

## **Enhancing aquaculture development in Africa: an analysis of the Tilapia Fishery Value Chain in Ghana**

### **Abstract**

Fish is important in the diet of millions of Ghanaians supplying protein and micronutrients needs. Fish consumption per capita has increased in recent years as a result of rapid expansion of inland aquaculture sector (mainly Nile tilapia). This paper looks comprehensively at the value chain of the tilapia fishery sector in Ghana to identify particular areas of intervention and development opportunities in achieving food security and nutrition, safety, quality and trade benefits.

A mixed of methods (including; stakeholders workshop, interviews and document analysis from official sources) were employed in collecting data between January and December 2014. The analysis indicates that farmed tilapia products are currently not exported but locally consumed. However, there is a potential for export if processed as smoked and salted. In 2012, about 28,000 t of tilapia were supplied to the local market. The bulk of the supply came from cage culture (85%) with the remaining coming from ponds and dugouts. About 98% of tilapia coming from aquaculture is supplied directly to the local markets whilst 2% is family consumed (subsistence). The marketing channel involves farmers selling to wholesalers/retailers and to consumers/hotels. The processing technology is generally low (mainly sun drying, small size smokers).

A range of approaches are suggested as a way forward to sustain and enhance the contributions of the tilapia fishery sector to food security and trade capacity. These approaches include; the need to develop a practical guide for aquaculture exporters by the relevant stakeholders, strengthened capacity building for public institutions to export aquaculture products, training of aquaculture personnel and proper documentation of aquaculture products.

### **Keywords**

Aquaculture, Value chain, Ghana, Tilapia, Fishery, Export

## **1. Introduction**

### ***1.1. Fisheries and Aquaculture Sector of Ghana***

The fishery sector of Ghana has two major components: marine (sea and lagoons) and inland (lakes, rivers and reservoirs). The aquaculture sector is also becoming more widespread in the country. The marine sector is made up of small-scale/artisanal sector, semi-industrial/inshore, industrial/deep-sea and tuna sector. The inland fishery is considered wholly small-scale/artisanal.

Ghana fish production from marine, inland reservoir and aquaculture sources has been fluctuating around 440,000 t over the last 10 years. Although there is strong growth in aquaculture production - MoFAD estimates that the production for aquaculture has risen from 5,000 t in 2000 to nearly 28,000 t in 2012 (MoFAD, 2013), it remains small and has not kept pace with the demand for fish in Ghana which is estimated at about 1 million t per annum. In the foreseeable future, Ghana will therefore continue to import fish such as sardinella and mackerel to supplement the domestic supply.

#### *Figure 1: Fish production in Ghana*

Over 3.5 million people (Asiedu 2012; BNP, 2009) in Ghana (both urban and rural dwellers) depend on fisheries as means of livelihood (i.e. fishers, processors, traders and boat builders). Fisheries also contribute 1.5% to GDP and accounts for 7% of agricultural GDP (GSS, 2014). Taxes from fishing licenses and market tolls represent less than 5% of local revenue (FAO, 2006).

Fish is the preferred and cheapest source of animal protein in Ghana; about 75 percent of the total annual catch in the country is consumed locally. The per capita consumption of fish is estimated at about 25 kg per annum, representing 60 percent of animal protein intake by Ghanaians (Sarpong *et al.*, 2005). Ghanaians prefer consuming fish in smoked form because of its flavour and delicacy. Fish species such as tilapia, catfish, horse mackerel, chub, sardinella, anchovy, herrings, tunas, are popularly consumed when smoked. Other traditional methods employed to preserve and process fish for consumption and storage include drying, salting, frying and fermenting and various combinations of these.

Aside it being consumed locally, some fish and fishery products are also commodities for the export business (regionally with the neighbouring countries, internationally with the European Union (EU) mainly; UK, France, Spain and Netherlands). In 2014, there were 60 approved establishments in Ghana that were authorised to export fishery products in EU: 10 processing plants and 50 freezer vessels (Failler *et al.*, 2005). Currently, none of these establishments are processing fish coming from aquaculture sources. The quality and safety of the capture fishery products are essential to the consumers. For the EU countries, a Competent Authority (CA) was selected by EU to verify the sanitary standards of the approved establishments and to be in charge of the analysis, according to the Fishery Products Regulations (2007)<sup>1</sup>. Since 1998, the CA has been the Ghana Standards Authority (GSA) under Ministry of Trade and Industry. If for the European consumers' quality is important, it should be the same for Ghanaian and regional consumers. The public institution in charge of this issue is the Fisheries Commission. Two projects, namely, the Ghana National Aquaculture Development Plan (GNADP) (2012-2016) and the West Africa Regional Fisheries Programme (WARFP) (2012-2017) are currently assisting the Fisheries Commission to achieve deeper technical knowledge, quality management and sustainable development of aquaculture value chain in Ghana.

