysed using Porter’s five forces model.

The second part is a detailed analysis of the value chain that focuses on the supply chain, main actors and roles, relationships, power and trust, governance and value distribution.

Finally there is a brief description of positioning in the industry with emphasis on the key success factors in the industry, addressing the issues of demand and supply among the value chain actors.

METHODOLOGY

The study area used in the collection of data was the central and eastern Uganda in the districts of Kampala, Wakiso, Mukono, Jinja, Iganga and Kamuli. Semi-structured interviews were conducted in these areas from June to July 2010.

The sample used included 90 farmers (81 males: 9 female), 13 restaurants, 51 traders and 12 processors and 150 consumers. Responses were received from three factories, 8 supermarkets and 10 local markets. Two focus groups were also conducted in Jinja and Kamuli at Masese and Kibuye landing sites respectively.

Four Icelandic farmers cum processors were interviewed. This sample was chosen out of convenience and prior knowledge of their activities in selling farmed fish for exports. Their activities are vertically integrated from production, processing and exporting and their number represent a broad sample of aquaculture processors and exporters.

Data on imports, exports and total production in tonnes of different lakes for the different species was collected Uganda Bureau of Statistics and Ministry of Finance Economic Planning and Development. The methodology by Grant (2005) and Porter (1998) was used to conduct the general industrial analysis. The value chains of the industry were analysed following the principles and methods of Kaplinsky and Morris (2000) and Porter (1998) to develop maps of material and financial flows from input suppliers to market. Margin on sales of each kilogram of live catfish was calculated as the difference between the selling price and the average unit cost of production by the farmer. For homogeneity, the sales value for each final product (whole gutted, smoked, fillet), was calculated in terms of live weight equivalent. All prices used for the study are converted to US dollars at the exchange rates on 31st of December for the appropriate year (Thordarson 2008). Data from the Iceland fish farmers was used for key success factors to discuss and determine possible solutions and suggestions to problem in the Ugandan farmed catfish value chain.

THE AQUACULTURE INDUSTRY IN UGANDA

African catfish (*Clarias gariepinus*) and Nile tilapia (*Oreochromis niloticus*) are the two main species farmed in Uganda (FAO-Fishstat 2009). The production of catfish is more than twice that of tilapia.

Earthen pond production accounts for most of the catfish aquaculture production units. In 2006, cage farming of catfish and tilapia in lakes and reservoirs using low volume (8 m³) high density cages was started and is continuing to grow (USAID-FISH 2009). The industry produces mostly fry, fingerlings/bait and table-size fish. The major bottlenecks requiring attention in the industry are; quality of seed, feed, water management, farm management and marketing (USAID-FISH 2009).

Several of these have and are still being addressed in order of building up a full-fledged private sector driven aquaculture industry in Uganda. Thirty five thousand tonnes of catfish were produced in 2008 compared to 17,000 tonnes of tilapia in the same year.

The contribution of Ugandan aquaculture to global production and national economy has been negligible but growing. By 2008, Uganda was accounting for 0.05% of the world aquaculture production and was third in African Aquaculture production after Egypt and Nigeria (FAO-Fishstat 2009). Available figures for 2005, when production was less than 10,000 tonnes, estimated that about 32,000 individuals involved directly or indirectly in aquaculture (FAO 2005).

Several products of farmed catfish on the market are sold through different methods of marketing. Farmers and middlemen buy catfish fingerlings from hatcheries (USAID-FISH 2009). Table-size fish is sold live, frozen, smoked, or filleted to consumers by farmers, restaurants, processors and farmers' coops (USAID-FISH 2009). Regionally most of the fish is exported to Congo, Sudan and Kenya (Dhatemwa 2009).

Demand for fish and fish products in surrounding countries

Overall the total demand for fish products in the nations surrounding Uganda has increased. In 2000 to 2008 the total demand increased from 2.2 to 2.9 million tonnes while the total supply decreased from 0.82 to 0.78 million tonnes (FAO 2010). The fish supply deficit roughly doubled during this period and was highest in Congo followed by Sudan, Kenya, Tanzania and Rwanda in that order. Apart from Rwanda, these nations have fish supplied from both freshwater and marine sources.

