



Technology Adoption and Economics of small-scale Fish processing in the Nzema East District of Ghana. The Case of Smoked Fish

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TECHNOLOGY ADOPTION AND ECONOMICS OF SMALL SCALE FISH PROCESSING IN THE NZEMA EAST DISTRICT OF GHANA. THE CASE OF SMOKED FISH.

ABSTRACT:

This paper looks into the preservation methods available to the small scale smoked and salted sun-dried fish processor in the Nzema East district of Ghana. The paper also examines the effect of fuel wood performance on the quality of smoked fish in producing the preferred fish texture and taste to meet consumer demand; assess the profitability of small scale smoked fish processing; and compare smoked fish with the salted sun-dried fish processing in the Nzema East district of Ghana. The data for the paper include experimental tests of smoked fish processing at selected smoked fish processing units to assess the performance of different types of fuel wood used in smoked fish processing; focus group discussions which were carried out with selected producers of salted sun-dried and smoked fish in the Nzema East district. The secondary data used in this study was information obtained from the literatures studied, website information and reports from other fisheries institutions/ organizations. Other information was obtained through personal communications with smoked fish processors.

From the experimental tests, various forms of fuel woods tested were grouped into “bad” and “preferred” fuel woods. Mangrove was found to be excellent in producing the consumer preferred colours of golden brown or dark brown, while wawa produced the not preferred colours of light brown. Profitability analysis such as profit and profit margins were calculated and market margins and efficiency to assess the market performance of the small scale smoked fish and compared with the salted sun-dried fish processor in the Nzema East district of Ghana. The results showed positive profits and margins.

Key words: profitability analysis; market efficiency; wood efficiency; operational efficiency

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CHAPTER ONE

INTRODUCTION

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 km², 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 Efaso, on the Western border with Ivory Coast as indicated by the dashed line in Figure 1.1. 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.

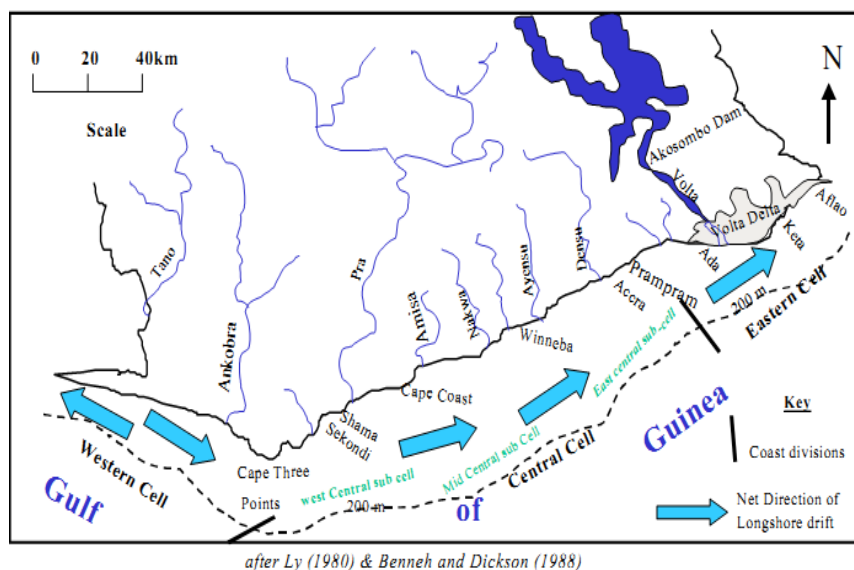


Figure 1.1: The coastal morphology and inland fishery waters of Ghana (Benneh& Dickson, 1988)

Fishing vessels in Ghana are divided into three categories: industrial vessels, semi industrial vessels and canoes.

The industrial vessels are offshore or distant waters fishing vessels which with 30 – 200HP diesel engines. In Ghana, the industrial vessels are supposed to operate beyond the 50m deep but most of the time competing with the canoes on the shallow waters. As at 2006, there were 61 industrial vessels contributed to 6% of the total annual marine catch (Anon., 2007)

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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. (Anon., 2010).

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 (Kwadjosse, 2007).

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 50depth 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. (Anon., 2008).

Fish caught from the ocean 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 available in Ghana, and these include salted sun-dried; cool storage; canning; freezing and smoking. This study focuses on the smoked fish processing and preservation among the people living in the Nzema East district of Ghana where the people use smoked fish processing as a way of fish preservation.

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Study Area:

The Nzema East district has an area of 2,194 km², a coastline of 70 km stretch of sandy beaches with a total population of 74,321 people. The study area lies between latitudes 9° and 10° N, and longitude 0° and 2° W see figure 1.2 below.

There are 16 fish landing sites and 388 small-scale smoked fish processing plants in the Nzema East district of Ghana; 604 small scale food processing units; and 725 edible oil processing units; all scattered over the district.

Marine fishing and smoked fish processing are the main occupation of the people living in Nzema East district of Ghana, and this has resulted in an influx of women from other towns and cities in Ghana into the district to seek employment and other economic activities in the Nzema district.

