

**MINCED SARDINELLA FILLETS IN FISH-LANDING AND
MARKETING SITES IN SENEGAL**



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MINCED SARDINELLA FILLETS IN FISH-LANDING AND MARKETING SITES IN SENEGAL

by

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PREPARATION OF THIS DOCUMENT

The study on the production and marketing of a value-added product (minced fillets) from sardinella species in fish-landing and marketing sites in Senegal was proposed by FAO within the framework of the Cooperative Research Programme on Fish Technology in Africa coordinated by the Fish Utilization and Marketing Service (FIU), FAO Fisheries Department. This service commissioned Dr Yvette Diei-Ouadi, International Fish Technology and Quality Assurance Consultant at that time, to collect field data on the utilization of minced small pelagic fillets within several locations in Senegal. The two main small pelagic landing regions (Thiès and Dakar) were consequently covered in the purpose to:

- gather reference data on the extent and modalities of production, the socio-economic importance and the use of this intermediate product;
- identify gaps in the production and marketing and possibilities for further improvements to ensure safe and good quality semi-product;
- identify potential intended uses and markets;
- propose guidelines for extension and promote exchange of technology within the Africa region.

The mission took place from 6 to 27 April 2002 and the draft report was submitted on 28 May 2002. The report was subsequently edited and printed by FAO.

Diei-Ouadi, Y.

Minced sardinella fillets in fish-landing and marketing sites in Senegal.

FAO Fisheries Circular. No. 999. Rome, FAO. 2005. 20p.

ABSTRACT

Owing to their low value, small pelagics are generally neither iced nor chilled and large quantities are processed using traditional techniques. Most common products found in local markets were kethiak (roasted, salted and dried *Ethmalosa* or *Sardinella*), tambadiang and yauss (whole dried *Ethmalosa*). However, in the recent five years, a semi-finished product predominantly made up of minced fillets of sardinella (*Sardinella aurita* and *S. maderensis*) and bonga shad (*Ethmalosa fimbriata*) appeared in the fresh fish utilization scheme in Senegal and is steadily increasing in local beaches and markets.

Fish mincing activity is a substantial source of income for the poorer stratum of the population, and the end products from minced fish fillets contribute to food security of the whole community. Almost all operators are women that had a monthly net income which was much higher than the minimum wage in Senegal.

Taking into account the density of operators per site, there is more volume of fresh fish minced daily in Dakar central market (in Pikine) than processed in Pentium Senegal, the city's largest processing centre.

A variety of minced fish end-products have been reported, including fish balls, sandwich of cooked minced sardinella, cakes, attractive presentations for salad and for main dish, stuffed eggs and wrapped eggs. They are consumed within households, in restaurants and chop bars or within the premises of schools and colleges. These products were from low-value fish species commonly considered as "fish for the poor". However, they have the advantages with regard to the whole fish from the same species, to be boneless (hence an easy intake), and practically indiscernible from the flesh of other fish species (the connotation "fish for the poor" is thus disguised.) These were important attracting factors for medium income groups in purchasing minced sardinella fillets, though the poorer among urban population are the major customers.

The various forms of products and consumption patterns represented significant potential niches for promoting these species or other underutilized fish in countries where they are landed in large quantities. Extension to rural areas in Senegal is another opportunity to increased utilization of fresh small pelagics. The promotion of ready-to-eat end products is the key to the success of the technology.

However the expansion of fish mincing and marketing requires that critical weaknesses be effectively addressed. These include a design of a safer and more durable mincing equipment, a use of a manual backbone remover, an adoption of a production flow diagram complying with good handling and good processing practices, a supply in basic facilities (potable water, regular removal of solid waste and drainage of waste water, toilets) at the processing and market places, and a refrigerated display to prevent losses if readily minced fillets are to be sold.

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1. INTRODUCTION

Senegal is a great West African fishing nation known for the importance of the marine fisheries, which account for almost 90 percent of the total captures. Marine fisheries are the first source of foreign currency, ahead of tourism, and are thus a vital sector to the country. It provides employment and contributes to 273 billion CFA francs¹ (US\$ 124,28 million in landings value and US\$ 265,71 million in export earnings) to the national economy. In 1999, fisheries accounted for 11 percent of the gross domestic product (GDP) of the primary sector and 2.5 percent of the total GDP.

Annual per capita supply of fish and seafood in 1999 was 34.9 kg, ranking these products as the first source of animal protein, far ahead of meat products (19.6 kg)².

The contribution of artisanal fisheries to these figures is significant. More than 85 percent of the total landings are of artisanal origin. Small pelagics represent more than 75 percent of the artisanal catches and 55 percent of total marine catches. In the industrial fisheries these species are either frozen or canned, while in the artisanal fisheries they are mostly cured, for domestic consumption and for export. Owing to their low value, small pelagics are seldom refrigerated. Common processed products found in local markets were Kethiak (roasted, salted and dried *Ethmalosa* or *Sardinella*), tambadiang and yauss (whole dried *Ethmalosa*). However, in recent years, a semi-finished product made from minced fillets of small pelagics appeared in the fish utilization systems in Senegal and is increasing in importance in local beaches and markets. The product is also made in markets of Nouakchott (Mauritania) and recently (2002) also appeared in landing sites in Gambia.

The joint FAO, Fish Utilization and Marketing Service/Fisheries Department Group (Accra, Ghana) (FIIU/RAFI) survey³ on low-cost fish retailing equipment in large urban areas in West Africa, conducted from November 2000 to January 2001 reported that minced sardinella fillets production was an opportunity for increased contribution of underutilized species to food security of poorer urban communities and to incomes of small-scale fish operators. The study showed that they competed well with products from other small-scale fish species but that some improvements in their production and marketing were necessary to make them more effective and sustainable. The need for promoting the commercialization of similar value-added products once market potential is confirmed has been highlighted during the Seventh Expert Consultation on Fish Technology in Africa held from 10 to 13 December 2001 in Senegal.

In connection with that recommendation FAO has launched a study in Senegal, aiming at appraising the dynamics of the marketing, the socio-economic, safety and quality implications of the production and marketing of minced sardinella products, and proposing improvements to ensure its safety and the effectiveness of the production scheme. The study was conducted in collaboration with the Direction of Oceanography and Marine Fisheries (DOPM) and covered the most important small pelagic landing sites. The Institute of Food Technology (ITA) assessed the safety of the mincing operations and conducted stability tests on samples of minced fillets to determine shelf-life under various storage conditions.

