

## APPLICATION OF PORTER'S FRAMEWORK TO ASSESS AQUACULTURE VALUE CHAIN IN KENYA

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## ABSTRACT

Aquaculture (fish farming) is an agricultural as well as fisheries activity, competing with other agricultural enterprises and artisanal fisheries for the same basic inputs. Therefore, aquaculture is subject to the same basic resource constraints that traditional agricultural activities face. The literature suggests that competition within a value chain is between chains and not individual actors. This study examined the aquaculture value chain in Kenya, assessing the entire value chain, and determining the appropriate points to participate in economically sustainable ways. The competition analysis assessed attractiveness at each stage of the chain by reviewing the rivalry in terms of five competitive forces within the Kenyan aquaculture industry; competitive rivalry, the threat of new entrants, bargaining power of suppliers, threat of substitutes and bargaining power of buyers. The aquaculture industry in Kenya is assessed using Porter's model with marketing mix (Ps) and factor evaluation matrix (FEM). Input supply is found to be the most difficult value chain function in which to participate because it requires relatively large initial capital outlays and additional operating funds. Although fish farming is the driving function of the entire value chain, the significant capital investments required could be a barrier to entry. Fish farming has largely benefited from the support of government, NGOs and other regional development initiatives. The study established that the easiest sector to enter (in terms of low barriers to entry and exit and low labour requirements) is the fish marketing sector. This chain function provides the most flexibility and liquidity to participants, whether as full-time or part-time occupation. Overall, participation in the Kenya aquaculture value chain will depend on the prospective entrant's level of experience, time, capital commitment and financial goal (long term stability versus liquidity). Aquaculture requires a long term commitment and high capital outlays, as well as persistence, and should therefore be considered by those looking for long term stability and not short term benefits. Established fish farmers may consider diversifying into input supply and value addition as well.

**Key words:** Kenya, aquaculture, tilapia, value chain

## INTRODUCTION

The increase in international fish supply chains has led to the marginalization of local small scale sectors such as fishing, wholesaling and processing. For example, the Nile Perch industry in Kenya provides foreign currency earnings to large international processing firms in the Lake Victoria Basin Nile Perch value chain; however, the local community does not appear to benefit from these earnings [1]. The proliferation of Nile Perch has hindered the growth of other fish species that local communities and small scale fishermen rely on [1]. In addition, the expansion of the chain has led to mechanization of the process and loss in local processing employment to the local community. International supply chains are generally characterized by food safety and traceability regulations and global climatic changes, which have caused changes to the food production system, enhancing the challenges to small scale sectors involved in food value chains.

Aquaculture in Kenya involves the culture of fish in ponds, and it uses the same inputs as other traditional agricultural enterprises and artisanal fisheries, thus creating competition for the same basic farm resources [2, 3]. The literature reports the vulnerability of small scale farmers in developing countries and the challenges they face in agriculture. The constraints and critical success factors for aquaculture development have been identified in Nigeria [4]; eastern Tanzania [5]; Lake Naivasha region of Kenya [6]; and Taiwan [7]. The cited studies identified various opportunities to grow the aquaculture industry and highlight success factors such as the use of quality fingerlings and feed. The aquaculture industry in Kenya is achieving substantial growth because of strong legislative and regulatory environments, established intensive hatcheries, and small, medium and large scale feed mills that manufacture industrial aqua feeds [8]. Non-governmental Organization (NGO) participation has also been identified as the critical link between government and the private sector, which is indispensable in encouraging small scale farmers to practice aquaculture [3, 8].

Aquaculture has the potential to improve food security and incomes for rural populations in addition to the improved nutrition, if managed correctly [9]. Its development has the potential to create new jobs, improve food security among poor households, and remove variability in household income flow as a result of additional and off-seasonal production activity. Aquaculture expansion, even when integrated with other agriculture, has positive effects on per capita income across sub Saharan Africa [9, 10]. Additionally, sectoral linkages, such as the post-harvest sector, further enhance this opportunity for the rural poor. The lower labour requirements make aquaculture even more promising as it can be carried out by vulnerable households, such as female and child-headed households and people living with HIV/AIDS that are common in the region [9, 10].

This study explored challenges for participation in the aquaculture value chain in Kenya using Porter's framework for competitive analysis. It focused particularly on challenges to participants at the different stages of the aquaculture value chain.