Demand for fish and fish products in Uganda

The demand for fish products was calculated as the volume of fish that the growing Uganda population needs to be able to access the global average of 15.8 kilograms of fish/person per year (Delgado *et al.* 2003; NEMA/UNEP 2004). With this assumption, this demand has been increasing over the years and currently (2011) approximately 460,000 tonnes. With declining catches, the supply deficit has also been increasing.

Demand for catfish as bait

An estimation of three million baits per day is required in the Lake Victoria fishery and Uganda's requirements are estimated at 13% of this figure (Isyagi 2007). In consideration of regional bait market, there is limited use of long lining fishing in DRC and Rwanda. (Dhatemwa 2009).

DETERMINANTS OF AFRICAN CATFISH FARMING INDUSTRY PROFITABILITY IN UGANDA USING THE PORTER'S FIVE FORCES MODEL

The section considers the active forces in the African catfish farming industry in Uganda that determine competitiveness and profitability of the sector using the five forces model.

Rivalry among competing producers and sellers

Amongst farmers, internal rivalry is rather low as they are scattered throughout the country serving different local markets. However the following forces could cause farmers to compete internally. The costs of getting out of an aquaculture enterprise in Uganda are rather high. Most farms have a breakeven period of 3 to 5 years (USAID-FISH 2009). This is a high exit barrier forcing the farmer to stay in business and compete if he/she is to gain returns on investment (Thompson and Strickland 2001). The lack of new product innovation by processors to attract different markets increases internal pressure on producers competing for the same market. On the other hand, Uganda's population and projected demand for fish is increasing, presenting a slack in projected internal rivalry.

Competition from substitute products on the market

There are several products that directly compete for the same market with aquaculture products. These include products of chicken, Nile perch, Nile tilapia, *R. argentea*, beef and pork (Figure 8).

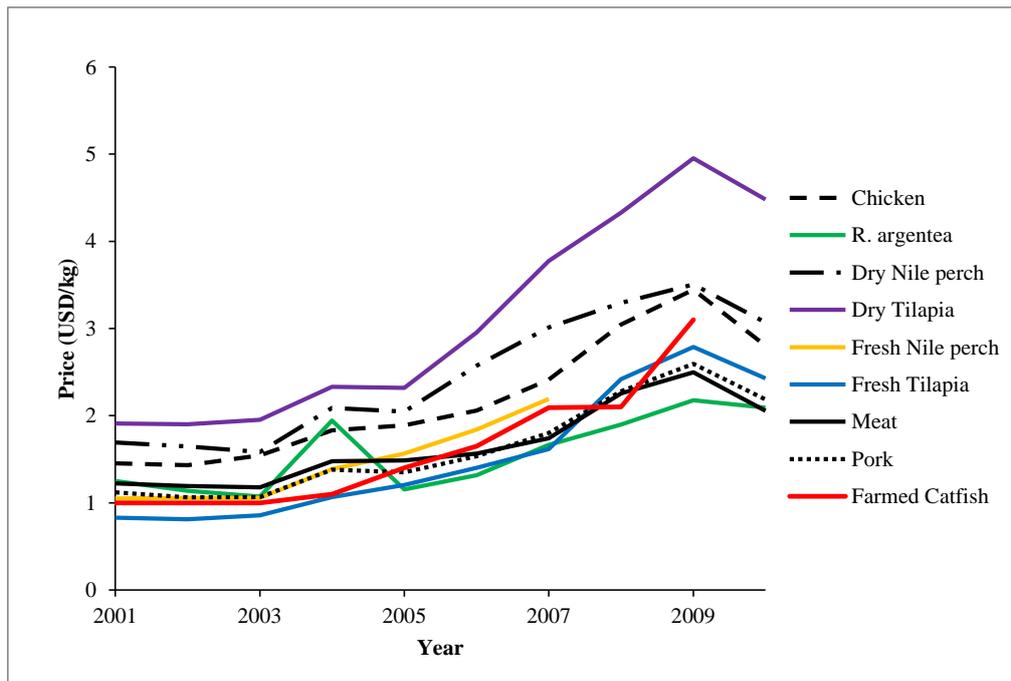


Figure 1 Average market prices for animal protein products on the Uganda market 2001 to 2010 (UBoS, FAO)

The farmers noted that catfish products are facing competition from Tilapia and low quality Nileperch products on the local market as a result of catfish being of inconsistent supply (32%) small in size (39%) and less tasty (20%) among other reasons.

