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# Fish Processing Technologies in Rivers State, Nigeria

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**Abstract:** The study assessed the status of fish processing technologies to ascertain the level of mechanization and to know the various processing methods available. Also, it evaluated the effectiveness and efficiency of various processing techniques and assessed the contribution of women to the post harvest fish processing in Rivers State, Nigeria. This information was gathered using structured questionnaires, which was designed and administered between November 2007 and January 2008. A total of 3 traditional techniques of processing of fish were observed: rafter 6(6%); drum oven 72(73%) and mud oven 21(21%) and their energy sources were firewood or charcoal. The majority of the traditional fish processors (84%) were illiterates and post harvest losses ranged between 7 and 10%. The two different types of processing machines observed were kiln 5(33%) and dryer 10(67%) and their sources of energy were electricity, firewood/wood shaving, charcoal and gas. Some kilns and dryers had combined energy sources for their operations. The kilns and dryers had capacities ranging from 75-400 kg day$^{-1}$ and price range of ₦45,000-₦430,000. The major factors that were taken into consideration before the purchase of machines by the processors were ruggedness (40%), cost (30%) and the least was multi purpose uses (5%). Women involvement in traditional method of fish processing was 100%, while modern technology was 67%. The mechanization tool level (MTL) was 13%.

**Key words:** Fish processing, technologies, effectiveness, efficiency, status, level of mechanization, evaluation

## INTRODUCTION

The processing and preservation of fish were of utmost importance since fish is highly susceptible to deterioration immediately after harvest and to prevent economic losses (Okonta and Ekelemu, 2005). The development of fishing machinery and techniques that can be employed for effective fish handling, harvesting, processing and storage can never be over-emphasized especially in the age when aquaculture development is fast gathering momentum in Nigeria. The production system is mainly artisanal and fish is marketed mostly in five different forms: fresh, smoked, dried, salted and frozen (FAO, 1996). Reilly *et al*. (1997) reported that food quality and safety associated with aquaculture product will differ from region to region and habitat to habitat and will vary according to the method of production and post harvest processing. Some of the traditional fish processing methods are associated with contamination which is injurious to man consumption.

Davies (2005) suggested the appropriate technology that will produce satisfaction of basic need to users and equally preserving economical balance. Eyo (1997) reported on the level of post harvest losses in Kainji Lake Basin and that study revealed 9% of the fish caught is lost at checking and 3% at landing, bringing to 12% by weight the level of post harvest losses. For dried fish, 16% is lost before and during processing and 6% from storage prior to sales, bringing the total loss of fish to 35% in the lake. Eyo (1997) reported a loss of 1000 metric of fish in Kainji Lake which was estimated to about 80 million naira was lost during handling of fresh fish alone in 1995. The end product from post harvest processing could be convenient for transportation, storage and utilization (Musa, 1998; Akande and Asuquo, 1998). Processing of fish either through smoking or drying are widely used in fish preservation, in the process, moisture content present in the fish is extracted through heating, thus inhibiting the action of micro-organisms and

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prolong shelf life (Clucus and Ward, 1996; Oyeleye, 2003; Akinneye *et al*., 2007). Eves and Brown (1993) reported the processing of fish by smoking or drying enhances the nutritive value and promotes digestibility of protein. The need to mechanize fish processing has drawn the attention of national agricultural research to devote utmost interest and resources to engineering researches. These are to produce machinery that will minimize drudgery, reduce labour intensities, unsanitary and inherent unhygienic handling that are mostly involved in traditional manual operations. Eyo (1992) reported different types of preserving methods which include drying, smoking, freezing, chilling and brining. The prominent fish preservation method in Niger Delta is by smoking. This could be adduced to the fact that not all the fishing communities around the rivers have assess to electricity to freeze their fish. However, electricity is fast becoming a less reliable source of energy for fish preservation/processing.

Olokor (1997) analysed the various advantages of adopting solar energy as a means of drying fish over the traditional method. These were as follows: labour requirement is minimal, the end products are devoid of carcinogenic substances usually associated with smoked fish product, the running cost is low and the solar tent dries within 4 h. Eyo and Mdaihilli (1997) reported that about 90% of the fish landed are processed (smoked) and sold by the women folks, who combine the function of the processors and marketers and the remaining are consumed fresh. This study was therefore, designed to assess the status of fish processing techniques, to ascertain the level of mechanization and to know the various processing methods available. In addition, it evaluated the effectiveness and efficiency of various processing techniques and assessed the contribution of women to post harvest fish processing in Rivers State, Nigeria.

