

# **TRADITIONAL FISH PROCESSING AND MARKETING OF THE GAMBIA**

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## **ABSTRACT**

The artisanal sector is the major producer of cured fish as about 40% is marketed and consumed smoked and/or dried. Fish is the cheapest source of animal protein in the country, and traditional processing of fish in The Gambia is an important means of making fish available to consumers, especially those living in rural areas. Post harvest losses are high, estimated at 20-30%. The market for smoked fish is expanding, although inadequate market information and low level of organisation among producers and traders limit the efficiency of the trade.

This paper is to assess the improvements required in order to improve the quality and profitability of the smoked fish. To do so the markets for smoked fish and status of the cured fish industry in The Gambia is analysed. Existing methods of fish processing in The Gambia are reviewed. Lessons are drawn from the techniques used in the Icelandic fish industry and how it can be applied in The Gambia. Further research and recommendations required to improve the quality and profitability of smoked fish are highlighted. The discussion on this paper is based on extensive literature review and recent project work.

Methods of fish handling and processing are generally inadequate and result in major fish losses. The handling and processing techniques need to be improved. This will improve the quality of cured products, increasing availability and nutritional values of the fish to consumers and profitability for the producers.

For the cured fish industry to experience growth and gain better access to lucrative markets, there is a need for an organised and structured cured fish industry with a reliable information network. The industry needs to abolish the individual operational strategy. This reorganisation should result in better co-operation between companies and individuals and thus improving the rate of value change from fishing to marketing.

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## 1 INTRODUCTION

Fisheries in The Gambia, comprised of the artisanal and industrial sub-sectors, contribute about 5% to the GDP (Fisheries Dept, The Gambia, 2000). In 1999, total fish landings were estimated at about 40,000 t. Of this, the industrial landings were estimated at about 10,000 t, which were mainly exported as frozen products. The export of fish yields 10% of the foreign exchange earnings for the country, estimated to be about \$3.65 million in 1999 (Fisheries Dept, The Gambia 2000). Catches of all foreign industrial fishing vessels licensed to fish in Gambian waters are landed outside the country, processed and labelled as products of foreign countries for exports. Therefore the value of trade in fish products emanating from The Gambia is underestimated.

The artisanal fisheries sub-sector in The Gambia provides about 90% of the domestic fish supply and employs the majority of Gambians in the fishing industry (Ndow 1997). The landings of the artisanal sector in 1999 fell just short of 30,000 t (Mendy 2000). The climate in The Gambia is warm (up to 40°C) and there are limited ice supply and cold storage facilities at the landing sites. Therefore, a large part of the artisanal catch that cannot be marketed immediately is smoked or dried for preservation. This sector is the major producer of cured fish, as about 40% of the annual artisanal catch is marketed and consumed smoked and/or dried (Njai & Njie 1998). Smoked products are either hot-smoked or smoked-dry depending on market requirements. The main smoked products are shad (*Ethmalosa fimbriata*) and catfish (*Arius spp.*), and to a lesser extent shark (*Piscisc spp*) and longneck croacker (*Pseudolithus brachynathus*). However, studies have shown that the low levels of technical know-how in proper processing techniques, packaging and marketing problems contribute to post harvest losses which are estimated to be about 20 - 30% (Jallow 1995).

As Gambians have become more involved in fisheries activities, from production to marketing, there is evidence that the cured fish trade has been growing. Previously this sector was dominated by foreign nationals (Njie 1993). Fish production has increased and consequently the market for cured fish has expanded with products distributed not only to remote parts of the country (inland markets), but also to the sub-regional markets and to a lesser extent to ethnic markets in Europe and U.S.A. However, the growth and development of the cured fish trade has been constrained by several factors, such as inadequate market information and low level of organisation among traders (Njie 1993).

On the whole it appears that there are basic educational problems in the cured fish industry such as a lack of awareness of the importance of hygiene and the acceptance of losses of fish through smoking processes as inevitable. Fish is an important part of the diet in The Gambia and traditional processing of fish is an important means of making fish available to consumers, especially those living in rural areas.

The main objective of this paper is to assess the improvements required in order to improve the quality and profitability of the smoked fish from capture of fish (raw material) through processing, up to the time it is marketed. To do so it is necessary to develop knowledge of the nature of existing markets of smoked products and to review

the fish smoking techniques used in The Gambia. The sub-objective of this paper is threefold. First to assess the existing and potential markets and the demands of these markets regarding quality and packaging of smoked products. Secondly to highlight the importance of effective marketing information systems for the production of smoked fish in The Gambia. Thirdly it is to highlight the improvements in fish smoking that are required in the cured fish industry to serve these markets.

Due to the limitation to this study that is being carried out in Iceland where it is very difficult to simulate the situation in The Gambia and the lack of information of the status of the cured fish industry in Gambia, this paper is a descriptive analysis. Hence, the status of the cured fish industry in Gambia and the markets for smoked fish will be analysed with the emphasis on pointing out the need for improvements and further studies. Lessons will be drawn from the techniques/skills used in the fish industry in Iceland and how it can be applied in The Gambia. The discussion is based on extensive literature review and recent project work. This study is an attempt to offer directions for future research that could lead the way for a more productive cured fish industry. The recommendations will help to form a basis for the improvement of smoked fish quality and can also raise the income of the fishing community as well as increase food supply.

The paper is divided into five sections. The introduction highlights the rationale and objectives of the project. Section two provides background information of the fisheries sector in the Gambia. The marketing constraints and processing of smoked fish in The Gambia is described in section three. Section four is a discussion of the impact the smoking techniques used has on the quality of the end product. This section will also identify ways for effective marketing of the smoked fish. Recommendations on improvements required to improve quality and profitability of smoked fish are also highlighted in this section. Finally section five provides the conclusions drawn from the present analysis.

## **2 BACKGROUND**

This part of the paper is a description of the background information of The Gambia and an overview of the fisheries sector in The Gambia, with emphasis on the artisanal sub-sector.

### **2.1 Geography of The Gambia**

The Gambia is one of Africa's smallest coastal countries with a population of 1.2 million. The country lies between latitude of 13° 'N and 13° 4' N and is 10,483 km<sup>2</sup> in area (Photius 1998). The country falls within a sub-regional zone, which is characterised by two distinct seasons, a rainy hot season and a cooler dry season dominated by the northwesterly dry winds or hamattan.

The Gambia has a relatively small continental shelf area of about 4000 km<sup>2</sup>, with a 70 km coastline. The continental shelf area of The Gambia represents only about 14% of the

total shelf area of Senegal and The Gambia (Photius 1998). It should be noted that these countries have reciprocal fishing agreements.

The Gambia has a 200 miles Exclusive Economic Zone (EEZ), which lies near the warm equatorial counter current and the cool Canary current. Therefore there are seasonal upwellings of the cool water off The Gambia, which are important for fish production (Lesack 1986). The seasonal upwelling coincides with a relatively large abundance of pelagic fish, which is reflected in large fishing activities during the cold season. The species composition varies noticeably with seasonal variations in water temperature, which determines the patterns of fish migrations (Mendy 1999).