The prices of these products averaged over the whole country have been increasing for the past ten years. The price per kilogram of farmed catfish also increased and by 2009 it was averaged at three US dollars. Traders attributed this to lack of demand for quality differentiation from consumers. This makes it rather easy to switch between fish products. The low prices offered locally for fresh fish also presents a barrier for importers to sell fresh fish on the same market. Therefore the threat from substitutes is high putting downward pressure on prices.

Buyer Power

In Uganda, it is mainly a result of lack of national cold chains and a few large chain supermarkets situated in the capital city. However, no single fish farm in Uganda has been able to produce the required quantities consistently to justify bargaining¹. To solve this farmers in the central region have an active cooperative that has got about 250 famers² through which members sell their products. This is lacking in other parts of the country leaving them little room to bargain. Being a commodity product, ‘fish’, fresh catfish faces stiff competition from other ‘fishes’ on the market since buyers consider them more or less the same. The strong buyer power implies a downward pressure on prices (Grant 2005).

Threat of New Entry

The threat of new entry into the aquaculture industry in Uganda is very low. This comes from the greater weight of entry barriers in comparison to incentives (Porter 1998b). The business requires high level of experience and is known to be risky (Leonard and Blow 2007). It is expensive to enter the aquaculture industry.

Supplier Power

There is high supplier power as the industry is growing. This has been a result of few suppliers for example Uganda has one fish net and one extruded fish feed manufacturer and supplier presenting a monopoly situation (USAID-FISH 2010).

¹ Interview with chairman WAFICOS a fish farmer’s cooperative society in Kampala Uganda

² -do-

In summary, the aquaculture industry faces low competition from within (internal rivalry) but high competition from external competitive forces. Suppliers and buyers hold high bargaining power making the overall effect from vertical competitive forces negative to the profitability of the industry. However the horizontal forces are moderate as there is low threat of new entrants in the industry and mild competition from substitute products. The model indicates low profitability of the industry.

Characteristics of the farmed fish market in Uganda

Tveterås and Kvaløy (2006) method of determining the structure of a market (traditional vs. demand market) was used to classify the African catfish market in Uganda. The table below is a summary of the findings from interviews with the different actors and literature.

Table 1 Characterizing farmed fish markets in Uganda

Characteristic	Findings
Traditional products	Due to lack of cold chains in the country most catfish is sold the day it is harvested. However there are privately owned cold stores by industrial processors
Few value added products	Catfish products that enter factories ³ get further processing into hot and cold smoked catfish, fillets, and catfish sausages. Artisanal processing also occurs at a small scale ⁴ .
No formal documents	All the respondents had no formal contract documentation for transactions between suppliers and customers. Only the fish farmers’ coop is implementing documentation for accountability and traceability.
Independent retailers	No retailers (100%) had formal relationship with fish suppliers and could easily switch supplier depending on supply price, quality and availability. Only the farmers’ coop is obliged to retail the members produce.
Low requirements	Marketing farmed fish technically requires documentation by law but none of the respondents had applied these in their previous transactions.
Low demand for freshness	Traditionally there is low demand for fish ‘freshness’ from consumers but farmers acknowledge that live fish sell faster than dead fish. Fresh fish here means fish kept close to its original state of quality at harvest.

Generated from interviews with stakeholders

STRUCTURE OF FARMED AFRICAN CATFISH VALUE CHAINS

Aquaculture as a growing industry Uganda has been supported by a number of stakeholders. These actors along the entire value chain carry out both primary and support activities and can be categorised as actors in Inputs supplies, Production, Marketing, Research, Finance and Legislation.

Input suppliers. These include feed producers, seed producers, and equipment suppliers. In 2010 a local company (UPBL) installed the first extruder for floating fish feeds in Uganda. There are 11 commercial seed producers in the country who produce quality catfish fingerlings. Uganda Fishnet Manufacturer makes nets for cages and pond seines (USAID-FISH 2010). Other companies⁵ directly or indirectly procure fish handling equipment for farmers.