## MATERIALS AND METHODS

Evaluation of fish processing technologies in Rivers State using Port Harcourt city, Obio Akpor, Okirika, Emohua, Eleme, Ogu-Bolo, Ikwerre, Oyigbo, Asari-Toru and Etche local government areas as a case study was conducted by means of a structured questionnaire, administered through a participatory learning technique. The survey was carried out between November 2007 to January 2008. Each of the ten local government areas was divided into 5 zones. Furthermore, each zone was divided into 2 locations. Thus, a total of 100 processing centres were visited. Care was taken to include semi-urban towns in the sample to obtain fish processing communities. Some of the issues addressed by the questionnaire included to determine the mechanization level of fish processing, to know various processing methods available, evaluate the effectiveness and efficiency of the various processing techniques and to assess the contribution of women to the post harvest processing. Recommendations were made on the way forward. The data were subjected to quantitative statistical analysis using SPSS version 11.0 software.

## RESULTS AND DISCUSSION

A total of 100 enterprises involved in post harvest processing of fish activities in Port Harcourt, Obio-Akpor, Okirika, Emohua, Eleme, Ogu-Bolo, Ikwerre, Oyigbo, Asari-Toru and Etche local government areas of Rivers State in Nigeria. The study revealed that the traditional methods of processing fish were still prevalent (82.4%), while mechanization level was 13%. All the preliminary processing operations such as washing, cutting and salting were undertaken manual both in the traditional and modern methods of fish processing. Most of the processing centres adopting traditional methods have been in existence for more than 10 years. The study showed 3 different types of traditional technologies of fish processing are in use in Rivers State. Rafter (6), Drum oven (72) and mud oven (7). Among these methods, drum oven was prominent (Table 1).

From Table 2, the cost of construction of traditional technologies varied from ₦3500-₦4700. The traditional methods used fuel wood/charcoal, sawdust and wood shavings to process fish. The most popular and widely used fuel wood is called mangrove wood (natives called it Angala in Niger Delta). It was preferred for good smoke, flavor and fast rate of fish drying. It is also believed that it contains some acidic chemicals when used as fuelwood increase the shelf life of fish (Eyo, 1992). Some of the problems of traditional techniques of fish processing as expressed by the fish processors were: high incidence of losses during processing, no temperature control, exposure of the food products to dust, insects, mould

Table 1: Equipment used in fish processing operations and the respondents

| Operations | Number of equipment utilized | | Mechanization level (%) |
|---|---|---|---|
| Washing | Manual | Washing machine | |
| | 100 | 0 | 0.0 |
| Cutting | Knife | Mechanical cutting | |
| | 100 | 0 | 0.0 |
| Salting | Manual | Machine | |
| | 10 | 0 | 0.0 |
| Smoking/ drying | Rafter, drum and mud oven | Kiln and dryer | |
| | 99 | 15 | 13.0 |

Table 2: Mechanical, economical and educational characteristics of the adopted technologies

| Item | Traditional | Mechanization |
|---|---|---|
| Sources of energy | Fuewood/charcoal, sawdust, | Gas, electricity, wood shaving, kerosene stove |
| Cost of procurement of equipment (#) | 1,500-2,700 | Kiln 45,000-200,000, dryer 78-430,000 |
| Losses (%) during processing handling | 7-10 | 2-3 |
| **Types of processing system observed** | | |
| Rafter | 6 | |
| Drum oven | 72 | |
| Mud oven | 21 | |
| Kiln | | 5 |
| dryer | | 10 |
| Machine acquisition | Locally | Locally |
| Maintenance culture | Erratic | Periodic |
| Capacity (kg/ day) | 6-21 | 75-400 |
| **Years of experience (%)** | | |
| 0-10 | 20 | 15 |
| 10-20 | 49 | - |
| >20 | 14 | - |
| **Literacy level** | | |
| Primary | 65 | - |
| Secondary | 26 | 6 |
| Post secondary | - | 14 |

spores and bacteria, some products of fuel combustion, which constitute health hazards to consumers and thus, observations were in agreement with Akinneye *et al.* (2007). The capacity of the traditional methods is between 7-20 kg day$^{-1}$. The Table 2 also revealed that the majority of the traditional fish processors (84%) were illiterates. Losses during the traditional fish processing ranged between 7 and 10%. The result was in accordance with Eyo and Mdaihilli (1997) reports.

Two different types of processing machines were observed: kiln (33%) and dryer (67%). Kilns were of 3 types: mini kiln, portable smoking kiln and cabinet smoking kiln. They have 3 different sources of energy namely: kerosene stove, wood shaving and butane gas. In this system, the entire smoking process is under control. Incidence of losses (2-3%) during the processing handling such as charring and burning of product does not arise. Smoking process is complete within 6 h for a medium size fish. Thus, mechanization is faster than traditional methods. Fishes smoke under this system are cleaner and more hygienic, less labour intensive and durable. According to Food Agriculture Organization (FAO, 1985), there will be a scarcity of fuel wood for drying and smoking fish with time but with the adoption of kiln, the incidence of deforestation for fish smoking is reduced. More importantly, the problem of erratic supply of electricity will not arise, thus, it can be used in the rural areas. The cost of the machines ranged from (₦45,000-₦200,000) depending on the following factors, the quality of the constructional materials, capacity of the system, year of acquisition. The capacity of the system ranged from 75-300 kg day$^{-1}$. The operational and maintenance culture were periodical and hence, elongate the shelf life of the machines. The cost of maintenance and service were moderate compare to their productivity. All the kilns observed were locally produced and their spare parts are readily available in the markets. It can easily be operated.