¹ Average exchange rate in 2000: 1 US dollar (US\$) = 700 CFA francs (CFAF).

² FAO Food balance sheets for 1999 and FAOSTAT database.

Are included in this figure beef and veal, mutton and goat meat, pig meat, poultry meat, other meats, and offals.

³ Document under review for publication.

2. RATIONALE FOR THE STUDY ON MINCED SMALL PELAGIC FILLETS

This study, which falls within the FAO mandate of food security and reduction of poverty, was justified for six reasons that call for priority actions for an increased contribution of small pelagic fish species to social, economic, and nutritional conditions of the population:

- large volumes of small pelagics are annually landed in Senegal and in other countries in the region;
- though a lot of fish is processed, losses occur during the peak fishing season of small pelagics owing to the limited capacity of the artisanal facilities;
- generally known as low-value species, small pelagics are primarily hot-smoked and sun-dried;
- these species are consumed across the major stratum of the population represented by the poorer communities and are also important source of incomes for them;
- the need for good handling and processing conditions for consumer's health protection;
- the need to provide data on extension patterns and diversification of marketing channels for the development of the artisanal post-harvest fisheries.

3. FISH PRODUCTION DATA

The latest data from the two fisheries departments (marine and inland fisheries) gave a total production of 453 289 tonnes in 2000 against 507 040 tonnes in 1999. Total marine fisheries, as illustrated in Table 1 showed a decrease (–17 percent), while the artisanal landings increased to about 8 percent, with spectacular leap of 18 percent in small pelagics catches, mostly from Thiès region. This region accounts for 72 percent of the total marine landings and 82 percent of the small pelagics in Senegal.

Table 1: Marine fish landings (in tonnes) in Senegal* .

Region	1999			2000		
	Total landings	Artisanal landings	Artisanal small pelagics	Total landings	Artisanal landings	Artisanal small pelagics
Dakar		29 687	18 596.56		29 280.32	21 058.74
Thiès		219 908.37	179 306.63		246 774.98	208 913.45
St-Louis		32 486.83	24 325.78		34 285.95	21 800.42
Fatick		1 0911.14	3 739.06		8 844.56	1 872.87
Ziguinchor		17 589.85	1 422.09		15 585.31	742.42
Louga		2 636.46	62.15		2 849.25	89.5
Kaolack		417.10	3.8		587.15	59.85
Total	479 308	313 637	227 458	390 256	338 209	254 537.25

* Source: DOPM and DPCA statistical data.

The artisanal landings in 2000 had an estimated value of 54 billion CFA francs (US \$ 77 million), equivalent to 63 percent of the value of the total landings.

4. UTILIZATION OF SMALL PELAGICS

It should be emphasized that owing to their affordability, small pelagics are widely consumed in Senegal. Their consumption in a fresh form is mainly during the peak fishing season, from March to June, in fish-landing centres and villages close to these centres. Generally considered as low-value fish or fish for the poor, small pelagics are scarcely iced or refrigerated and the main utilization method remains curing into artisanal local products called kethiak (roasted, salted and dried *Ethmalosa* or *Sardinella*), tambadiang and yauss

(whole dried *Ethmalosa*). According to the 2000 data, out of the 36 857 tonnes of artisanally processed products recorded, 26 000 tonnes is made up of small pelagic fish species.

5. THE MINCED SARDINELLA FILLETS

5.1 Pre-survey available information

Although any Senegalese seems familiar with fish balls (“boulettes”) and stuffed fish (“farci”)⁴, neither the origin of the practice of fillet mincing, nor the expansion of the operations in markets or landing sites could be accurately dated and explained. However, it was known that in Saint-Louis region, mullet poached with minced fish fillets were being used in a local dish (“farci”) for some generations. It was also acknowledged that fish mincing in public places is not common in rural areas.

Where it is known, the process of mincing involves mainly *Sardinella maderensis*, *S. aurita* and *Ethmalosa fimbriata*, for their relative abundance and their affordability. While low-income groups in urban zones purchase their fish then mince it in the site of purchase, medium income groups usually mince at home themselves. With regard to high-income strata of the population it was said that their minced semi-product is made up of high value (demersal) species, which are also minced at home.

5.2 Methodology of the study

The 3-week study was conducted during the *Sardinella* glut fishing season according to a planned methodology based on the available information:

- The major landing sites of small pelagics which provide 87 percent of sardinella and bonga shad were visited. These are Thiès (Mbour, Joal, Kayar) and Dakar (Dakar, Pikine) regions.
- The main fresh fish market in Dakar (“Marché central”), with a daily throughput of 60 to 100 tonnes of fish (50 to 60 percent of sardinella and bonga shad) originating from Thiès region and Hann landing site. It is a place where many women provide fish mincing services. The fish unloaded there is mostly sold on a wholesale basis and dispatched to Dakar secondary markets and processing sites (Pentium Senegal being the largest one) or to hinterland.
- Some important secondary markets with fish mincing operations.

Data were collected from minced fish operators, consumers, fisheries inspectors and markets administrators. This was done in collaboration with human and logistical support from DOPM while the Institute of Food Technology (ITA) collaborated in the samples analysis. Accordingly, the study was divided into two parts:

5.2.1 Interviews

A questionnaire was designed to collect the information regarding the social role of fish mincing business, its profitability, the extent of the activity, the safety and hygienic conditions under which fish handling and mincing operations were taking place, the marketing channels, the use of the semi-product, and the potentials for its expansion.

⁴ According to people met, “farci” is a bigger size fish balls.

Table 2 is a breakdown of the several people met. It takes into account some practical constraints and field realities, which to some extent restricted the number of interviewees. However, measures were taken to interview a sample representing at least 10 percent of people operating in a given market during the survey.

Table 2: Outlook of the sites visited.

Site	Number of minced fillets operators counted	Number of operators interviewed	Number of customers interviewed	Number of fish cleaners counted	Interview of fisheries staff or market administrators
DAKAR CITY					
Central market	36	2	3	59	Yes
Hann artisanal landing site	11	2	2	57	Yes
Cambéréne market	43*	3	2	45	Yes
Tilène market	27	3	5	27	No
Pikine market ⁵	32	3	2	28	Yes
Castor market	24	3	2	21	No
TOTAL	173	17	16	237	
MBOUR CITY					
Landing site	71	3	3	NF	Yes
Market	4	0	00	NF	
TOTAL	75	3	3	–	
JOAL CITY					
Landing site	00	01**	00	8	No
Big market	4	2	00	4	
Small market	5	1	00	5	
TOTAL	9	4	00	17	
KAYAR CITY					
Landing site	00	00	00	16	Yes
Market	00	00	00	00	
TOTAL	00	00	00	16	
OVERALL TOTAL	257	24	19	303	

* 22 among them were combining the fish cleaning and mincing activity.