## METHODOLOGY

The study used Porter's model for competitive analysis in conjunction with the marketing mix (Ps) and the factor evaluation matrix (FEM). The competition analysis assessed attractiveness at each stage of the chain by applying Porter's model within the Kenyan aquaculture industry. Porter's Five Forces of Industry model inclusively identifies Customers, Suppliers, Substitutes and Potential Entrants as competitive market players instead of just the established industry players. Porter's model consists of five causal variables (forces) and links each of the five forces to the market players: Customers - Bargaining Power of Buyers; Suppliers - Bargaining Power of Suppliers; Substitutes - Threat of Substitute; New Entrants - Threat of New Entrants; and Competitors - Intensity of Rivalry [11]. Each of the model's five components, has measurable components which classify each force as having a "Low", "Moderate", or "High" strength. The collective strength of the five forces determines how attractive the industry is to potential entrants. The ideal industry would have a "low" strength for all five forces [12, 13].

The marketing mix analysis identified performance indicators in terms of 5 Ps (product, place, price, promotion and procurement) that lead chain actors to participate in a particular function. Although the term "marketing mix" is often synonymous with the four Ps of marketing which are product, price, place and promotion, there are variations of these with the inclusion of as many as 7 Ps [14]. However, in this study only 5 Ps have been included with the inclusion of Process / Procurement to signify the process of attaining raw materials for the supply chain function under review.

In order to quantify the model, performance radar charts and FEM were used to track the performance of the value chain actors. The FEM is commonly used to compare the competitiveness of the different value chain participants in terms of the traditional five marketing factors, for example: product, place, price, promotion and procurement (process). Product refers to product offered by the value chain participant; place refers to the location of the business in relation to strategy; price refers to the respondents' negotiating power and method of price determination and margins; promotion is whether or not participants perform any promotional and advertising activities; and procurement (process) refers mainly to raw material purchases as it affects production.

The sample of value chain actors surveyed for the study is discussed in the next section. The FEM analysis involved three steps: (1) each value chain participant was asked to score the importance of the five marketing factors to their business on a scale of 1 to 5, where 1 is not important and 5 is very important; (2) each respondent was also asked to score the performance of their business in terms of the five marketing factors on a scale

of 1 to 5, where 1 is poor and 5 is excellent; and (3) the average scores from (1) and (2) were then multiplied to create an index. The index was then compared to the reported constraints, which subsequently helped to identify opportunities and success factors [15, 16, 17].

### **Data collection**

The study was conducted in three provinces in Kenya; the Central province, Nyanza province and the Rift Valley province. Personal interviews were conducted for all respondents except female fish farmers who were interviewed as focus groups. Interviewing of fish marketers and input suppliers was conveniently undertaken in a single trip in a group format because of time and budget constraints, as well as the widely dispersed nature of subjects. While male fish farmers had extra help and thus time for interviews, the female fish farmers had other duties and had to be interviewed during the convening of educational workshops in their regions. This study, like other studies also noted that women's dual household functions ensure they are time constrained, an aspect that can undermine their efficiency and productivity and result in their function mostly as labour. This is also due to their lack of education and inability to attend training sessions due to time constraints [18, 19].

The four main groups in the aquaculture value chain that were identified included input suppliers, fish farmer / input suppliers, fish farmers, and fish marketers. The fish farmer / input suppliers group are fish farmers who also provide fingerlings and fry and include farmers who have hatcheries. Four separate questionnaires were used for the supply chain groups. A total of 6 input suppliers, 301 fish farmers, including 3 fish farmer/ input suppliers and 98 fish marketers were interviewed.

The input suppliers included suppliers of fishing gear / equipment and highly specialized nets and liners, aqua shops, irrigation and greenhouse materials suppliers. All of the input suppliers interviewed were also government-accredited aquaculture equipment suppliers. The input suppliers group were sorted into harvest equipment suppliers, aqua shops and agrovets shops, and irrigation / greenhouse materials suppliers. The harvest equipment suppliers provide highly specialized nets and fishing gear. Aqua shops and agrovets shops are usually small scale shops in relatively close proximity to fish farmers. Aqua shops sell aquariums, feed, fingerlings, fry, nets, transportation bags and packaging papers for fish/fry, liners and greenhouse materials. Aqua shops stock mainly aquaculture products, often as part of the government-accredited aqua shop franchise while agrovets shops are suppliers of agricultural products but also stock aquaculture products upon request.

Some of the fish farmers are also input suppliers. The fish farmer / input suppliers group is practising aqua culturists or farmers who also supply fingerlings, brood stock and fry to other fish farmers. Input suppliers and fish farmer / input suppliers supply material inputs to other fish farmers for fish production.

The 98 fish marketers interviewed were from City Market - Nairobi, Gikomba Market - Nairobi, both in the Central province; the open and indoor markets at the Kisumu Market - Kisumu in the Nyanza province; and markets in the Rift Valley province, Eastleigh municipal and wholesale markets, and Eldoret Market. Fish marketers included small scale wholesalers, market traders and small scale fish processors that operate in the markets. Wholesalers, traders and processors were combined into one group for the purpose of the study because there were relatively small numbers of these in the four provinces surveyed.