The farmers are the most important actors in the industry. These are both grow-out farmers and hatchery producers. Interviews revealed that 80% of them started fish farming after the year 2000. Most of the farms (90%) use earthen ponds to culture catfish. All hatcheries practise tank based fingerling production. Monoculture and polyculture are practised by approximately equal proportions of farmers i.e. 46% and 56% respectively. Most farms have a production cycle of six to eight months in which period the catfish under good management is expected to weigh approximately 0.8 to one kilogram (Isyagi *et al.* 2009a). The produced fish goes through the intermediary channels of marketing involving other actors or farmers themselves.

The processing and marketing section of the industry involves middlemen (local collectors, wholesalers), and fish farmers’ groups whose chief aim is sales to the best bargain buyer. The middlemen collect the live catfish from farms and distributed it. Live fish is pooled from different

³ Greenfields Uganda Ltd. Pearl Uganda Ltd (2008). UPBL. Sausage King Ltd.

⁴ Edhron enterprises Ltd.

⁵ An example is Balton (U) ltd which imports hatchery feeds for farmers on order and Wagtech (U) ltd for water testing equipment (USAID-FISH 2010)

farms in case one farmer cannot raise the required volume. Processors and local market retailers get farmed catfish from these middlemen.

Collaborations between farmers and support actors can be divided into four major categories i.e. financial, technical support, information and knowledge, and legislation.

Flow of farmed African catfish products

The value chain of farmed African catfish in Uganda is rather complex in detail however for simplicity a rather general scheme can be traced out to illustrate the general flow of products and value from one stage and actor to another (Figure 11).

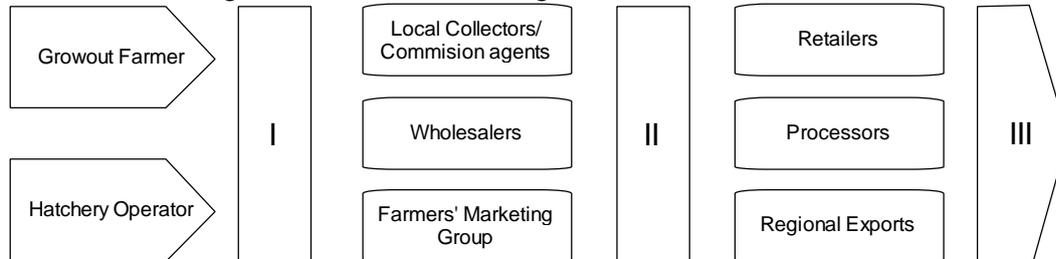


Figure 2 General farmed African catfish value chain in Uganda.

- I) Total volume of farmed catfish exiting production in upstream part of the value chain
- II) Total volume of farmed catfish entering and exiting intermediary actors
- III) Volume of catfish from intermediary actors to the downstream part of the chain for consumption and utilisation

From the above flows, two relevant value chains can be defined for Uganda's grow-out farmed African catfish. The regional export market chain; Grow-out farmer ---> Coop ---> Processor ---> Regional exports; and the domestic market chain; Grow-out farmer ---> middleman ---> Processors and Retailers ---> Consumer.

The functions in the chains can be grouped as those of farmers, traders, processors and retailers. The two chains differ in composition depending on whether they extend to domestic or regional export markets, but the function of the actors across the channels remains relatively similar. The regional export value chain is vertically integrated from farmers to processors and export. This extends into the Congo, Sudan and Kenya markets.

Information and learning within the chain

With commercial aquaculture being relatively new practise, this brings a challenge to information flow and subsequent learning. This has presented situations of *zero-sum* relationships in the domestic value chain (Kim and Mauborgne 2005). For example 57% of the interviewed farmers had no knowledge of better markets relying on middlemen for information. Farmers in Kamuli, Iganga, Jinja, and Mukono. Farmers (58%) obtained price information from traders, 23% asked fellow farmers what their last selling price was and the rest (9%) had no option but to sell their fish to whomever was willing to buy.