** A former fish mincing operator met incidentally at this site informed the survey team that they were 3 women there some 8 to 10 months ago, but their mincers were no longer operational.

NF: Not found on that day.

When a response from direct interview seemed not realistic, in order to avoid biased answers, a second visit was paid to cross-check the relevant information. During this validation phase, which was practically feasible in Dakar, other operators in the same site were taken into account. This was found useful for data linked to the daily quantity of raw material minced and for the income earned. The team noted that the best way to collect reliable data on these figures was to stay by the operator's stall for at least an hour, to count the customers, assess the weight of fish brought, the quantity of waste dumped, and estimate the money collected during that period of time. The quantity of fish was determined based of the team's field experience. Depending on the size, a heap of 3 pieces of sardinella or bonga shad generally weights between 650 g to 1 kg.

The team seized the opportunity of this exercise to evaluate the sanitary conditions within the stalls and the working practices.

⁵ Zinc 1 Market.

5.2.2 Sampling for laboratory assessment

The sampling was conducted after the first round of interviews, or during the validation of some data (in the case of Dakar region).

Uniform samples of sardinella or bonga shad purchased by the survey team were minced at different sites under the prevailing preparation conditions, and then analysed for their composition, their freshness, and their microbiological status. Owing to weaknesses in the diverse schemes of fish handling and mincing recorded, which involved possible risk of cross-contamination, the trials consisted in sampling minced fish after a thorough cleaning of the mincer, then a second sample was taken after the turn of at least six customers. Some stability tests were conducted to assess the shelf-life at ambient and low temperatures. Some samples of plastic bags used as packaging material were also taken to assess the safety (essentially microbiological evaluation). A sample processed at ITA served as reference.

5.3 Production of minced sardinella filets

5.3.1 Production sites

As per the data in Table 2, no fish mincing operation was reported in Kayar, and it was a very limited practice in Joal, despite the importance of small pelagic landings at these places. These are relatively smaller cities compared to Dakar and Mbour, the latter being the city where this business attracts the highest number of women in one landing site. The field investigations confirmed the indication of the fisheries officers that minced fish filets production is confined to urban areas. However, any Senegalese knows fish mincing. Fish flesh is traditionally pounded to obtain a paste that has the same intended use as the actual minced filets. Therefore the fact that no fish mincing operators were found in rural markets and landing sites does not mean that the practice is unknown.

Contrary to information provided by market administrators and fisheries officers the information collected in the field indicated that: (i) fish mincing is a much wider activity than initially presented to the survey team, (ii) its importance has little linkage with the volume of landings but rather on the size of the site and its comparative socio-economic status.

On average 1.5 tonnes of fresh *Sardinella* or *Ethmalosa* is minced daily per site visited (Table 3). Lower figures reported were for the lean fishing season. The survey team noted however that during the period of the study, supposed to be a sardinella season, some sites were facing a critical problem of supply in raw material while others were oversupplied, with obvious implications for prices and physical losses.

The data in Dakar Central Market indicate that the 36 operators daily mince an average of 1.7 tonnes of fresh sardinella or bonga shad. For ease of reference, this figure was compared with that of Pentium Senegal, the largest

Table 3: Estimated quantity of raw material ("fresh" fish) minced in the sites⁶ visited.

Site	Quantity (kg)
Dakar Central market	324–2 880
Hann artisanal landing site	22–572
Camberene market	645–2 785
Tilene market	810–1 080
Pikine market	768–960
Castor market	240–1 248
Average for Dakar	468–1 588
Mbour landing site	2 250–4 350
Joal bigger market	12–100
Joal smaller market	55–265
Average for Joal	34–183

⁶ Quantity based on the adjusted information of the interviewees then multiplied by the number of operators reported on the site.

fish processing centre in Dakar. This site produces 80 percent of fish processed in Dakar. It supplies the city's secondary markets as well as hinterland and neighbouring countries. About 3 to 4 tonnes of raw material is used daily by 220 artisanal fish operators (173 women processors and 43 male fish cleaners) working at the place. This gives an idea of the actual extent and dynamics of the fish mincing operations.

5.3.2 Producers of minced fish fillets

Except from Tilène market where only men, and in Hann landing site where few men operate, fish fillets mincing can be described as an exclusive women activity. They represented 89 percent of the minced fish operators counted.



Photo 1: A family-owned fish mincing unit at work.

At least half of the minced fish operators interviewed were either former fresh fish sellers, or have been combining the two activities together with fish cleaning. Fish mincing is a paid service for the owner of the fish: the mincers do not produce minced fish for sale. It is a non risky and profitable business compared to the sale of fish. They were therefore not ready to go into the sale of readily minced fish fillets, unless some cooling facilities are provided to them to preserve the minced product (reducing thus the risk factor) and they have access to the raw material at a wholesale price.

The report of the presence of men among the operators, and the fact that no operator sells minced fish, but provided mincing service against payment were additional information brought to the attention of fisheries officers and market administrators.

Table 4: Characteristics of the minced fish producers.

Place	Number of operators	Number of women	Age	Household size	Working experience (month)	Working hours per day	Working days per week
Dakar	173	143	35	9.8	39	8	6.4
Mbour	75	75	28	7.3	23	6	6.5
Joal	9	9	30	9	30	6	6.7
Average/total	257	227	31	8.7	31	6.6	6.5

Table 4 shows that fish mincing is a full-time activity for the operators involved. They work at least 6 days a week, for an average of 7 hours per day (from 6 to 12 a.m.). They appreciated their job and deemed it has fewer constraints, compared to house helps who work longer and do not have time to take care of their family. This is a huge advantage when one knows that in addition to their involvement in income generating activity, these women are responsible for household tasks, including feeding, clothing the kids and supporting husband and relatives. Apart from the youngest among them who lived with their mother, most of the operators had to prepare the meals and take care of the kids after closing from work.

It was reported that fish mincing is being done in markets and landing sites for more than 10 years. However its expansion is a recent phenomenon: about 60 percent of the interviewees had been involved in the business three years or less.