In addition to the rich marine waters whose productivity is enhanced by the flow of nutrients from the River Gambia (an estuary attracting fish for feeding and spawning), The Gambia is also believed to have a considerable potential for freshwater fisheries (Mendy 1996). The River Gambia lies in the sahelian region of the West African savannah. It has diverse fish resources and is 2-5m deep inland and 25m at the mouth as it empties into the Atlantic Ocean to the west. The river covers 20% of the country's total area and virtually splits the country into two equal halves (Figure 1). The flow of The River Gambia is typical of the tropics, with freshwater flood flushing the river and the lower estuary during the rainy season while seawater moves long distances up river during the dry season (Lesack 1986). Much of the estuarine reaches of the River Gambia are fringed with prolific mangrove swamps (Mendy 1996).

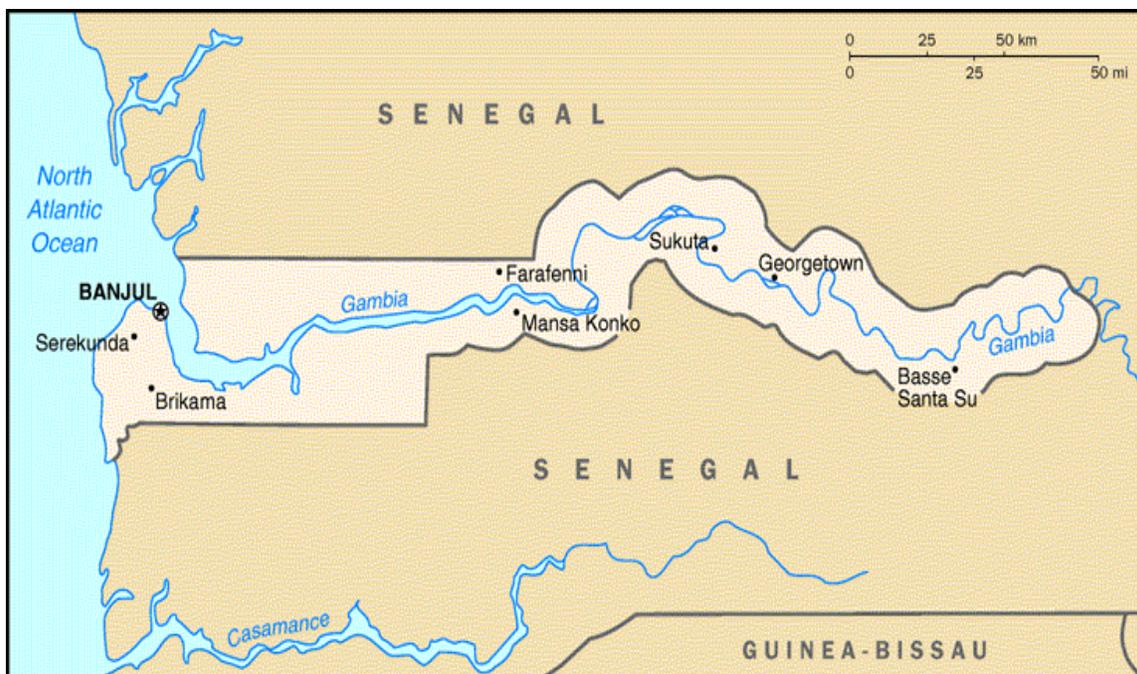


Figure 1: Map of The Gambia. (Photius 1998)

## 2.2 Fisheries of The Gambia

### 2.2.1 River fishery

The inland fishery potential is not well known, but it is believed that the fish resources of the river are underexploited and that improvements in fishing technology will allow for increased catch (Mendy 1996).

The lower reaches of the river has a brackish water regime which attracts certain marine fish species for breeding and feeding (Lesack 1986). Some of the marine fish species caught in the river include shad (*Ethmalosa fimbriata*), threadfins (*Polynemidae sp.*), marine catfish (*Arius sp.*) and solefish (*Cynoglossidae sp.*). The upper reach of the river has a freshwater regime where *Tilapia nilotica* and *Clarias luzerra* are important fish species. The most important crustaceans in the river fishery are shrimps caught by artisanal fishermen in the estuary (Mendy 1996).

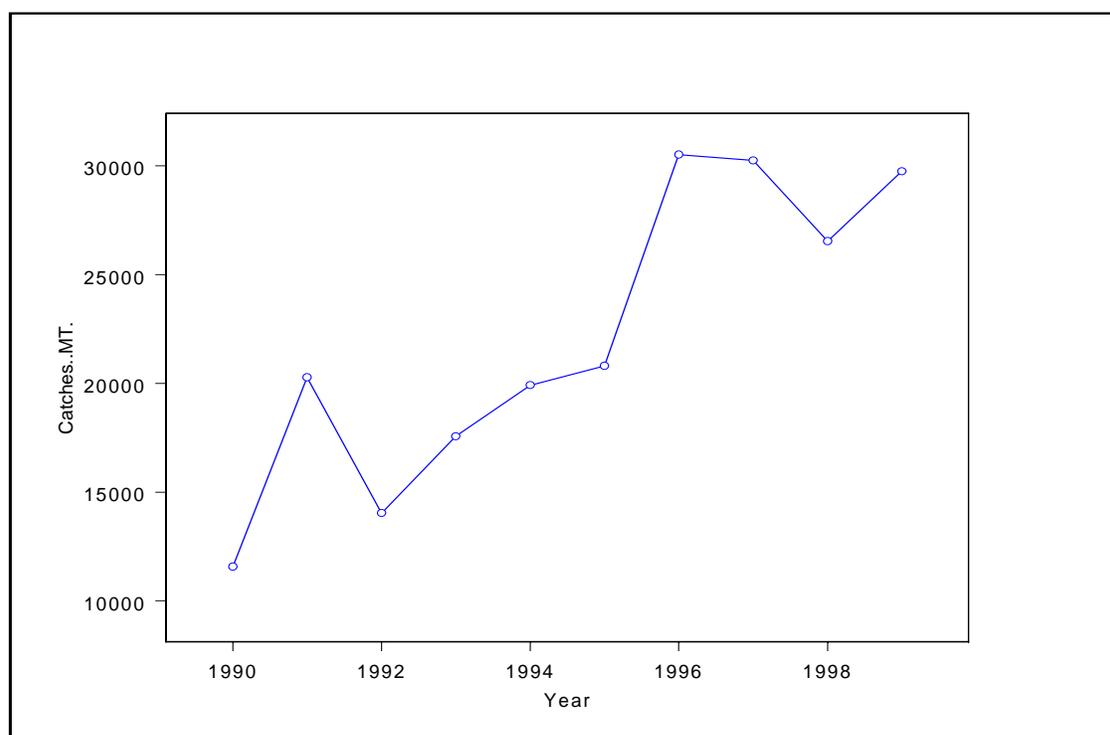
### 2.2.2 Marine fishery

The bulk of fish produced in The Gambia is from the marine fisheries where both artisanal and industrial fishing vessels operate. To minimise conflict between artisanal and industrial vessels, the fishery is divided into zones. Only artisanal fishermen are allowed within the 7 nautical miles (nm) and vessels with up to 250 Gross Registered Tonnage (GRT) capacity fish the grounds within the 12 nm limit. The EEZ beyond the 12nm is open to all licensed vessels of more than 250 GRT capacity. Vessels targeting

tuna as the main species are forbidden to fish within the 12 nm limit. This is basically aimed at conserving the nursery grounds of some fish species (Mendy 1996).