The farming of aquatic plants and animals (termed as aquaculture) is developing fast in Ghana compared to captured fisheries. There are a number of water bodies in Ghana which have the potential of increasing aquaculture production. The Volta Lake extends close to 40 percent of Ghana and has a total surface area of 8,482km<sup>2</sup>. The Volta Lake is oligotrophic, that is, low mineral nutrients content. Other important water bodies include Lake Bosomtwe (49km<sup>2</sup>), Weija (37km<sup>2</sup>) and Kpong reservoir (36.5km<sup>2</sup>) (Freeman, 1974; FAO, 1999). However, the potential of aquaculture is largely under-exploited (Hiheglo 2008; MoFA, 2013).

Currently, there are no major mariculture activities in Ghana, except one shrimp aquaculture joint venture between a Ghanaian and a Vietnamese company. Fish farming has become an alternative for increasing the fish production in Ghana since the marine and inland capture fisheries production have nearly reached its maximum sustainable level. According to MoFAD (2013), there are about 4,800 ponds in Ghana covering about 703 hectares.

---

<sup>1</sup> The Fishery Products regulations have been enacted by the Ghanaian Law in 2007.

Both extensive and semi-intensive cultures are practised in the aquaculture facilities in Ghana. Extensive culture is associated with dams, dug-outs and small reservoirs which are fished and restocked (Cobbina, 2010). Fish is cultured semi-intensively in earthen ponds either as monoculture or polyculture of tilapia (especially, *Oreochromis niloticus*) and African catfish (*Clarias gariepinus*). Tilapia species represent over 90 percent of farmed fish production. Cage and pen culture are practised in lakes, lagoons and rivers. Overall, cage farms currently account for less than 2 percent of farms by number but much more by production. In 2012, for example, aquaculture production from cages was over 24,000 metric tons compared to less than 2,000 metric tons from ponds and tanks (Kassam, 2014).

The Fisheries Commission (FC) is the lead government agency for aquaculture development, and the Water Research Institute of the Council for Scientific and Industrial Research (CSIR) is mandated to carry out aquaculture research. To promote fish farming and generate employment, imports of farmed fish have been recently prohibited into Ghana. However, this could be disadvantageous to Ghana if trade within ECOWAS is to be enhanced.

### ***1.2. Value Chain in Fisheries and Aquaculture***

Value chain in fisheries and aquaculture deals with how fishery business receives raw materials as input (capture and culture fisheries), add value to the raw materials through various processes and sell finished products to customers (De Silva, 2011, see Figure 2). Value chain in fisheries and aquaculture has a number of benefits such as providing policy makers and fishing company management with a systematic tool which allows them to understand the processes in the industry (Russell and Haanoomanjae, 2012). Until now, the concept of value chain has not been applied in the Ghanaian fisheries, particularly, in the aquaculture sector. Government finance and policies in the fisheries and aquaculture value chain of Ghana is poor. However, in recent times (2014) the Government of Ghana has established a value chain and post-harvest unit within the Fisheries Commission of the Ministry of Fisheries and Aquaculture Development (MoFAD).

*Figure 2: A simple value chain in fisheries*

### ***1.3. Objective/justification of the paper***

This paper seeks to gain a better understanding of the dynamics of the relevant value chains and arrive at policy recommendations as far as tilapia aquaculture sector of Ghana is concerned. The paper looks at several parameters: different actors involved, performance of the processing sector, quality sustainability requirements, value chain support institutions, level of commitments regarding quality and level of human skills. This will ensure that Ghana derives maximum benefits from fish trade and fishery resources, in particular, from the aquaculture resources.

### ***1.4. Content of the paper***

Following the introduction section are materials and methods. This is followed by analysis of the current tilapia fishery value chain and what can be done so that maximum benefits can be derived for a developing country such as Ghana. The paper ends with a conclusion section.

## **2. Materials and Methods**

### ***2.1. Data collection: Interviews and stakeholders workshop***

A selection matrix (see Annex I) enabled the selection of three major value chains of interest, among which is farmed tilapia value chain. Information was collected during a field visit in Ghana between January to February 2014. Several interviews were undertaken with stakeholders (fish processors, fish farmers, government institutions, policy makers, NGOs') operating along the fish chain as well as with the supporting institutions and management bodies. The analysis of the current functioning of the fish chain, its trends and bottle-necks led to the drafting of recommendations that could take into account for the design of a short to medium term implementation plan (3-4 years). A validation workshop provided opportunities for stakeholders to discuss and agree with the main conclusions and recommendations.

## **2.2. Data collection: Document analysis**

A number of publications produced by individuals, organizations and projects were analysed as secondary data sources (i.e. Ghana Standards Authority, Food and Drugs Authority, Ghana Statistical Service, Ministry of Trade and Industry, Ministry of Fisheries and Aquaculture Development, Fisheries Commission, West African Regional Fisheries Project, Custom Excise and Preventive Service, Food and Agricultural Organization). Documents generated in the field were also analysed (i.e. field notes and photographs, meetings, fish industry visits).

## **3. Analysis of the Current Tilapia Fishery Value Chain and the Way Forward**

### **3.1. Graphical representation**

The flow of farmed tilapia from production to consumption is presented in Figure 3. Farmed tilapia production in Ghana was about 28, 000 t in 2012 representing about 90 percent of total aquaculture production in Ghana. Cages, ponds and dugouts make 85%, 8% and 7% of the total production, respectively. There are about 3 000 fish farms but over 90% are non-commercial ponds. With respect to the culturing system, floating cages make about 3% whilst ponds make over 90%. There is existing policy in allocating 5% of irrigation areas for aquaculture business.