In the regional export chain, farmers obtain information through the coop. Information about market prices and demand is obtained through bargaining directly with the bulk processors. This gives the producer the ability to bypass intermediaries and get information and feedback about farmed fish directly from the end consumer (Knútsson 2001).

Power and trust

Farmers lack power due to the small farm sizes and low production volumes (Herr 2007). They acknowledge that middlemen are a 'necessary evil' since they collect the fish in bulk and pay promptly. In all cases, power is held by actors closer to the downstream part of the chain. Trust decreases and suspicion increases as one proceeds downstream the value chain (Grunert *et al.* 2010).

Governance

There is no clear form of governance. Any form of governance in the chain can be described as that driven by price (Keane 2008). Interviewed farmers reported that there existed high demand for fish including catfish in their localities. However this local demand is usually only for less than 100

kilograms of fish at a time. In case of large volumes of catfish, the need for a bulk purchaser is indispensable and hence the need for some form of coordination.

Since 2006, with the regional exports, there have been considerable efforts for some form of coordination that would see catfish production market (pull) driven (Wilkinson 2006). A vertically integrated value chain is emerging where catfish quality requirements the farmer has to meet are as a result of the product expectations demanded by customers.

VALUE ADDED DISTRIBUTION

The value added of farmed catfish was determined for different links in the value chain by the difference in average sales price data collected from different actors. All average prices per kilogram were calculated to live weight equivalent. Tracing volumes of catfish from farm to shelf was practically impossible due to absence of records in that regard.

Overall the value added between the actors is positive. However, much as these values are positive, in agreement with Loc *et al.* (2010), they have a high degree of variation. According to the authors this is an indicator of risk and could be a precursor to failure cases of catfish farmers in Uganda. In Nigeria, Velu *et al.* (2009) reported similar variations in value of table size catfish farm gate prices (2.39 to 3.33 USD/kg) being related to the size of the fish at harvest. Accumulators contribute the lowest value added about 15% of the average retail value (Figure 12). A similar situation in Nigeria was attributed to lack of cold storage (Velu *et al.* 2009).