In the questionnaires, respondents were asked to identify their target market and main, serious, minor and none competitors. The respondents were also asked to discuss changes they had noted in the industry and how they felt these factors affected their business. The price determination and margins section also addressed the bargaining power of suppliers and customers by asking respondents methods of price determination and whether contracts were in effect and / or enforced. The assessment of the strength of each of these factors and the valuation of high, medium or low force to each response was at the discretion of the researcher. The attractiveness of the industry is determined by the total power the participant has, as a function of the strength of the forces against him/her.

## RESULTS

### Porter's 5 forces framework

The key findings on how the various respondents evaluated the different threats are as presented below.

#### *Threat of substitutes*

For input supply, the threat of substitutes comes from inputs that are used for the capture fisheries and traditional agriculture that can also be used in aquaculture. The threat is high for the input supply sector because the industry is traditionally tied to the agricultural and fishery sectors. Therefore, many fishery and agricultural supply firms act as substitute suppliers.

Fingerlings that are caught from natural water bodies and fingerlings from government and private fish hatcheries are substitute products to the fish farming / input supply sector. However, fish farmers who perform their own breeding and hatchery activities (fish farming/ input supply) face low threats of substitutes because there are only a few accredited fish hatcheries. In this study, fish farmers reported that wild caught fingerlings had often been found to be of poor quality. This could also be due to the high rate of sham fingerlings sold by con-men to unsuspecting and novice farmers purporting the fingerlings to be of one breed, for example tilapia (*Oreochromis spp*), only to be found

to be of another less profitable breed, example, dagaa (local name for *Rastrineobola argentea*).

The main substitute to fish farming is capture fisheries. Other protein sources, such as chicken and beef, may also be substitutes for fish. The threat of substitute products is currently high for fish farming. However, as wild capture supply declines so does the threat. The declining threat of substitutes for fish farming could entice new entrants to join the sector, especially if they own land or have access to household land for pond construction. Opportunities exist to diversify into fingerling production to supply other farmers due to the low threat of substitutes given the few government accredited hatcheries and the respondents' assertion of the poor quality of wild caught fingerlings.

The substitutes to fish market trading include fish shops, butcheries and supermarkets but the threat is low for fish marketing. There are relatively low barriers to entry and exit because of the existence of other formal fish retail options and consumers' preferences. Consumers often purchase fish from the open market, which allows for orders to be made according to specific customer preferences. This trend has been noted in studies pertaining to fresh produce chains in Africa, Asia and Latin America [17].

### ***Threat of established rivals***

The threat of established rivals is high for the input supply sector. Aquaculture equipment is mostly sourced from established firms that provide the same harvest and fishing equipment to commercial fishermen, and provide irrigation and greenhouse equipment to horticulturists.

Government and private fish hatcheries constitute established rivals to the fish farming / input supply sector. The threat of established rivals is generally medium for the fish farming / input supply sector but high for those fish farmer / input suppliers in close proximity to large scale fish hatcheries. The threat to fish farming is high because established farmers have higher efficiencies in production, operate on larger scales of production, and have established markets. The input supply and fish farming sectors particularly require substantial investments in equipment and technological skills to achieve the efficiency.

For fish marketing, the threat is also high because of the relationship based nature of contract marketing. Traders that have been operating for longer periods have established stronger ties with suppliers and consumers.

### ***Threat of new entrants***

The aquaculture industry is growing in Kenya at a significant rate due to the Government of Kenya's (GoK) Economic Stimulus Package (ESP) program, which is promoting aquaculture with several subsidies. As a result, there is a rush into the input supply

business, particularly the establishment of aqua shops and agrovet shops in remote areas closer to the fish farmers [23]. Consequently, there is a high threat of new entrants but there are opportunities for existing agricultural shops to diversify into the supply of aquaculture products. There are many new entrants to the fish production sector as well due to the GoK's ESP that is building ponds in various constituencies for recipients.

The threat is medium to the fish marketing sector because of low entry and exit barriers. Fish as a protein source is becoming popular in Kenya and this is encouraging many new entrants into fish marketing. However, there are high procurement costs due to declining quantities from the wild capture fisheries, and quality issues of farmed fish, which appears to scare off many potential new entrants.

### ***Bargaining power of suppliers***

All of the aquaculture value chain participants in Kenya are price takers. The costs encountered further up in the chain are passed along all the way to the trader. Input suppliers source their raw materials from large scale, often international firms that import the materials into Kenya. The bargaining power of suppliers for input supply and fish farming / input supply is high because good quality inputs are sourced internationally and prices are determined on the global market. There is, therefore, no price negotiation. However, the bargaining power of suppliers is high for fish farming because input suppliers and fish farmer/input suppliers supply raw materials to fish farmers and these are established sectors and often have some control on the prices they charge to the fish farming sector.