The artisanal sub-sector evolved from the use of simple fish catching methods to more effective and efficient methods involving the use of highly mobile fishing crafts and improved fishing techniques. In a nationwide fisheries survey in 1997, the total number of vessels in the artisanal fleet was estimated at 1,785 canoes countrywide. Outboard engines of 6-40 hp are used in the artisanal fishing canoes, the main gears used are gillnets, seinenets, hooks & lines and traps, and the species targeted by this sector are the pelagics, demersals, cephalopods and crustaceans (Mendy 1996). Although the scale of operations by the artisanal fishermen can be generally considered small, the sub-sector continues to dominate the fisheries sector of The Gambia (Mendy 1996).

Although there are fluctuations in the total catches; there has been a general increase in the artisanal catches in the last decade (Figure 2). This can be attributed to improved fishing methods and the provision of infrastructure and credit facilities by the Government. It is also important to mention that an average of about 70% of the total annual catches in the artisanal fisheries is shad (Ndow 1997).



**Figure 2: Estimated annual fish catches from the artisanal sub-sector, 1990-1999. (Fisheries Department, The Gambia 1999)**

Industrial fisheries operations usually involve large offshore fishing vessels (often of foreign ownership). The industrial fleet is mainly comprised of modern trawlers, purse seiners and long liners. This sub-sector also targets pelagics, demersals, cephalopods and

crustaceans (Mendy 1996). Most industrial fishing is carried out by foreign vessels that land their catches in foreign ports where the catch is usually recorded under a foreign flag. However, there is a rule that all licensed foreign vessels should land 10% of their catches in The Gambia for processing and marketing, or pay the equivalent of the catches to the Government (Mendy 1996).

The industrial fish catches declined sharply in 1992 (Figure 3) due to a policy to reduce the number of licensed industrial vessels fishing in The Gambian waters. The number of licensed vessels in 1993 was 102, which has been drastically reduced to 19 licensed vessels in 1998 (Mendy, 1999). Over 90% of fish caught by these vessels are exported directly to markets in Europe and Asia (Ndow 1997).

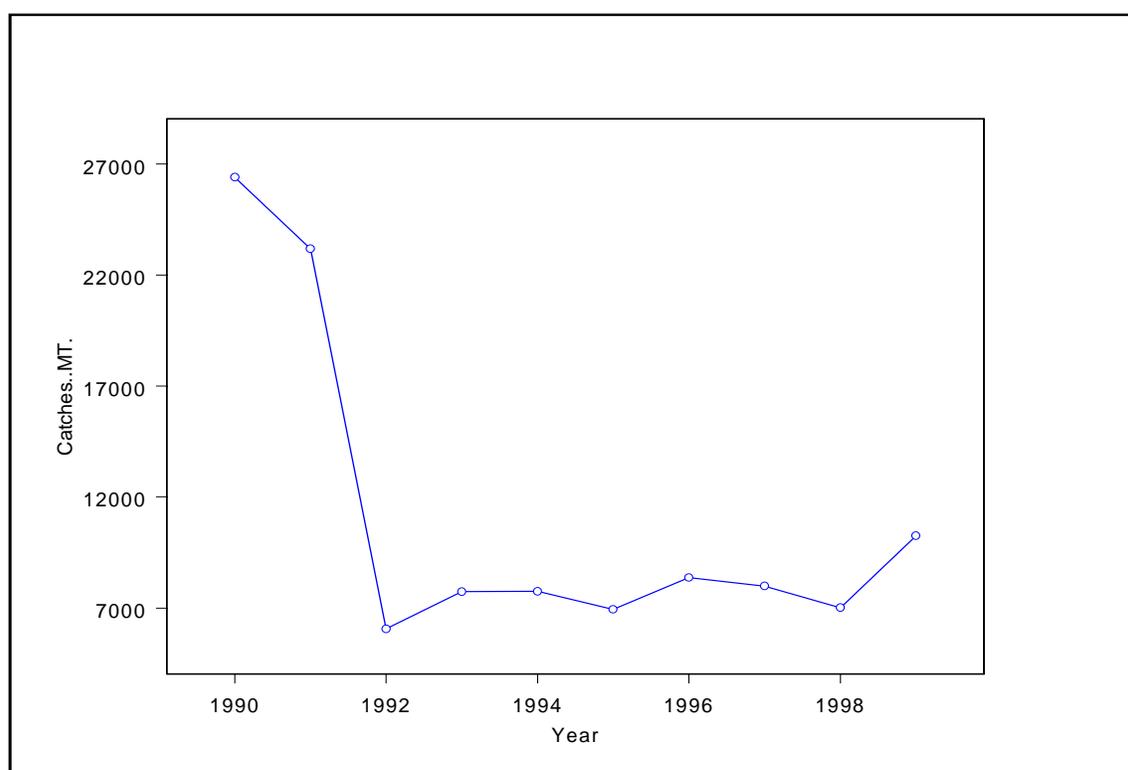


Figure 3: Estimated annual fish catches from the industrial sub-sector, 1990-1999 (Fisheries Department, The Gambia 1999)

### 2.3 Utilisation of fish resources

Although people have developed the taste for traditional fish products, fresh fish is generally more valuable and much preferred by consumers, and usually brings better returns to the fishermen. This could be due to the weak competitive status of the cured fish industry to the fresh fish industry. However, access to fresh fish can be a problem in rural areas (inland markets) due to the shortage of ice and lack of refrigeration. Therefore,

most consumers in these areas get access mainly to cured fish. Consequently, people in the urban areas tend to consume more fresh fish, (because of their higher purchasing power) but less cured fish (dried fish) which they generally use only in small quantities as flavourant. Additionally, in the urban areas, there is a preference for hot-smoked catfish, which is used in the preparation of traditional meals, i.e. stews. The improvement of the quality of fish through technological advances is important to reduce post harvest losses so as to utilise the country's resources to their full potential.

## **2.4 The cured fish industry**

Fish smoking is a major activity in the coastal landing centres. Shad and catfish are the two main species smoked by traditional processing techniques and to a lesser extent, sharks, barracuda and longneck croacker. These products are often inferior and prone to various forms of damage and losses. Due to vagaries of the fish market, cured products are at times stored for long periods under inadequate conditions resulting in fish losses from moulding. In addition, fish packaging can be problematic, which can also result in damage to products and add to losses (Sefa-dedeh *et al.* 1995).

Traditional processed smoked products serve different markets (Table 1); domestic urban and rural markets, sub-regional and international markets that contribute to an expanding market. Hot-smoked shad and catfish are most important to the urban markets, smoked-dry shad serves the rural and sub-regional markets while the low to medium moisture content hot-smoked catfish and other speciality products such as barracuda and long neck croacker serves relatively small ethnic markets in Europe and U.S.A. (Njai & Njie 1998).

The quantity and value of cured fish exported is considered to be high, but its importance is still not reflected as it should be in the trade statistics (Table 1). Most of the trade to Guinea Conakry/Bissau is overland and traders usually do not apply for export permits for products transported by road. It could be argued that this might be due to traders avoiding to pay customs duties. However, traders exporting products by air or sea do apply for export permits.