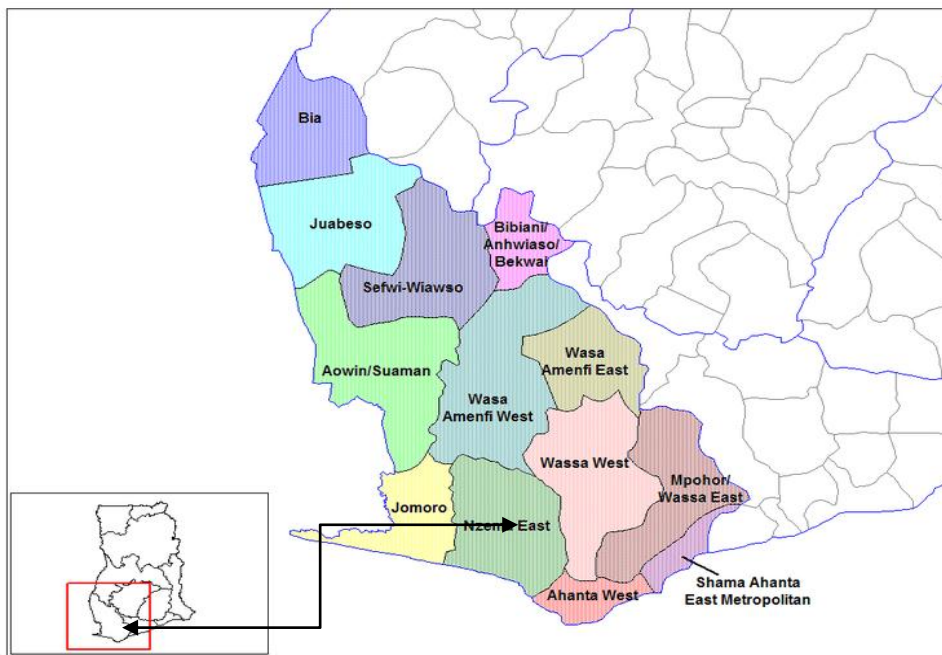


Figure 1.2: Map of Ghana showing the districts of the Western Region with an arrow pointing to the Nzema East district (Wikimedia, 2011)

The aim of this study is to examine the effect of fuel wood performance on the quality of smoked fish and to assess the profitability and market performance of the small scale smoked fish and compare with the salted sun-dried fish processor in the Nzema East district of Ghana.

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The primary data used in this study include number of smoked fish processing experimental tests that have been done at the smoked fish processing units to assess the performance of different types of fuel wood used in smoked fish processing; including focus group discussions which were carried out with the producers of smoked and salted sun-dried fish in the Nzema East district and the authors communications with smoked fish processors. The source of secondary data used in this study was information obtained from the literatures studied, website information and reports from other fisheries institutions/ organizations.

The methods used in this study include experimental tests at the smoked fish processing units to ascertain the kind of fuel wood used during field visit and how specific colours are obtained to meet the preferred customer need. The methods also include focus group discussions at the processing units to be abreast with what entails in the computation of profitability and market efficiency

To be able to achieve the three main objectives, the paper is consisted of eight chapters. The chapter one (chapter one) is the introduction of Ghana's fisheries resources. Chapter two provides the smoked fish technologies applied in Ghana, while chapter three covers the methodology and data analysis on fuel wood performance, leading to chapter four which covers the data analysis on investment costs of smoked fish and salted sun-dried fish processing and chapter five deals with the results of the research. Chapter six of the paper has the discussions, while chapter seven has the conclusion and the reference.

1.1 Background into the state of Ghana's fisheries:

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 between the periods 2000-2006 as indicated in the reported total fish catch as seen on table 1.1 below (Anon., 2008).

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Table 1.1: Fish Production in Ghana between the years 1997-2007 (Anon., 2008)

Year	Marine	Inland	Total Fish Landing
1997	395,889	76,200	472,039
1998	376,361	76,300	452,661
1999	332,641	89,400	422,041
2000	379,793	87,500	467,293
2001	365,741	88,000	453,741
2002	290,008	88,000	378,008
2003	331,412	82,450	413,862
2004	352,405	82,450	434,855
2005	322,789	82,654	405,443
2006	323,617	83,168	406,784

1.2: Contributions of fisheries in the Ghanaian economy:

Fisheries provide direct employment to about 2.2 million people in the country of Ghana, and it is currently contributing 4.4% to the Gross Domestic Product of Ghana and is more than the contribution of cocoa which is supposed to be the main traditional contributor to the GDP of Ghana (Anon., 2008).

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, as per table 1.2 indicated below (Anon., 2008).

Table 1.2: The contribution and share to Gross Domestic Product by kind Economic activity (Anon., 2008)

	Share of GDP			Contributions to the national Growth		
	2005	2006	2007	2005	2006	2007
Agriculture	36.0	35.4	34.7	1.5	1.6	1.4
Crops and Livestock	23.8	23.0	22.7	0.8	0.8	0.9
Cocoa Production &Marketing	4.6	4.4	4.3	0.6	0.1	0.2
Forestry and Logging	3.6	3.4	3.3	0.2	0.1	0.1
Fishing	4.1	4.4	4.4	-	0.7	0.2

From Anon., (2008) 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

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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 2006, fish realized a foreign income of about \$40,000,000 from the sale of about 10,000 tons of fish and fish products (Anon., 2008).

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 (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 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.

CHAPTER TWO:

SMOKED FISH TECHNOLOGIES IN GHANA:

According to Brownell et al., (1983), among the numerous reasons why fish is smoked include; to increase the shelf life of the fish; to enhance the flavour of the fish in soups and sauces; to reduce waste in times of abundant harvest; to preserve the fish for future use; to increase the protein intake among the people; and to make packaging easy for transportation to urban market centers.

According to Sirra, (2000) one of the methods for fish processing is the application of smoke during fish smoking. There are chemicals in fuel wood which improves flavour, increases the utilization of the fish and promotes its shelf life; then again, the fuel wood used in smoking creates heat and fire which dries the fish.

2.1 The overview of smoked fish processing methods available in the Nzema East district of 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 (Koranteng, 1993).

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 (Brownell et al.,1983).

2.2 Forms of smoked fish processing available in the Nzema East district of 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 (Anon., 2007).

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The Table 2.1 below explains the two types of fish smoking processes which are practiced in the Nzema East district of Ghana, depending upon the type and texture of the fish being smoked, and also depends upon the consumers' preference.

Table 2.1: Forms of smoked fish processing available in the Nzema East district of Ghana (Anon., 2007)

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%

2.3 Stages of fish smoking: The technology in smoked fish processing in the Nzema East district of Ghana may differ from processor to processor in terms of equipments and environment but it must satisfy the set standards for dry hot smoked processing as depicted in Table 2.2 below (Anon., 2007).

Table 2.2: The three stages of smoked fish processing (Anon., 2007)

1st Stage: The cooking stage	2nd Stage: The drying stage	3rd Stage: The Smoking 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.	Here the fire produces heat that is enough to dry the fish at this stage of smoked fish processing.	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 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 the Nzema East District, 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.

2.4 Methodology adopted for entry into the study area:

An enquiries made at the Nzema East district Assembly indicated that there were 388 smoked fish processors in the Nzema East district which is predominantly women who are scattered all over the coastal communities in the district.