Fish marketing usually includes traders of wild caught as well as farmed fish. However, farmed fish constitutes a small portion of fish products on the market; the majority is wild caught fish. Because farmed fish quantities are limited in markets, the main input suppliers for fish marketing are large scale wholesalers and middle men that bring the fish from the lake and farms. Suppliers appear to be in better negotiating positions with their customers due to the absence of formal contracts to the fish marketing sector. The high procurement costs that fish suppliers incur are passed on to fish marketers, which negates some of the positive effects of the low entry and exit barriers.

### ***Bargaining power of customers***

Input suppliers' (including joint fish farmer / input suppliers') customers are fish farmers. The typical fish farmer has low bargaining power when dealing with input suppliers. As part of the GoK's ESP, the government has attempted to implement policies and programs to stabilize prices [21]. However, prices are often determined by the costs of production, and coupled with government price stabilization programs, the bargaining power of customers to input supply may be considered medium.

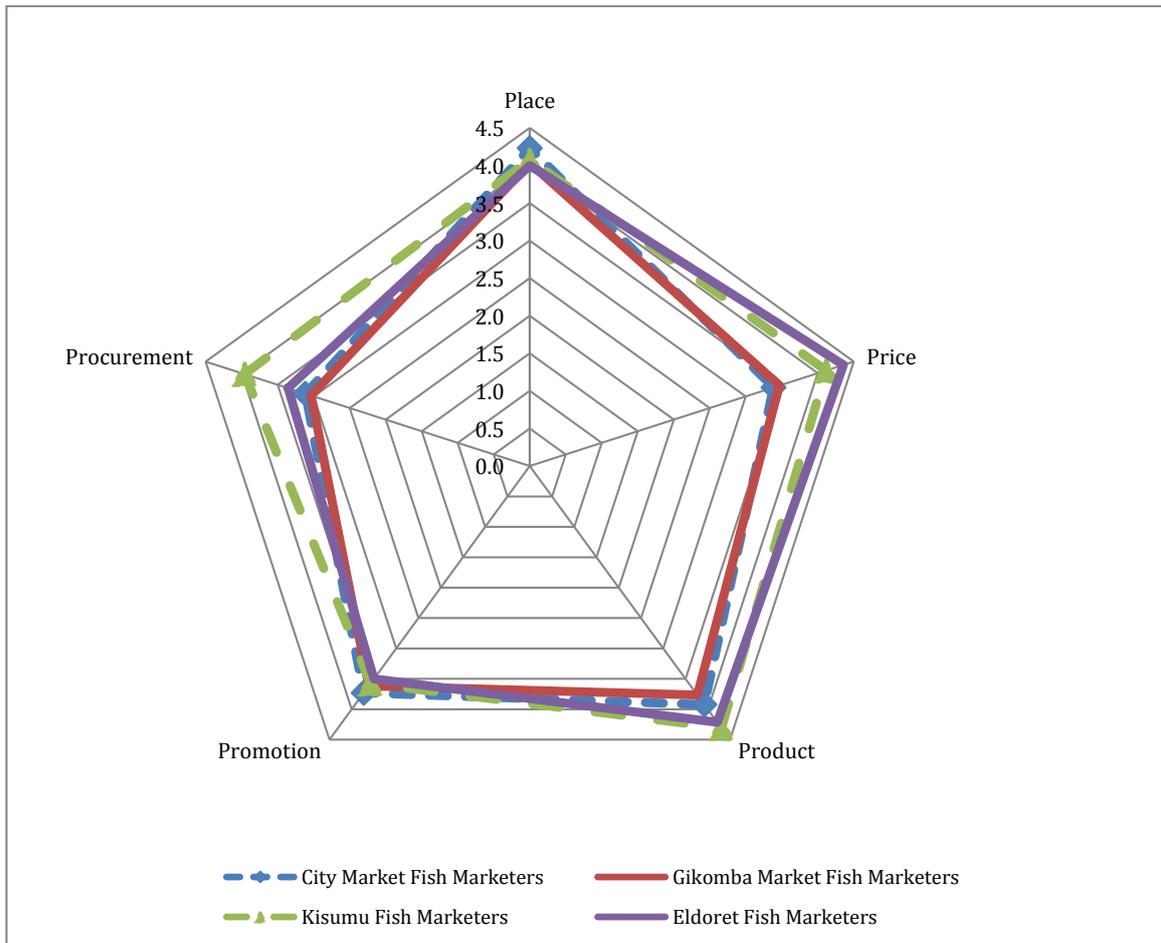
The bargaining power of customers of fish marketing and fish farming is dependent on the size of the market and the location. The customers of fish farmers typically live in the same community as the farmers. Small portions of farmed fish make it to formal markets, to other small scale fish processors, restaurants, hotels and institutions, or final consumers. Customers of fish farmers in large market areas and provinces where wild capture fish is readily available have more bargaining power than those in small rural areas. Due to the absence of formal promotion and the fact that fish is a homogenous product, customers have freedom to demand and negotiate for lower prices. In this way, customers are considered to have high bargaining power in the fish marketing sector and medium power in the fish farming sector.