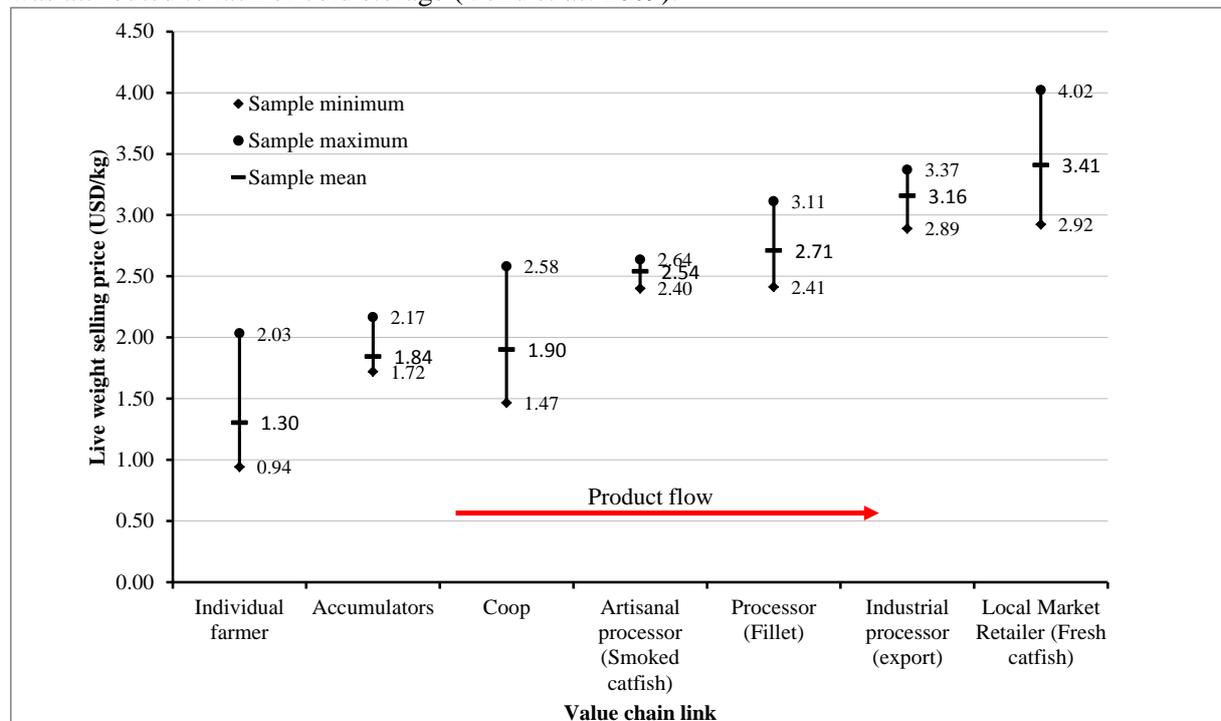


Figure 3 Price range and distribution along the African catfish value chain in Uganda

Processors add twice the value added by accumulators. Overall selling catfish through either the coop or the accumulators yielded close to similar added value (15%) i.e. 0.5 and 0.6 USD/kg (Table 7). The processor also adds about twice the value that the individual farmer obtains for catfish but one and half times the value if the fish is procured through the coop. The average price received by retailing catfish is 260% of the farm gate price (3.4 to 1.3 USD/kg).

The domestic value chain yields a higher final value within Uganda than the export value chain however; the price variation is higher in the former.

KEY FACTORS FOR COMPETITIVE SUCCESS

In this study its prudent to determine the key factors that will help the catfish farmer survive the competition in both value chains. These factors are a combination of how and what the catfish farmer and processor in Uganda does in order to satisfy the customer (Grant 2005). A reflection on the Icelandic farmers’ experiences helps to draw suggestions for probable improvement.

Who are the customers and what do they want?

Customers who consumed farmed fish had obtained the fish mainly from fish farms (56%) and the rest from markets and visits. Majority of the consumers (76%) reported that the prevailing prices of fish are high and affected their access to fish. There are four main reasons why the consumers bought fish in the first place. They buy because the price is comparatively low to other food products in the market (25%), fish is readily available (35%), it has a good taste (33%) and the rest is a matter of preference.

Three out of every four sampled consumers prefer 'fresh' fish which is fish less than 10 hours from harvest to buying. Due to lack of cold chains in the markets visited, the buyers have few other options of fish products. Another reason for this preference is probably the fact that by weight the smoked or processed fish is viewed as expensive.

The size most liked by the consumers (89%) is fish above 500 g with lots of fresh, less bones and easy to serve a big family (an average of 5 members per household).

They noted that fish has become scarce (70%) and very expensive and therefore 80% looked at farmed fish as an alternative to wild caught fish.

For the regional value chain, emphasis is on consistency in supply of farmed catfish of the right quantity and quality.

From the above, it is clear that consumers are looking for a relatively low price product, consistent supply, a quality product, closer to homesteads, and relatively big in size.

What are the competitors doing?

Since internal rivalry in the catfish farming industry is low, focus will be put on the competing products. These competitors have the following characteristics, they offer their products consistently in time and space. There are no erratic increases in prices a fact that farmers usually face when they have to recover their costs and push up prices. Demand for other meat products is higher during the festive seasons and therefore could cut into demand for fish (Dhatemwa 2009). Competitors sale similar products with little differentiation.

Key success factors for African catfish farming industry in Uganda

To compete on price, the producer should have low production costs. This requires being able to operate and sell at low costs. At the beginning of the chain, the farmer has to be good at aquaculture with the need to balance skills, technique and knowledge. For a constant flow of products, the end of the chain has to be certain. This requires marketing skills and knowledge of customers (business contacts) who will constantly buy the products.

One way to lower catfish production costs is by increasing the farmers' bargaining power over supply of inputs like feed (Olagunju *et al.* 2007). Feeds account for close to 70% of catfish production costs (Isyagi *et al.* 2009a). According to an interview held with the proprietor of Hólalax⁶ Mr. Friðrik, it is important the farmers keep a close working relationship with the feed producers giving valuable feedback on the performance of feeds and suggestions for improvement. This creates mutual trust between the two parties but mostly improves the bargaining power of the buyer especially when dealing with a monopoly supplier (Gummesson 2002). Furthermore, farmers can make sure they get steady supply of inputs through contracts with local suppliers of feeds (Pomeroy 2003). For Holalax this is done with Laxá a feed company in Akureyri, Iceland. For hatchery operators it is important to have more than one source of feed supply to improve your bargaining power. For example the farm had Arctic charr hatchery feed imports from both Norway and Scotland depending on price.

