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Thesis for the Degree of Master of Business Administration

# An Economic Evaluation of Artisanal Fish Processing with wood Fuel in Ghana

by

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August 2016

An Economic Evaluation of  
Artisanal Fish Processing with  
wood Fuel in Ghana  
(가나 목재 연료 활용 수산가공업의  
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Advisor: Prof. Young Soo Jang

by  
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A thesis submitted in partial fulfillment of the requirements for  
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The Graduate School  
Pukyong National University

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## List of acronyms

GDP	Gross Domestic Product
FAO	Food and Agriculture Organization of the United Nation
Ghc	Ghana (Ghc 3.83= approximately US\$ 1,)
IEZ	Inshore Exclusive Zone
TR	Total Revenue
TC	Total Cossts
PM	Profit margin of smoked fish
ME	Market operational Efficiency
ROI	Return on Investment
TVC	Total Value Cost
CMS	Cost of Marketing Services
PAH	Polycyclic aromatic hydrocarbon
COFI	FAO Committee on Fisheries
GDP	Gross Domestic Product
GRT	Gross Registered Tonnage
IMR	Institute of Marine Research
MCS	Monitoring Control and Surveillance
MOA	Ministry of Agriculture
NES	National Export Strategy
NORAD	Norwegian Agency for Development Cooperation
OMVG	Organization for Management of the Gambia River Basin
PRCM	Regional Coastal and Marine Conservation program
SRFC	Sub-Regional Fisheries Commission
UK	United Kingdom
USA	United States of America

WTO

World Trade Organization

WFP

World Food Program







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# **An Economic Evaluation Artisanal Fish Processing with wood Fuel in Ghana**

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## **Abstract**

Fish is an important source of food and income to many people in the developing world. In Africa, more than 5% of the population (about 35 million people) depend wholly or partly on the fisheries sector, mostly artisanal fisheries for their livelihood. Artisanal fishermen in Ghana land approximately 1235 tons of fish annually. Statistical data obtained from Ghana fisheries commission show that 3041 tons were caught in 2009 representing 6% of the total fish harvested that year (Ghana Fisheries Commission, 2012). Most of them are usually sold as a raw product. Fish is a highly perishable product whose spoilage begins immediately it is caught. Fishermen are therefore required to urgently process or preserve the fish caught so as to reduce post harvest losses caused by loss of quality when fish decomposes. Since time immemorial, Ghanians have employed various traditional methods to preserve and process fish for later consumption. The commonly used methods include; smoking, sun drying, salting, deep frying and fermenting besides various combinations of these. In Ghana, smoking is the most widely used method in fish preservation. Almost many species of fish available in the country can be smoked and it is estimated that 70-80% of the domestic marine and freshwater catch is consumed in smoked form. These preservation method is advantageous since it prolongs shelf life of the fish products, enhances flavor and increases utilization in soups and sauces. Besides, it reduces wastage in times of bumper catches and permits storage for the lean season. This ensures a constant fish supply round the year and makes fish easier to pack, transport and market. In most fishing communities, fish smoking is regarded

as the main economic activity and source of livelihood to women. In Ghana, the situation is the same since the activity is carried out by women in coastal towns and villages. Processing sheds are located along coastline and on the shores of Lake Volta. There are various methods of fish smoking. The smoking process can take the form of "wet" hot smoking or "dry" hot smoking. The method chosen will depend on the type of fish to be smoked, its uses and desired storage period. Both processes are carried out at temperatures above 80°C, which are high enough to cook the fish. This study explored the various wood fuels that are used for fish smoking. This fuel woods were grouped into "bad" and "Preferred" fuel woods depending on the consumers preference on the smoked fish products they produced. Mangrove was found to be excellent in producing the consumer preferred colours of golden brown or dark brown, while Wawa produced the non- preferred colours of light brown. Profitability analysis was also computed by calculating profit and profit margins, market margins and efficiency. these parameters were then used to assess the market performance of the small scale smoked fish.

# I. Introduction

In Ghana, fish smoking is one of the most widely used traditional methods for fish-processing . Studies on fish consumption patterns show that 80% of fish landed by artisanal fishermen is processed by smoking. Various species of fish are smoked, depending on their availability. Traditionally smoked fish from Ghana only sells at the local market, because they do not meet the standards for the European and other international markets perhaps due to the low quality of the products produced.

In the interior parts of the country fishes is obtained from lagoons are landed totally by artisanal fishermen. This huge catch is consumed locally because Ghanaians prefer consuming fish in smoked state due to its a desirable flavor and taste. The commonly smoked fish species include horse mackerel, chub, sardinella, anchovy, herrings and tunas (Anon., 2008).

According to Anon (2008), Ghana needs about 720,000 tons of food fish supply in a year. However, the fisheries sector supplies about 400,000 tons, and this creates a fish deficit of about 320,000. Ghana therefore spends a huge sum of money every year to import 320,000 tons of fish to supplement food fish shortages. This importation costs can be significantly reduced if fishermen reduce post harvest losses which sometimes rise to as high as 30% during the glut seasons. The losses are also significant during rainy or dull days consequently reducing the yield of species that are processed by sun drying.

Fish smoking is a preferred traditional preservation method with a considerable economic importance worldwide. The process utilizes smoke which is produced by incomplete combustion of wood to preserve fish. This smoke usually contains numerous individual components namely: aldehydes, ketones, alcohols, acids, hydrocarbons, esters, phenols, ethers, etc. (Doe, 1998; Guillen & Errecalde, 2002).

These components are transferred to the smoked fish by being deposited on its surface and subsequent penetration into the flesh. Doe, (1998). The resulting products end up acquiring a characteristic flavor and colour. In addition, it increases the shelf life of the fish product produced. Globally, there are three methods used to smoke fish: the traditional method by combustion, at either low temperature (cold smoking  $\leq 30^{\circ}\text{C}$ ) or high temperatures (hot smoking  $\geq 60^{\circ}\text{C}$ ); use of a high voltage electrostatic field which accelerates smoke deposition; and the use of liquid smoke which lowers the content of polynuclear aromatic hydrocarbons (potently carcinogenic compounds) in liquid smoked fish (Doe, (1998), Duffes, 1999, Espe et al., 2002, Hattula et al., 2001 and Sigurgisladdottir et al., (2002). Hot-smoking is the most widely used method in Ghana. Hot-smoking is a pasteurizing process—the preservative effect of which depends on the composition and preparation of raw material, temperature, relative humidity, density and composition of the smoke as well as the smoking time ( Doe, (1998) and Kolodziejaska et al, (2002). Production of smoked fish through hot smoking has rapidly increased over the past few years. For example, from 1010 tons/year in 2006 to 2350 tons/year in 2009 (Anonymous, (2000). Artisanal fishermen in Ghana land approximately 1235 tons of fish annually. Statistical data show that 3041 tons were caught in 2009 representing about 6% of the total fish harvested that year.

Anonymous, (2000). Most of these were sold locally after being processed through smoking. The application of hot smoking for the extension of the life span is a process of interest, given that fish contains fatty tissues which makes them spoil easily. This calls for immediate fish processing to prevent loss of the meat quality. Smoking is one of the most preferred traditional methods of preserving fish. The application of smoke during fish smoking avails chemicals in fuel wood which improves flavor, increases the utilization of the fish and promotes the rate at which the fish dries. In the past traditional model of smoker where utilized to process fish. These smokers were



later abandoned because they suffered from the following problems;

- poor quality product due to fish being damaged by difficult handling on wire nets used to support them over the fire;
- loss of smoke and heat, resulting in uneven smoking;
- limited capacity of smoking larger volumes of fish;
- time consuming in terms of the amount of time needed to handle

In recent years, all the fish smokers have embraced a new smoker called a "Chorkor". The modern cooking choker can smoke up to 15 trays of fish, This is why it has proven to be readily acceptable by women who practice traditional fish smoking. The trays are vertically arranged on top of each other with elements—to separate the fish and to form a chimney to effectively utilize the heat and smoke (the wire nets are even used extensively now in the traditional cylindrical ovens). The chorker has also been embraced due to the low construction cost durability long\_life (up to 15 years for a cement block and mortar oven, 8 years for a cement-faced mud oven, and 4 years if bare earth and well-covered when it rains) and large capacity (up to 18 kg of fish per tray; as many as 15 trays per oven). High quality and uniformity of product due to greater retention of heat and circulation of smoke (and reduced smoking time), easy to operate (no smoke in eyes, trays quickly changed, fireboxes very accessible), low consumption of firewood (very little waste of heat and smoke). Much less time and effort required for operation. The oven is also said to reduce the amount of fuel needed, hence providing savings in terms of labour and time.