## MARKETING MIX ANALYSIS

The FEM analysis described earlier is best depicted in the form of radar charts. Figures 1 and 2 are radar charts of the performance of value chain participants in the marketing mix factors. In Figure 1, the marketing sector is examined by comparing the performance of four markets: City and Gikomba markets in Nairobi, Central province; Kisumu markets in the Nyanza province; and Eldoret markets in the Rift Valley province while Figure 2 compares the performance of the remaining chain participants.

### Performance comparison of markets (Figure 1)

Despite the distance from the Lake Victoria Basin, City market scored highest (score of 4.2) in terms of place, followed by Kisumu market (score of 4.1). City Market is larger, has more modern market facilities and is centrally located. Gikomba and Eldoret markets scored poorly, with scores of 4.0 for each, maybe as a result of the perceived lower cleanliness standards and lack of proper facilities, respectively.



**Figure 1: Radar chart of Fish Marketers' Performance in terms of the Marketing Mix**

Regarding price, Figure 1 suggests that Eldoret is the leader (with a score of 4.4) maybe due to the absence of strong competition. Kisumu has a score of 4.1, which could be due to customer confidence that the product is fresh because Kisumu is the town from which most wild caught fish originates. Gikomba market scored higher (score of 3.5) for pricing than City Market (score of 3.4) possibly because it is a larger market and thus enjoys more competitive pricing.

Kisumu and Eldoret markets scored higher (with scores of 4.3 and 4.2, respectively) in terms of product possibly (Figure 1) due to their proximity to the Lake Victoria basin. City Market scored higher (score of 3.9) than Gikomba market (score of 3.8) probably due to the difference in facilities and customers perceptions of cleanliness, suggesting a better product can be purchased from City Market.

The scores for promotion were nearly equal amongst the markets. City Market had the highest score, with a score of 3.7. This is followed by Gikomba market and Kisumu markets; both scored 3.6 each. The scores in these three major markets are below 4

(above 4 indicates good performance) suggesting there is no formal promotion. Marketers engage their customers and maintain relationships to encourage sales. Eldoret markets scored lowest for promotion. This was probably because the region did not have any obvious fish culture, as evidenced by the significantly smaller fish market facilities and the strong dominance of processed (such as dried and fried) fish over fresh fish.

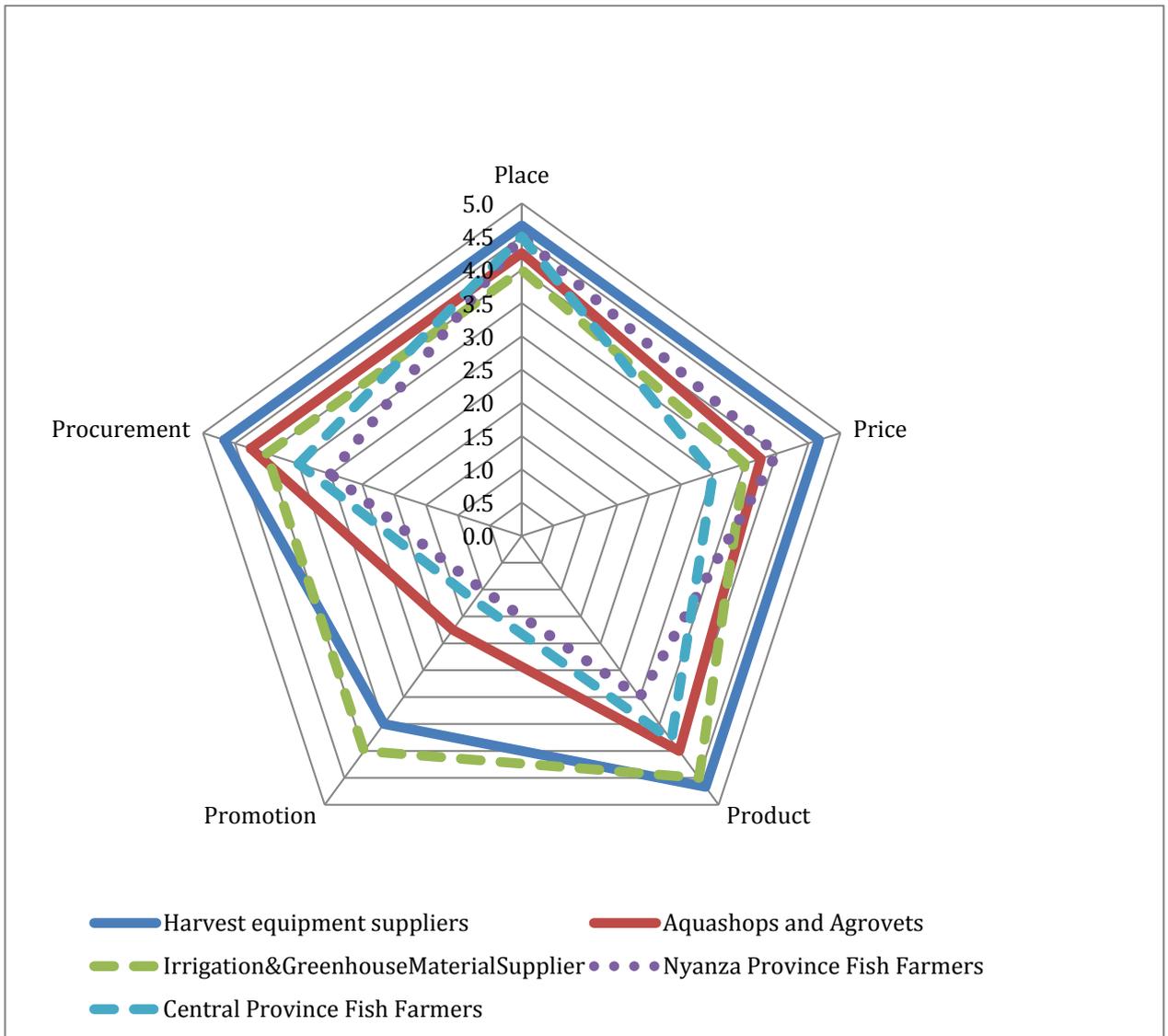
Regarding procurement, Kisumu markets scored high (score of 4.0), probably due to their close proximity to Lake Victoria (figure 1). They were followed by the Eldoret markets (score of 3.4), which are also closer to the Lake Victoria basin but encounter problems because there are no formal channels that deliver to the Eldoret markets. The lowest scores were from City market and Gikomba market, with scores of 3.1 and 3.0, respectively. The low scores may be due to transportation problems such as delays, poor sanitation, unreliability and thefts during transportation.