*Figure 3: Graphical representation of tilapia chain, Ghana*

According to Ghana's Environmental Protection Agency Act 1994 (Act 490) Schedule 2, (Regulation 3) an environmental impact assessment (EIA) is mandatory for land-based aquaculture. In the same legislative instrument, Schedule 5 (Regulation 30 (2)) contains the

provisions to regulate fish cage culture. The objective of Environmental Protection Agency Act is to ensure that aquaculture projects do not damage the environment.

Aquaculture production in Ghana has been increasing in the last couple of years with Ghana being the sixth (6<sup>th</sup>) largest producer of aquaculture products in Africa. Africa's share of global aquaculture production is about 2.3% estimated at 1, 485, 367 t in 2012 (FAO, 2014). In Ghana, aquaculture makes about 6% of total fish production of 440, 000 t. Aquaculture in Ghana is estimated to grow annually at 2-3% compared to Africa's annual growth rate of 11.7% (FAO, 2014).

About 27, 000 t of farmed tilapia goes to the local fishmongers who process them as smoked, salted, dried and fermented in the traditional way whilst 1 000 t is in the form of unprocessed frozen storage. Smoked and salted tilapia is preferred by most Ghanaians. The accessory activities (mostly processing) of tilapia production offers employment to majority of women (usually local traders), thus enhancing poverty reduction through regular incomes. The local transportation network mainly by road (through use of trucks, vans and smaller cars) caters for the transportation of tilapia from the producers to the local markets and consumers. The main market for tilapia products is the local market. Currently, the local markets can absorb all the tilapia production which makes producers reluctant to supply to the international markets. Furthermore, 500 t annually is consumed at the subsistence level. This clearly indicates the importance of fish to the food security and nutritional needs of most fishing families. The annual per capita fish consumption in Ghana is about 28 kg, which is higher than the Africa and World average of 9kg and 18 kg, respectively. Fish also makes 60% of protein needs of Ghanaians, compared to 15% and 20% at the global and low- income countries (FAO 2012, 2014).

### **3.2. Mapping of actors**

The high demand for aquaculture products in Ghana due to rapid population growth, the decline of capture fisheries and the reduced cost of farmed fish compared to other protein sources, have resulted in the booming of the aquaculture industry of Ghana. Aquaculture is becoming the preferred option used by agro-based companies to produce tilapia on commercial lines (mainly cages) along the Volta Lake. The Eastern region of Ghana (mainly, Asuogyaman district) which is on the Volta Lake has over 1,400 cages (Table 1). The Brong Ahafo region has over 1,300 ponds with the Upper East region having over 500 dugouts and dams. These mixed production methods clearly indicate that many inland fishers are interested in the aquaculture business, but they need to be supported with other inputs such as seed, feed, credit facilities and veterinary services. Generally, most farms are not productive because of poor husbandry practices, feeding and pond management. The technical knowledge in these areas is very poor. Training institutions, agencies and developmental partners must collaborate with government to provide training and extension services to fish farmers to improve their knowledge in aquaculture practices.

#### *Table 1: Aquaculture by production systems*

There are three large commercial fish feed producers, namely, AgriCare Ltd and Ghana Agro Food Company Ltd (GAFCO) located in Tema, and Raanan Fish Feed Ltd established in Prampram. In addition to the feed production, Raanan Fish Feed Ltd also imports equipment for aquaculture. These feed mills produce about 1,500 t of feed annually with 70% of inputs sourced locally. Feed contribute about 60 percent of production cost which ultimately affect price of table



size tilapia. Currently, the ProteInsect project<sup>2</sup> is being run with some members of the Ghana Aquaculture Society (GAS) by using fly larvae as a source of protein for fish diet. This will go a long way to boost both the small and medium aquaculture industry.

There are a total of 19 hatcheries with 3 public and 16 private (Table 2). The eastern region has the highest number of hatcheries with 14. These hatcheries produce about 79 million fingerlings annually and have witnessed increased production over the past years. The Government of Ghana has adopted a strategy of increasing aquaculture production by encouraging the private sector to participate in the production of fingerlings. To this effect, in 2012, the Ghana National Aquaculture Development Plan (GNADP), 2012 – 2016 was developed by the Government of Ghana through the Ministry of Food and Agriculture (MoFA) and the Fisheries Commission. However, these hatcheries are confronted with challenges such as inadequate personnel, equipment and broodstocks.