The chorker is however associated with problems of manipulating the trays which prevented this from being realized. While there are still problems with the Chorkor in Ghana, it has proven to be a significant tool in terms of fuel consumption. There is an acute shortage of fish. During the study, it was noted that in most cases women used only 4 or 5 trays at a time because of the shortage of

regular supplies of fish. The inadequate fish supplies have caused some social problems.

This sometimes forced women who process fish to supply the fishermen with gasoline on credit and to deduct the money after the fishing trip. These fishermen are therefore obliged to supply the women with the entire catch from that trip. In other instances the fishermen sell the fishes to their wives. This is a disadvantage to women who enter into fish smoking business whose husbands are not fishermen. In some cases, the fishermen sell the catch to women who are able to buy even if the women are not their wives. These women then sometimes engage in illicit sexual affair with these fishermen. Additionally, it was noted that there is increased competition among the fishermen with motorized boats and those with non-motorized boats. The latter are unable to get a sufficient catch each time as they can only fish at limited distances, whereas fishermen with motorized boats can provide fish but have to account for the cost of the motor and fuel, thus increasing the price of fish to the consumer.

This paper consists of five chapters. Chapter one introduces and reviews Ghana's fisheries resources, chapter two provides information on smoked fish technologies applied in Ghana, chapter three covers the Analytical Method and data analysis on fuel wood performance, chapter four covers the Analytical Results and chapter five deals with conclusion.

The objectives of this study are:

- 1- To identify the preferred artisanal fish smoking method used in Ghana.
- 2- To examine whether the type of wood fuel used affects the quality of smoked fish.
- 3- To determine the market performance for smoked fish using profitability analysis.



## II. Fisheries in Ghana

### 1. General background

Ghana is in the west of Africa and shares borders with Burkina Faso on the north, Ivory Coast on the west, Togo on the east and the Gulf of Guinea (Atlantic Ocean) on the south. Ghana has a land area of 238,588 km<sup>2</sup>, with an estimated population of about 22 million. Ghana has a coastline of 539 km which runs from Aflao, on the Eastern border with Togo through Efase, on the Western border with Ivory Coast. Ghana has a narrow continental shelf with territorial sea of 12 nautical miles, contiguous zone of 24 nautical miles and Exclusive Economic Zone of 200 nautical miles.



<Figure 1> Map of Ghana (Wikimedia, 2011)

### The climate

Ghana lies within the tropical equatorial belt, it experiences high temperature of between 25°C and 35°C, with minimum variation throughout the year, and, for this reason, the difference in climatic

conditions is due mainly to the amount and distribution of rainfall. There are two distinct wet seasons in the year—a major one in May–June and a minor one in August–September. Annual rainfall averages between 82 mm in the southeast and 215 mm in the southwest.

The dominant wind in Ghana is the southwesterly monsoon, which is a relatively weak wind, reaching a maximum speed of only 5 ms during the boreal summer.

## **Agriculture**

Agriculture in Ghana consist of a variety of agricultural products and is an established economic sector, and provides employment on a formal and informal basis. Ghana produces a variety of crops in various climatic zones which range from dry savanna to wet forest and which run in eastwest bands across Ghana. Agricultural crops, including yams, grains, cocoa, oil palms, kola nuts, and timber, form the base of agriculture in Ghana's economy In the year of 2013, agriculture employed 53.6% of the total labor force in Ghana.

## **Employment**

The fishing industry is one of the major sources of employment in Ghana. The industry is dominated by private-sector initiative, with local entrepreneurs offering job opportunities to several thousands of the labour force in fishing operations, fish handling and processing, fish distribution and marketing. Over 150,000 fishers are engaged in marine capture fisheries. It is estimated that another 1.5–2 million people rely directly on these fishers others are also engaged in ancillary or related occupations such as canoe carves, input suppliers, office workers for industrial fleet, etc. In addition, estimates shows

that about 500,000 people are engaged in processing, distribution and marketing of fish throughout the country.

## **Fishing Industry**

Fishing vessels in Ghana are divided into three categories: industrial vessels, semi industrial vessels and artisanal. The industrial vessels are offshore or distant waters fishing vessels with 30 - 200HP diesel engines. In Ghana, the industrial vessels are supposed to operate beyond the 50m deep but most of the time they compete with the canoes on the shallow waters. As at 2006, there were 61 industrial vessels which contributed about 6% of the total annual marine catch .

The industrial vessels are mostly owned by Ghanaians or foreign-Ghanaian joint partnership. The industrial vessels are either industrial trawlers with single trawl, shrimp trawl and pair trawling (currently banned in Ghana). The operations of the industrial vessels are also prohibited in the Inshore Exclusive Zone (IEZ), the industrial vessels can also be classified as the Tuna boats which use tuna purse seine, long line gears and they operate far off shore.

The semi-industrial vessels are wooden built vessels ranging between 9 -12 meter lengths, participating in inshore fisheries. They are equipped with 30-90 HP diesel engines and there are about 240 such vessels operating in Ghana with Ghanaian or foreign-Ghanaian joint partnership. The semi-industrial vessels use either purse seine gears or trawlers and operate through the continental shelf; however, those vessels which are below 10 meters in length operate in competition with the canoes in the 50 meters depth zone inside the IEZ without towed gears (Anon., 2010).

The semi-industrial vessels produce about 2% of the total marine yearly catch and their products consist of both the pelagic and demersal species such as, tunas, round sardinella, chub mackerel, shrimps, cassava, burrito, sole, etc.

## **Fish processing**

Once fish has been caught, it needs to be processed promptly because of enzymatic and microbial processes which deteriorate the quality of the dead fish. Fish begins to spoil within 12-20 hours after being caught and brings unpleasant taste, smell and texture depending upon the size and type of the fish species, reducing consumer acceptability for that particular fish species, and if the fish is not eaten fresh as soon as it is caught, it needs to be processed for future use or store frozen to help prevent post-harvest losses (Obodai et al., 2009).

There are several traditional fish processing and preservation methods used in Ghana. These preservation methods include salting, sun-drying, cool storage, canning, freezing and smoking. This study focuses on the smoked fish processing and preservation among the people living in the Ghana where most people use smoked fish processing as a way of fish preservation.

## **The fishery Under Industry**

The fishery sector in Ghana includes marine and inland fisheries. The marine fishery constitutes over 80% of the total fish landing, including inshore and offshore fisheries. The inshore fisheries mainly consist of small-scale artisanal canoes fishing contributed about 70% of the marine fish supplies in Ghana. The inshore fishery output by purse seine vessels from 2007-2013 is presented in table 1, where



some of the caught species were round sardinella, flat sardinella, chub mackerel, scad mackerel and others. The highest fish catch was in 2010 (11,891.84 tonnes) whereas the lowest was in the year 2009 (4,974.3 tonnes).

Ghana's marine fisheries incorporate diverse fish species. The country's marine catch is dominated by pelagic fish. Round Sardinella, Flat Sardinella, Chub Mackerel, Anchovy, Frigate Mackerel, Sea breams, Burrigo, Scad Mackerel, Cassava Fish, Tiger Fish, Cuttlefish, Soles, Red Mullet, Hake, Yellowfin, Bigeye, Skipjack, Black Skipjack and other tuna type fishes. In addition, the major demersal fish species are lujanidae (snappers), serranidae (groupers), and polynemidae (threadfins) (Bank of Ghana (2014)). Generally the tuna catch is dominated by skipjack or black skipjack though the catch of Bigeye and Yellowfin are significant (Clark, 2011).



**<Table 1> Inshore fishery output by purse seine vessels**

unit : tonnes

	2007	2008	2009	2010	2011	2012	2013
<b>Round sardinella</b>	3,585.03	2,599.61	4,326.38	4,712.45	2,888.73	7,262.2	5,792.79
<b>Flat sardinella</b>	49.33	77.68	2,644.04	2,320.05	128.21	273.79	565.96
<b>Chub mackerel</b>	1,307.71	2,023.96	1,335.01	1,176.62	1,265.65	2,088.49	1,177.49
<b>Scad mackerel</b>	13.43	29.23	71.29	190.25	62.34	71.01	59.51
<b>Others</b>	532.16	1,987.79	5.49	388.38	899.84	1,147.85	933.7
<b>Sub-total</b>	<b>5,487.66</b>	<b>6,718.27</b>	<b>8,382.21</b>	<b>8,787.75</b>	<b>5,244.77</b>	<b>10,843.34</b>	<b>8,529.45</b>

**Source:** Fisheries Commission of Ghana

In the case of inshore fishery output by trawlers, the highest catch was 2010 with 10,008.687 tonne; whereas the lowest catch was in 2012 having 1,2047.742 tonne of different fish species- refer to table 2. The main catch consists of species like solo, cassava fish, red fishes, cuttlefish burrito and small pelagic. As showing in table 2.