### **Performance Comparison of Input Suppliers and Fish Farmers (Figure 2)**

Majority of the fish farmers are located in the Nyanza and Central provinces therefore, we examine performance of fish farmers from each of those two provinces as two groups.

For place, figure 2 indicates that harvest equipment suppliers scored highest, with a score of 4.7. Their location in fishing and fish farming towns such as Kisumu, and metropolitan centres, such as Nairobi serve as loci for business. Aqua shops and agrovet shops had a score of 4.3 possibly because of their strategic locations in remote localities close to fish farmers. Irrigation and greenhouse material suppliers had a score of 4.0 also probably due to their location in a major metropolitan city such as Nairobi allowing them to lobby for large government contracts. Fish farmers in the Central and Nyanza provinces had an equal score of 4.5. This could be because the Economic Stimulus Package (ESP) program has achieved noticeable success in both provinces.

Harvest equipment suppliers have the highest score of 4.7 for price in figure 2 probably because their inputs are competitively priced. Aqua shops and agrovet shops had a score of 3.8, which is still competitive, especially given their remote locations and lower transaction costs. However, irrigation and greenhouse material suppliers had a score of 3.5 which could be attributed to their products often being subsidized by the government through programs such as the ESP. The cost to the farmers is therefore significantly lower.



**Figure 2: Radar chart of Input Suppliers and Fish Farmers' Performance in terms of the Marketing Mix**

Fish farmers in the Nyanza province had a score of 4.0 for price maybe because of their location in the Lake Victoria basin, a strong fishing community. Fish farmers in the Central province had a score of 3.0 for price, which could indicate that prices are relatively lower in the more metropolitan areas of the Central province.

In Figure 2, harvest equipment suppliers had the highest score of 4.7 for product while irrigation and greenhouse material suppliers had a score of 4.5. The high scores may be attributed to the quality of products, which are mainly imported. Aqua shops and agrovet shops had a score of 4.0. Their products are also of good quality and sometimes are sourced internationally. Aqua shops and agrovet shops are relatively new and they lack the experience and scale to compete with the larger scale input suppliers. Fish farmers in

the Central province had a score of 3.8 for product probably because of close proximity to the government hatcheries and, therefore, have access to good quality fingerlings and fry. Fish farmers in the Nyanza province had the lowest score of 3.0 which may be due to their remote locations. This province reported the highest rate of farmers sourcing fry from local rivers.