Study trips were made into 15 coastal communities in the district to meet every individual smoked fish processor who smokes not less than 25 baskets of fresh fish a day for dialogue discussions and by the end of the visit, three major smoked fish processors who have been in the smoked fish processing business for about 20 years and smokes a minimum of 25 baskets of fresh fish a day had been met.

Again experimental tests were conducted at the processing units of these smoked fish processors to access the effectiveness of fuel wood species on the quality of smoked fish as explained in the chapter 4 of this paper.

Also, smoked fish processing in the Nzema East district of Ghana is a profitable venture because a basket of flesh fish is purchased at GHC 25, which is processed and sold for GHC70 per basket, with a net profit of GHC 35.59 as analyzed in chapter 5.

Analysis was also made on the salted sun-dried fish which is seldom practiced in the district. Salted sun-dried fish processing is profitable in the study areas, but smoked is mostly practiced because it is in high demand and less laborious, so on the average 25 baskets of fresh fish would be processed in a day, and also sell 25 basket of smoked fish a day compare with salted sun-dried fish which uses the fresh fish that has goes bad and this serves as discouragement from consuming the product.

The smoked fish processors are very much aware about the lean season, and in order for them to stay in business during the lean season, they travel to other coastal communities to buy fresh fish for processing and storage to be resold to meet future demand during the lean season.



Figure 2.1: Turning time of smoked fish at the processing unit on chorkor kiln oven (Field visit, 2011).

2.5 The overview of salted sun-dried fish processing methods available in the Nzema East district of Ghana:

The people of Nzema East district of Ghana, mostly engaged in the smoked fish processing than the salted sun-dried fish as mentioned earlier, because the salted sun-dried fish preservation is facing lots of quality challenges and also due to the laborious nature of the preservation process.

The salted sun-dried fish preservation business has the potential of creating jobs, improve food security, create incomes and enhance nutrition during the lean fishing season, if the processing technology is improved (Abila, 1997).

Salted sun-dried fish preservation suffers severe post-harvest losses during the rainy seasons. Another eminent post-harvest loss is the numerous spoilage of the product due to fat and protein degradation from hydrolysis and proteolysis, making the whole product low quality with poor marketing (Dampha et al., 1995).

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Table 2.3: Stages of salted sun-dried fish processing (Bille et al., 2006)

Stages	Methods	Details
1 .	Chilling	Fish are preserved immediately after being caught from the ocean at -4°C before the process of salted sun-dried begins.
2 .	Preparation	Fish are washed to clear of dirt and other unwanted materials on the fresh fish.
3 .	Brining	Fish is soaked in about 2% salt water solutions for 15 minutes or more.
4 .	Dripping	Fish are taken out from brining but put in a basket to allow the salt solution to drip out.
5 .	Drying	Fish are spread on either coconut/palm branches or raffia/rubber mat for racking in the sun for several days.
6 .	Storing	Fish are taken from being dried in the sun for several days and kept in the store house.
7 .	Packaging	Fish are being packed in the baskets for sales at the salt sun-drier fish market.

The way in which the salted sun-dried fish is dried any where in the sun including the beaches, rocks, grass, or sand during the preservation processes contributes in making the salted sun-dried fish harmful for human consumption with lots of dirt and strange materials not meant for human consumption Anon.,(1998). Another reason why many fish processors do not undertake salted sun-dried fish processing is as a result of the seven stages painstaking processing methods as described in the Table 2.3 above.

2.6 Fisheries marketing:

Fish trading, including fresh and smoked fish products, in the Nzema East district in Ghana have increased significantly over the years. Most of the smoked fish processors in the Nzema East districts send their products to the fish markets at Ainyinasi fish market; Ellubo border market and Tikobo-Number-One fish market. These marketing centers are within the middle of the nearby districts which have no access to the sea but within the travelling distances of between 20km - 70km depending upon the location of a particular smoked fish processor.

There are number of faraway large smoked fish markets in Ghana such as the Kedjetia fish market in Kumasi; Wenchi Market; AgonaNkwanta fish market; Techiman fish market, just to mention few. These marketing towns are in the middle of Ghana with no access to the sea so the

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marine smoked fish is an important product to the people living in and around these marketing towns. And through the research it came out that about 100 out of the 388 small scale smoked fish processors from the Nzema East districts send their smoked fish products to far away distant markets such as AgonaNkwanta market; Kedjetia fish market in Kumasi and Techiman fish market.

About 25 smoked fish processors from the fishing communities in the Nzema East district also send their products to the regional markets such as Denu market on the Ghana-Togo border, Togo, Nigeria and Benin. These are countries that share a common border with Ghana. Fish sales at these market centers are at the retail level. Smoked fish producers from Ghana retail their products to the buyers in these countries who will also retail them in their respective countries (Gordon et al., 2011).

Even though, marketing information is not readily available to the small scale Ghanaian fish producers. Smoked fish producers normally use their experience and knowledge of the fish marketing system to store their smoked fish products for a very long time hoping for a better future price. This practice can sometimes lead to fish spoilage due to inappropriate storage facilities (Essuman et al., 1992)

Cost of transporting the fish product to the 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 to marketing centers, smoked fish producers usually travel in groups during specific marketing days in one truck load of fish 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.

CHAPTER THREE

METHODOLOGY USED AND DATA COLLECTION.

3.1 Good fuel wood to produce the preferred taste and colours in smoked fish:

According to Osuji, (1976) hot smoked fish has a longer shelf life and very tasty. The smoke from the fuel wood deposits tars, aldehydes and phenols which protect the fish from developing micro-organism. On the contrary, the components in the smoke have negative health effects on humans including the probability of causing cancer and other health related diseases (Garrow et al., 1994).

The aroma of the smoked fish depends upon the magnitude of smoke that has coated with the fish. The smoke establishes the colour; the colour heavily relies on the type of fuel wood used in smoking the fish and also on the smoking method applied in fish smoking (Anazonnwu- Bello, 1976).

To determine the effect of fuel wood species on the excellence of smoked fish, series of tests were conducted in the Nzema East district of 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

The criteria used in the selection processes for smoked fish processing units during the experimental tests and dialogue discussions were

- To pre-select processing units that smoke a minimum of 25 baskets of fresh fish (round fish and not fillets) in a day from the 388 smoked fish processing units in the Nzema East district of Ghana
- To meet at least, one smoked fish processing unit in the Nzema East district that have been in the smoked fish business for a period of not less than 20 years.