<Table 2> Inshore fishery output by trawlers

unit : tonnes

Trawlers	2007	2008	2009	2010	2011	2012	2013
Sea breams	7.162	5.89	1.5	0.148	0.1	0.49	0
Cassava fish	182.18	138.6	295.09	225.03	206.9	273.46	317.03
Burrito	196.32	274.08	446.61	326.741	169.05	245.09	264.98
Trigger fish	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Red mullet	0.18	0.04	0	0	n.a.	n.a.	n.a.
Flying gurnard	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Cuttle fish	20.34	19.79	29.22	1.124	0.35	8.411	1.852
Others	437.51	434.58	722.54	667.88	519.08	682.99	710
Sub-total	843.69	872.985	1,494.96	1,220.923	895.48	1,204.02	1,233.86
Total inshore	6,331.35	7,591.28	9,877.17	10,008.687	6,140.25	1,204.742	9,823.305

n.a not available

Source: Fisheries Commission of Ghana

## 2. Contributions of fisheries in the Ghanaian economy

Fisheries provide direct employment to about 2.2 million people in the country. The sector currently contributes 4.4% to the Gross Domestic Product of Ghana which is more than the contribution of

cocoa which used to be the main traditional contributor to the GDP of Ghana.

Fish is an important source of food and provides daily cheap protein for both humans and partly for animals. The average per capita fish consumption in Ghana is between 20–25kg as against the per capita fish consumption of the world which is pegged at 17kg (Anon., 2014).

**<Table 3> The contribution and share to Gross Domestic Product by kind Economic activity**

	Share of GDP			Contribution to the national Growth		
	2008	2009	2010	2011	2012	2013
<b>Agriculture</b>	36.0	35.4	34.7	1.5	1.6	1.4
<b>Crops and Livestock</b>	23.8	23.0	22.7	0.8	0.8	0.9
<b>Crops production and marketing</b>	4.6	4.4	4.3	0.6	0.1	0.1
<b>Forestry and Logging</b>	3.6	3.4	3.3	0.2	0.1	0.1
<b>Fishing</b>	4.1	4.4	4.4	–	0.7	0.2

**Source:** Government of Ghana Budget Statement and Directorate of Fisheries.

The Ghanaian fish consumer derives about 60% animal protein from fish and out of this portion; fish from the ocean provides 85.5% per capita consumption and contributes about 14.5% per capita consumption. It is also estimated that average Ghanaian spends about 22.4% of the household expenditure on fish consumption. On the foreign income contributions, fish provides about 50% in the form of foreign income to the national economy of Ghana.

In the year 2009, fish realized a foreign income of about \$40,000,000 from the sale of about 10,000 tons of fish and fish products.

About 75% of the landed total artisanal catch is consumed in Ghana as food fish, and most Ghanaians prefer consuming the food fish in smoked form because of its flavour and delicacy when prepared as smoked fish. Fish species such as horse mackerel, chub, sardinella, anchovy, herrings, tunas, are popularly consumed as smoked fish.

According to Marine fisherie divison, Ghana needs about 720,000 tons of food fish supply in a year, however, the fisheries sector supplies about 400,000 tons, and this creates a food fish deficit of about 320,000. Ghana therefore spends about \$200,000 every year to import 320,000 tons of fish to supplement food fish shortages.

### **3.The overview of smoked fish processing methods available in the Ghana**

Smoked fish processing is the main economic activity for the people living in and around the coastal areas and also along the river banks of Ghana. The main employment for these people is to process and preserve the fish for marketing. The smoked fish business is dominated by women whose economic activities in the fish processing sector has become more important considering the low levels of income of many women in Ghana.

The smoked fish sector has also become an alternative means of employment for the girls who could not enrolled in formal education, or learn a trade, these girls and many others enter into the smoked fish sector either to assist parents or husbands, or for their own upkeep.

## 4. Social-cultural dimension of fish processing in Ghana

Smoked fish processing is the main economic activity for the people living in and around the coastal areas and also along the river banks of Ghana. The main employment for these people is to process and preserve the fish for marketing. The smoked fish business is dominated by women whose economic activities in the fish processing sector has become more important considering the low levels of income of many women in Ghana. The smoked fish sector has also become an alternative means of employment for the girls who could not enrolled in formal education, or learn a trade, these girls and many others enter into the smoked fish sector either to assist parents or husbands, or for their own upkeep.

### Fish processing in Ghana

The processing of Smoked fish is in two forms, the “dry hot smoke” and the “wet hot smoke”. The dry hot smoke applies heat removes moisture and cooks the fish; and the wet hot smoked only applies smoke to the fish, and this smoke is sufficient to manage the outside spoilage of the fish. The Table 3 below explains the two types of fish smoking processes which are practiced in Ghana, depending upon the type and texture of the fish being smoked, and also depends upon the consumers’ preference.

<Table 4>: Forms of smoked fish processing available in Ghana

Types of processes	Shelf-life	Duration in smoked	Moisture content (%)
Wet hot smoked	About 3 days	About 2 hours	40-50
Dry hot smoked	About 9 month	About 18 hours	10-15

Source: Fisheries Commission of Ghana.

## 5. Stages of fish smoking

The technology in smoked fish processing in Ghana may differ from processor to processor in terms of equipment and environment but it must satisfy the set standards for dry hot smoked processing as depicted in the following (Anon,;2007)

### **1st stage: The cooking stage**

The fish is cooked at a temperature of 63°C. Here enough heat is produced to cook the fish for preservation and makes it safe for consumption.

### **2nd stage: The drying stage**

Here the fire produces heat that is enough to dry the fish at this stage of smoked fish processing.

### **3rd stage: The Smoking stage**

The fuel wood used in smoking the fish produces a smoke which has a number of compounds that kill the bacteria on the fish. The smoke also builds the colour of the fish which starts developing between the temperatures of 54.4°C and 60°C. The fuel wood also helps to preserve the fish by giving it a longer shelf life.

According to Jong et al., (1992) to avoid the growth of food poisoning bacteria, smoked fish must not be consumed immediately after it is smoked but rather, allow the heat to settle at the temperature of 2°C and this temperature must constantly be maintained until the fish is finally consumed. In Ghana, the smoked fish is immediately packed for marketing the moment it is brought off from the fire because of lack of humidity in the storage facility, and also the level of smoke could reduce the moisture content of the fish to lower the possible growth of fungal. The hot smoked fish are often sent to the market in ventilated baskets which have been

pre-packaged in brown paper because according to the smoked fish processors in the study area, brown papers do not easily generate heat nor pose a health risk.



<Figure 2> Turning time of smoked fish at the processing unit on chorkor kiln oven

## 6. Marketing of smoked fish

Most processors do not wait for traders to come to them – they actively seek market opportunities by transporting smoked fish to various large markets within and outside their district or region of origin. In these markets, processors are excluded from selling directly to consumers. They sell fish in packs of hundred to retailers who in turn retail to consumers in the same markets or smaller neighbouring markets.

In some cases women who act as intermediate traders go to processors in their communities to buy the fish, which they sell to retailers in central markets. Retailers sell smoked fish to consumers (individuals and food vendors) at the same (central) markets or in smaller, surrounding markets whilst others transport it to villages for retailing. While the majority of these traders deal solely in smoked



sardinella, a few sell other types of smoked fish as well.

Though they operate as individuals, most retailers are members of trader associations. Almost all markets visited had an association for smoked fish sellers in general and, in some cases, specifically for sellers of smoked sardinella. Members of these associations help each other in times of need and also share information on prices and supplies. They are typically headed by so called “commodity queens”. The queen’s main functions include the establishment of informal market rules as well as the settling of disputes between retailers. One common rule, for example, makes it mandatory for every person selling fish in a particular market to give a specific quantity to the queen or pay the equivalent amount in cash. Failure to do so would warrant a fine or expulsion from the market. The commodity queens are appointed by an overall market queen whose role is inherited. In the lean season, when fish is scarce, those retailers that are able to afford it resort to Purchasing frozen fish from local cold stores and smoke it themselves.

## **Trade in Fish**

In Ghana, fresh fish are sold in a peculiar measured basket or blue bag as shown in figure 5 which is approximately 25kg with an average price of GHC 25.00. Again, fish sold in the other coastal districts of Ghana such as Sekondi, Dixcove, Shama, etc. are measured in a basin, and this basin measured twice as the basket or blue bag as per the figure 6 below. Basin of fresh fish sold at GHC50.00 per basin.