The operators were between 28 and 52 year old (average 31) and represent typical lower income families in urban areas of up to 15 persons. The household size of disadvantaged

strata in Dakar is between 9.5 and 11.9. These data give an indication of the number of people directly “fed” by the fish mincing business.

5.3.3 Quality and safety issues in the minced sardinella fillets production

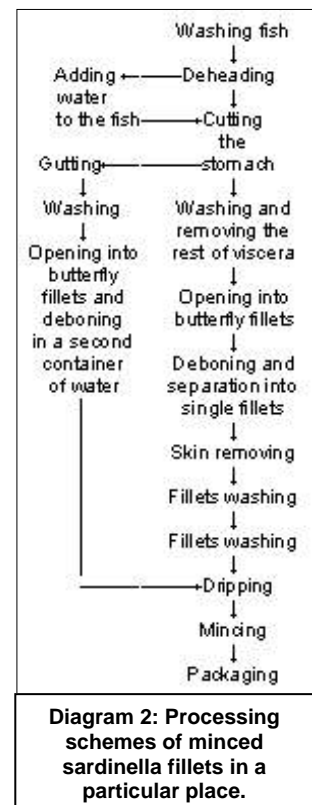
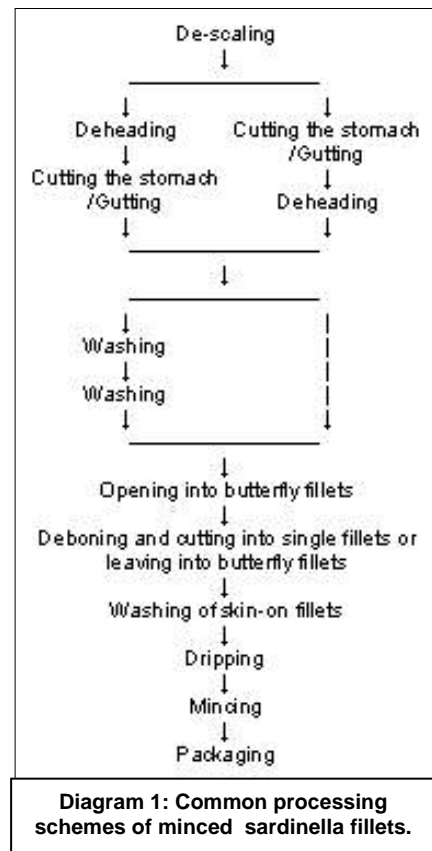
Customers of minced sardinella or bonga shad usually purchase themselves the necessary quantity of fish then pay for the service of an operator to mince it on the same site. The process can be described into two main schemes (diagrams 1 and 2) depending on the relative safety of the fish preparation method. There are some common points to the two diagrams and some peculiarities that indicating potential sources of hazards:

- As seen in pictures 2 to 4 representing some production steps, wearing jewels during the operation is a common practice. So is handling fish without washing hands after shaking people’s hands or after holding a child or vegetables and spices.



Photo 2: An operator gutting fish.

- It was noted that fish collected from the customer was seldom washed before cleaning started. Yet washing the fish is the best way to get rid of 90 percent of the bacteria at the surface of the fish and to decrease the bacterial load during the subsequent handling steps. Washing fish before cleaning was applied only by few women out of the 13 at Castor market. These women used water at least three times (steps 1, 4, 8 and 9 in diagram 2), and this made the difference in the flow and nature (social status) of the customers observed during the survey, though the service was much more expensive than the women operating differently.



The existence of a second group of women fish mincers was a contrast in the hygienic status of fish handling practices and working conditions in that particular market of Dakar. Based on the fisheries officers' briefing and the team's field observation on the predominance of demersal fish, Castor market is located in a less populous district. Groups of women fish cleaners, sellers and mincers have put their stalls just outside the entrance of the market fish on a very dense situation. They were operating under the worst conditions seen during the whole study. It was said that these women were on a temporary site, they paid daily taxes but did not have access to any basic service.



Photo 3: Removal of a skin on a butterfly fillet.

They operated all according to diagram 1 and charged less than the group established within the premises of the market (CFAF25 against CFAF50 to 75 per heap of 3 fish). The longest queue of customers in this market was with three women who applied comparatively better hygienic working practices, though their service was more expensive:

- The repeated use of the same water to wash the fish from several consumers was a common point to all the operators counted. Water was changed depending on the operator's visual appreciation of its dirtiness, and this can vary from 4 to 5 customers' packages (average estimate of 6 to 8 kg of fish) in the best case (Diagram 2), to 5 to 8 customers (8 to 15 kg of fish) in the case of Diagram 1.



Photo 4: Removal of a backbone from a skin-on butterfly fillet



Photo 5: Last washing of skinless single fillets (Diagram 2 operator).



Photo 6: Skin-on butterfly fillets ready to be minced.

- Apart from the repeated use of water for many customers, it was noted that some operators did not use potable water at all. Some market sites were not supplied with tap water. This led to the use of lower quality water from wells.

- The mincer was used several times without being washed. Less than 2 percent of the workers counted washed the mincer between customers. These ones were in the group of operators within Castor market. The fragility of the apparatus requires that it be dismantled from time to time to get rid of the scraps of fish that often block it. It was noted during the survey that the apparatus stopped functioning after an average of 8 to 10 kg of fish. While in most cases the scraps of fish were simply removed with a stick or with fingers, some of the women in Diagram 2 seized the opportunity of dismantling to wash their mincer. Cleaning the mincer between customers would not be a critical matter if fish were thoroughly washed with potable water when taken from the hands of the customer.
- The sanitary conditions of the fish handling and preparation environment are poor: the floor is often sandy, dirty, or of damaged cement or tiles; lack of drainage facilities for waste water; irregular and inadequate removal of solid wastes, absence of toilet facilities and potable water at some places. The operators were aware of these conditions and at least two thirds among them unanimously stated that they would have attracted much more customers and boosted their business if hygiene within the places was improved.

It is clear that improvements to be brought in the fish mincing operations require that basic facilities and services be provided. The responsibility of the market or landing sites administrators is involved, as they collect regular taxes and several levies from the operators. It is fundamental that appropriate action be taken accordingly:

- The packaging material is a plastic bag either brought by the customer or given to him/her for free. Plastic bags are commonly sold in markets and landing sites and are meant for multiple purposes, including packing vegetables, other foodstuffs, clothes, shoes, etc. As it was not particularly designed for packaging prepared food, its sterility may not be guaranteed for packaging minced fish, known as relatively sensitive product compared to whole fish.
- The results from ITA confirmed the inadequate working practices and environmental conditions. The load before cleaning the mincer illustrates that customers in the earlier periods of the operation have safer product than the following ones (contamination increases with the number of uses of the mincer.).