**Table 1: Distribution of different artisanal smoked products according to markets (Central Statistics, The Gambia , FAO 1997, Njai & Njie 1998).**

Market	Products	Estimated share (%)	Quantity (kg)	Value (US\$)	US\$/kg
<b>Urban markets</b>	Hot-smoked shad	90	13875	8,325	0.60
	Smoked-dry shad	2 - 5	1278	281	0.22
	Smoked shark	35	30875	22,318	0.82
	Hot-smoked catfish	90	33885	51,844	1.53
	Smoked speciality products	10	1350	2,484	1.84
<b>Rural markets</b>	Hot-smoked shad	7	971	301	0.31
	Smoked-dry shad	35	8951	3580	0.40
	Smoked shark	2 - 5	1543	1,419	0.92
<b>Regional markets</b>	Smoked-dry shad	60	27031	47,304	1.75
	Smoked shark	60	88227	194,099	2.20
	Smoked speciality products	2	685	1,665	2.43
<b>Ethnic markets (Europe &amp; U.S.A.)</b>	Hot-smoked shad	3	256	486	1.90
	Hot-smoked catfish	10	6777	18,501	2.73
	Smoked speciality products	88	5881	20,584	3.50

The price of smoked fish in the rural markets is higher than in the urban markets (Table 1). This is because of the transport and other costs incurred by the trader during distribution from the processing site to the marketing points in the rural areas. In addition, this price difference is due to the consumer demand of these products in this area. This high cost can also be attributed to the high number of middlemen at various levels in the marketing chain (to be discussed further in section 4).

Women processors are the predominant dealers involved in the domestic marketing of hot-smoked products while export of the smoked-dry products is mainly by men. The operations of the women fish processors are characterised by small-scale direct marketing (daily basis) and low profit margins (Njai & Njie 1998). The operations of male fish smokers are more intensive and their products are marketed to the inland and sub-regional markets where the profit margins are higher.

For the sub-regional markets, especially in Nigeria, Cameroon & the Ivory Coast, transportation of products is either by sea or air. Traders travel by air to countries of destination of the products and co-ordinate and supervise the marketing. For the ethnic markets in Europe and USA, exports are by air and usually the trader accompanies the products for marketing. This practice reflects the lack of structural organisation in the cured fish trade as most traders operate on an individual basis, except for a few that operate in small units of two or three members. Also, there are times when the trader has arrangements on agreed prices with the buyers prior to the exportation of the products. Based on F.O.B. values, exporters of smoked fish pay 10% duty (Njai 2000).

The artisanal sub-sector contributes significantly towards fish exports, either directly or indirectly through industrial fishing companies. However, the sub-sector's direct exports

are limited to traditional cured products. Traders encounter problems such as rains, bad roads and rough handling of products that are transported by land to the inland markets and to Guinea often leads to fragmentation of products and thus economic losses (Sefaddeh *et al.* 1995). This suggests that effective packaging of products could reduce fragmentation of fish.

The increasing trend of cured fish exports (Table 2) is an indication of the increasing demand for fish from the sub-regional and international markets. The decrease in the values is attributable to inflation and the devaluation of most currencies in the sub-region during the reference period.

Table 2: Exports of cured fish products from The Gambia (FAOSTAT, 2000/Fisheries Dept, 1999)

Year	Quantity(metric tonnes)	Value ( 1000\$)
1990	514	557
1991	528	321
1992	750	330
1993	901	387
1994	983	427
1995	1000	458
1996	1045	495
1997	1063	529

### **3 FISH INDUSTRY, DISTRIBUTION, PROCESSING & MARKETING**

This section describes fish handling and distribution in the artisanal sector and the processing techniques used in fish smoking is also reviewed. In addition, the marketing constraint faced in the cured fish industry, which limits the efficiency of the trade is analysed.

#### **3.1 Fish handling**

The existing ice production facilities serve only a portion of the Gambian fishing and processing communities (Jallow 1995). Fishermen do carry ice to sea but the lack of ice production facilities close to the major coastal fishing centres increases the cost of ice for operators who have to transport it long distances. This means that the fishermen often do not carry enough ice on their fishing trips. The lack of ice can result in loss of freshness or, at times, spoilage of fish. Fish are not gutted prior to landing, because customers will doubt the freshness of gutted fish.

Onshore fish handling in the artisanal sector is often poor (Njai 2000). Fish (shad) are usually scooped out of the boats with all sorts of containers, such as buckets. This method of unloading the catch by hand takes considerable time during which the

temperature of the fish increases considerably. This extra handling can cause damage to the fish such as looseness in flesh, and bruising of the skin can result in contamination of micro-organisms. When all the fish have been off-loaded and put into boxes, the boxes are arranged in piles under sheds with open walls for the purpose of counting and selling (open auction market). Since most of the fish are usually not properly iced, the quality of the fish can deteriorate before the end of the sales. This shows that there are basic educational problems, such as lack of awareness of the importance of hygiene and the importance of using ice (to be discussed further in section 4).

### *3.1.1 Fish distribution*

Most of the fish landing centres along the coast are not easily accessible to consumers. Therefore, the collection and distribution usually involve a chain of traders or middlemen.

Fish distribution is mainly in the hands of fish brokers, retailers and wholesalers (Bah 1999). Fish brokers (small-scale traders) buy smaller quantities of small pelagic fish (shad) from artisanal fishermen at the landing beaches and transport it on bicycles or mobilettes. The scope of operation of this category is usually 2 to 10 miles radius from the landing centres with less than 200 kg of fish (carried in baskets with ice) per trip. They supply fish to the immediate environment and nearby village markets.

Retailers normally buy 2-3 tons of fish from artisanal fishermen at the landing centres. The fish (with ice) is then distributed to inland or neighbouring markets within the urban areas in hired insulated vans. Retailers normally sell their fish directly to the consumers in market places or at times to other retailers that operate on a small scale (Bah 1999).

The wholesale traders buy 5-10 tons of fish at a time, mainly shad from artisanal fishermen at the landing centres. The fish (with ice) is also distributed in insulated vans to central points in townships and inland markets. The fish is sold mainly to private traders dealing primarily in the selling of fresh fish, or to processors for smoking or drying of fish. Processors also buy directly from artisanal fishermen for smoking or drying (Bah 1999).

Hot-smoked fish that is mainly marketed in the urban areas is transported by hired vans to markets. This fish is usually wrapped in paper and packed in locally weaved baskets. The hot-smoked fish to be exported by air to ethnic markets in Europe and USA is chilled and wrapped in plastic films packed in polystyrene boxes (Njai 2000).

Smoked-dry fish is transported in trucks to inland markets or to the port for export to neighbouring countries by sea. The smoked-dry fish is wrapped in paper and packed in locally weaved baskets or wooden crates. However, recent studies have shown that traditional packages are generally not impermeable to moisture, insects and micro-organisms, and also offer little protection from physical damage (Sefa-Dedeh et al. 1995). These problems highlight the need for future research on proper packaging materials for smoked fish.