A total of 10 dryers were observed, the dryers were grouped into 4 categories based on source of energy namely: dryers with electricity 2(20%), dryers with gas, kerosene stove, wood and woodshaving and electricity 6(60%), dryers with gas 1(10%), dryers with gas and kerosene stove 1(10%). Multi sources of energy dryers were favoured having the advantage of inherent flexibility in the use. Besides, these dryers tend to all levels of technologies, low to high, making it possible to adapt to different levels of technologies (cost and simplicity) and to any target group of users. All the dryers were locally produced with readily available spare parts. The study gathered that maintenance and operation cost were moderate. The cost of procurement ranged from ₦78.000-₦430.000 depending on capacity. The capacity of the dryers ranged between 100-400 kg day$^{-1}$. Losses due to processing handling of this system were between 2-3%.

The machine operators were literates. Table 3 shows that literate fish processors have higher awareness index, good management index and willingness index. These could be attributed to the fact that the literate processors are usually, people involved in other business such as teaching and trading. Thus, they are informed and equipped to pursue their goal. This study revealed that the degree of acceptability was dependent on literacy level. Thus, there is need for some level of education for fish processors since this will enable them achieve more in their business.The opinions of those who purchase these machines, ruggedness (40%) and cost (30%) were major factors taken into consideration (Table 4). Multi purpose uses (5%), simplicity of operation (15%) and ease

Table 3: Effect of literacy on mechanization of fish processing

| Index | Literate | Illiterate |
|---|---|---|
| Awareness | 75 | 47 |
| Good management | 82 | 34 |
| Availability | 68 | 39 |
| Willingness | 90 | 86 |

Table 4: Criteria used by fish processors for adopting mechanization

| Criteria | Fish processor (%) |
|---|---|
| Cost | 6(30) |
| Multi purpose | 1(5) |
| Simplicity of operation | 3(15) |
| Ease of maintenance | 2(10) |
| Ruggedness | 8(40) |

Table 5: Sex of technology operators in the processing centres

| | Sex of machine operators (%) | |
|---|---|---|
| Processing technology | Male | Female |
| Rafter | - | 100 |
| Drum oven | - | 100 |
| Mud oven | - | 100 |
| Kiln and dryer | 77 | 23 |

of maintenance (10%) were not taken seriously in selecting machines to purchase. Table 5 revealed that women (100%) were the major actors in the processing of fish under the traditional techniques. In the mechanization of fish processing, women (77%) were predominant. According to the reports of Bolorunduro (2001) and FAO (1992), confirmed that women were responsible primarily for post harvest activities.

## CONCLUSION

All the processing centres visited were owned by individuals. With reference to capitalization, personal saving maintained 100%. The existence of mechanized fish processing was <10 years. The majority of traditional processing methods were >10 years. The main processing technique used in preserving fish was by smoking/drying fish. The fish processing operations were still being undertaken manually by the processors who were predominantly peasant processors. The traditional processing of fish was time consuming and tedious. For fish, whose food and industrial uses are growing fast, there is much need to develop appropriate technology to process fish.

The study revealed traditional processing as prevalent. There are 3 different types of processing methods of smoking fish namely: rafter, drum oven and mud oven and the prominent among them was drum oven. The source of energy was firewood. Mechanized processing utilizes kilns and dryers and the main sources of energy were firewood/food shaving, gas, electricity and kerosene stove. Kilns were of 3 types namely: mini kiln, portable smoking kiln and unmovable smoking kiln. Dryers were of 4 types depending on the sources of energy used for their operation namely: dryers with electricity, dryers with gas and kerosene, dryers with gas and dryers with multi sources of energy, gas, electricity, charcoal/firewood and kerosene stove. The cost varies: depending on the size, constructional materials and capacity of the machines. Post harvest losses were more pronounced in traditional processing method (7-10%), while modern processing machines were between 2-3% losses. Literacy level affected the degree of acceptability of mechanization. Women dominated the traditional fish processing techniques, while men were key actors in the improved fish processing technologies.

## RECOMMENDATIONS

Appropriate technology on fish processing operations should be developed by research institutes, engineers and Nigeria equipment manufacturers and be jointly demonstrated by small-medium and large scale fish processors, relevant research institutions and Agricultural Development Programmes (ADP). The technology should be gender friendly.

The provision of basic infrastructure amenities such as electricity, water, accessible road and filling stations will not only go a long way to improve the standard of living of rural fish processors, it will also serve as encouragement for the processors to adopt machinery using diesel, petrol and kerosene as sources of power/energy.

Government and agricultural machinery companies should give the requisite assistance towards the commercialization of viable fish processing machinery emanating from the research institution, which if mass produced are made available to the processor at subsidized rate.

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