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- To conduct familiarization tour within the coastal fishing communities in the district including Ankobra; Asanta; Kikam; Esiam; Anyianzinli; Sanzulley; Krisan; Eikwe; Nralekyi; Nrale-kpole; Baku; Ekabaku; Benyin; Akonu and Atuabo to ascertain the smoked fish processing units that would fit into the criteria of smoking 25 baskets of fresh a day.

At the end of the familiarization visit 200 out of the 388 smoked fish processing units were found to meet the criteria of smoking a minimum of 25 baskets of fish in a day, and these were selected for the group dialogue discussions about the economics of smoked fish over other fish processing such as salted fish in the district.

Also, out of the pre-selected 200 smoked fish processing units, there were the final three smoked fish processing units selected for the investigative experimental tests on comparative study on good fuel wood performance based upon years of experiences of being in the business. The figure 4.1 below shows experimental test on the effect of fuel wood species on smoked fish at one of the processing units.

The final three smoked fish processing units selected for the experimental tests were Eduku Nyanzu's smoked fish processing unit at Asanta; Maame Asafua's smoked fish processing unit at Kikam and Auntie Ndakeleba's smoked fish processing unit at Eikwe. These units are located at about 10 km, 15km and 25 km respectively from Axim, which is the district capital of the Nzema East district and a major fishing center in the district.

Data compiled for this study was obtained from the familiarization tour, experimental tests and various dialogue discussions held with the smoked fish processors living along the coastal communities in the Nzema East district of Ghana, while the source for the secondary data came from literature reviewed from resource centers including the internet and institutions and organisation.



Figure 3. 1: Chorkor smoked oven with fish on tier trays for smoking (Field visit, 2011)

3.2: Experiments on the effect of fuel wood on the quality of smoked fish:

The test on the effect of fuel wood on the quality of smoked fish was performed at Eduku Nyanzu's smoked fish processing unit at Asanta. This processing unit was chosen based on the following criteria:

1. The proprietors for Messrs Eduku Nyanzu's smoked fish processing unit have managed this unit for well over 40 years. Also this smoked fish processing unit has a strong smoked fish processing team of 5 permanent members with each of them having worked with this same unit for over 25 years.

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2. This smoked fish processing unit is the only unit that smokes a minimum of 100 baskets of fresh fish in a dayweek amongst all the 388 smoked fish processing units visited in the Nzema East district.



Figure 3.2: Heaps of mangrove fuel wood ready for fish smoking (field visit, 2012)

Through focus group discussions, the 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 3.1.

There are about ten different kinds of fuel wood species used for smoked fish processing in the Nzema East district of 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

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smoked fish, and the processors buy particular kind of fuel wood based on preference and choice.

Table 3.1: Ten fuel wood species used in smoked fish processing (Field visit, 2011)

Common English Names	Common Local Names
Mango	Amango baka
Coconut trunk	Kukue baka
Wawa	Egunli / Ebitiye
Mahogany	Mahogani
Mangrove	Nrateke
Neem	Anwe gyan
Rubber tree	Worobaka
Afre/Fuanle	Afre/Fuanle
Teak	Tiek
Leucaena	Egyani

Then also, according to the smoked fish processors there are other forms of fuel wood species which they called “fire lighters”, which cannot be used as stand alone 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 3.2 below:

Table 3.2: Supporting fuel wood species in smoked fish processing (Field visit, 2011)

Common English Names	Common Local Names
Coconut branches	Kukue erlake
Coconut husks	Kukue abunle
Palm branches	Arele mlake
Shrubs	Ngleka

After the smoked fish processors have specified the type of fuel wood species that could be used, a head load of each fuel wood species which is about 30 kg was ordered for the test and each head load of fuel wood species has a different price based upon its performance proficiency and importance.

The prices of fuel wood ranged between GHC 3.00 and GHC 10.00 with 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 are the least prices of GHC 3.00 respectively. However, for the purpose of the experimental test, a head load of each fuel wood species was purchased at an agreed average price of GHC 5.00 each.

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After acquiring a head load of each fuel wood species, two chorkor kiln ovens with a one tier tray each were secured from Eduku Nyanzu's smoked fish processing unit for the experimental exercises. Each of the chorkor kiln oven had two separate combustion chambers for smooth and easy fire set so that two different fuel wood species could be experimented in a day. The experimental test lasted for 5 days.



Figure 3.3: Local fishermen selling fish to the smoked fish processors in a measured blue bag (Field visit, 2011)

At the Nzema East district of Ghana, fresh fish were sold in a peculiar measured basket or blue bag as shown in figure 4.3 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 3.4 below. Basin of fresh fish sold at GHC50.00 per basin. Comparatively, the processors from the Nzema East district prefer fish sold in a basin to the fish sold in a basket or blue bag because the basin as a unit measure is more economical than the basket as a unit measure.



Figure 3.4: Fresh fish sold in basins outside the coastal area of the Nzema East district (Field survey, 2011).

Anytime experimental test is being ran to test the effect of each fuel wood on the quality of smoked fish, a basket full of fresh fish would be purchased, and ten baskets of fish were purchased to run ten separate tests involving ten separate fuel woods.

Every combustion chamber of chorkor kiln oven was packed with a basket full of fresh fish on a one tier tray for the test as shown in figure 3.5. The packed fish on each of tier tray chorkor smoked kiln oven was smoked for 2 hours at 30 minutes turning interval (*please see a picture of fish turning time in figure 2.1*) during the experimental test, using the dry smoke methods.



Figure3.5: Fish packed on tier of chorkor trays for smoking (field visit, 2012)

Normally, fresh fish packed on ten tier trays chorkor kiln oven can be smoked for a maximum of 8 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), but that was not the case during the experimental test due to the number of the tier kiln oven.

According to Martin, (1978), herrings which have been gutted can be smoked for about 2.5hours in order to achieve the preferable colours of golden and dark brown colours. Maddison et al., (1993) reportedthat 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.