## 3.2 Fish processing (smoking)

Fish smoking is relevant in the artisanal fisheries in that it prolongs the shelf-life of the fish, enhances flavour and increases utilisation of the fish, reduces waste when catches are good and increases protein availability to people (Jallow 1995). However, despite these positive achievements, there is still more work to be done to reduce the losses that occur during and after fish processing. According to Bernaseck (1991), variations in product quality stem from the differences in the freshness of the raw material and the preparation of the fish prior to smoking. Differences between fish species may also be reflected in the quality of the smoked fish (Sefa-dedeh et al. 1995)

Traditionally, fish is not filleted before smoking, but large fish (e.g. catfish) is normally cut into portions. The choice of whether fish will be hot-smoked or smoked-dry depends on the type of fish to be smoked and how long the product is going to be stored. Sefa-dedeh et al. (1995) found that both processes are carried out at temperatures of 80°C and above, which is high enough to cook the fish. Results from previous studies have shown that the hot smoked process takes about 1 -3 hours and yields a product with about 35 - 45 % moisture content, but with a limited shelf-life of 1 - 3 days at ambient temperatures (Jallow 1995). The smoke-dry process takes about 10 - 18 hours, and sometimes 3 - 4 days and yields fish of 10 - 15% moisture content, sometimes even below 10% with a shelf-life of 3 - 9 months when stored properly (Jallow 1995). Bernaseck (1991) found that the shelf life of the smoked fish depends more on the cooking and the state of dryness of the fish than the smoke itself.

### 3.2.1 Fish smoking equipment

Fish smoking equipment used is diverse in nature and may be dependent on availability of resources. The most common fish processing equipment in use in coastal fish landing centres is the modified chokor oven. Introduced in 1985, this oven proved to be a successful technology with high efficiency in fuelwood use. According to Jallow, (1995) this oven has a capacity for smoking the large quantities of shad that are usually landed and smoked in the coastal landing centres. It is made of rectangular enclosed walls, divided into compartments of 1.5m long x 1m high and 1.5m wide. Each compartment has a front door/stoke hole to access the fire place. The fish are placed on metal grills for smoking (Njai & Njie 1998).

Women who do not have access to these ovens often use poorly constructed traditional fish smoking ovens of low capacity and efficiency at the landing sites or in their homes. These smoking ovens are of different types such as the traditional ovens (open fire banda), mud ovens and cut-up barrels (Njai & Njie 1998).

The most common firewood used for fish smoking is the local woods such as wolloh (*Terminalia macroptera*) and Keno (*Pterocarpus erinaceus*) (Jallow 1995). Palm fronds, coconut fibres and shells are also used for smoking fish, but on a relatively small scale (Njai & Njie 1998).

### 3.2.2 *Hot-smoked shad & catfish production*

Hot smoking of shad and catfish is practised by women and usually on a relatively small scale due to preservation and marketing constraints. The shelf-life of this product is 1 to 3 days. The temperature of the ovens varies but averages from 110°C to 120°C. The smoking takes 1 - 3 hours but is usually prolonged for catfish to lower the moisture content

Traditionally, hot-smoked shad products are not scaled or gutted before smoking. The fish is cleaned with fresh water and smoked whole. The preparation for catfish smoking involves proper gutting, descaling and cleaning of fish and some brining. Large fish are normally cut into portions whilst the smaller fish are left whole. After the initial preparation, the fish is soaked in boiling water for 2-5 minutes to coagulate and harden the skin. The skin is then scraped (thick skin) and the fish cleaned thoroughly and left to drip-dry prior to smoking (Sefa-dedeh et al. 1995).

The fish is arranged on the oven grill and covered, thus creating a smoking chamber. The door of the oven is also covered, in order to reduce burning and to allow heat and smoke to take effect on the fish (Sefa-dedeh et al. 1995). The fish is then smoked until brown. Fish is then uncovered and turned over individually. This is time consuming and could lead to breakages. However, the turning of the fish helps to allow smoke deposition on both sides of the fish (Njai & Njie 1998). The fish is then covered again and smoked until fully brown and well cooked. After this process, the fire is lowered and the fish uncovered and left to cool. After cooling, the product is unloaded and packed in locally weaved baskets for marketing.

### 3.2.3 *Smoked-dry shad production*

The shelf-life of smoked-dry shad is long, usually 3 - 9 months depending on storage conditions. There may however be high risks of rancidity during prolonged storage conditions due to the fatty nature of the fish (Bernaseck 1991).

Fresh shad is cleaned with freshwater and arranged on the oven grills with the belly of the fish facing the fire and subjected to high fire temperature. The production process of dry smoked shad is such that an initial high heat is applied. However, if not controlled, the initial high flame occasionally results in the burning and charring of the fish. Fire of a lesser intensity is applied in later stages to dry the fish and impart smoke on it (Jallow 1995). The fish is left uncovered throughout the smoking process to expel moisture. The product is hard-dry shad flesh enclosed in a hard skin (with casing of scales). The outer hard skin protects the flesh against contamination and acts as a barrier to pests, but can be susceptible to fragmentation which can lead to losses (Bernaseck 1991). Smoking temperatures generally exceed 80°C and even 100°C. The smoked fish is packed in wooden crates or locally weaved baskets and stored for subsequent transport to markets. The distribution process of the smoke-dry fish at times takes a long period and producers often store the products for weeks or months waiting for a favourable market (Tetteh 1988).

### **3.3 Marketing of smoked fish**

Previous studies have shown that the fish trade has been increasing in The Gambia, both in terms of the quantities of products and fish species traded, as well as the number of people it engages and the markets served (Essuman 1992). However, the cured fish trade is still constrained by several factors (discussed below) that limit its efficiency and quality (Njie 1993).

#### *3.3.1 Market information*

Fish processors and traders often complain about the unavailability of markets. This is mainly due to the absence of reliable market information (Njie 1993). Operators therefore store their products for lengthy periods. There is evidence that under the often inadequate conditions of storage for long periods at high temperatures and high humidity, mould attacks can result in fish losses (Sefa-dede et al. 1995). Good market information network for traders might alleviate these problems.

#### *3.3.2 Transportation*

The cost of transport is high and may limit profitability (Njie 1993). Operators at times have to accumulate sufficient quantities of smoked fish before they can sell profitable consignments. This is practiced to avoid the relatively high cost of transport to domestic markets to sell small volumes. It takes three days by road from The Gambia to Guinea. Frequent breakdown of vehicles often result in changes of vehicles which adds to the cost of transport and causes delays which affect quality (Tetteh 1988). This also results in delays for marketing.

#### *3.3.3 Customs & tariff barriers*

Custom duties and other charges levied on fish and fishery products can be high. These duties are sometimes increased without notice, making business trips more expensive and less profitable for operators (Njie 1993).

#### *3.3.4 General trend on the fish market*

Due to the limited buying power of consumers, smoked fish product variety is limited mainly to shad and catfish (Njai & Njie 1998). Shad is relatively cheap and abundant. Smoked catfish is a higher priced product than shad. The product is a favourite to the more affluent consumers in the urban markets and is often in short supply. There is evidence that smoked shark and other smoked fish products such as barracuda are mainly destined for export or for the more affluent domestic consumers (Njai & Njie 1998). Prices of catfish, sharks and barracuda vary according to size and quality. Bigger

products of high quality and with evenly golden brown smoke colouring on fish with no breakages command higher prices than smaller sized products (Essuman 1992). On the whole there is a demand for high quality smoked products which is a vital factor to make marketing profitable. Fish is widely consumed due to its affordability and availability to consumers with annual per capita fish consumption estimated at 23 kg (Central Statistics Department, The Gambia. 1999).