In Figure 2, irrigation and greenhouse material suppliers have the highest score of 4.0 for promotion possibly because the government agency responsible for fisheries distributes fliers advertising government's initiative for fish farming such as the ESP. Harvest equipment suppliers also benefit from government promotion and government-sponsored training activities. Aqua shops and agrovet shops and fish farmers perform dismally at promotion with scores of 1.8 for aqua shops and agrovet shops, 1.2 for fish farmers in the Central province and 1.0 for fish farmers in the Nyanza province. This could be because they all rely of word of mouth.

Regarding promotion, harvest equipment suppliers score highest with a score of 4.7. Aqua shops and agrovet shops have a score of 4.3. Suppliers are often part of a franchise so although they operate independently, procurement is not an issue. Irrigation and greenhouse material suppliers also have a good score of 4.0 possibly because they also have well established supply chains developed from years of experience.

Figure 2 shows that fish farmers in the Central province have a relatively higher score of 3.5 compared to fish farmers in the Nyanza province (3.0). This could be because those in the Central province are ideally located in a central location close to large metropolitan areas and therefore roads and transportation are significantly better than those linking fish farmers in the remote locations in the Nyanza province. Small-scale fish farmers in Uganda with proximity to markets or good roads are reported to have the greatest marketing opportunities for their fish [22].

### **FACTOR EVALUATION MATRIX (FEM)**

This is an index created by multiplying the average scores of the perceived importance of the 5Ps with the average scores of the self-assessed performance of the different value chain participants. A higher index indicate a better performance of the value chain group. The results of the FEM scores of the value chain participants illustrated in Table 1 expand on those of the radar charts. In terms of total performance, harvest equipment suppliers scored highest, followed by the Kisumu, Eldoret and City markets. The lowest scoring performances were from the aqua shops, agrovet shops and fish farmers. Promotion scores were the lowest for all value chain actors except irrigation and greenhouse material suppliers and Eldoret fish marketers. The lowest scores for irrigation and greenhouse material suppliers were price and that of Eldoret fish marketers were place. Place had the strongest score for City Market fish marketers; product had the strongest score for

irrigation and greenhouse equipment suppliers; and price scored highest for Eldoret fish marketers.

## DISCUSSION

The input suppliers, fish farmer / input suppliers and fish farmers require relatively large initial capital outlays and additional operating funds. However, these sectors also receive some government and NGO support under the ESP program and regional development initiatives. The government and NGO assistance to these sectors helps to reduce the transaction costs associated with such value chain functions. Potential entrants considering participation in input supply need to receive some training and remain up to date on information and trends.

Input supply is the most difficult value chain function to participate in but some of the difficulty may be eased through strategic alliances. Experienced fish farmers with the right skills and knowledge to propagate fish can expand into input supply. They also need to be able to supply enough fingerlings to cover their personal use for production and those of their customers. Thus, only established fish farmers can assume this role. Input supply requires full time commitment and potential entrants without other commitments should consider this value chain function.

Fish farming may not be the easiest aquaculture value chain function, but it is the driving function. Patience and persistence is required to reap any benefits because the production cycle is relatively long and returns on investment may take years to fully recoup. Returns are also based on the scale of production, quality of inputs and practices employed. Despite the high capital investments and entry barriers, once the knowledge has been acquired, only periodic updates are needed and every season is an opportunity to improve on the previous one. Some of the costs can be minimized by practicing an integrated system where waste and by-products from the ponds (such as the pond floor mud and water) can be used in other agricultural sectors. The by-products from the agricultural sector could also be used as inputs in fish farming.

The substantial capital investment needed for fish farming has been identified as a major barrier to entry into the sector. The Government of Kenya through the Ministry of Fisheries Development and the National Economic Stimulus Package are making strides to reduce this barrier. Although, the Aquaculture Stimulus Package is a national programme, it has been noted to be heavily focused in the Nyanza province because of ideal growing conditions [23]. The Nyanza province has seen the highest adoption rates and new ponds built since the implementation of the Economic Stimulus Package (ESP) program. The Government of Kenya has established a mechanism for emerging commercial farmers which educates farmers on credit use and availability and provides them with an initial capital source under the ESP program. In addition to providing access

to credit, the ESP program also builds ponds for recipients. This has resulted in a substantial influx of farmers into the aquaculture sector [23, 24].

Aquaculture is not as labour intensive as other agricultural activities and extra labour can be hired for the labour intensive periods, such as during pond construction and harvest. It is also possible to own the ponds as a group and share responsibilities. Fish farming also allows for family participation once the skills have been acquired. The sale of fish also enhances community relations and once established, creates a stable source of income and food. However, it is a long term commitment and the decision should be viewed as such. These benefits of aquaculture development have been noted in other studies [10, 22, 25].