<Figure 3> Local fishermen selling fish to the smoked fish processors in a measured blue bag

### **Fish bound for regional markets**

Whilst most fish sold is for domestic consumption, some of it ends up crossing international borders. Processors from Shama, Cape Coast (Duakoro) and Elmina (Bantuma) sell their produce in Denu, a market on the Ghana–Togo border. The fish here is sold to retailers coming from Togo, Nigeria, and Benin. It has a better quality appearance than the fish sold domestically. Processors smoke it using a mix of firewood and coconut shells before further smoking it at low temperatures with sugarcane bargasse (remnants of sugarcane after it has been crushed to extract the juice). This gives it a shiny appearance. This higher quality is reflected in the price fetched by the processors which, on average, is 25% higher<sup>1)</sup> than smoked fish sold in other markets.

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1) The average price per basin of smoked Eban during the March 2011 lean season was GHc360 in Denu, compared to GHc270 in other markets.

These processors are few in number and can be found in small villages in Central Region and in Shama (Western Region). The latter number around 25 in total. It is clear by simply visiting a household of one of these processors that they have made significantly higher investments than other processors. They have large smoking facilities and are able to smoke large amounts of fish (up to 100 pans a day during the bumper season)<sup>2)</sup>. Not all of it is sold immediately - they are able to store large quantities which they sell at a later date (fish that has been well-smoked and stored has a shelf-life of five months or more). One smoker from Bantuma explained how she was, at the time of the interview, selling fish which was smoked during the bumper season. This, she explained, allowed her to generate income even when fish catches were low.

The processors sometimes collaborate with each other and pool resources in order to transport and sell their fish to urban market. Trucks are loaded with baskets of fish from various processors and only a few of them actually travel to the urban market. There, they sell their own fish and that of their colleagues. This collaboration works in other ways too. These processors have a mutual agreement whereby they travel to the urban markets on alternate market days so as not to flood the market with too much smoked fish - which would reduce prices and, in turn, profits.

In other markets, local informal cartels dominate the market transactions. Thus, processors are not permitted to sell directly to the retailers crossing the border to buy Ghanaian fish. Instead they must sell through local market women who act as intermediaries. Language works in favour of this arrangement too - since Ewe is spoken on

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2) Basins (or pans) are widely used to transport fish. With wet fish (live weight), a single basin weighs about 30kgs. With smoked sardinella, usually packed to hold 500-600 pieces each of roughly 25g, then the basin weighs about 13kgs. For transportation.

both sides of the border (but not typically in Western or Central Region) and some of the Ghanaian border traders also speak French. These market women get a commission of around GHc2.00 per pack sold (or GHc 6.00 per basin).

During the high season, smoked marine fish also passes through Tamale - serving both domestic markets and Burkina Faso. It is very rare for processors to travel there to sell their fish but some retailers travel to Takoradi and Kumasi to source smoked fish.

Cost of transporting the fish marketing centers has been a major constraint on profitability in the smoked fish processing. Due to the long distances travel and the related high transportation cost, they transport them to the markets to marketing days in one truck and share the transportation costs.

The local government levies various charges on smoked fish producers which serve as a disincentive. These include custom duties; market levies; and revenue taxes. These charges can be so high such that it discourages people from engaging in the smoked fish business.

### III. Analytical Method & Data

#### 1. Methods used

This study utilized both primary and secondary data. Primary data was obtained by interviewing the fish processors while secondary data was obtained by reading previous studies and checking records from Fisheries Commission in Ghana. The price data on various fish species for the period between 2000 and 2014 was obtained from the statistical reports at the Fisheries commission in Ghana.

Primary data was collected from the various agents participating in the smoked fish marketing channels (fishermen, small scale processors, wholesalers, and retailers) using an interview schedule. Target data included list of investment assets and their monetary values, buying and selling prices of fish and the quantities handled by different agents. The data was obtained by interviewing participants selected using purposive sampling. The participants were randomly selected from three landing beaches.

The criteria for selecting the beaches were generally based on the volume of fish they processed per day and the potential demand for smoked fish and fish products. Samples utilized comprised of 18 fishermen, 12 fish traders and 9 artisanal fish processors. The average investment cost comprised of both fixed assets such as land and processing equipments and variable costs which are incurred from day to day.

To determine the profitability of smoked fish, the profit ( $\pi$ ) analysis equation is obtained by TR-TC. Total revenue generated by smoked fish products was then estimated by multiplying unit selling price with quantity of smoked product sold.

Where,  $\pi$  = profit per basket of fish sold.

TR = Total Revenue

TC = Total Costs

Further information in regard to the preferred wood for fish smoking, the quantity of each type of wood spent to smoke one basket of fish was also collected.

Profit margin (PM) was calculated using the formulae shown below from the profits and revenues

$$PM = \frac{N. \text{profit}}{\text{Revenue}} \cdot 100\%$$

The market operational efficiency (ME) was then computed from the values of profits obtained above and revenue using the relation

$$ME = \frac{\text{Value added by marketing}}{\text{Cost of Marketing Services}} \cdot 100\%$$

This enabled us to compute the value added by marketing by subtracting the total cost price of the fish products from the total selling price.

Return on investment (ROI) was calculated as:

$$ROI = \frac{\text{Profit}}{TVC} \cdot 100\%$$

Cost analysis was finally carried out using estimates of revenue and costs.

## 2. Data obtained

Data on the cost of fresh fish per basket was found to be GHC 25 and after processing it is sold for GHC 70 per basket, with a gross profit of GHC 45.

## 3. The identification of fuel wood used in Ghana

To identify the effect of fuel wood species on the excellence of smoked fish, series of tests were conducted in Ghana to ascertain the local technology adopted in the smoked fish processing, and amongst the tests was to measure the fuel wood efficiency performance in producing the preferred colours and taste of smoked fish to meet preferred consumers demand.





<Figure 4> Chorkor smoked oven with fish on tier trays for smoking

There are about ten different kinds of fuel wood species used for smoked fish processing in Ghana. Smoked fish processing units acquire one or two particular fuel wood species at a time, but not three or more fuel wood species because of the cost involve and also each particular fuel wood species has a peculiar feature or texture on the quality of the smoked fish, and the processors buy particular kind of fuel wood based on preference and choice.

Through information obtained from smoked fish processors, the types of fuel wood species used in processing smoked fish include the following as spelt out in Table 5.



<Figure 5> Heaps of mangrove fuel wood ready for fish smoking

Through information obtained from smoked fish processors, specified that the types of fuel wood species used in the smoked fish that could produce the preferred smoked fish include the following as spelt out in Table 5. There are about ten different kinds of fuel wood species and each has a peculiar feature or texture on the quality of the smoked fish, and the processors buy a particular kind of fuel wood based on preference and choice.



**<Table 5> Ten fuel wood species used in smoked fish processing**

<b>Common english names</b>	<b>Common local names</b>
Mango	Amangobaka
Coconut trunk	Kukuebaka
Wawa	Egunli/Ebitiye
Mahogany	Mahogani
Mangrove	Nrateke
Neem	Anwegyan
Rubber tree	Worobaka
Afre/Fuanle	Afre/Fuanle
Teak	Tiek
Leucaena	Egyani

**Source:** smoked fish processors.

The smoked fish processors also identified other forms of fuel wood species which they called “fire lighters”, which cannot be used as standalone fuel wood species but are being used as supporting wood species to help in bringing out smooth burning and these are also listed in Table 6 below:

**<Table 6> Supporting fuel wood species in smoked fish processing**

<b>Common english names</b>	<b>Common local names</b>
Coconut branches	Kukueerilake
Coconut husks	Kukueabunle
Palm branches	Arelemlake
Shrubs	Ngleka

**Source:** smoked fish processors.

The fish processors started by specifying the species of fuel wood used, ordered for a head load of each wood species which is about 30kg for testing species by species. Each head load of fuel wood species was noted to have a different price based upon its performance proficiency and importance to the locals.

The prices of fuel wood ranged between GHC3.00 and GHC 10.00 with the mangrove, mahogany and rubber tree topping the head load prices of GHC 10.00 each, while Wawa, coconut trunk, neem and the supporting fire lighters were the least priced costing GHC 3.00 respectively.

The combustion chamber of chorkor kiln oven was used to smoke fish packed with a basket full of fresh fish on a one tier tray as shown in figure 7. The packed fish on each of tier tray chorkor smoked kiln oven were smoked with a regular turning interval until the desired product quality was produced. This took approximately 2 hours at 30 minutes for all wood species tested.



<Figure 6> Fish packed on tier of chorkor trays for smoking

Normally, fresh fish packed on ten tier trays chorkor kiln oven can be smoked for a maximum of 3 hours at an hourly turning

interval depending upon the nature of the fish species and the texture of the fish in order to achieve the golden or dark brown colour Ikenweiwe, (2010). According to Martin, (1978), herrings which have been gutted can be smoked for about 2 hours in order to achieve the preferable colours of golden and dark brown colours. Maddison et al., (1993) reported that a 71 kg of tuna could be smoked for duration of about 3 hours in order to achieve the preferred colours of golden brown or dark brown.