3.3Measuring the efficiency of fuel wood performance on the quality of smoked fish:

During the experimental test on the effect of fuel wood species performance on smoked fish, it was observed that certain fuel wood species such as coconut trunk, leuceana and teak species were burnt out completely after 10 hours, others such as neem and mango species were also

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burnt out after 24 hours, while others such as mangrove and afre fuel wood species burnt out completely after 72 hours depending upon their sizes and dryness of the fuel wood species.

However a simple mathematical analysis as shown in Table 3.3 below was used to determine the efficiency of fuel wood performance on the quality of smoked fish:

- 1 Head load of each fuel wood species was used in smoking a basket full of fish.
- 2 Having completely smoked out each basket full of fish, the remaining fuel wood species was 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 Table 3.3.

Table 3.3: Computation fuel wood species efficiency on smoked fish –mangrove (Field visit, 2011)

The cost of fuel wood species used in smoking a basket full of fresh fish:	GHC5 . 00
Less cost of fuel wood species remained after smoked a basket of fish:	GHC2 . 50
Fuel wood species efficiency performance in monetary terms:	GHC2 . 50

Table 3.4: Efficiency of fuel wood performance and classification on the quality of smoked fish (Field visit, 2011)

Types of Fuel wood species	Amount purchased for the test run (GHC)	Amount left after the test run (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

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, it means 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 on 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.

4.4 Combustion of fuel wood on smoked fish:

The effect of fuel wood species performance on smoked fish, allows grouping of smoked fish into colours namely, the “golden brown; dark brown and the light brown” smoked fish colours as preferred by consumers were both the golden brown and dark brown colours being preferred as the best smoked fish. 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 can be considered as a “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 as “bad fuel wood” if it produces a smoke that can coat the fish into a light brown colour which is not preferred by customers.

For example Leucaena 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.

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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 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 come from the beach seine fishing within their respective communities, and fish 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 which are found at the sea bed or close to the sea bed, which include groupers, snappers and threadfins (Koranteng, 1998).

CHAPTER FOUR:

DATA ANALYSIS ON INVESTMENT COST FOR SMOKED AND SALTED SUN-DRIED FISH PROCESSING IN THE NZEMA EAST DISTRICT OF GHANA.

4.1 Profitability and marketing analysis of smoked and salted sun-dried fish processing in the Nzema East district of Ghana:

Before entering into the smoked and salted sun-dried fish processing there should be available fund to invest in the business. The amount of fund to be invested in the fish processing will depend upon the type of business enterprise one wants to venture being smoked fish, salted sun-dried fish processing, and how big one wants it also whether small scale or large scale.

The investment materials needed for smoked and salted sun-dried fish processing in the Nzema East district of Ghana include land; smoke house, fish processing equipments; 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 4.1 below gives an overview of investment costs of smoked and salted sun-dried fish processing units for Messrs Asafua and Ndadeleba processing units respectively in the Nzema East district of Ghana.

Table4.1: Investment costs on smoked and salted sun-dried fish processing for Messrs Asafua and Ndadeleba processing units respectively in the Nzema East district of Ghana (Field visit, 2011).

No.	Investment/fixed materials details:	Amount in GHC(Smoked fish)	Amount in GHC(Salted sun-dried fish)
1	Land acquisition (100m × 100m) :	1,200.00	-
	Land acquisition (100m × 150m) –Mostly sun dried at the beaches, almost for free:	-	150.00
2	Buildings(smoking shed; store & cooling room, small office and processors’ kitchens or shed):	1,000.00	200.00
3	Smoking ovens 4 chorkor smoked kiln oven with 10 tiers of trays each:	500.00	-
	Tarpaulin (to serve as drying racks for drying the fish on in the sun):	-	500.00
4	Equipments: wire tiers, knives, cutlasses.	100.00	10.00
5	Accessories such as bowls; baskets, basins, rubber buckets, etc:	150.00	50.00
	Total Investment/fixed costs:	2,950.00	910.00

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4.2 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 equipments, 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 and salted sun-dried fish processing include the raw material cost (which is the fish), lantern or electricity (depending upon the location), water and packaging materials. Tables 4.2; 4.3; 4.4 below give an overview of Variable Cost of smoked and salted sun-dried fish processing units for Messrs Asafua and Ndakeleba processing units respectively in the Nzema East district of Ghana .

Table 4.2: Labour cost of smoked and salted sun-dried fish processing for Messrs Asafua and Ndakeleba processing units respectively in the Nzema East district of Ghana (Field visit, 2011).

No:	Labour details for smoked and salted sun dried fish:	Amount in GHC(Smoked fish)	Amount in GHC(Salted sun-dried fish)
1	Manager salary (GHC400 /month):	4,800.00	2,400.00
2	Assistant Managers-2 (GHC 300X 2/month):	7,200.00	2,400.00
3	Casual labourers to assist in the smoking of fish-charge per basket (2 persons x GHC1 x 26 baskets):	15,600.00	-
4	Other food and drinks to serve as motivation during the fish smoking (GHC5X300 days):	1,500.00	-
5	Total Labour costs:	29,100.00	4,800.00

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Table 4.3: Other Variable Cost of smoked and salted sun-dried fish processing for Messrs Asafua and Ndadeleba processing units respectively in the Nzema East district of Ghana (Field visit, 2011).

No:	Other variable materials details for smoked & salted sun-dried fish	Amount in GHC(Smoked fish)	Amount in GHC(Salted sun-dried fish)
1	Raw material cost (flesh fish 25 baskets/day x 300days x GHC 25):	187,500	-
	Raw material cost (flesh fish 5 baskets/day x 300days x GHC 5.00):	-	7,500
2	Truck to cart the fish from the shore to the smoke house (GHC 0.20 x 26 baskets x300 days):	1,569	-
	Carting the fish from the shore to the processing house (GHC 0.20 x 5 baskets x300 days):	-	300
3	Fuel wood- mostly mangrove for smoking (2 heaps x GHC 150) including storage & transport :	300	50
4	Electricity for the year @GHC 5/month:	60	60
5	Water for the year @GHC 10/month:	120	50
6	Packaging material: (Brown papers, large baskets for loading, etc):	150	100
7	Maintenance and repairs: 5% on investment costs:	148	46
8	Insurance: 2% on investment costs:	30	30
	Total other variable costs:	189,877	8,136

Another component of the Variable Cost aspect of both the smoked and salted sun-dried 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 the Nzema East district of Ghana consider labour costs as part of Variable Cost. Table 4.4 below gives an overview of marketing cost component of smoked and salted sun-dried fish processing units for Messrs Asafua and Ndadeleba processing units respectively in the Nzema East district of Ghana.