*Table 2: Hatchery Operators*

Internal demand for tilapia species is high mainly due to the growing middle class with preference taste for tilapia coupled with rapid population growth (3% annually, GSS 2010). Therefore, there are virtually no exports of fresh tilapia. On the other hand, evidence from the Customs Service at the Kotoka International Airport indicates that some salted tilapia (“*koobi*”) are exported to the USA. Additionally, individuals are permitted to carry up to 20 kg of salted tilapia (which represents the maximum weight of fish an individual can carry without declaring taxes). This forms part of the bulk export of salted/smoked which is estimated around 115 kg or

---

<sup>2</sup> See: <http://www.proteinsect.eu/index.php?id=32>

0.3% of exported fishery products in 2012. On the other hand, salted tilapia from southern Ghana marketed in the middle and northern belts eventually end up with consumers in Burkina Faso or westwards to Ivory Coast. In tilapia marketing in Ghana, fish farmers mostly sell to wholesalers or retailers and the retailers in return sell to consumers (Figure 4). In some cases, aqua farmers sell directly to the final consumers who come to the fish farms. Sunwoo Culturing Farms for instance sells to about 5 major wholesalers who in turn sell to other retailers. Tropo Farms sells to wholesalers and consumers (Table 3).

*Figure 4: Tilapia marketing Channel*

*Table 3: Major tilapia fish farms in Ghana*

### **3.3. Performance of the processing industry**

Currently, there is no industrial processing for aquaculture products in Ghana. Farmed tilapia are processed on a small-scale level such as smoked, dried, fried, salted and fermented. There are an adequate number of processors available but the technology applied to processing are relatively low in terms of the level of investment and/or basically traditional (sun drying, small size smokers and salting). These low-technologies of processing turn to be labour intensive, but provide livelihood support to the fishers (women) especially those in the rural communities in Ghana. However, it is difficult to sustain such jobs. As observed by De Silva and Yamao (2006), female roles in fish processing (especially in processing factories) are associated with job insecurity, health issues and harassment. Consequently, there is the need for innovation in the processing sector in addition to women empowerment. Capture tilapia are already amongst the inland fish supplied to industrial smoking industry authorized to export to Europe. In future, if aquaculture products are approved to be exported to the EU, approved tilapia farms will be able to sell their catch to these smoking establishments.

Moreover, there is the need to develop a practical guide for aquaculture exporters by the relevant stakeholders. Aquaculture operators in Ghana should be trained and guided on how to export their products to the EU markets.

### **3.4. Quality sustainability requirements**

According to information collected during the study, including interactions with major tilapia farm companies, it does not appear that currently farmed tilapia would be of interest to the European market. Other species such as African catfish, *Heterobranchus* species, *Heterotis* species and Volta perch (*Lates niloticus*) are currently farmed or have also good prospect for culturing (Aquaculture Research and Development Centre, pers. Comm., 2014). Some of these farmed species might be potential exports to the European markets. A careful move must however be observed in respect to the species likely to have a market in Europe, as Asia and South America are heavily present with very low prices. Therefore, a detailed market study in Europe should be conducted in this regard.

Moreover, it is necessary to set a brief framework in which Ghana and aquaculture establishments will have to evolve if an aquaculture farm wants to export its farmed products to Europe. Some of the major points to achieve, in any case, stipulated by the EU through the ‘Better Training for Safer Food’<sup>3</sup> (BTSF website, 2014), are among the following:

For Ghana to get approved by EU inspectors to export fish farmed products to Europe:

- The Competent Authority (CA) for aquaculture products should be officially selected by EU Inspectors and the capacity and necessary facilities assessed;

---

<sup>3</sup> <http://ec.europa.eu/chafea/food/index.html>

- The Aquaculture Products Regulations should be enacted in the Ghanaian Law;
- The Aquaculture Products Regulations should be enforced at the level of the CA itself, with the necessary laboratories and the approved aquaculture establishments.

To be approved by the CA for Aquaculture products to export their products to Europe, the Ghanaian Aquaculture Establishments (private sector) should address the following:

- Operators should have their farm established in an adequate location with no health hazard around;
- Operators should have their employees applying the Good Hygienic Practices and Good Aquaculture Practices such as given by the Ghanaian Law;
- They should apply the Hazard Analysis and Critical Control Point (HACCP) rules on their farm and retain all documentation;
- They should, amongst others, record information on product suppliers (feed and others), recipients, date of delivery, and product quantity or volume as well as evidence of the veterinarian medicines administered.

In this regard, there is the need for documentation, database, information, *etc* on aquaculture and fishery products that should be recorded and available online for general public purposes. The online documentation centre should also provide information on export procedures and requirements as well as updated list of all exporters with detailed contact information

### **3.5. Value chain support institutions**

As shown in Table 4, a number of institutions provide support to the fish value chain, including fish exports and imports. Services rendered by these institutions include: certification, traceability, enforcement of sanitary conditions and regulating best practices in relation to the aquaculture value chain. However, some of them are limited largely in terms of logistics, manpower and capacity building of their employees.

#### *Table 4: Farmed tilapia value chain support institutions*

The necessary measures needed to be taken as far as value chain support institutions are concerned is the need to strengthen the capacity of public institutions to deal with export of aquaculture products. Although aquaculture products are not yet being exported to Europe, some aquaculture producers might want to start soon. This requires public institutions to be ready to handle this and to be able to respond to the needs.

With regards to aquaculture products export to Europe, matters that should be discussed include: strengthening growing-out techniques in aquaculture from hatcheries to fish farm; expanding disease control of farmed fish, including use of veterinary medicines approved for Ghana and their labelling and running fish analysis (microbiology, heavy metals, and histamine) on local accredited laboratories.