Rapidly changing economic and political climate in the sub-region has destabilised the markets (Tetteh 1988). With slowing down of the economy in the past years, the export of smoked fish to Nigeria was relatively low. For the past three to five years, the exports of smoked fish to Nigeria is increasing again (Essuman 1992). Ivory Coast, with its stable economy, has evolved into a major market for smoked fish from The Gambia, both in volume and value. The markets in Cameroon, Guinea Bissau and Guinea Conakry which also constitute important markets for smoked exports from The Gambia are expanding (Ndow 1997). Ghana is the single most important market for dried shark and to a lesser extent of smoked fish. All products to these markets are transported either by sea or air.

### **3.4 Organisational structure and strategy of the cured fish industry**

According to Njie (1993) the level of organisation of the cured fish trade is inadequate. This is characterised by the general trend to operate individually. Associations for the marketing and distribution of artisanal products hardly exist in The Gambia. Hence, individual traders often have problems of identifying markets. They therefore tend to deal in small volumes that are less profitable and sometimes delivered to uncertain markets (Njie 1993). This could be attributed to the lack of market information to producers which could be due to the lack of a structured organisation in the industry. For the cured fish industry to experience growth and gain better access to lucrative markets, there is a need for an organised and structured cured fish industry.

Fish prices are sensitive to the forces of supply and demand. Wide price fluctuations continue to be a dilemma to fish processors and traders (Essuman 1992). The smoked fish trade for the domestic markets is dispersed and wholesale and retail traders normally function with very limited operating capital (Moen 1983). This indicates a need for a sales organisation of traders and processors to monitor the prices of fish with regards to its demand from the consumers.

## **4 DISCUSSION AND RECOMMENDATIONS**

The main emphasis in this section is to identify the different ways for effective marketing of smoked fish. The impact of smoking technique used on the fish regarding its quality and nutritional value is also assessed in this section, with recommendations highlighted for improvements required in order to improve the quality and profitability of the smoked fish.

#### **4.1 Fish handling**

Proper fish handling in the artisanal sector is generally poor. Lessons could be drawn from the Icelandic fish processing industry, where most landed fish are bled and gutted, (fishes such as herrings and red fish are not gutted). Bleeding should be done before the fish goes into rigor to avoid gaping and looseness in the muscle. Fish should always follow a cold chain. Gutted fish should be washed in cold/iced water of temperatures between 2°C to 5°C before they are cooled in ice and water of temperatures between -1°C to +2°C. And after cooling, the fish are to be stored in ice water of 0°C. The use of ice to chill the fish can help to prevent fish from gaping especially during processing. Extra handling of fish should be avoided and fish are to be put in fish tubs with ice or in local insulated containers. Fishermen should be encouraged through educational training to use more ice in tubs/local insulated boxes, which helps to reduce the melting of ice and also maintains a low temperature. This results in the extension of storage life of fish and also helps keep the fish fresh to maintain its high quality. In this way, losses could be avoided, as fish to be processed will be of high quality with no looseness or gaping in the flesh. In addition, the fishermen need to be encouraged to bleed and gut the fish, as gutting can reduce the rate of spoilage. In this case, the public could also be educated on the advantages of gutted fish.

#### **4.2 Smoked fish processing**

Hot smoked fish is susceptible to fragmentation, which is believed to be related to the high processing temperatures and rough handling of the products. The generally high temperature to which the fish is subjected, might in part be attributed to difficulties encountered in the manual control of the flaming firewood. In the process some of the fish become charred (Sefa-dede et al. 1995). This could be alleviated by means such as pre-drying and temperature control. To reduce fragmentation, the fish should be dried for 1 hour at 25°C and relative humidity of 40-45% prior to smoking, reducing its moisture content to about 50% (Sefa-dede et al. 1995). In addition, pre-drying is important in fish smoking as adequately dried products can be resistant to fragmentation (Ikeme 1991). Horner (1992) indicated that the use of lowered temperatures and less air during smoking gives a smoke with more flavouring and preservative substances to the smoked fish.

In addition, excessive handling of the fish during smoking contributes to the fragility of hot-smoked fish. Fish are placed on oven grills and have to be turned individually. This is both time consuming and leads to lots of breakages (Njai & Njie 1998). Hence, the use of trays in ovens is essential. Fish that are supported on trays are easier to re-arrange. These trays means that more fish can be smoked with less fuel and with greater ease of manipulation as trays can be easily moved from one level to another (Stroud 1988). Throughout the process, trays of fish should be moved to different parts of the kiln to ensure that all fish get evenly smoked (Horner 1992). Training of fish smokers in proper processing and handling techniques would help improve fish processors' technical know-how and enhance the development of the fish trade. In addition, consideration should be given to improve the design of the artisanal chokor oven using sound engineering design

concepts so that an inexpensive oven with trays could be made using indigenous materials, which would be simple to operate and produce a quality product with low fuel costs.

#### *4.2.1 Smoking process control*

Horner, (1992) found it is best to keep the temperature in the smoke chamber below 30°C, at the start of the smoking process. This is because the process dries the fish to a certain extent, as well as depositing smoke on the surface of the fish. To achieve this, the air vents into the firebox should be almost closed so that the sawdust smoulders, rather than burns. The fire burn is slow and the smoke going through the chamber is diluted with air. But with the air vent fully closed as currently practised, all the air is drawn through the damper to the fire. Thus the fire burns more strongly, causing the initial high flames encountered during smoking. If the temperature is too high with rapid air flow, the fish surface becomes sealed off, trapping the moisture inside and causing case hardening (Horner 1992). The control of air entering the oven would provide some control of the smoking and drying process, particularly during windy conditions (Stroud 1988). Therefore, consideration should be given to the provision of simple damper made from metal or stone to restrict the amount of air entering the oven.

#### *4.2.2 Smoke production and components*

The use of wood rather than sawdust for smoking in The Gambia makes for a hotter fire with less smoke and the fish is charred rather than smoked. In a sawdust fire, unless there is a force rapid flow, the air cannot easily get to the fire, so the sawdust smoulders rather than burns giving the fish an uncharred golden brown colour (Horner 1992). This shows that using sawdust for smoking can result in high quality smoked products. The use of alternative fuels, e.g. sawdust, palm fronds or coconut fibres should be studied as the heavy use of firewood contributes to the charring of fish and the depletion of the forest. The typical smoke flavour results from a number of chemicals found in the smoke, but it is mostly attributed to phenols (Horner 1992). Some phenolic substances might also have preserving effects on the smoked product by delaying oxidation and rancidity of the highly unsaturated fish lipids (Sveinsdóttir 1998). The smoke compounds reduce the surface pH and thereby make the smoked fish a less favourable environment for most bacteria. Colour development during smoking is thought to be caused by reactions of the maillard type where the smoke components play the dominant role (Sveinsdóttir 1998).

According to Horner, (1992) most 3,4 benzopyrene (indicator of carcinogenicity) are taken up during hot smoking (70 - 80°C). Polynuclear aromatic hydrocarbons (PAH) levels are higher in hot smoked fish than cold smoked produce as the formation of PAH depends on the temperature (Horner 1992). Therefore, it is essential that temperatures be reduced during hot smoking process to avoid the accumulation of these substances on fish. Maximum amounts in the smoked fish can be limited by government regulations. This could be done through the supervision and monitoring by fisheries inspectors on the proper practice of processing methods and from analytical checks of the smoked fish in the quality laboratory.