#### **4. The efficiency of fuel wood performance and quality of smoked fish**

Observation on the efficiency of fuel wood performance on smoked fish, showed that fuel wood species such as coconut trunk, leuceana and teak species burnt out completely after 10 hours. Others wood species such as neem and mango species took about 24 hours to burnt out. The mangrove and afre fuel wood species burnt out completely after 72 hours depending upon their sizes and dryness of the fuel wood species.

A simple mathematical analysis as shown in Table 7 below was then used to determine the efficiency of fuel wood performance on the quality of smoked fish:

1. Head load of each fuel wood species used in smoking a basket full of fish.
2. Having completely smoked out each basket full of fish, the remaining fuel wood species are quantified in monetary terms.
3. Then, the quantified left over figure is deducted from the total cost of that fuel wood species, to give the amount of fuel wood species used in monetary terms as depicted in Table7.

**<Table 7> Computation fuel wood species efficiency on smoked fish**

The cost of fuel wood species used in smoking a basket full of fresh fish	GHC 5.00
Less cost of fuel wood species remained after smoked a basket of fish	GHC 2.50
Fuel wood species efficiency performance in monetary terms	GHC 2.50

**Source:** smoked fish processors.

The study showed that mangrove fuel wood specie worthy only GHC 2.50 was enough to smoke a basket full of fresh fish. Similar calculation was done for other wood species and the result showed that the mangrove fuel wood specie was more efficient in terms of the quality of smoked fish than the Wawa fuel wood specie. Also, based on the same analysis, fuel wood species were classified as high efficiency; low efficiency; while others were also classified as good; bad; as summarized in the table below.

**<Table 8> Efficiency of fuel wood performance and classification  
on the quality of smoked fish**

Types of Fuel wood species	Amount to purchase (GHC)	Amount left(GHC )	Fuel wood Performance	Quality of fuel wood species	Fuel wood species classification
Mangrove	5.00	2.50	Excellent	Good	Golden Brown
Afre/Fuanle	5.00	2.00	High efficient	Good	Golden Brown
Rubber tree	5.00	2.00	High efficient	Good	Golden Brown
Mahogany	5.00	2.00	High efficient	Good	Golden Brown
Neem	5.00	1.00	Preferred	Good	Dark Brown
Mango	5.00	1.00	Preferred	Good	Dark Brown
Leucaena	5.00	1.00	Preferred	Good	Dark Brown
Teak	5.00	1.00	Preferred	Good	Dark Brown
Coconut trunk	5.00	0.00	Less preferred	Bad	Light Brown
Wawa	5.00	-5.00	Less preferred	Bad	Light Brown

**Source:** smoked fish processors.

For example, a head load of mangrove fuel wood specie was bought at GHC 5.00 for the experiment, and after the experiment the remaining fuel wood was quantified in monetary terms to be GHC2.50. This explains that, in real terms only GHC 2.50 amount of mangrove fuel wood specie was used in smoking a basket full of fresh fish.

A head load of wawa fuel wood species was bought at GHC 5.00

for the experiment, and after the experiment the remainder was quantified in monetary terms as GHC0.50. In real terms, about GHC 4.50 amount of wawa fuel wood specie was used in smoking a basket full of fresh fish.

From the above analysis, it was clear that the mangrove fuel wood specie is more efficient in terms of the quality of smoked fish than the wawa fuel wood specie. Also, based upon the above analysis, certain fuel wood species were declared as high efficiency; low efficiency; while others were also classified as good; bad; etc.

## **5. Combustion of fuel wood on smoked fish**

The effect of fuel wood species performance on smoked fish, allowed us to group smoked fish into different colours namely, the “golden brown; dark brown and the light brown” smoked fish colours based on consumers preferences. products that had both the golden brown and dark brown colours are considered by consumers preference best smoked fish. The low-performing fuel wood species were noted to produce light brown smoked fish which most often were not preferred by consumers.

Also, the effect of fuel wood species performance on the smoked fish made it possible to categorized the fuel wood species into “good fuel wood species and bad fuel wood species” depending upon the quantity or quality of smoke that each fuel wood species can coat the fish being smoked. Fuel wood species were considered as a “good fuel wood” if it could produce a smoke that could coat the fish into either a golden brown or dark brown. Fuel wood species were described as “bad fuel wood” if it produced a smoke that could coat the fish into a light brown colour which is normally not preferred by customers.

Leucaena species was considered as “preferred” on the fuel wood performance column and as a “good” on the quality of fuel wood

column because it produced a dark brown smoked fish.

The effect of fuel wood species performance on the smoked fish, were also grouped into: excellent; high efficient; preferred and less preferred depending upon its efficiency and performance on the smoked fish. Mangrove fuel wood species was considered as the most excellent fuel wood specie based upon its combustions on the fish. Both the coconut trunk and Wawa fuel wood species were considered the less preferred fuel wood species because their combustions produced a zero and negative performance on the smoked fish.

The fish species that the processors normally smoked comes from the beach seine fishing within their respective communities, and fishes were examined by the researcher during the experiment in the raw state before smoking to determine their local names. Then again, Kwei, (2005) was used to determine the scientific or botanical names of the fish species. The fish species being smoked include flat sardinella, cassava fish, chub mackerel, and red snapper, round sardinella, herring, skipjack and yellow fin.

The fish species can be grouped into pelagic or coastal and demersal or deep sea fish species. Pelagic or coastal fish species are the migratory species such as round and flat sardinella, chub mackerel, skipjack and yellow fin. Demersal or deep sea fish species are those found at the sea bed or close to the sea bed, which include groupers, snappers and threadfins.

## **6. Profitability and marketing analysis of smoked fish processing in Ghana.**

The study identified that for one to invest in fish processing in Ghana, he needs the following materials: land, smoke house, fish processing equipment; smoking ovens and start-up capital. The



start-up capital is also considered to be the preliminary capital which consists of the means to acquire the business land; digging of water well; buying of water tanks; construction of smoke house and store house for the fish processing business.

Table 9 below gives an overview of investment costs of smoked fish processing units in Ghana.

**<Table 9> Investment costs on smoked fish processing in Ghana**

No.	Investment/fixed materials details	Amount in GHC
1	Land acquisition (100m x 100m).	1,200.00
2	Buildings(smoking shed; store & cooling room, small office and processors' kitchens or shed)	1,000.00
3	Smoking ovens 4 chorkor smoked kiln oven with 10 tiers of trays each	500.00
4	Equipments: wire tiers, knives, cutlasses	100.00
5	Accessories such as bowls; baskets, basins, rubber buckets, etc	150.00
	Total Investment/fixed costs	2,950.00

**Source:** smoked fish processors.



## 7. Operating costs

The operating cost also includes the Fixed Cost and the Variable Cost. The Fixed Cost is the type of cost which does not change with the level of production or sales. When sales increase or decrease without a change in production, the Fixed Cost will remain the same. The Fixed Cost component of the smoked fish processing include: Land; buildings; smoking ovens; tier tray equipment, etc.

The Variable Cost is incurred only when production or sales take place and varies with output. Variable cost may include wages of hired labourers, utilities and materials used in production, etc. The component of Variable Cost of the smoked fish processing include the raw material cost (which is the fish), lantern or electricity (depending upon the location), water and packaging materials.

Tables 10; 11; 12 below give an overview of variable cost of smoked fish processing units of Ghana.

**<Table 10> Labour cost of smoked fish processing in Ghana**

No	Labour details for smoked fish	Amount in GHC
1	Manager salary (GHC400/ month): $400 \times 12$	4,800.00
2	Assistant Managers2 (GHC300X 2/ month): $600 \times 12$	7,200.00
3	Casual laboures to assist in the smoking fish charge per basket (2person* GHC 1 * 26 baskets)	15,600.00
4	Other food and drinks to serve as motivation during the fish smoking (GHC 5 X 300 days)	1,500.00
5	Total Labour costs	29,100.00

**Source:** smoked fish processors.

**<Table 11> Other Variable Cost of smoked fish processing  
in Ghana**

No	Other variable materials details for smoking fish	Amount in HC (Smoked fish)
1	Raw material cost (flesh fish 25 baskets/day x 300days x GHC 25)	187,500
2	Truck to cart the fish from the shore to the smoke house (GHC 0.20 x 26 baskets x300 days)	1,569
3	Fuel wood- mostly mangrove for smoking (2 heaps x GHC150) including storage & transport	300
4	Electricity for the year GHC 5/month	60
5	Water for the year GHC 10/month	120
6	Packaging material: (Brown papers, large baskets for loading, etc)	150
7	Maintenance and repairs: 5% on investment costs	148
8	Insurance: 2% on investment costs	30
	Total other variable costs	189,877

**Source:** smoked fish processors.

Another component of the Variable Cost aspect of the smoked fish processing is the marketing cost. Marketing cost of the Variable Cost include the transportation; sales tax, district assemble common tax, carting costs, etc. Due to occasionally hiring of people to give helping hands during fish processing, the smoked fish processing units in Ghana consider labour costs as part of Variable Cost. Table 12 below gives and overview of marketing cost component of smoked fish processing units for some processing units in Ghana.