### **3.6. Level of commitments regarding quality**

None of the tilapia producers in Ghana have laboratories to carry out detailed analyses on environmental and product quality. The major aquaculture establishments in Ghana (i.e. Tropo Farms, West African Fisheries and Sunwoo Culturing farms) have probes to monitor basic environmental parameters (temperature, oxygen and PH). The Water Research Institute (WRI),

Aquaculture Research and Development Centre (ARDEC), University of Ghana and other private laboratories carry out environmental analyses for aquaculture practitioners. The Environmental Protection Agency (EPA) demands environmental impact assessment before a permit is issued for fish farming.

Currently, buyers of tilapia do not have any means to assess the quality of tilapia they buy from producers. There are no labels with the required information on tilapia being sold locally. The Fish Health Inspectorate Division of Fisheries Commission and the Food and Drugs Authority are tasked to ensure that tilapia consumed locally is of good quality and safe for consumption. These aforementioned institutions must be strengthened in enforcing the fish safety laws.

As already mentioned, the GSA usually carry out analyses of fishery products meant for export to the EU market and should be assisted to do the same if tilapia is to be exported. All the aforementioned institutions are highly committed to ensure that tilapia meant for consumption are of the required quality and safe. There should be an awareness creation among producers to produce tilapia of good quality and safe for consumption.

### **3.7. *Human skills***

The performance of the aquaculture sector is limited by inadequacy of skilled personnel. The WRI is the only aquaculture research institute, although the universities also carry out some research in aquaculture. There are about 30 aquaculture experts in the five (5) public universities offering training in aquaculture. There are no private aquaculture research institutions. The Fisheries Commission is in the process of establishing Post-Harvest Unit to coordinate value chain activities. There is also a general lack of qualified aquaculture marketing personnel. The inadequate personnel in the aquaculture front demands more training. New training institutions

should be established and existing institutions should be assisted with exchange programmes and logistics to undertake more work on value chain. The Ministry of Fisheries and Aquaculture Development through the Fisheries Commission have been sending some of their personnel to Iceland, UK, Korea and China for aquaculture training. Few staffs of the Fisheries Commission occasionally upgrade themselves outside Ghana. There is urgent need to strengthen the capacity of personnel working on aquaculture farms.

#### **4. Conclusions**

Farmed tilapia can be used to reduce poverty and hunger in Ghana despite major challenges such as poor standards, inadequate regulations and veterinary services, inadequate feed and seed supply and lack of skilled personnel. Currently, the growing middle class Ghanaians have developed strong taste for farmed tilapia and there is a good and readily available market for all sizes of tilapia locally. The fish farmer locally gets a better price for a kilogram of tilapia in Ghana than in Europe where there is competition with tilapia coming from Asia and South America. These factors are currently a hindrance for farmed tilapia to be exported to the European markets.

The only eventual way farmed tilapia could interest Europe countries would be by processing it in a value addition perspective to reach a niche market. Indeed, to a small extent, Ghanaian industrial smoked tilapia products from wild origin are steadily present in European countries.

Ghana should promote other culturable species such as the *Clarias* species, *Heterobranchus* species, *Heterotis* species and *Lates niloticus* that can be oriented towards the export sector. A

market study should be conducted first of all for all fish farmed business operators in Ghana, regional countries and European countries as part of their business plan.

Eventually, Ghana which has already started strengthening the local aquaculture sector would reach a higher step and would be able to export aquaculture products to other African countries. However, aquaculture products must achieve acceptable quality standards in order to export to EU markets. The aquaculture marketing system (e.g. infrastructure, research, planning) must be improved as well. To conclude, aquaculture value chain institutions should play their roles effectively to enhance trade within the region and internationally.

### **Acknowledgements**

This work was supported by the UNIDO/MOTI Trade Capacity Building Programme for Ghana US/GH/06/005. We thank all government agencies and institutions in Ghana who assisted us with data. Administrative support was provided by AETS-Consultants (Lon, France).

### **5. References**

- Asche, F., Gudmundsson, E. and Nielsen, M. (2006). *Revenue distribution through the seafood value chain*. FAO Fisheries Circular No. 1019, FAO, Rome.
- Asiedu, B. (2012). An investigation of fish catch and poverty levels for enhanced management of small-scale fisheries of Ghana. PhD dissertation, University of Ghana, Legon, Ghana. 203 pp.
- BNP. (2009). *Big number programme*. Preliminary report, Food and Agriculture Organisation, WorldFish Center and World Bank, Rome and Penang, Malaysia. 38 pp.
- Cobbinah, R. (2010). Aquaculture in Ghana: economic perspectives of Ghanaian aquaculture for policy development. United Nations University. 49 pp



De Silva, D.A.M. and Yamao, M. (2006). The involvement of female labor in seafood processing in Sri Lanka: impact of organizational fairness and supervisor evaluation on employee commitment. *In: Proceedings of the seventh Asian Fisheries Forum, December 1-2, 2004, Penang, Malaysia: First World Symposium on Gender and Fisheries*. Selangor, Malaysia, Asian Fisheries Society. 14 pp.