### 4.2.3 *Quality*

There is also evidence that some of the smoke components, e.g. formaldehyde has a toughening effect on the muscle protein (Stroud 1988). According to Sveinsdottir, (1998) deposits of substances such as phenol, formaldehyde and nitrites also inhibits bacterial growth on the product. Studies have shown that the condition and extent of spoilage of raw material can influence the extent of the brown colour formation as fish muscle extracts contribute to browning of the surface (Horner 1992). Hence, it is important to have high quality raw material for smoking as appearance and texture of the smoked fish are largely affected by the quality of the raw material, and process parameters such as brining treatment, time and temperature. Therefore it is important that provisions are made to ensure adequate ice at all levels as required, and to encourage the use of it through education by improved extension services.

### 4.2.4 *Nutritional value*

The smoking process has a minimal effect on the two classes of muscle lipids, triglycerides and phospholipids and significant changes are not detected in the overall fatty acid composition (saturated, monoenoic and polyunsaturated fatty acids) in smoked fish (Burt 1989). Studies have also shown that salt can encourage oxidation of lipids in smoked fish (Sveinsdóttir 1998). Furthermore Sveinsdóttir, (1998) indicated that fat-soluble vitamins are protected by the antioxidant effects of some smoke compounds. However, smoking can result in some loss of thiamine (2 - 25%) and minor losses in niacin and riboflavin, attributed to heating effects. In addition, smoking affects the nutritional value of fish, mainly by reducing the biological availability of proteins (Stroud 1988). Overheating, as might occur in some of the traditional ovens such as `banda` oven, reduces the availability of lysine (Horner 1992). The loss of lysine usually occurs during the initial stages of smoking with high fire. As a result of dehydration the relative lipid content increased by smoking (Eyabi and Eyabi et al. 1988). The distribution of fat on the surface of the fish also changes during the smoking process and this might modify smoke absorption (Ikeme and Gugnani 1988). Therefore it is essential that a low temperature be used in the initial stage (pre-drying) with gradual increase of temperature to shorten the processing time and avoid nutritional losses. High smoking temperatures are known to reduce lysine levels (Horner 1992). Further research work is required to establish the upper and lower temperature limits to determine the optimum temperature for producing hot-smoked or smoked -dry products.

### 4.2.5 *Shelf life*

According to Horner (1992) the shelf life extension of smoked fish can be from the combination of lowered water activity and the uptake by the product of bacteriocidal and antioxidant components of wood smoke. Brining and prolonged smoking appear to be useful in increasing the storage life of hot smoked fish by retarding the development of mould growth without increasing the development of lipid oxidation (Stroud 1988).

Prolonged smoking also increases the relative dry matter content of fish, thereby having a low moisture content with longer shelf life (Stroud 1988). The shelf life is also affected by storage temperature. The decrease in the water activity in the tissue due to salting and pre-drying, the procedure of smoking, amount of smoke components, packaging materials and the production hygiene are also of importance to shelf life (Sveinsdóttir 1998). Due to the malpractices in the use of chemical preservatives, the Fisheries Department has not recommended their use by fish processors. However, better training in technical know-how on fish processing could help to improve and increase the shelf life of the fish.

#### *4.2.6 Packaging*

Sveinsdóttir (1998) indicated that before packing, fish is to be cooled, since while cooling a great deal of water evaporates. If fish is packed while it is warm, moisture will condense on the surface and that encourages the growth of mould. The source of spores can be moist sawdust or wood (Sveinsdóttir 1998). Packaging forms an important part of food processing because it facilitates handling during storage and distribution within the marketing chain. Packaging material must possess certain characteristics, such as adequate strength to protect the packaged product from damage, it must be readily available and easy to use, and should be clean to prevent contamination by undesirable substances. Therefore, it is imperative that processors/exporters improve and upgrade their packaging techniques. To do so, there is the need to investigate the use of local materials for better packaging and to develop improved low cost packaging methods.

#### *4.2.7 Government participation*

Collaboration should be initiated amongst processors and government towards the building of improved storage facilities for cured fish and guidelines should be developed for the proper storage of cured fish. Strong extension service will also aid training and provide a forum for two-way communication. Thus the needs of the industry and any lack of acceptability of improvements will be better understood. Lack of governmental structure in the industry also hampers efficient marketing. The government needs to formulate a policy for the cured fish industry, pass comprehensive laws and regulations and develop an implementation strategy. This will help to create a conducive environment for the industry to become more efficient, better organised and profitable like the fresh fish industry.

### **4.3 Marketing of smoked fish**

Despite the fact that trade in cured fish is relatively lower in both volume and value than trade in frozen fish in The Gambia, still almost half of the artisanal catch is utilised in the cured form. Hence, it is important to ensure healthy trade and improved processing techniques and distribution systems.

#### 4.3.1 *Marketing of high quality smoked fish*

The urban population is rapidly increasing due to the rural - urban drift. The largest part of the increasing population comprises consumers who provide a growing market for smoked fish. Hence, the improvement of the quality of smoked fish is essential, as a large number of people will then have access to affordable high quality animal protein. In addition, high quality products and good packaging can gain greater consumer acceptability, which will increase demand, providing producers with additional income (Nautilus 1997). This is especially the case where the aim is to develop the market for higher income consumers. Market forces should be allowed to dictate the quality of products offered to consumers (Tetteh 1988). Therefore, improvement is required in fish processing practices to a level sufficient to comply with the quality requirements of domestic and export markets. This could strengthen the competitive position of high quality smoked fish in relation to other food commodities in the market.

#### 4.3.2 *Market information*

One of the most important factors in increasing efficiency in the industry is market information. The lack of wholesale markets and market intelligence can be a constraint to efficient marketing (Nautilus 1997). However, in improving markets for existing products, one has to undertake market research in aspects such as market price trends, as well as product quality and price relationship, seasonality of product supply and product packaging (Creupelandt 1985). With information from market research it would be 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 (Creupelandt 1985). 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 can stimulate and assist the sales of fish to the benefit of the industry.

Market information is a vital factor for efficient production planning. Therefore, the cured fish industry needs to be structurally organised for the development of existing and potential markets. This could result in easy access to reliable market information, enabling producers to do necessary production planning (Creupelandt 1985). As operations become larger, the need for production planning to meet requirements of these expanding markets will become even more apparent. However, problems of available product volumes, and the seasonal supply of different products have to be tackled with due consideration being given to the overall level of production. There is often a need to improve the availability of a product by better production planning which will necessitate provision of storage for the processed products where the availability of raw materials is seasonal. When raw materials are available throughout the year (e.g. shad), then the arrangement of adequate and continuous supplies to meet market demands will not require storage, but better production planning (Nautilus 1997). In his research on the Icelandic fish industry Bjarnason (1996) concluded that long term planning undertaken jointly between exporters and foreign buyers, could benefit both the exporter and the economy in

general, as export prices and product demand would be more stable. Mutual commitment of fish suppliers and processors is essential for effective co-operation and availability of products to the consumers (Knútsson 1996). In an organised industry, the processors would have contracts with fishermen for the supply of raw materials. Better co-operation among all participants in the value chain would lead to simpler value chain that would return better marketing information enabling producers to engage in long term planning.