The presence of *Clostridium* was noted in a sample in one location. This observation was made in empty plastic bags (without minced fillets) from the same location, which had seven counts of *Clostridium*. The bacteria in that sample could therefore come from the first clients' products or from the plastic bag. In fact, the analytical findings on these bags were that before being used, they already contained substantial bacteria. With exception of the absence of *Salmonella*, they had some bacterial counts lower than samples in diagram 1 and diagram 2, but higher than the control sample.

The control sample from ITA served to establish storage time. Based on the microbial status, a freshly prepared minced fillet of good quality (from sardinella fish grade 6/7 in Torry quotation) and handled hygienically must be cooked within 12 hours if kept at ambient temperature, but within 36 hours in the fridge (4 °C). The data are of interest for housewives as there is usually a delay between mincing the product and cooking. This can be particularly

long in households where only one meal is taken a day, which is prepared in the afternoon, while fish is minced generally early in the morning.

These analyses, which were the first on this type of products, constitute a good starting point as guide for customers, operators and extension officers. They would however need to be replicated and combined with histamine analyses, including testing samples of various degrees of freshness.

Table 5: Microbiological assessment of samples of minced sardinella fillets.

Bacteria (UFC/g)	Diagram 1		Diagram 2		Control
	Before cleaning	After cleaning	Before cleaning	After cleaning	
Total bacteria count	3.4×10^5	7.2×10^4	1.2×10^4	10^4	1.1×10^3
Total coliforms	2.6×10^4	8×10^2	2×10^4	4×10^1	3.3×10^2
Faecal coliforms	1.3×10^4	3.6×10^2	< 10	10^1	1.2×10^2
Pathogenic <i>staphylococcus</i>	< 100	< 100	< 100	< 100	< 100
<i>Clostridium</i>	0	0	3	0	0
<i>Salmonella</i> (UFC/25g)	Absence	Absence	Absence	Absence	Absence

Table 6: Freshness and chemical assessment of samples of minced sardinella fillets.

Sample	Freshness			Chemical parameters	
	Sensorial quotation ⁷	N-TVB (mg NH ₃ /100g)	Histamine (mg/100g)	Fat %	Protein %
Control	9	25	8.35	6.64	22.34
Diagram 1	6	25	16.54	16.37	20.22
Diagram 2	7	20	<Detection limit	7.84	20.34



Photo 7: Mincing operation.



Photo 8: Minced sardinella fillets being packaged.



Photo 9: Mincer being dismantled for cleaning and washing.



Photo 10: dismantled parts of a mincer ready for cleaning.

⁷ According to Torry scoring table.

5.3.4 Facilities and equipment

The basic equipment used for fish mincing is represented in Table 7. The variation in the price of dustbins and knives lies in their size or quality (strength).

Depending on the site or the working habit of the operator, a table or stool is used to support the mincer, as shown in pictures 1, 7 and 9. When a table or a concrete cement block is used as a display, a bench served as a seat. A chopping plank is usually placed on top of the cement block to immobilize the mincer. Using two stools is a common practice in Mbour landing seat and Dakar central market, one serving to immobilize the mincer and another one as a sit. On the other hand a table or a concrete block, then a bench as a seat, were the main tools used in all markets premises and in Hann landing site.

Table 7: Inventory of the equipment used for fish mincing.

Type	Cost per unit (in CFA F)	Number per operator	Useful life (in month)
Mincer	7 500–9 000	1	5–6
Wooden table	7 000	1	12–18
Wooden plank	Salvage equipment	0–1	2
Wooden bench	1 200	1	12
Wooden stool	400-500	1–2	10
Plastic pan (40 l)	1 000	1–2	5–6
Plastic bucket (10 l)	500	2	5
Plastic bin	700-1 000	1	2–3
Plastic strainer	400	1	3
Other container (1-2 l)	400	0–3	3
Knife	300-500	1–2	2–3

The buckets and basins were generally used to store water, and to clean and wash the fish. It was noted that the more tools the worker has, the longer the lifespan of each, and that women who had a processing scheme similar to diagram 2 had generally more containers.

The mincer is an imported machine with a bowl of approximately 300 g-capacity. All the operators had one unit for fish mincing; some may own a second one to mince vegetables, leaves and spices.

The cost of a mincer varies depending on the place of purchase or the bargaining skill of the operator. The interviews reported an average cost of CFAF8 000. An overwhelming majority of the respondents mentioned that the mincer's lifespan varied from 5 to 6 months (up to one year). This short lifespan was the critical concern of the persons met.

Among issues raised by the operators the mincer's weaknesses were the first preoccupation (Table 8).

Table 8: Problems faced by the fish mincing operators.

Problem	Number of respondents			
	Dakar	Mbour	Joal	Total
Fragility of the mincer	9	00	2	11
Capacity of the mincer	6	00	3	9
Wound when operating the mincer	3	00	1	4
Wound when removing fish's spine	7	00	2	9
Working environment (space, table, hygiene)	5	3	00	8
Supply in/cost of potable water	2	00	02	4
High levies and taxes	1	00	00	1
Customers bargaining the cost of service	1	00	00	1
Total	34	3	10	47

It can be noted from Table 8 that 51 percent of the problems are closely linked to the mincer. The short lifespan of the apparatus,

which is the direct consequence of its fragility, combined with the lack of spare parts on the local market were very disconcerting facts for the operators. The justification of these shortcomings could be the intensive use of the machine, which is not actually designed for "semi-industrial" purpose but rather for household use.

This calls for an improved design, which would be stronger, more durable, safer, and have appropriate capacity. The actual capacity needed would be 2 to 3 times more as the current bowl cannot hold more than two single fillets at once.

The tediousness of the process of deboning with the fingers, in particular for good quality fish (firm vertebral column), was the second concern raised by the operators. There is hence a need to use a manual backbone remover to prevent any wound that represents a potential source of contamination of the product.

A local manufacturer was met to discuss the feasibility of addressing these two types of weaknesses. The problem raised by the manager was that unless he was assured of the funding of the pilot assessment and potential markets, he would not provide to the survey team broad figures of the retail cost of improved equipment. He thought however that it could not be time consuming to design this prototype and test it, and is ready to concur if any institution would meet his conditions.