De Silva, D.A.M. (2011). Value chain of fish and fishery products: origin, functions and application in developed and developing country markets. FAO Rome. 63 pp

Failler, P., Yolaine, B. and Asiedu, B. (2014). Value chain analysis of the fishery sector in Ghana with focus on quality, environmental, social, sustainable, food safety, organic requirements and its compliance infrastructure. UNIDO/MOTI TCP Project. 98 pp.

FAO (1999). Year Book of Fisheries Statistics. Vol 88/1, Rome, FAO. 752pp

FAO (2006). Contribution of fisheries to national economies in West and Central Africa—Policies to increase the wealth generated by small-scale fisheries. *New Directions in Fisheries—A Series of Policy Briefs on Development Issues No. 03*. Rome, FAO. 12 pp.

FAO (2012). *The State of World Fisheries and Aquaculture 2012*. FAO Rome. 209 pp.

FAO (2014). *The State of World Fisheries and Aquaculture 2012*. FAO Rome. 223 pp

Freeman, P.H. (1974) Environmental Aspects of a Large tropical reservoir: a case study of the Volta Lake, Ghana. Office of Science and Technology Agency for International Development Washington, D.C. 340 pp.

Ghana Statistical Service (2010). *Ghana's Economic Performance 2009 in figures*. Ghana Statistical Service, Accra.

Ghana Statistical Service (2014). *Revised Gross Domestic Product 2014*. Ghana Statistical Service, Accra. 9 pp

Hiheglo, P.K. (2008). Prospects, challenges, antidotes and future prospects of aquaculture in Ghana. MSc. thesis, Department of Social Science and Marketing Studies, Norwegian College of Fishery Science, University of Tromso, Norway. 88pp.

Kassam, L. (2014). Aquaculture and food security, poverty alleviation and nutrition in Ghana: Case study prepared for the Aquaculture for Food Security, Poverty Alleviation and Nutrition project. WorldFish, Penang, Malaysia. Project Report: 2014-48.

Ministry of Fisheries and Aquaculture Development (MoFAD) (2013). Annual Progress Report 2012. MoFAD, Accra Ghana. 44 pp

Russell, D and Haanoomanjae, S (2012). Manual on value chain analysis and promotion. Regional training on value chain analysis Project ref. N° SA-4.1-B20 Pescares Italia SRL Project Funded by the European Union.

Sarpong, D.B., N.K. Quatey and S.K. Harvey (2005). The economic and social contribution of fisheries to gross domestic product and rural development in Ghana. FAO Sustainable Fisheries Livelihoods Programme (SFLP), GCP/INT/735/UK. 53 pp.

### Annex I: Fish chain selection

	Criteria	Quotations	Priority level	Tuna brine frozen	Cephalopods frozen	Aquaculture Tilapia	Shrimps	Smoked Anchovies	smoked inland fish
<b>Criteria 1: Current and Potential Domestic Consumption</b>									
1	Current Fish and Fishery Products Production	<p><b>1 : Low:</b> Current production is low with regard to current demand, possibilities to increase the production doesn't exist, there is no long-term vision, no awareness campaign exist to eat Ghanaian fish rather than imported ones.</p> <p><b>2 : Risky:</b> Current production could be increased by better fishing techniques / better management but the possibility stays unreliable (fish stock unreliable, funding is difficult to find to increase production, fleet, fishing gears, equipment are old, training in the new technology is costly, feed is expensive).</p> <p><b>3 : High:</b> Current and potential production are high, the stock is sustainable, fleet and fishing gear and equipment are new, feed is local and/or cheap.</p>	2	2.75	2.00	2.00	1.00	2.50	2.50
2	Health conditions of the products (fresh, frozen, smoked) when arriving to the end consumer	<p><b>1. Poor:</b> Bad condition of the products due to non-compliance of the FBO with sanitary regulations and their implementation, bad state of the roads, loss of post-harvest losses and short comings seen in the cold chain (spoilage, breakdown of equipment, cross contamination), bad storage or packing conditions.</p> <p><b>2. Just acceptable:</b> the products are alright but the date of expiry (pre-emption) is imminent.</p> <p><b>3. High:</b> Condition that reflects high compliance with sanitary rules and also longer delay.</p>	2	3.00	3.00	2.00	-	2.50	3.00

	Criteria	Quotations	Priority level	Tuna brine frozen	Cephalopods frozen	Aquaculture Tilapia	Shrimps	Smoked Anchovies	smoked inland fish
<b>Criteria 2 : Importance for Current and Potential Export</b>									
3	Current Fish and Fishery Products Export	<p><b>1: Low:</b> FBO has hardly no product to export due to the lack of compliance with the regulations, bad market opportunities, bad strategies, bad production, few countries</p> <p><b>2: Risky:</b> FBO has some products to export but the market is not powerful enough and this market hasn't been developed for a long time. Perhaps it doesn't concern a lot of countries.</p> <p><b>3: Good:</b> FBO has several partners, large quantities of products concerned, high compliance with sanitary regulations, high conformity assessment. The company is well known.</p>	1	6	6	2	6	4	4
4	Potential investment in processing, packing, cold chain equipment, smoking equipment	<p><b>1: Important:</b> investing to create AV to the product requires heavy funding, no confidence in the return</p> <p><b>2: Possible but do have risks:</b> investing to create AV to the product is possible but subjected to many issues that can could put the FBO in danger (cost too high, decrease in the number of clients, products is not trendy anymore).</p> <p><b>3 : Good:</b> FBO are already equipped, investment will be quickly reimbursed, technology is not too complex.</p>	1	2	6	6	2	4	4
<b>Criteria 3: Current and Potential Upstream Downstream Processing (value addition / bulk commodity)</b>									
5	Quality assurance techniques	<p><b>1 : None:</b> The FBO has not run a conformity assessment for the product</p> <p><b>2: Some :</b> Some chain links for the product of the FBO are followed by conformity assessment</p> <p><b>3: All:</b> All the chain links for the product of the FBO are checked under a conformity assessment</p>	2	3.00	3.00	1.00	1.00	2.00	2.00