**<Table 12> Marketing costs on smoked fish processing in  
Ghana**

No	Marketing materials details for smoked fish	Amount in GHC (Smoked fish)
1	Transportation costs to the marketing centers (GHC5 x 25 baskets x 300 days)	37,500.00
2	Sales tax: GHC 0.50 x 300 days:	150.00
3	Local council tax: 25baskets x 300day x GHC0.20	1,500.00
	Total marketing costs	39,150.00

**Source:** smoked fish processors.

## IV. Analytical Results

### 1. Profit

The Profit was classified as the income the processor received from the sales of smoked fish. Profit was identified as the main brain behind the establishment of the smoked fish processing, and it was computed by subtracting the total production cost from the sales revenue received from the sale of fish. The bottom line of calculating profit was that, all forms of costs including the start-up costs were to be considered when computing the production costs. Table 13 below gives an overview of the total costs summary of smoked fish processing units for some processing units interviewed during the study.

**<Table 13> Total Cost summaries on smoked fish processing in Ghana**

No	Cost summaries for smoked fish	Amount in GHC (Smoked fish)
1	Variable Cost	
a	Other total variable costs	189,877.00
b	Total Labour costs	29,100.00
c	Total Marketing costs	39,150.00
	Total variable costs	258,127.00
2	Total investment / fixed costs	2,950.00
	Grand total costs:	261,077.00

**Source:** smoked fish processor

Profit from the sales of the smoked fish could be “gross profit” or “net profit”. Gross profit was the total revenue received from the

sale of fish before considering the other production costs. The gross revenue from the sales of smoked fish in Ghana was computed by multiplying the number of baskets of fish sold by the price received per basket of fish received from sales.

The Net Profit was later calculated as the amount of money left after all forms of production costs were deducted. The smoked fish processors in Ghana were always anxious about the net profit because it measured the viability and efficiency of their businesses. The net profit can also be called the net returns. Table 14 below gives an overview of revenues and profits on smoked fish processing units interviewed.

**<Table 14> Revenues on smoked fish processing Ghana**

No.	Revenues for smoked fish	Amount in GHC (Smoked fish)
1	Total sales of smoked fish: 25 baskets of fish x GHC 70 X 300 days	525,000
2	Less total costs	261,077
3	Gross Profit per annum	263,923.50
4	Gross Profit per basket of fish sold	35.20

**Source:** smoked fish processors.

it was unfortunate to realise that fish processors in Ghana who earned their living through smoked fish processing considered themselves as unemployed. They mis-understood the concept of 'employment' to mean that an employed person is one that works in the formal sector and has to be neatly dressed, work in some office and come home in the evening, and earn an income at the end of every month.

The study revealed that majority of the fish processors in Ghana are engaged in gainful employment. Those that were fully engaged in

smoked fish processing earned an annual income quite substantial and well above what those entitled to a monthly salary earn.

The study also realized that the average production days for the fish processors is 300 days in a year; the average working hours during the day is 18 hours, and on the average, a smoked fish processing unit smokes and sells 25 baskets of fish in a day.

The smoked fish is sold for GHC70. The fish is also sold in a peculiar basket as a measuring unit, shown in figure below.



<Figure 9> Chopped steaks of shark and skates to be smoked

## 2. Profit margins for smoked fish in Ghana

To determine the profitability of smoked fish, the profit ( $\pi$ ) analysis equation is obtained by  $TR-TC$ .

Where,  $\pi$  = profit per basket of fish sold.

TR = Total Revenue as shown in table 14 above

TC = Total Costs, shown in the table 13 above

The results provided in table 14 above shows that profits per basket of fish is GHC 35.19 for smoked fish. The profit per basket of processed fish was obtained by dividing the total revenue by the number of sales in a year to get the daily sales revenue and further divided the daily sales by the number of baskets sold to get the revenue per each basket. This gives a total annual profit of GHC 263,923.50 for smoked fish.

## 3. Profit margin of smoked fish

Profit margin (PM) is defined by

$$PM = \frac{N.Profit}{Revenue} \cdot 100\%$$

From the profits and revenues table in table 14 the profit for smoked fish was computed to be GHC 263,923.50 and revenue for smoked fish was GHC525, 000 . This gives the profit margins of 50.27%.



#### 4. Market operational efficiency of smoked fish

The market operational efficiency (ME) was computed from the values presented in Tables 13 and 14 above and the relation

$$ME = \frac{\text{Value added by marketing}}{\text{Cost of Marketing Services}} \cdot 100\%$$

The value added by marketing was calculated by subtracting the total cost price of the fish products from the total selling price, the value added for smoked fish is GHC337,500 (Raw material cost of fish was GHC187,500 as in table 13 and revenue from the sale of smoked fish was GHC525,000 as shown in table 14) While the cost of marketing services was calculated from the total cost of rendering marketing activities such as packaging and storage processing, transportation, market taxes, handling charges, and any other marketing charges was found to be GHC 39,150 for smoked fish as shown in table 12 above.

The calculated ME-values show that smoked fish processing had a marketing efficiency of 862.07% and these efficiencies are reflections that smoked fishes have a great potentials in Ghana.

Smoked fish products were noted to have a great potential and strong marketability in the areas where information was widely available at lesser cost, transaction cost was low, and fish processors had sufficient resources to access large markets.



## 5. Return on investment of smoked fish

The Return on investment (ROI) was calculated using values from Table 14 as:

$$ROI = \frac{\text{Profit}}{TVC} \cdot 100\%$$

From table 14 smoked fish shows a profit of GHC 263,923.50 While in Table 11, the Total Variable Cost for smoked fish is GHC 186,877 The return on investment is 1.42 for smoked fish. It also means that for every GHC 1 invested in the smoked fish there is a return of GHC 1.42

## 6. Cost analysis of smoked fish processing

Cost analysis was carried out using estimates shown on Table 15. The cost per basket of raw fish for smoking was GHC 25.00. The raw fish cost was expressed as percentage of output price of smoked fish as 35.71. The raw fish cost in percentage to the total cost ratio of smoked fish was estimated as 42.08 GHC.

**<Table 15> Costs analysis for smoked fish processing units in Ghana**

	Smoked fish
Income per basket produced	70.00
Cost per basket of raw fish	25.00
Other costs per basket	9.41
Net profit per basket	35.59
Value added per basket	10.59
Value added in percent of raw fish price	42.37
Raw fish cost in percentage of total cost	42.08
Raw fish cost in percentage of output price	35.71
Other costs in percentage of output price	13.44

**Source:** smoked fish processors.

## 7. Measuring the efficiency of fuel wood performance of the quality of smoked fish

The test on the effect of fuel wood species performance on smoked fish revealed that fuel wood species such as coconut trunk, leuceana and teak species burn out completely after 10 hours; neem and mango species burn out after 24 hours, while mangrove and afre/fuanle fuel wood species also burn out completely after 72 hours depending upon their sizes and dryness.

## 8. Combustion of fuel wood

The effect of fuel wood species performance on smoked fish, enables fish to be smoked into colours namely, the “golden brown; dark brown and the light brown”. most Consumers prefer golden brown and dark brown smoked fish colours. The low-performing fuel wood species produce light brown smoked fish which most often are

not preferred by consumers. (Holden et al., 1919).

Also, the effect of fuel wood species performance on the smoked fish made it possible to categorized the fuel wood species into “good fuel wood species and bad fuel wood species” depending upon the quantity or quality of smoke each fuel wood species can coat on the fish being smoked. Fuel wood species is considered “good fuel wood” if it can produce a smoke that can coat the fish into either a golden brown or dark brown as preferred by the consumers.

Fuel wood species is also described “bad fuel wood” if it produces a smoke that can coat the fish into a light brown colour which is not preferred by customers, and is termed “preferred fuel wood” if it produces a smoke that can coat the fish into either golden brown or dark brown which is preferred by customers. Aronson et al., (1994). For example in table 4.4 above, *Leucaena* is considered as “preferred” on the fuel wood performance column, and as a “good” on the quality of fuel wood column because it produced a dark brown smoked fish.