Limited access to resources can also be substantially remedied through diversification in the form of integrated aquaculture (with both crops and livestock) [5, 26, 27] and other cultures (cage, bait and ornamental). A review of the state of aquaculture development and government initiatives affecting aquaculture in Kenya suggests integrated agriculture as a viable opportunity for Kenyan aquaculture development [26, 27]. Integrated agriculture and aquaculture in the form of finger ponds<sup>1</sup> for wetlands of the Lake Victoria basin is suggested as a link between conservation and livelihood demands, especially for women who can form groups and work together [27, 28].

## CONCLUSION

Participation in the input supply stage of the value chain is the most challenging because of the relatively large initial capital outlays and operating capital requirements. The fish farming sector, however, is the main thrust of the entire aquaculture value chain in Kenya. In spite of some capital investments required, which could be a barrier for entry, this stage has benefited the most from the support of government, NGOs and other regional initiatives. The fish marketing stage is the least difficult to join because it does not require substantial capital investments and has flexible working hours. These low barriers to entry and exit and low labour requirements make it the easiest to participate in. This chain function provides the most flexibility and liquidity to participants, whether as full-time or part-time occupation.

## RECOMMENDATIONS

Participation in the Kenya aquaculture value chain will depend on the prospective entrant's level of experience, time, capital commitment and financial goal (long term stability versus liquidity). Aquaculture requires a long term commitment and high capital outlays, as well as persistence, and should, therefore, be considered by those looking for

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<sup>1</sup>Finger ponds are ponds on the banks of rivers which are dug out during the dry season and fill during the flood cycle, thereby trapping fish as the flooding recedes

long term stability and not short term benefits. Established fish farmers may consider diversifying into input supply and value addition.

While access to capital remains a major threat, the results revealed prospective entrants into the input supply stage need more information and training to deal with the changing economic and environmental climate. All value chain participants expressed concern regarding the unpredictable economy, fluctuating US dollar (especially as it affects input prices) and the increase in crime in all sectors. Although location was indeed advantageous, cleanliness and attention to detail could help evade some of the challenges at the marketing stage. The government of Kenya should be commended as it appears to be making strides in boosting the aquaculture sector through its incentive schemes and ESP. However, more private sector involvement is still needed. The government needs to also focus on addressing the infrastructural challenges as these constraints continue to hinder progress of the sector. There is a need for a multi-level collaborative effort between farmers, input suppliers, government, NGOs and retailers to determine a long term strategic plan that includes and benefits all value chain participants.

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**Table 1: Factor Evaluation Matrix for Value Chain Participants\***

		Harvest equipment suppliers	Aqua and Agrovet shops	Irrigation & Greenhouse Material Supplier	Nyanza Province Fish Farmers	Central Province Fish Farmers	City Market Fish Marketers	Gikomba Market Fish Marketers	Kisumu Fish Marketers	Eldoret Fish Marketers
<b>Place</b>	<b>Importance Ranking</b>	4.67	4.00	4.00	4.00	4.00	5.00	4.00	5.00	3.00
	<b>Performance</b>	4.67	4.50	4.00	4.50	4.50	4.23	4.03	4.08	4.00
	<b>Score</b>	21.78	18.00	16.00	18.00	18.00	21.15	16.13	20.38	12.00
<b>Price</b>	<b>Importance Ranking</b>	4.67	3.50	4.00	4.50	4.50	5.00	5.00	5.00	5.00
	<b>Performance</b>	4.67	4.00	3.00	4.00	3.00	3.38	3.47	4.12	4.36
	<b>Score</b>	21.78	14.00	12.00	18.00	13.50	16.92	17.33	20.58	21.79
<b>Product</b>	<b>Importance Ranking</b>	4.67	4.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
	<b>Performance</b>	4.67	4.00	4.00	3.00	3.80	3.92	3.77	4.31	4.21
	<b>Score</b>	21.78	16.00	20.00	15.00	19.00	19.62	18.83	21.54	21.07
<b>Promotion</b>	<b>Importance Ranking</b>	3.67	2.50	4.00	1.00	1.00	3.00	3.00	3.00	4.00
	<b>Performance</b>	3.33	1.00	4.00	1.00	1.20	3.73	3.62	3.58	3.50
	<b>Score</b>	12.22	2.50	16.00	1.00	1.20	11.19	10.85	10.73	14.00
<b>Procurement</b>	<b>Importance Ranking</b>	4.67	4.00	4.00	5.00	5.00	5.00	5.00	5.00	5.00
	<b>Performance</b>	4.67	4.50	4.00	3.00	3.50	3.12	3.04	3.96	3.36
	<b>Score</b>	21.78	18.00	16.00	15.00	17.50	15.58	15.19	19.79	16.79
<b>TOTAL SCORE</b>		<b>99.33</b>	<b>68.50</b>	<b>80.00</b>	<b>67.00</b>	<b>69.20</b>	<b>84.46</b>	<b>78.33</b>	<b>93.02</b>	<b>85.64</b>

\* The scores reported here are based on the averages for each value chain grouping

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