	Criteria	Quotations	Priority level	Tuna brine frozen	Cephalopods frozen	Aquaculture Tilapia	Shrimps	Smoked Anchovies	smoked inland fish
6	Possibility to create value added production in processing it and putting it on the market	<p><b>1 : Low:</b> the product is mostly consumed fresh, possible processing but at an expensive cost</p> <p><b>2: Possible:</b> fish product consumed fresh and processed but the processing requires important modifications</p> <p><b>3: High:</b> product is processed and the way of processing is totally under control, the required investments have been made and we are in a productive stage.</p>	2	3.00	3.00	3.00	2.00	2.00	2.00

Criteria 4: Competiveness									
7	Competiveness level of the fish products in local markets, regional and international	<p><b>1: Low:</b> fish product is present in informal business, in small quantity and there would be a lot of effort required to increase the productivity and widen the range of commercialisation circuit.</p> <p><b>2: Limited:</b> fish product is present on local and regional markets but the concurrence with other origin is tough and the way to increase the competitiveness of the product is expensive.</p> <p><b>3: High:</b> fish product is present on regional and international markets; perhaps it would need to diversify the partners and the value added chain.</p>	2	3	3	2	2	1	2
Criteria 5 : Regulations, Certification and other Measures									
8	Enforcement of fishery products regulations, or any other regulations	<p><b>1: Hardly any:</b> No control body is inspecting regularly if there are enforcements</p> <p><b>2: Some :</b> There is some control of some of the chain link</p> <p><b>3: All /nearly all</b> the chain link of the value chain are</p>	2	3	3	2	1	1	2

		submitted for inspection							
9	Certification schemes are followed	0: the value chain doesn't have any link certified by a certifying body 1: some chain links are certified by a certifying body 2: all /nearly all the chain link that needs certifying are under certification by a certifying body	2	1	0	0	0	0	0
10	Some reliance on IUU fishing	<b>1 : Exist:</b> There is proof that over 50% of the fishing fleet practise IUU fishing (at least one convicted last year, has been reported as relying mostly on IUU fishing the previous years, is black listed, has paid a fine) <b>2 : Risky:</b> There has been evidence that between 30 - 50 % of the fleet has been reported IUU fishing 2 years ago but not in this last year <b>3 : None:</b> none of the fleet were ever reported as practising some IUU fishing, the FBO is holding certificate of best practices (or the like)	2	2	2	3	2	2	3

Criteria 6 : Environmental and social impact									
11	Environmental impact	<b>0 : High:</b> fish value chains are detrimental to environment or the environmental impact is non-measurable <b>1 : Risky:</b> fish value chains have an environmental impact under some control <b>2 : Without consequence:</b> fish value chain doesn't change the environment <b>3 : Positive:</b> the fish value chain contributes to the preservation of the environment	2	2	2	2	1	2	2
12	Poverty reduction is	<b>1: Little:</b> investing in the value chain will create hardly any difference regarding poverty reduction, gender balance wouldn't be achieved. <b>2 : Noticeable:</b> some impact is noticeable as some jobs will be	1	6	4	6	4	6	6

	achieved	created / sustainably maintained by investing for the value chain. <b>3 : A lot:</b> investing in the value chain will create more jobs for the vulnerable including women, on a sustainable basis.							
<b>Criteria 7 : Short Term Impact Potential</b>									
13	Potential investment could show results within the next 3 years in processing, packing, cold chain equipment, smoking equipment, training, certification	<b>1: Low probability:</b> investment needs some more time to show such results because the investment is too high, little margin will be gained from this new technology/ training / certification <b>2: Possible but risky:</b> investment for the product might not be sustainable, some other regulations might appear and need to be complied with, other issues might arise <b>3:High probability:</b> the investment was not much, the rest of value chain has proved to be sustainable.	1	6	2	6	2	4	4
<b>Criteria 8 : Potential for Import Substitution</b>									
14	Imported products are being processed and re-exported	<b>1 : Rarely:</b> The FBO requires sometimes to import products to processed. <b>2: Regularly:</b> The FBO requires small amount to process and to re-export. <b>3: Vast majority:</b> The majority of the processing that goes for export in done with products imported to Ghana.	2	2	1	1	1	1	1
			<b>Total</b>	<b>44.75</b>	<b>40</b>	<b>38</b>	<b>25</b>	<b>34</b>	<b>37.5</b>