Avoiding middlemen could also improve pricing (Vallejo *et al.* 2009). Fiskeldisstöðin Hlíð⁷ has all the value creation happening under one roof. The company deals directly with the customers shunting the middleman. This way prices have stabilised for over the past ten years. Where middlemen can not

⁶ Hólalax hf. is a small scale fish farm in Northern Iceland producing high quality Arctic char (high price fish) products for export market. They have both hatchery and grow out operations. Produce 100 tonnes of 800g whole fish for the European market and 250g fillets plus 200,000 to 400,000 fingerlings per year.

⁷ Fiskeldisstöðin Hlíð is a small scale family aquaculture and processor business by Mr. Gunnar

be avoided, collaboration in the whole chain is important if one is to have competitive prices (Knútsson 2001). If the product price cannot outcompete substitutes, new product development might be a solution to consumer acceptability (Kasapis 2009) and competitiveness (Asche *et al.* 2001). A quote from Mr. Ásgeir highlights this;

For Norlandia, having competitive prices comes from the access to cheap energy from hot water, good climate, good dry air, no pollution and no humidity, thus producing dry processed fish cheaply. *"Business continuity is important; there is no need to start the enterprise and then close"* Mr. Ásgeir. Therefore being competitive would require proper business agility (Bostock *et al.* 2009). The catfish farmers should think of variable costs, volume they can supply and understand who their customers are and finally knowing if alternative markets exist for the produced fish. This also highlights the importance of record keeping. Another option given was to keep the number of employees on the farm to a minimum. For example Hólalax had 3 employees to produce the 100 tonnes per year.

For consistent supply; Stability in supply is usually a result of financially strong growers in the industry or having cooperation among small scale growers. Smallholders with good market access and the ability to supply fresh fish of consistent quantity and quality are likely to command the highest prices and net returns. For example Mr. Gunnar regularly smokes salmon fillets yet at times would not get raw materials. The proprietor solves this by having supply from his indoor fish farm so that the customer could still access the product anytime for the past twenty years. Further more, it is important to produce what the customers can consume, then plan and build demand gradually (Subhash 2000). Hólalax produces 100 tonnes of arctic charr per year and would gradually get to the permitted 500 tonnes of arctic charr revealed Mr. Friðrik. It is not advisable to have big investments into fish farming prior to determining the market demand for your products. This would usually result in underutilisation of farm capacity and huge overheads that will run a farmer out of business (Isyagi 2007). It is better to have small culture unit volumes with high density than big volumes with wasted water space.

For the fingerling business, the Hólalax proprietor advises that *"..when you are producing small fish you have to be sure that you can sell it"* this very important to avoid costs of for maintaining unsold fish. Having both a hatchery and grow-out operation ensured that fingerlings not sold could be channelled to full grow-out operations. In this kind of system, if sales went down in one operation, the other operation could sustain the farm operating costs.

Also commercial fish farmers should know that fish farming is a technically risky business (Leonard and Blow 2007) and that they should put all their effort where their investment is and not expect free assistance.

For quality products; *"...if you have a good quality raw material...am sure you can turn it into a good product but how to do it..that is the question..."* Mr. Ásgeir. Quality for farmed fish starts deteriorating during harvest and price is reduced. Therefore, farmers need to harvest the fish with minimum stress (Mr. Friðrik) and deliver it to the next actor in the value chain in as much the same condition as it was harvested (Petra 2010). This rapid deterioration requires the raw material should be either kept live or degutted and cooled (Marriott *et al.* 2004). For fatty fish, for example catfish, during gutting there is need to completely remove the liver out of the fish such that its does not spoil the smoked or dried products through oxidation (Mr. Ásgeir). There is also need to keep the processed product in cool dry ventilated place with minimum moisture less than 11% for a good dry product.