Other relevant operational deficiencies raised by the operators were the bad working environment and the lack of potable water.

5.4 Marketing and use of minced fish fillets

5.4.1 Purchasers of minced fish fillets

As previously mentioned, fish fillets are minced on request from customers who bring their fish to the operator. Four types of customers were identified, based on difference in the quantity of fish purchased and the intended use of the semi-product:

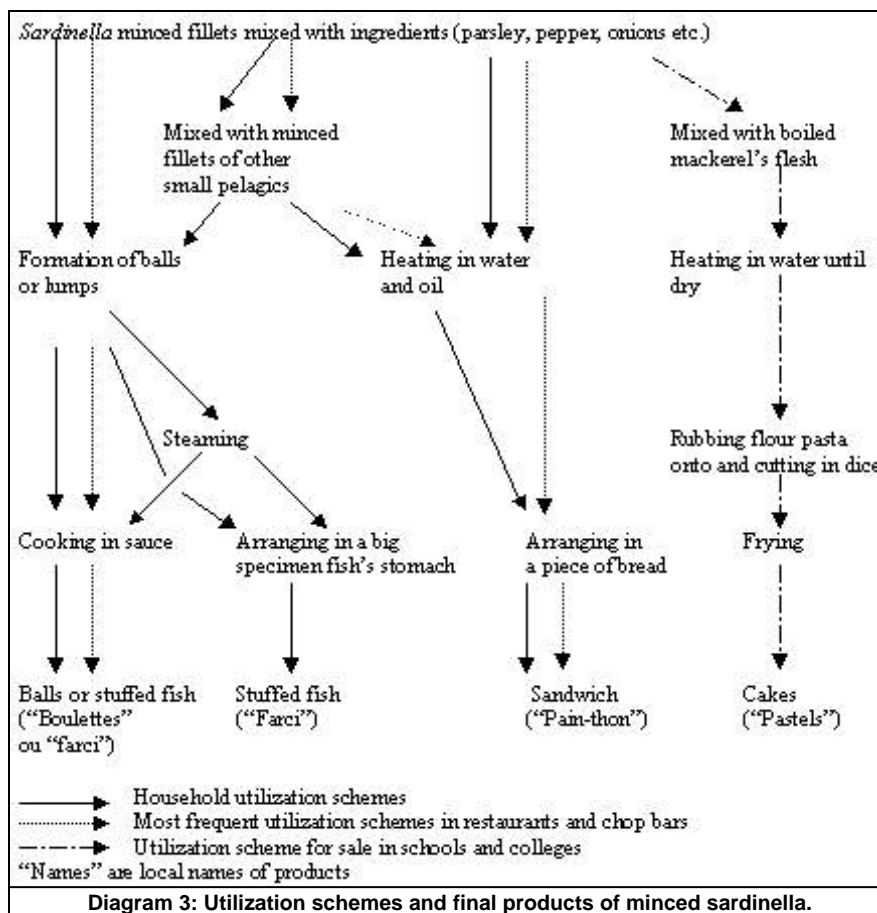
- Housewives: the family size of the customers interviewed is 11 (between 5 to 20), this is the size of a typical low-income family. A quantity of 1 to 2 kg of fresh fish is minced per purchaser on a daily basis or at least three times a week. sardinella is the predominant species, but some women also use bonga shad (*Ethmalosa fimbriata*), horse mackerel (*Trachurus* sp.), Spanish mackerel (*Scomberomorus* sp.) or skipjack tuna (*Katsuwonus pelamis*). Women who supplied food to groups of purse seine fishermen are also in this category of purchasers.
- Although they may have a fish mincer at home, a number of women belonging to the medium income stratum minced their fish in markets and landing sites in order to save time once at home to prepare the meals. They were seen in most instances at the stalls of operators working according to diagram 2. Their frequency of purchase is less than the low-income groups (once to twice a week).
- Restaurants and chop bar owners: they preferred sardinella species. They manage low standard restaurants with an estimated 15 to 20 daily consumers of fish balls. Depending on the consumers' affluence in the restaurant they purchased and minced 4 to 8 kg of raw material 4 to 5 times a week.
- Traders of ready-to-eat minced fish products at the entrance of schools and colleges. They have the same purchase frequency and quantity as the owners of restaurants and chop bars, but always purchase whole Spanish mackerel in addition to minced sardinella fillets.

- Traders of packaged minced fillets. Usually on a daily basis, they purchase 5 to 10 kg of sardinella that they mince, package and cover with ice. It is then sold in apartment districts (“quartiers HLM”). They have been reported only in Dakar central market.

The majority of the customers interviewed insisted that fish should be minced in their presence, but in fact many left the fish with the operator to complete one’s shopping in the market. The purchasers thus ignored the conditions under which their product had been prepared, and whether the packaged product was actually made from the fish they left. This was one of the contradictions reported during the survey.

The cost of mincing varied generally from CFAF10 per fish to CFAF25 per heap of 2–3 pieces, depending on the size of the fish. The exception was the pricing in the stalls inside Castor market where it varied from CFA F50 to 75 per heap of 3 pieces. Some cases of bargaining about the charges for the service have been noted.

5.4.2 Intended use of minced fish fillets



Six types of final products were identified from the minced fish fillets. The most frequent are fish balls in tomato sauce, served with a local dish made up of fried rice (Thiebou Dienn). Diagram 3 presents the utilization scheme and the several forms of end products.

Other end products reported by medium income women, but not represented on the diagram were fish balls as attractive presentations for salads, and two types of entrée one made up of stuffed eggs and another one with spiced fried minced fillets wrapping egg.

Though none of the customers interviewed had mentioned the existence of sandwich in schools and colleges, the possibility of the sale of this ready-to-eat product should not be underestimated. In effect the sandwich prepared in family served for breakfast, and also as snacks to be taken away by school children.

All these products are probably interesting market niches to be explored.

6. SOCIO-ECONOMIC ANALYSIS OF THE PRODUCTION OF MINCED FISH FILLETS

The major end products from minced sardinella fillets (fish balls, sandwich, stuffed fish, stuffed eggs, wrapped eggs) are prepared and consumed within the household but are seldomly sold. Therefore, the survey team based its data collection on the semi-product itself in order to provide figures on the socio-economic importance. The purpose was to assess the contribution of minced small pelagic fillets to income and employment of poorer groups, to food security of the whole community, to the reduction of post-harvest losses and to utilization of low value fish species. The data analysed in previous chapters (5.3 and 5.4) are relevant indicators of the social importance of this product. They relate to the volume of minced small pelagic fillets produced daily in relation with the total quantities of fresh small pelagics landed, and to numbers and social status of people involved. This chapter will cover mainly the economics and the consumption patterns of minced fillets.