Also, mangrove is considered as “excellent” on the fuel wood performance column and “good” on the quality of fuel wood column because it produces a dark brown smoked fish. Again, wood species *afre/ uanle* is considered as “high efficient” on the fuel wood performance column and “good” on the quality of fuel wood column because it produces dark brown smoked fish. While the *wawa* wood specie is considered “less preferred” on the fuel wood performance column and “bad” on the quality of fuel wood column because it produces light brown smoked fish (Martin, 1978).

The effect of fuel wood species performance on the smoked fish, were grouped into: excellent; high efficient; preferred and less preferred depending upon its efficiency and performance on the smoked fish. Mangrove fuel wood species was considered as the excellent fuel wood specie based upon its combustions on the fish. Both the coconut trunk and *Wawa* fuel wood species were considered less preferred fuel wood

species because their combustions produced a zero and negative performance on the smoked fish.



## V. Conclusion

### 1. Issues related to smoked fish smoking process

This study has showed that Ghana's smoked fish sector has become a center of employment for girls who could not make it through the formal sectors as a results of not being able to complete their education, these girls join the sector with various reasons including earning money for the payment of their children school fees; payment of medical bills for the family and also to assist parents or husbands, or for their own upkeep.

The use of chorkor smoke kiln oven has enhanced improvement in technology of the smoked fish processing. It has brought about numerous production advantages to the smoked fish processing which include the reduction of finger burns during the smoked fish processing; minimizing the excessive man-hours and reduced severe labour work in the smoked fish processing; and have also brought about the production of smoked fish in different colours, taste and texture that have enhanced consumers demand for the smoked fish and have added value to the smoked fish.

Despite the advantages numerated above, there are numerous health disadvantages that are linked to the smoked fish processing such as asthma; skin rashes / eczema; swelling of the eyes; piles and rheumatism. According to Chaven et al., (2009) diarrhea and skin disease is found to be rampant among fish processors during fish drying. It is also reported that fishing communities without proper sanitation spend about 6% of their time in the hospitals and medical centers compare with their counters living around the non costal communities.

## **2. Efficiency of fuel wood performance on smoked fish**

Mangrove was rated as an excellent fuel wood species on the quality performance on smoked fish because it could produce the preferred colours of golden brown that satisfy consumers need. The challenge is excessive use of mangrove in smoked fish processing may lead to depletion of wetland areas in the coastal areas and this contravenes the governments policy on wetlands management.

This issue needs to be discussed by the stake holders and the government to look into alternative substitute for the ten fuel wood species used in smoked fish processing.

## **3. Assessing the economic benefits available to the smoked fish processing in Ghana**

From the profit analysis in table 14 in chapter 5, the annual gross profit for smoked fish is GHC 263,923.50. From the table 15 below, the net profit per basket of fish of smoked fish is GHC35.59. The raw income per basket of fish as shown in the table 15 above indicates that the smoked fish has an income of GHC70 per basket Even though, in terms of production costs, the products actually pay higher production cost, the smoked fish pays higher production cost of about 9.41.

The production cost of each basket, in addition to buying the fish, is GHC 9.41, 27% of the total cost (raw fish cost being the rest, 73%) as indicated in tables 9 and 15 above, makes the smoked fish processing bit risky as every GHC 1 invested, about GHC0.73 goes into raw materials and this means that the people in Ghana rely so

much on smoked fish, therefore so sudden break in the supply of raw materials will mean no job in the area and the end result would be social vices.

On the issue of production and marketing, it was revealed that when 25 baskets go into the production also 25 comes out each day as depicted in the Tables 11 and 14 of chapter 5, also means that when 25 basket of fish is processed, an other 25 baskets more is sold out, this serves as good sign of continue in business.

On the process of value added per basket of fish, the smoked fish has 10.59 which means that for every one basket of fish processed, the smoked fish would contributed about GHC10.59 to the profit.

Then again, for every basket of fish processed, the raw fish cost in terms of percentage of total cost is about 42.08 and this means the fisheries product have the capacity to meet part of the fixed cost, which is a good sign that the fish processing is a good venture in Ghana.

In the discussing the margins, smoked fish has a market margin of 50.27% which is an indication that the fishery product show high level of profitability and resilience (Table 14), however, smoked fish is more stronger and resilient in terms of competition with other products, as a result of that many people in Ghana , find it more convenient to enter into the smoked fish processing farm.

The marketing efficiency figures (Tables 12 and 14) of 674.13 and 103.20 for smoked fish is a reflection of the potential for fish ventures in Ghana. Fish have great potentials and strong marketability in the area as information is widely available at lesser cost, transaction cost is low, and investors have sufficient resources to access large market.

The marketing efficiency figures of 862.07% for smoked fish , is a reflection that there is a ready information pertaining to the development of the market available to both the buyers and sellers, it tells how all the market player are absolutely aware about the transactions of the market. Fish have great potentials and strong



marketability in the area as information is widely available at lesser cost, transaction cost is low, and investors have sufficient resources to access large markets.

The paper shows that smoked fish processing is a profitable venture in Ghana. The smoked products are very efficient in the market operations, with smoked fish being more profitable than raw fish. Also, as the smoked fish is in high demand with added value it being practiced more in Ghana than the salted sundried fish processing.

The turn over from the smoked fish processing is faster in Ghana. As entrepreneurs want a quick turn over on their investments, they are willing to invest in smoked fish processing which has swifter turn over and higher value added. The process is claimed to be so laborious but consumers always give credit to the product and make payment instantly.

The profitability and marketing efficiency of smoked fish reveals that smoked fish is more proficient in bringing improvement into the lives of the people living around the coastal areas of Ghana.

However, on the quality of smoked fish processing as already discussed, fresh fish should not be put on the bare sand and must be thoroughly washed before smoking. The smoking process should be improved to avoid the fish from being contaminated before smoking.

The smoked kiln ovens should be improved again, as the case of the introduction of chorkor type of smoking kiln ovens which is believed to be a marked improvement over the traditional rounded mud and the oil drum ovens to help avoiding smoke related illnesses and diseases among the smoked fish processors and consumers as well as the smoking environment is full of smoke on the eyes of the smoked fish processors).

Improvement in the smoked kiln ovens will limit other health hazards in the lives of the people and cease the unnecessary body burns experienced by the smoked fish processors.



The small scale smoked fish processing in Ghana will face a challenge over fuel wood if the government does not embark on forestation program. Some fuel wood species are considered illegal although there are no alternative substitute for fuel wood in smoked fish processing. Such species which are considered as excellent fuel wood with high efficiency on the smoked fish need to be promoted for planting by creating initiatives like establishing tree nurseries and expanding wetland areas in Ghana. The government and fisheries institutions should form a participatory approach in the development of alternative substitute for fuel wood in smoked fish processing that would improve the methods of producing the smoked fish in preferred colours and textures. The lack of wholesale markets and market intelligence can be a constraint to efficient marketing. However in Ghana, there is need to improve markets for existing products.

## **General recommendations for development of fisheries sector in Ghana.**

### **Development of Consumer Demand**

Nowadays, the practice of fish avoidance in Ghana is diminishing as the result of civic education and intensified fish promotion run by the Fisheries Department. There is however need to promote the wider use of smoked fish products in the diets of people dwelling in the remote parts of the country, as well as in parts where people were historically not fishermen. In all of these areas there are traditions of fish avoidance, yet at the same time there exist problems of malnutrition, sometimes acute, that should be ameliorated. The market for smoked fish products should be organized on a fairly modest scale without heavy funding requirements. The Department should aim at maintaining maximum contact between extension workers in Fisheries,

Health, and Agriculture (Home Economics) which are key to success for any consumer demand development program. This could be most efficiently secured through a concentration on institutional and public contexts of interaction, such as schools, clinics, marketplaces, and the like. Distribution of sample products in order to gauge and cultivate consumer acceptance, and the use of fish products in food-for-work schemes such as those sponsored by the WFP, might be considered as well. Both UNICEF and WFP involvement could be sought to help with such tactics.

The policy makers should develop a policy with the aim of developing a training syllabus for teaching institutions of all descriptions, from primary to university and technical school level. Obviously it would be desirable to co-ordinate product promotional efforts in this program.

The development of a market for fish powder, as distinct from fish itself, is a task that should be undertaken throughout Ghana as a whole. The idea of introducing or expanding the use of fish products as a protein base in infant weaning foods should be encouraged. Fish powder technology proposal will be more efficient in encouraging effective utilization of small-sized species like *Sardinella*. Linkage between the latter and a promotional program to upgrade diets through greater consumption of fish products could yield substantial benefits in terms of national nutrition welfare.