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Table 4.4: Marketing costs on smoked and salted sun-dried fish processing for Messrs Asafua and Ndukeleba processing units respectively in the Nzema East district of Ghana (Field visit, 2011).

No:	Marketing materials details for smoked & salted sun-dried fish	Amount in GHC(Smoked fish)	Amount in GHC(Salted sun-dried fish)
1	Transportation costs to the marketing centers (GHC5 x 25 baskets x 300 days):	37,500.00	-
	Transportation costs to the marketing centers (GHC5X5baskets X 300days) :	-	7,500.00
2	Sales tax: GHC 0.50 x 300 days:	150.00	150.00
3	Local council tax: 25baskets x 300day x GHC0.20 :	1,500.00	-
	Local council tax: 5 baskets x 300day x GHC0.20 :	-	300.00
	Total marketing costs:	39,150.00	7,950.00

4.3 Expected Profit

Profit is the income one receives from the sales of smoked or salted sun-dried fish. Profit is the main brain behind the establishment of the smoked or salted sun-dried fish processing, and it is computed by subtracting the total production cost from the sales revenue received from the sale of fish. The bottom line of calculating profit is that, all forms of costs including the start-up costs have to be considered when computing the production costs. Table 4.5 below gives an overview of the total costs summary of smoked and salted sun-dried fish processing units for Messrs Asafua and Ndukeleba processing units respectively in the Nzema East district of Ghana.

Table 4.5: Total Cost summaries on smoked and salted sun-dried fish processing for Messrs.' Asafua and Ndukeleba processing units respectively in the Nzema East district of Ghana (Field visit, 2011).

No.	Cost summaries for smoked & salted sun-dried fish	Amount in GHC(Smoked fish)	Amount in GHC(Salted sun-dried fish)
1	Variable Cost:		
a.	Other total variable costs:	189,877.00	8,136.00
b.	Total Labour costs:	29,100.00	4,800.00
c.	Total Marketing costs:	39,150.00	7,950.00
	Total variable costs:	258,127.00	20,886.00
2	Total investment / fixed costs:	2,950.00	910.00
	Grand total costs:	261,077.00	21,796.00

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Profit from the sales of the smoked or salted sun-dried fish could be “gross profit” or “net profit”. Gross profit is the total revenue received from the sale of fish with out due consideration for other production costs. The gross revenue from the sales of smoked or salted sun-dried fish in the Nzema East district of Ghana is computed by multiplying the number of baskets of fish sold by the price received per basket of fish received from sales.

The Net Profit is the amount of money left after all forms of production costs have been deducted. The smoked and salted sun-dried fish processors in the Nzema East district of Ghana are always anxious about the net profit because it measures the viability and efficiency of their businesses. The net profit could also be called the net returns. Table 4.6 below gives an overview of revenues and profits on smoked and salted sun-dried fish processing units for Messrs Asafua and Ndadeleba processing units in the Nzema East district of Ghana respectively.

Table 4.6: Revenues on smoked and salted sun-dried fish processing for Messrs. Asafua and Ndadeleba processing units respectively in the Nzema East district of Ghana (Field visit, 2011).

No.	Revenues for smoked and salted sun-dried fish	Amount in GHC(Smoked fish)	Amount in GHC(Salted sun-dried fish)
	Total sales of smoked fish: 25 baskets of fish x GHC70 X 300 days:	525,000	-
1.	Total sales of salted fish: 5 baskets of fish x GHC20 X 300 days:	-	30,000
2.	Less total costs:	261,077	21,796
3.	Gross Profit per annum:	263,923.50	8,204.50
4.	Gross Profit per basket of fish sold:	35.20	5.47

According to the information obtained from the smoked fish processors in the Nzema East district during the field visit, it will come as a surprise to the reader that most of the people in the Nzema East district of Ghana earn their living through smoked fish processing, ironically the people considered themselves as unemployed.

The concept of the term ‘employment’ has different meaning to the people of the Nzema East district of Ghana. For them, to be employed means one has to be neatly dressed, go out to work in an office and come home in the evening, and earn an income at the end of every month.

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Though, majority of the people in the Nzema East district of Ghana claimed they are not in gainful employment; however, they are into brisk smoked fish processing with annual income quite substantial and compare well with most of the monthly salary income earners including those in the teaching service and other civil servants in the Nzema East district of Ghana.

To help the people of the Nzema East District of Ghana to understand that they have actually ventured into business entities and that they need to prepare their minds to face up the future business challenges, simple financial training was given to assist the processors on how to generate investment budget.

Also, from the discussions with the people of the Nzema East district of Ghana it came out that fish purchased for processing as smoked and salted fish is basically from the artisanal fisheries obtained through the canoeing and the beach seine fishing. And periodically, fresh fish could also come from the other coastal districts of Ghana.

Again, it was 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 throughout the year of 300 days, while the salted sun-dried fish processors also produce and sell 5 baskets of salted fish in a day as indicated in Tables 4.3 and 4.4 above.

The smoked and salted sun-dried fish is sold for GHC 70 and GHC20 respectively and the fish is also sold in a peculiar basket as a measuring unit, shown in figure 4.1 below.



Figure4.1: Smoked fish packaged ready for marketing (field visit, 2012)

Mostly, smoked fish processors sell their products at the fish marketing centers, and the major fish marketing centers are Ainyinasi, Ellubo, and AgonaNkwanta, fish markets just to name a few.

From the investment cost in Table 4.1 above, it is shown that the fish processors of the Nzema East district of Ghana do not have salted sun-dried fish as the major production line because of lack of quality in the production of salted sun-dried fish, so there is a huge difference in the investment cost of the two products with smoked fish having GHC 2,950 and GHC 910 for salted sun-dried fish.

Salt sun-dried fish is gradually losing its importance due to the laborious processing procedure. However, for the sake of this paper, analysis has been made on the economic viability of the salted sun-dried fish processing in the district.