Icelandic firms have realised the need for product presentation in recommended ways (Engle and Quagraine 2006). *"You buy food with the eyes and product presentation is so important"* Mr. Gunnar. *"The fish not only needs to be fresh but needs to look good...."* Mr Kristján. There is need to have consistence in form, texture, shape and colour to build loyalty from customers and improve sales over time (Kinnunen and Pistis 2007). For example Egilssíld processes smoked herring and salmon fillets. These are cold smoked, sliced and vacuum sealed attaining a shelf life of one year. The shelf life is a function of a high quality raw material. Much as the fish is fatty, keeping the temperature low with good hygiene improves shelf-life (Bostock *et al.* 2009).

Product identity is also important (Engle and Quagraine 2006). Customers associate brand to the quality of a product (Balabanis 2006). For example, the case of Egilssíld and Fiskeldistöðin Hlíð

firms. Both companies have small scale production of smoked salmon fillets but distinct products identities that give them separate market lines. Egilssíld uses fast salting, fast smoking a grid powered oven, and fast packaging for its products. On the other hand Fiskeldisstöðin Hlíð offers manual traditional salting that takes time, uses wood oven, and produces drier spiced fish. The focus is on maintaining the quality the customer wants. This way their product identity and innovation is distinct (Engle and Quagraine 2006).

On Other Issues; Farmers need to have good production technologies to produce harvest size fish in a short time. For Hólalax, collaborating with the government hatchery has helped the farm the production time of arctic charr from over 30 months to 18 months. In terms of product distribution, the producers should have enough volumes to justify the transportation costs (Erik 2010). To remedy the inadequate size of producers, horizontal cooperation should be supported at different stages of the value chain to benefit from the economies of scale that could exist in the service delivery (Pietrobelli 2008).

CONCLUSION AND RECOMMENDATIONS

The study has provided the first detailed account of aquaculture value chains in Uganda particularly on African catfish. Analysis of the aquaculture industry and the determinants of profitability have revealed low internal rivalry and low bargaining power of the catfish farmer thus low profitability. Value chains and the participants reveal a multi-faceted value chain that is emerging into vertical integration. The key drivers are price and fish quality. Relationships are mainly zero-sum but the improvements in cooperation are aimed at yielding plus sum relationships. Contrary to several findings in aquaculture value chains, the African catfish value chain in Uganda is to a large extent not governed by middlemen but, rather lost value and bargaining power are, a result of size and scale of production. Actors in the regional value chain have a potential for higher income and global market penetration. Therefore governance in the regional export value chain is more likely to be effective than the domestic value chain. The key success factors thereto are also most likely to have a positive impact in this emerging value chain. The Uganda government has been successful in promoting environmentally friendly aquaculture as a poverty reduction tool as reiterated in the strategy thereof. However these efforts have not been effective in supporting fair distribution of benefits along value chains and reducing the vulnerability of farmers. By regulating and facilitating the smooth operation of these value chains, the government would make the most important intervention. Farmers note that increased certainty over their variable costs and revenue will clear their investment climate.

"What value creation changes should African catfish farmers in Uganda adopt to improve sales, cost performance and margins?" Due to small sized farms, production and uncoordinated structure; cooperation among actors in the domestic value is a must to improve profitability. On the other hand, consistence in supply of quality and quantity will improve competitiveness of the regional export value chain.

Cooperation is needed in the domestic chain to improve the bargaining power of individual farmers. Existing fish farmers' cooperatives should be supported to reinforce the regional export value chain for global competitiveness. Further research is needed to elaborate the structure and function of farmed fish value chains. This could be done through tracking of fish volumes through the chain. Another important issue that would require addressing is the input costs at each link to determine the exact added margin instead of value. This requires data on inputs and outputs at each link. It would also be recommended to trace the regional export value chain into the neighbouring countries to estimate exactly the final value added in this channel. The reason for this is that live weight catfish to regional markets like Congo goes for less than 4 US dollars yet indicated prices of over 12 USD per kilogram for the same catfish from Nigeria. There is also need to determine the specific support different chain actors need to comply with emerging environmental and social, regulations and standards; and finally, what new public-private partnerships can be adopted to regulate production using private sector led value chain governance.

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