## **National Fisheries Policy and Planning**

It is imperative that a comprehensive statement of policy covering the future development of the national fisheries be elaborated, with particular regard to the respective roles to be played by the small-scale artisanal sector and medium-scale commercial sector in fish harvesting, processing, and marketing. Current policy statements

are rather vague on specifics, and leave the impression that government wants to encourage the interests of both sectors without really coming to grips with the competitive relations and inconsistencies that are involved. Equally it is hoped that government authorities will move to establish a policy aimed at promoting further development of commercial fish processing firms. Fish is highly perishable and requires to be processed in order to avoid post harvest losses. These huge losses should be curbed since the fishery situation is already facing over-capacity which threatens the ability of the standing stocks in Ghana to withstand additional fishing pressure.

In order to reduce post-harvest losses, the Ghanaian government should come up with a policy that encourages investment in fish processing. The government in collaboration with the private sector should come up with ways of providing credit to the artisanal processors and traders at low interest rate to spur growth in the fish marketing and trade chain. The low interest rates will allow greater uptake of funds to invest in fisheries trade and processing activities for income generation, particularly for women and poor households.

## **Transportation infrastructure**

The single greatest obstacle to the wider domestic and regional distribution of fish and fish products in Ghana is the extremely deficient state of the road network. At all times the road conditions and poor transport links in general contribute to product wastage and limit the distribution of smoked fish products. Bad roads increase the marketing margins as transporters/wholesalers recover the high cost of vehicle maintenance from consumers. Although most road works and rail and steamer system rehabilitation must be planned and financed at the macro-level, the possibility of effecting improvements in landing site feeder road connections and small-scale waterborne transport services

through community level actions should be considered.

## **Tariff barriers**

Tariff barriers continue to hamper fish trade despite efforts of regional bodies to introduce preferential trade policies for their member states. Common trade policies are essential. Customs duties and other formalities in the sub-region need to be re-examined to reflect an Economic Committee of West African States (ECOWAS) standard. Therefore, to have an effective inter-regional trade in fishery products, the simplification and harmonization of tariff structures should encompass the sub-region. Besides, any meaningful expansion of inter-regional fish trade would require liberation of trade policies.

## **Fish Technology Division**

Quality control for the fisheries in Ghana is the primary responsibility of the Fisheries Department. This study proposes that an independent division be created that will operate the Fish Technology Laboratory. The aim of this division will be to conduct research and set fish quality standards for both domestic and international markets. The Division will be responsible for promoting optimal utilization of fish resources through product development, recommend improved methods of fish handling, processing, and marketing. In addition, the Laboratory will be supposed to serve an extension role with regard to the dissemination of information on research results and the general education of the public on matters relating to fish handling and utilization. In order for it to deliver on its mandate, the Laboratory should be adequately funded, stocked with essential facilities and hire qualified and experienced personnel.

## **Market information**

Market information is a vital factor for efficient production planning. It is one of the most important factors in increasing efficiency in an industry dealing with highly perishable goods like fish. The lack of wholesale markets and market intelligence can be a constraint to efficient marketing. However in Ghana, there is need to improve markets for existing products. It is recommended that a study be undertaken on aspects such as market price trends, product quality and price relationship, seasonality of product supply and product packaging. Information from market research will make it easier to identify supply gaps, the planning of supplies to markets where or during periods when prices are highest. This will also provide the basis for improving product quality and packaging in order to meet existing and potential market demands. The market information should include where the demand is greatest, where it is likely to achieve greatest level of sales on a regular basis and in the shortest period of time. Hence the collection and publishing of information on market trends and opportunities will stimulate the sales of fish to the benefit of the industry. The smoked fish processing industry needs to be structurally organized so that these products get to the potential markets in time given their relatively short shelf life.

## **Landing sites, markets, and the organization of trade**

Faulty fish handling practices along the distribution routes compound those that have already occurred at the landing site, resulting in further loss from breakage and spoilage to fresh and cured products before they can reach the consumer. Loads of fish in the back of pick-ups often serve as a platform for other heavy cargo and passengers to rest upon. Dried and especially smoked pieces of table fish are frequently packed in large open-weave baskets which offer no

protection from dust, rain, or insect infestation, and which weigh so much (100 kg and more) that their contents tend to get crushed and fragmented. The conditions under which fish are kept and offered for sale at final market points for the most part merely extend this pattern of indelicate handling that began at the landing site. Whilst improvements in handling need to be made throughout the distribution network, they would be to little avail unless a start was first made at the landing site level. Product damage inflicted during handling at that early stage is impossible to rectify at any later stage. Major market centers throughout Ghana lack adequate receiving and bulk storage facilities for either fresh or cured fish, a situation which impedes the development of a true wholesaling sector within the marketing system. Bulk assembly, transport, and storage/distribution of smoked fish products could effectively be managed by relatively small numbers of dealers in the chief fisheries regions if they operated on a sufficiently large scale and restricted their activities only to these functions. The likely gains to be realized from this clearer separation of wholesale and retail trade include cheaper and steadier supplies of fish to principal nodal points in the distribution system and better opportunities for fish to penetrate into retail outlets further afield. For such arrangements to evolve however, requires joint action by the local authorities responsible for market administration and development on one hand, and the traders who would run wholesale operations on the other. It is possible that the traders themselves could better look after their interests through the formation of a wholesalers' association.

Whilst improvements in transport links would do much to ameliorate the situation, other impediments to effective distribution of fish products also need to be attacked through project action at the community level. In terms of marketing organization, a true wholesaling sector needs to be created so that both fresh and processed fish can reach a wider range of consumers at reasonable



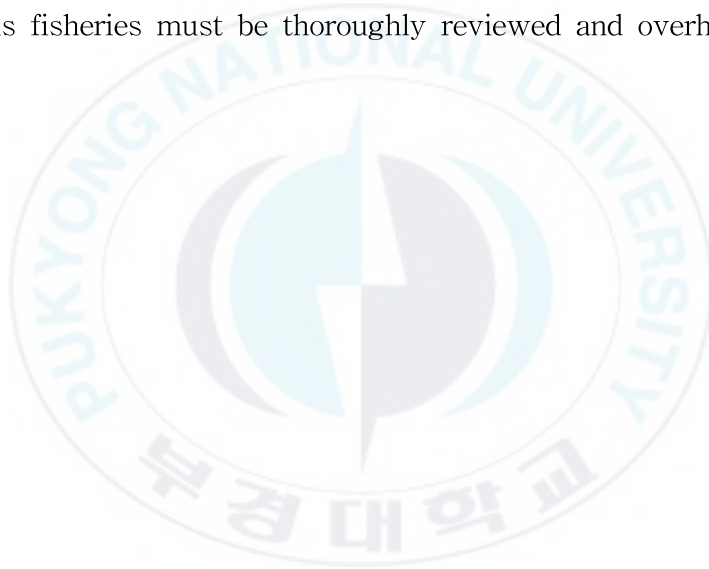
prices.

Improved physical facilities and handling practices are also long overdue. As indicated above, most landing and trading places, whether old and formally established or new and informal, feature very rudimentary facilities. Unhygienic handling practices are the rule rather than the exception. Cemented and roofed receiving stations and clean water supplies are rare. Washing and gutting slabs or sheds are generally lacking, as are adequate drying racks, salting vats, and fish stores. Smoking kilns are generally of poor design, resulting in imperfect curing and highly inefficient use of firewood, supplies of which are dwindling to critical levels in some areas. At all points along the chain of distribution, fish products are exposed to rough treatment, with little or no provision being made to protect them from contamination or insect infestation.

## **Other issues**

The role of fish products in promoting nutritional welfare countrywide cannot be over emphasized. It is also suggested that suitable agencies; national and international, governmental and non-governmental, serve as channels for project undertakings. In most cases, it would be appropriate to have the FAO serve as executing agency, given the experience and skills it can draw upon through its fisheries department. In terms of funding sources, as always the sticking point, it can only be suggested that consultations be held with those countries and agencies that recognize the critical importance of the fisheries and have either assisted similar sectorial development work in Ghana or other African countries in the past or may have some interest in doing so in the future. A wide range of other issues warrant urgent attention by policy analysts and planning personnel. For example, a comprehensive review needs to be carried out for

existing management structures and enforcement procedures for the major fisheries. That is, novel and more effective systems of revenue generation for the support of fisheries research, extension, and administrative services, and for the development and maintenance of local landing sites and markets need to be elaborated and put to practical test. Innovative approaches such as the designation of controlled fishing zones as exclusive breeding and conservation areas, special use of commercial areas, and community - controlled territorial - use - right - for - fishing (TURF) areas should be considered and tried; and regulations pertaining to gear types and mesh sizes within the various fisheries must be thoroughly reviewed and overhauled.





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