4.4 Computation of the Profit margins for smoked and salted sun-dried fish of the Nzema East district of Ghana using Iliyasu et al., (2011),

Profits: To determine the profitability of smoked and dried fish, the profit (π) analysis equation is obtained by TR-TC.

Where, π = profit per basket of fish sold.

TR = Total Revenue as shown in table 4.6 above

TC = Total Costs, shown in the table 4.5 above

The results provided in table 4.6 above shows that profits per basket fish are GHC 35.19 and GHC5.47 for smoked and salted sun-dried fish respectively. 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 GHC263, 923.50 for smoked fish and GHC8, 204.50 for salted sun-dried fish.

Profit margin of smoked and salted sun-dried fish:

Profit margin (PM) is defined by:

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

Profits and revenues for smoked and salted fish are given in Table 4.6, by which the Profit margins are found to be 50.27% for smoked fish and 27.35% for salted fish.

Market operational efficiency of smoked and salted sun-dried fish:

Following Iliyasu et al., (2011), the market operational efficiency (ME) is computed from the values presented in Tables 4.5 and 4.6 above and the relation

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

The calculated ME-values show that smoked fish processing has a marketing efficiency of 862%, while the corresponding value for salted sun-dried fish is 283.02%.

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The value added from marketing is calculated by subtracting the total cost price of the fishery products from the total selling price, the annual gross product of the two types of production (see Table 4.6).

Return on investment of smoked and salted sun-dried fish:

Return on investment (ROI) can be calculated as, values from Table 4.6:

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

The return on investment is 1.42 for smoked fish and 1.01 for salted sun-dried fish respectively. It also means that for every GHC 1 invested in the smoked fish there is a return of GHC1.42, while for every GHC1 invested in the salted sun-dried fish there is a return of GHC1.01

CHAPTER FIVE

RESULTS

5.1 Profitability Analysis

The results provided in table 4.6 above shows that profits per basket of fish are GHC 35.19 and GHC5.47 for smoked and salted sun-dried fish respectively. 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 GHC263, 923.50 for smoked fish and GHC8, 204.50 for salted sun-dried fish.

5.2 Computation of profit margin

From the profits and revenues table in table 4.6, the profit for smoked fish was computed to be to be GHC 263,923.50 and revenue for smoked fish was GHC525, 000 while the profit for salted sun-dried fish was GHC8, 204.50 and revenue was GHC30, 000. This gives the profit margins of GHC50.27% and27.35% for smoked and salted fish respectively.

5.3 Market operational efficiency of smoked and salted sun-dried fish

The value added by marketing is 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 and that of the salted sun-dried fish to be GHC 22,500 (Raw material cost of fish was GHC187,500 and that of salted sun-dried fish was GHC7,500 as in table 4.3 and revenue from the sale of smoked fish was GHC525,000 and that of salted sun-dried fish was GHC 30,000 as in table 4.6).

While the cost of marketing services is 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 found to be GHC 39,150 for smoked fish and GHC7, 950 for salted sun-dried fish as shown in table 4.4 above.

The calculated ME-values show that smoked fish processing has a marketing efficiency of 862.07% and salted sun-dried fish has 283.02%, and these efficiencies are reflections that smoked and salted sun-dried fish have a great potentials in the Nzema East of Ghana.

The marketing efficiency figures of 862.07% and 283.02% for smoked and salted sun-dried fish respectively, reflect the potential for fish ventures in the Nzema East district of 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 markets

5.4 Return on investment of smoked and salted sun-dried fish:

From table 4.6 smoked fish shows a profit of GHC 263,923.50 and salted sun-dried fish of GHC8, 136. While in Table 4.3, the Total Variable Cost for smoked and salted sun-dried fish is GHC 186,877 and GHC8136 respectively. The return on investment is 1.42 for smoked fish and 1.01 for salted sun-dried fish respectively. It also means that for every GHC 1 invested in the smoked fish there is a return of GHC1.42, while for every GHC1 invested in the salted sun-dried fish there is a return of GHC1.01

5.5 Cost analysis of smoked and salted fish processing

As indicated in the Table 5.1, cost per basket of raw fish for smoking is GHC 25.00 compare with GHC 5.00 which is the cost per basket of raw fish for processing into salted sun-dried, while the raw fish cost in percentage of output price of smoked fish is 35.71 and that of salted sun-dried is 20, then again the raw fish cost in percentage of total cost of smoked fish is 42.08 and that of salted sun-dried is 35.95.

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Table 5.1: Costs analysis for smoked & salted sun-dried fish processing from Messrs Asafua and Ndakeleba fish processing units at Kikam and Eikwe in the Nzema East district of Ghana respectively (Field visits, 2001).

	Smoked fish	Salted sun-dried fish
Income per basket produced	70.00	25.00
Cost per basket of raw fish	25.00	5.00
Other costs per basket	9.41	8.92
Net profit per basket	35.59	11.08
Value added per basket	10.59	6.08
Value added in percent of raw fish price	42.37	121.60
Raw fish cost in percentage of total cost	42.08	35.92
Raw fish cost in percentage of output price	35.71	20.00
Other costs in percentage of output price	13.44	35.70

5.6 Measuring the efficiency of fuel wood performance on 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/fuuanle fuel wood species also burn out completely after 72 hours depending upon their sizes and dryness.

5.7 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”. Consumers prefer smoked fish in colours, and the most preferred colours are the golden brown and dark brown 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.

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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 the “preferred fuel wood” if it produces a smoke that can coat the fish into either golden brown or dark brown which 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/fuuanle 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 Baumer, (1974). 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 the less preferred fuel wood species because their combustions produced a zero and negative performance on the smoked fish.

CHAPTER SIX DISCUSSION

6.1 Issues related to smoked fish smoking process:

The smoked fish sector in the Nzema East district of Ghana has become a center of employment for girls who could not make it through the formal sectors as a result of not being able to finish school, these girls join the sector with various reasons including to get money for their children's school fees; payment of medical bills for the family and also to assist parents or husbands, or for their own upkeep (Brownell et al., 1983).

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; has minimized 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 Nti et al.,(2002) .

Despite the advantages enumerated 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 compared with their counterparts living around the non coastal communities.