#### *4.3.3 Transportation*

Roads play a vital part in fish distribution. The absence of roads linking landing sites to markets is a major barrier to the flow of products. Poorly maintained roads add to the cost of distribution, since they cause delays in the deliveries of products and increased spoilage losses. To facilitate the flow of fish within and among countries in the sub-region, and cut down storage time, it is essential that road networks be improved. In addition, a good distribution chain with the intervention of public/private sector investments would result in increases in the quality and quantity of fish available for consumption.

#### *4.3.4 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 harmonisation of tariff structures should encompass the sub-region. Also any meaningful expansion of inter-regional fish trade would require liberation of trade policies.

### **4.4 Organisational structure and strategy**

The precondition for improvement in the industry is a better structured cured fish industry. An industry with good level of organisation will often have better access to markets dealing in large volumes of products (Creupelandt 1985). The large structured organisation will be able to undertake better product packaging and transport and has better access to wholesalers. Also a structured organisation could provide a secure sales channel for members' products at ruling market prices. Tetteh, (1988) indicated that with a structured industry the marketing organisation could be able to sell their products so the producers could obtain sufficient continuing income to support themselves and their families and protect members from the more extreme fluctuations of the fishery and the markets.

Middlemen at various levels in the value chain play a useful role in distributing fish supplies throughout the country. However, there is evidence that the high number of middlemen cause the prices of fish to be high and barely affordable to consumers (Essuman 1992). Products are processed at a considerable distance from where they are

traded. Middlemen seek to keep information from producers, so that they can negotiate low prices to the producers, allowing for a disproportionately high mark-up by the middlemen.

Nautilus (1997) has pointed out that the establishment of a central fish auction market would be a way of improving market efficiency and determining prices, thereby reducing the number of middlemen. This would also make the monitoring of price information easier, which, if made available to cured fish producers, would strengthen their bargaining position (Nautilus 1997). A better understanding of the whole process by producers and joint ventures amongst producers and traders could be necessary to optimise the linkages within the value adding chain (Knútsson 1996). This could lead to more effective distribution and a simpler value chain from fishing to marketing, which may have the added benefits of lowering costs in the long term. This could result in obtaining correct market information on time which could increase value creation (Knútsson 2000). This can also result in lower inventories (steady flow of supplies), higher quality that meets consumers needs and faster overall response time with better information flow between producers (Knútsson 1996).

For marketing to be more efficient in the rural markets the number of middlemen could be reduced at the village level. Village agricultural associations or co-operatives already exist in most villages. These could act as agents for producers, providing the services of marketing the produce on behalf of the producers. This could be in the form of joint ventures between fish producers and agriculture associations. In this case, without the interference of the middlemen the producer could increase his profit margin. Therefore, an improvement in the availability of fishery products to the consumers through the development and /or upgrading of rural markets is essential. This will help improve national marketing and distribution schemes from urban to rural areas.

Entering markets in countries where the political climate is unstable, as is currently the case in the sub-region can be risky especially for small-scale operators. Hence, it is important for these small operators to make a kind of a strategic alliance with domestic companies in those countries. This should reduce the risk, save time, increase flexibility and be profitable for the trader and their partners (Knútsson 1996). In addition, the small-scale operators can benefit from strategic alliances by letting the established marketing companies take care of their marketing activities. Because of economies of scale, this will enable sales organisation to have offices in more countries than is possible for the individual small operators. This also reduces risk because of broader market scope, lower cost of marketing and less dependence on one or few customers (Knútsson 1996).

On the whole it could be suggested that good co-operation in a structured industry could lead to efficient marketing through better access to market information with fewer middlemen involved in the trade that would lead to better planning. This would benefit all participants in the value chain and make the chain simpler and clearer leading to a more efficient and profitable industry for all participants.

## 5 CONCLUSION

Methods of fish handling and processing in The Gambia are generally inadequate and result in major fish losses. Improvements are needed. Hence, it is vital that emphasis be placed on increased awareness through training for fishermen and processors on improved handling techniques that can result in high quality fish. The use of insulated containers and adequate ice at all stages is required and should be encouraged as this helps maintain the quality of the fish. However, these containers cannot be used without an adequate and cheap supply of ice. Therefore, the provision of cost effective ice production facilities at the major coastal fishing centres should be the government's priority in artisanal fisheries development. Additionally, there is the need to improve education (formal and informal) with regards to the importance of the resource and also the importance of improved processing, storage and distribution. In addition, a grading system could be applied for the smoked fish where fish with high grades (high quality) fetches high prices.

Having discussed the processing techniques used in The Gambia and the impact it has on the quality of the fish, there is little doubt that the artisanal sector lacks efficient processing techniques. Improvements are needed to bring about better control and quality of the product. Therefore, the traditional system of smoking has to be improved in areas such as the pre-smoking treatment, which can help to limit biological, microbiological, chemical and physical damage. It is essential that the smoking ovens be improved to limit pollution from high temperatures and smoke, limits fire hazards and control nutritional damage and consequently improve product quality. In addition, improving ovens can increase fuel economy and reduce the smoking time. Furthermore, the improvement of packaging (using low cost local effective packaging materials) and good storage conditions can protect cured fish against spoilage. It is imperative that an efficient distribution network is built up, as a good distribution chain can increase the quantity and quality of the product.

There is little doubt that the quality standards of the products, which are highly dependent on the processing, are a vital factor in the reduction of post harvest losses. Therefore, the achievement of higher standards brought about by improved processing practices and equipment will no doubt contribute immensely to bring about loss reduction. This can be facilitated if there is widespread technical knowledge and good hygienic practices. The quality and quantity of cured products could then improve, increasing availability and nutritional values of the fish to consumers and profitability for the producers. This could strengthen the marketing position of smoked fish, increasing the competition of the cured fish with other commodities, which can help to bring better returns for the industry in the long term. Hence, the need for continuing efforts in improving the system of getting fish from the water to the consumer is apparent and efforts by government to encourage better utilisation should continue.

For the marketing of smoked fish the situation reveals that the cured fish trade is faced with problems that limit its efficiency and quality. Hence, the processing and packaging

techniques need to be improved in order to help promote sub-regional trade of fishery products, with a reliable information network for effective marketing in an organised industry. This will help to enhance the development of the fish trade, both locally and at a sub-regional level.

One type of an organisational structure is a strategic alliance amongst producers and traders. In this way both can benefit from reduced costs and access to new markets. It can also be a good way to respond to changes, getting access to market information and hence strengthen their competitive status regarding customer demands on quality and diversity of products. This can also result in fewer middlemen engaged in the trade, simpler value chain with better production planning and an increase in value creation. Hence, the need for the industry to abolish the individual operational strategy and structure and move towards a more co-operative structure is essential for a more efficient and profitable industry.

As the population continues to expand in The Gambia and the sub-region, fish supply is increasingly going to depend on efficient distribution and improved trade in fishery products. To achieve this, not only should government address problems of tariff barriers, but fish producers, processors and traders should also maintain or improve the quality of their products by tackling the technological problems that confront the cured fish industry. This could be done through the full participation of fisherfolk in educational programmes relating to fish quality, processing and distribution. In addition, the government should set a minimum standard for quality assurance in the cured fish industry and make sure that these standards are effectively applied throughout the industry.

Although, it may not be easy to reduce post harvest losses in the short-term, long-term results will depend on proper planning and co-operation.

It is hoped that this review, together with the recommendations put forward will form a basis for the improvement of quality and profitability of smoked fish in The Gambia.

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