Note: marks for sub-criteria with priority level of 1 are double. Source: Authors Own realisation (2014)

## Tables

**Table 1: Aquaculture by production systems**

Regions	Pond production			Cage production		Others (Dugouts, Reservoirs, Dams)	Production (mt)
	No. of Ponds	Total Surface area (ha)	Production (mt)	No. of Cages	Vol. (m production		
<b>Greater Accra</b>	275.00	75.00	158.05	350.00	43,750.00	1,531.25	-
<b>Ashanti</b>	1,205.00	150.63	384.68	39.00	4,875.00	20.00	-
<b>Northern</b>	90.00	2.85	1.23				450.90
<b>Eastern</b>	292.00	30.23	75.58	1,473.00	179,222.50	19,768.38	
<b>Brong Ahafo</b>	1,393.00	64.66	260.00	-	-	-	-
<b>Western</b>	644.00	82.80	207.00	3.00	225.00	7.88	-
<b>Upper East</b>	49.00	13.39	34.70	-	-	-	599.34
<b>Upper West</b>	17.00	0.80	0.00	10.00	1,000.00	1.97	380.30
<b>Volta</b>	247.007	98.32	282.72	416.00	50,900.00	2,919.02	-
<b>Central</b>	537.00	184.92	367.54	-	-	-	-
<b>Total</b>	<b>4,749.00</b>	<b>703.66</b>	<b>1,771.56</b>	<b>2,278.00</b>	<b>279,972.50</b>	<b>24,248.50</b>	<b>1,430.54</b>

**Production 2012 – 27,450.56**

**Source: Fisheries Commission/ MoFAD, Ghana (2013)**



**Table 2: Hatchery Operators**

Region	Name of Hatchery	No of Fingerlings Produced	Species of Fingerlings Produced	Remarks
Greater Accra	Catfish Ghana Ltd	120,000	Tilapia and catfish	Private
Ashanti	Ashaiman Aquaculture Demonstration Center (PAC)	1,872,000	All male tilapia	Public
	Pilot Aquaculture Center (PAC)	70,000	Tilapia and catfish	Public
	Kumah Farms	668,000	Tilapia and catfish	Private
Western	John Kpemli Farms	279,970	Tilapia and catfish	Private
Eastern	Adom Farms	2,347,219	Tilapia and catfish	Private
	Fish Reit	3,000,000	Tilapia	Private
	Grace to Glory Farms	1,050	Tilapia	Private
	Jasa Farms	23,400,000	Tilapia	Private
	Lee Farms	216,000	Tilapia	Private
	Sun Woo Culturing System (hatchery)	1,500,000	Tilapia	Private
	Triton Aquaculture Africa Ltd.	3,600,000	Tilapia	Private
	Data Stream farms	1,524,000	Tilapia	Private
	Wilksaddo Farms	12,000	Tilapia	Private
	Water Research Institute	14,202,030	Tilapia	Private
	Crystal Lake Fish Ltd	14,968,000	Tilapia	Private
	Maleka Farm	600,000	Tilapia	Private
	West Africa Fish Ltd	1,400,000	Tilapia	Private
Tropo Farms	9,600,000	Tilapia	Private	
<b>Total</b>		<b>79,380,269</b>		

**Source: Fisheries Commission/ MoFAD, Ghana (2013)**

**Table 3: Major tilapia fish farms in Ghana**

<b>Farm</b>	<b>Location</b>	<b>No. of employees</b>	<b>Annual output (tons)</b>	<b>Means of selling</b>	<b>Potential for export?</b>
Sun Woo Culturing Farms	Akosombo, E/R	61	2,600	Wholesalers	Yes
Tropo Farms	Asutuare, Mpakadan, E/R	120	4,000	Wholesalers & Consumers	Yes
West African Fisheries	Asikuma, E/R	50	2,000	Wholesalers & Consumers	Yes

**Source: Field Survey (2014)**

**Table 4: Farmed tilapia value chain support institutions**

<b>Institution</b>	<b>Services offered</b>
Fisheries commission	-fish production -fish processing -fish marketing & sanitary
Ghana Standards Authority	-fish health certification - fishery products regulations - Fish Inspection Unit (CA – EU) -fish traceability
Food and Drugs Authority	-fish traceability -fish products consumptions
Ministry of Trade and Industry	-innovation & technology (particularly on fish processing) -incentive regulations
Custom Excise and Preventive Service	-fish export and imports -examination of relevant documents related to imports
Ghana Export Promotion Authority	-promoting, coordinating & monitoring of fish export
Bank of Ghana	-monitor financial transactions of fish exporting companies
Food Research Institute	-fish processing
Water Resources Commission	-issue water use permit for aquaculture activities
Water Research Institute	-carry out scientific research on broodstock management, fingerlings production, water analysis and public advise on fish marketing
Environmental Protection Agency	-environmental impact assessment
Federation of Association of Ghanaian Exporters	- promote the expansion and diversification of Ghanaian exports to foreign markets
Ghana chamber of commerce	-local business promotion and trade opportunities including aquaculture

**CA: Competent Authority**

**EU: European Union**