6.1 Profitability of the fish mincing service

The investment costs (IC) include the fixed costs and depreciation of the facilities listed in table 7 while variable expenses related to the cost of packaging material, rent of stall, water, taxes and waste removal. For purpose of comparison, a clear distinction was made between operators applying bad handling and processing practices (operators 1) and the two women who had relatively hygienic practices (operators 2).

6.1.1 Investment costs

The only differences in investment between the two types of operators lie in the number of containers and knives used. Some of the operators 1 had either a wooden table or a wooden stool, while others rent a concrete cement block to install their mincer on. On the other hand, all the operators 2 rent a concrete cement block as the major component of their stall.

Table 9: Total investment costs of two types of fish mincing operations.

Item	Investment cost (CFAF)		Lifespan (months)		Investment cost/month (CFAF)	
	O1	O2	O1	O2	O1	O2
Mincer	8 000	8 000	6	5	1 333	1 600
Wooden table	0–7 000	00	12–18	00	388–583	00
Wooden bench	0–1 200	1 200	12	12	100	100
Wooden stool	1 600–2 000	00	3; 10	00	267–333; 80–100	00
Plastic pan	1 000–2 000	2 000–3 000	6	7	167–334	334–501
Plastic bucket	1 000	1 000	5	5	200	200
Plastic bin	700–1 000	700–1 000	3	2	233–333	350–500
Plastic strainer	400	400	3	3	133	133
Other container	0–400	800	3	3	0–133	266
Knife	300–500	300–1 000	2	3	150–250	100–334
Total	14 250–20 750	14 400–16 400	-	-	2 634–3 275	2 816–3 367

Despite the use of more containers and knives that could have increased their initial capital, operators 2 have less investment costs than operators 1. This is because their initial capital does not include the cost for the concrete cement, as they rent it while operators 1 invest in wooden table or bench.

The more equipment (for the same purpose) the operator has, the longer the lifespan of each. Though they were cheaper than a table the stools are weaker and have a shorter lifespan, which puts pressure on the monthly investment cost. It is therefore advisable to have relatively expensive equipment, but which is durable, easily manageable in terms of hygiene and gives more comfort (a table and a bench rather than 2 stools).

6.1.2 Operating costs

The lower taxes were recorded with women at the entrance of Castor market. As previously said, women operators 2 used more water to clean the fish and equipment, in addition, they paid rental fees for the stall which belongs to an individual. These were the reasons of their higher operating costs. The monthly costs were calculated on the basis of 24 working days a month (average of six days per week).

Table 10: Operating costs of two types of fish mincing operations.

Item	Daily costs (in CFAF)		Monthly costs (in CFAF)	
	O 1	O 2	O 1	O 2
Market taxes	50–200*	100	1 200–4 800*	2 400
Rent the stall	0–100	100	0–2 400	2 400
Water	25–75	50–125	600–1 800	3 000
Waste removal	25–50	50	600–1 200	1 200
Packaging bag	0–100	100–150	0–2400	2 400–3 600
Total	100–425	400–500	2 400–10 200*	7 200–12 600

*Entry fees to Central market are 200 CFA F. No additional cost is paid in this case (no stall rent fees for the display).

6.1.3 Returns

The gross income (Table 11) was based on a daily income ranging from CFA F200 to 3 000 (average CFA F1 525) for operators 1 and from CFA F750 to 4 250 (average CFA F2 650) for 2, during 24 days per month.

Table 11: Monthly income of two types of fish mincing operators.

Item	Operators 1	Operators 2
IC/month	2 635–3 275	2 820–3 370
OC/month	2 400–10 200	7 200–12 600
Total monthly costs	5 035–13 475	10 020–15 975
Gross monthly income	8 400–72 000	16 000–102000
Net monthly income	3 365–58 525	5 980–86 025
Average monthly income ⁸	36 600	63 600

Though their service was expensive, operators 2 received more customers, and despite their higher total monthly costs, they had

⁸ Based on the average of net monthly income of each of the operators interviewed.

the highest net income. These figures confirm the field observation about difference in customers' flow between women at the entrance of and those inside Castor market. They are also sufficient indicators of the consciousness of certain type of consumers with respect to hygiene and safety of food.

The average net monthly income of CFAF36 600 and CFAF63 600 respectively indicate that fish mincing operation is a significant source of income, in view of the social status of the people involved. This enabled them even to subscribe to the thrift collectors' scheme, an informal saving scheme that they contributed to between CFAF200 and 1 000 daily. About 46 percent of the operators interviewed earn between 36 600 and 63 600, while 18 percent have more than CFAF63 600 per month.

It should be mentioned that this is much higher than the minimum wage at the time of the study, which is equivalent to CFAF35 000 in Senegal.

6.2 Consumption patterns

Sardinella was originally consumed whole by poorer communities for their affordability in comparison with other fish species and meat products. In addition minced fillets have other advantages:

- They do not have bones, which are usually unpleasant to many consumers. A recurrent reply from customers who never ate whole sardinella or bonga but preferred minced flesh of the same species, was that they did not have to remove the bones while in whole form, whatever the vigilance one always faces the problem of bones in the throat.
- Sardinella or small pelagics in general are always regarded as fish for the poor.
- If this is particularly true for the whole fish, it is unlikely for minced products, as they are consumed across almost all strata of the urban population. In effect, once minced it is practically impossible to detect by sensorial assessment the species of origin. This justified the steady trend towards minced small pelagics fillets by medium income groups and other people who, under normal circumstances do not buy these species for their reputation of being fish for the poor. This shift in habit is also the consequence of the scarcity and high prices of demersal fish (mainly processed or prepared for export to European Union markets), and the rising price of meat products.
- It is in the medium income groups that imaginative ideas on products, like fish balls for attractive presentations of meals and salad, wrapped boiled eggs or stuffed eggs as entree or main dish, were noted. This would be an interesting outlet to explore and harness.
- Minced sardinella fillets lower the housewife's shopping basket. This was equally perceptible in families where sandwiches with minced small pelagics have replaced canned products sandwiches.
- Minced end products enable a diversification/variation in meals.