6.2 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 is seen as a possible means

of depleting the wetland areas in the coastal communities, and this does not favour the government policy on wetlands management.

Then also afre/fuanle; mahogany; neem tree and leucenea which serve as good substitutes for mangrove are considered by the government as forest trees which cannot be easily use in smoked fish processing because illegal falling will mean the depletion of the forests zones in the Nzema East district of Ghana. However, mango and rubber trees though equally good are not in abundance in the Nzema East district and could not be relied on.

This is a dicey issue is still being discussed among the stake holders and the government to look into alternative substitute for the ten fuel wood species used in smoked fish processing.

6.3 Assessing the economic benefits available to the smoked and salted sun-dried fish processing:

From the profit analysis in table 4.6 in chapter 4, the annual gross profit for smoked fish is GHC 263,923.50 and that of salted sun-dried fish GHC8, 204.50. From the table 5.1 below, the net profit per basket of fish is GHC35.59 for the smoked fish and GHC11.08 for salted sun-dried fish, which explains that the net profit from the smoked fish is more than that of salted sun-dried fish.

The raw income per basket of fish as shown in the table 5.1 above indicates that the smoked fish has an income of GHC70 per basket and the salted sun-dried fish is GHC 25 per basket Even though, in terms of production costs, the two products actually pay higher production cost, the smoked fish pays higher production cost of about 9.41, the salted sun-dried fish pays about GHC 8.92 on every basket of fish bought for production.

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 4.1 and 5.1 above, makes the smoked fish processing bit risky as every GHC1 invested, about GHC0.73 goes into raw materials and this means that the people in the Nzema East district are so much relied on smoked fish, so sudden break in the supply of raw materials will mean no job in the area and the end result would be social vices.

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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 4.3 and 4.6 of chapter 4, also means that when 25 basket of fish is processed, an other 25 baskets more is sold out, this serves as a good sign of continue in business.

On the other hand also, salted sun-dried fish processing incurs a production cost of 74% and only some 26% raw material costs as shown in table 5.1. Which is a sign that the **producers** of salted sun-dried fish do not solely rely on salted sun-dried fish but probably can or have other alternative livelihood program for living in case there is no catch for processing.

On the process of value added per basket of fish, the smoked fish has 10.59 as against salted sun-dried with 6.08 respectively which means that for every one basket of fish processed, the smoked fish would contribute about GHC10.59 to the profit, while salted sun-dried fish adds about GHC6.08

Then again, for every basket of fish processed, the raw fish cost in percentage of total cost is about 42.08 or GHC42.08 compared with salted sun-dried fish with about 35.92 or GHC 35.92, and this means the two fisheries products have the capacity to meet part of the fixed cost, which is a good sign that the fish processing is a good venture in the area.

In the discussing the margins, smoked fish has a market margin of 50.27% and salted sun-dried fish has a market margin of 27.35%, which is an indication that the two fishery products show a high level of profitability and resilience (Table 4.6), however, smoked fish is more stronger and resilient than the salted sun-dried fish in terms of competition with other products, as a result of that many people in the Nzema East district of Ghana, find it more convenient to enter into the smoked fish processing far than the salted sun-dried fish.

The marketing efficiency figures (Tables 4.4 and 4.6) of 674.13 and 103.20 for smoked fish and salted sun-dried fish respectively is a reflection of the potential for fish ventures in the Nzema East district of 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.

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The marketing efficiency figures of 862.07% and 283.02% for smoked and salted sun-dried fish respectively, 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.

CHAPTER SEVEN

CONCLUSION:

The smoked fish and salted sun-dried fish processing are profitable ventures in the Nzema East district of Ghana. The two products are also very efficient in the market operations, with smoked fish far more profitable than the salted sun-dried fish. Also, as the smoked fish is in high demand with added value it being practiced more in the Nzema East district of Ghana than the salted sun-dried fish processing.

The turn over from the smoked fish processing is faster than that of the salted sun dried fish processing in the Nzema East district of Ghana. As entrepreneurs want a quick turn over on their investments, they have switched to the smoked fish processing which has swifter turn over and higher value added than the salted sun dried fish processing which is claimed to be so laborious and consumers at times would credit the product and make payment at a later date.

The few salted sun-dried fish processors in the Nzema East district of Ghana also complaining of the sector being met out with various quality problems, due to high post-harvest losses as a result of down pour of rains during sun drying period for the fish which ends up causing the product not only going waste and of poor quality but also thwarting the efforts of these poor processors.

Another factor which compounds the problems of the salted sun-dried fish is the unhygienic way of drying the fish at anywhere spacious in the sun, including the beach shores, on rocks and gravels, even on grasses. The unhygienic way of drying the fish in the sun also makes the fish stinks all over the drying place and the stench could also be smelled on the physical bodies of the processors because there is no scientific method of drying the fish.

Then again, the traditional ways of drying the fish anywhere in the sun with its associated stench contribute in polluting the fish with dirty elements including insects; sand particles; filth and other foreign materials one can think imagine, and these render the salted sun-dried fish product into low quality and reduce consumption.

However, if the production of the salted sun-dried fish can be refined with the introduction of very simple and less expensive racks; further improvements in the production quality; and

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repackaging the product under more hygienic condition, then the salted sun-dried fish will be more appealing to the consuming public and stand at a better position in terms of market and profitability even better than the smoked fish.

In comparing the profitability and marketing efficiency of smoked fish with that of salted sun dried fish, it is realized 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 chorker 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 (*please see picture 4.4 in chapter 4 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.

Constraints:

The small scale smoked fish processing in the Nzema East district of Ghana is facing a challenge over fuel wood species for processing from the government. The government has embarked on the afforestation and wild life conservation program, of which the supply of fuel wood species for smoked fish processing is considered illegal although there is no means of alternative substitute for fuel wood in smoked fish processing.

Also, mangrove species which is considered as an excellent fuel wood with efficiency on the smoked fish has led to the depleting of all other wetland areas in the Nzema East district and any other district which uses mangrove fish mongering.

Apart, from mangrove being used as fuel wood, there has been major forest degradation in the Nzema East district since every good tree in the forest is either being used as fuel wood for fish

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smoking and being cut down boards by illegal chain – saw operators, and the government is highly against this forest degradation.

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.

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