7. CONCLUSION

This study revealed some interesting information about the dynamics of fish mincing and use of the end products:

- the activity has considerable implications in terms of food security of poorer communities especially;
- it is an important method of fish utilization, as in the minced form, small pelagics appear to be much more acceptable across the whole population;
- the activity stands more and more as a necessity for middle income groups in effective management of their household time through mincing fish in the site of purchase;
- the operation is expanding and much more people are involved in the mincing activity than it was some three years before;
- the data showed also the noticeable contribution of the activity in terms of employment and income, the average net income of the majority of the operators being higher than the national minimum wage;
- appears as a regulator in post-harvest activities, as most of the operators were former fresh fish traders reconverted;
- fish mincing is a dynamic activity but for sustainability and expansion of marketing channels it requires some major improvements in equipment and facilities, hygiene and practices of the operators.

8. RECOMMENDATIONS

Based on field observation, there are three possibilities to be explored for the development of minced fillets and the subsequent end products:

- promoting the operations of mincing and sale of minced fish fillets;
- strengthening the current situation consisting in supply of service (in mincing fish purchased by customers);
- promoting the marketing of ready-to-eat products such as sandwich of fish balls, cakes, wrapped boiled eggs and fish balls in public places (restaurants, chop bars and schools).

Each of these schemes has potentials for extension to rural areas, to more consumer strata, and to countries where low-value fish and other underutilized species are landed or imported.

Recommendations to be considered accordingly are:

- (1) The supply in basic facilities: toilets, potable water, regular removal of solid waste, drainage of waste water, fall under the responsibility of market managers, since the operators regularly pay the relevant taxes and levies. The mincing operation is supposed to use potable water extensively. Water is used for fish cleaning, flushing the offals, and cleaning the equipment to prevent cross-contamination. The supply in these facilities wherever they lack, should be of utmost consideration in any improvement programme.
- (2) For better and safer working conditions of the operators, there is a need to design a manual tool to remove the backbone.
- (3) An appropriate mincer is necessary to cater for its intended use (semi-industrial rather than family purpose). It should be accordingly designed, with an appropriate capacity for the bowl (at least 1 kg, that is approximately 6 butterfly fillets or 12 single fillets.) It should be strong and durable (adequate lifespan of at least 2 years instead of the present 6 months), and be safe for use.

It is obvious that such an improved design would increase the cost per unit and thus impact on the investment capital. The operators interviewed were aware, but said that they were ready to purchase similar equipment. This would however require a support in loans or an appropriate micro-credit system addressing these operators, most of who have rather tight financial means.

A contact was established with a local manufacturer during the study for a design, costing of improved equipment (manual backbone remover and durable mincer) and for the first trials. Support should be sought to fund the industrial production of these important tools.

- (4) It is fundamental that all the operators adopt a fish mincing diagram that complies with Good Hygiene Practices (GHP) and Good Manufacturing Practices (GMP). Emphasis should be put on washing the fish once collected, then after degutting, before filleting it. Using potable water and changing water as much as possible must be some of the priority actions. If these practices are adequately in place, washing the equipment between customers would not be fundamental. This will definitely boost the number of people willing to mince fish in landing sites and markets, but were reluctant owing to the prevailing practices. Diagram 4, obtained after some slight improvements in diagram 2, is proposed for extension. Training of operators in the adoption and promotion of this diagram will be necessary.
- (5) Mincing of skinless fillets rather than the skin-on ones should be advised, because it reduces the risk of contamination by eventual bacteria at the surface of fish and it prevents the mincer from being blocked. Also should be cutting fish into butterfly fillets rather than single fillets that generate more losses of flesh and wastes.
- (6) Sensitization on the use of ice after the packaging of minced fillets in safer packaging material. The operators would have a small insulated



Diagram 4:
Proposed processing scheme of minced fish fillets for extension.

container for sale of ice, or could advise customers and direct them to a place to buy ice.

- (7) Marketing of readily minced fillets has the advantage of avoiding the queues and delays to buyers, but is the most risky option both from an economic and from a food safety point of view. To be successful and ensure safety of the product, it should be done within a refrigerated display, and in any case, ice should be available. In order to prevent losses from unsold daily packages, the equivalent to the lowest quantity of fish usually minced by the operator can be displayed and once sold, another set is minced and displayed. The nature of the operators (former fresh fish sellers) makes this option very unlikely owing to the issue of risk in the sale, they have already raised. The option needs consequently to be carefully monitored.
- (8) Customers should be sensitized and informed on the shelflife whether in the case of minced fish or sale of readily minced fish.
- (9) The promotion of the final products from raw minced fillets is an interesting niche that should bring more women in the production and sale, and make these products known in other places within the artisanal sub-sector in Africa region.

9. REFERENCES

African Development Bank. 2000. *African development report 2000: Regional integration in Africa*, African Development Bank and Oxford University Press, Abidjan.

Clucas, I.J. & Ward, A.R. 1996. *Post-harvest Fisheries Development: A guide to Handling, Preservation, Processing and Quality*. Chatham Maritime, Kent ME 44TB, UK.

Diei, Y. 1997. *New quality assurance approach in artisanal fishery*. IDAF Newsletter 35, 10-13pp.

Diei, Y. & Ndiaye, O. 1998. *Field Guide: Good handling and processing practices in artisanal fishery*. DIPA/WP/129.

Direction de l'océanographie et des pêches maritimes (DOPM). 2000. *Résultats généraux de la pêche maritime sénégalaise en 1999*, Dakar.

Direction de l'océanographie et des pêches maritimes (DOPM). 2001. *Résultats généraux de la pêche maritime sénégalaise en 2000*, Dakar.

Direction de la pêche continentale et de l'aquaculture (DPCA). 2000. *Résultats généraux de la pêche maritime sénégalaise*, Dakar.

Direction de la prévision et de la statistique. 1997. *Enquête sur les dépenses des ménages de la capitale*, rapport national, Dakar, 40pp.

Gouvernement du Sénégal. 1999. *Lettre de politique sectorielle des pêches maritimes*, Dakar, 11pp.

Jallow, A.M. 1994. *Utilization of bonga (Ethmalosa fimbriata) in West Africa*. FAO Fisheries Circular. No 870. Rome, FAO. 28pp.

Teutscher, F., Tall, A. & Jallow, A.M. 1995. Workshop on seeking improvements in Fish Technology in West Africa. Pointe-Noire, Congo, 7-9 November 1994. IDAF/wp/66.

