Research Journal of Agriculture and Environmental Management Vol. 6(3), pp. 046-054, April, 2017
Available online at http://www.apexjournal.org
ISSN 2315-8719© 2017 Apex Journal International

Full Length Research

Awareness and adoption of improved fish processing technologies among fish processors in Lagos State, Nigeria

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Accepted 29 March, 2017; Published 18 April, 2017

This study assessed the awareness and adoption of improved fish processing technologies among fish processors in Lagos State, Nigeria by randomly sampling 112 fish processors from four purposively selected fishing communities. Copies of interview guide were administered on the fish processors for data collection. Data were subjected to inferential statistics such as frequency count, percentage and mean. The results revealed that the fish processors were predominantly females (64.3%), married (79.5%),with mean household size, age and fish processing experience of 6 persons, 41.52 years and 21.48 years respectively. Close to one-half (48.2%) of the fish processors had no formal education while 35.7% only had primary education. More than three-quarters of the fish processors made use of smoking methods either with pepper (28.6%) or salting (48.2%).Drum oven (59.8%) was the most commonly used processing equipment followed by mud oven (25.0%). About 90.18% of the fish processors were aware of the fish processing technologies with highest level of awareness observed with Charcoal fish smoking kiln (68.8%) followed by solar dryer (50.9%) and kerosene dryer (41.1%). Significant proportions of the fish processors were aware of improved processing technologies through LASADA (36.6%) and FIIRO/media (31.25%). Adoption of improved fish processing technologies was generally low as 27.7 and 22.3% adopted charcoal fish smoking kiln and solar dryer respectively. Lack of access to improved technologies (58.0%) and the high cost associated with the acquisition of the technologies (53.6%) were the most important reasons for the non-adoption of improved fish processing technologies.The study concluded that the low level of adoption is a function of the effectiveness of extension services and characteristics of the technologies. It is therefore recommended that the improved fish processing technologies should be made readily available and accessible by all fish processors.

Keywords: Improved technologies, adoption level, traditional processing methods, smoking kilns, fish spoilage.

INTRODUCTION

The importance of fish especially to people living in developing countries has been well documented in literatures. Fish is one of the cheapest sources of dietary proteinespecially in isolated fishing communities (Adewuyiet al., 2010; FAO, 2010); source of employment as the fishery sector generates employment to over 70% of persons living in rural areas (Shettimaet al., 2014; Federal Department of Fisheries - FDF, 2013). It is also of medicinal value and further useful for industrial purposes such as in the production of fish meal. Nigeria is a highly populated country and hence the demand continues to be increasing at an increasing rate while the local supply of fish has failed to meet the fish demand. This thereby creates a gap between the fish demand and supply thereby causing nutritional and food insecurity (Kumolu-Johnson and Ndimele, 2011). This is notwithstanding the vast resources that favour artisanal, aquaculture and industrial fish production that the country

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is blessed with.

Successive governments at all levels have attempted to bridge this gap, but yet the gap keeps widening. One of the means utilized in bridging this gap is the importation of canned and frozen fish and fish products with reasonable amounts of money that ought to have been utilized for developmental projects. For instance, United States Agency for International Development - USAID (2010) submitted that Nigeria spent more than $600 million on importation of about 750,000 MT of fish per annum while Oota (2012) put Nigeria's annual spending on fish importation at ₦100 billion. This is a reason why the country has been tagged the highest importer of fish in Africa and one of the highest in the world(Tundeet al., 2015). It also makes to importation as a major fish supply in Nigeria contributing up to 50% of the nation's fish demand. The country's reliance on fish importation in order to bridge the fish and supply gap has also been attributed to enormous postharvest fish losses. Eyo (2001) categorized postharvest fish losses into three, namely; physical, economic and nutritional losses. According to Kumolu-Johnson and Ndimele (2011), losses lost by spoilage of fish amounts to 10-12 million tonnes per year while up to 20 million tonnes of fish are discarded at sea in a year. This made postharvest losses to be a major bane in the fish industry especially in the artisanal subsector of fish production (Bolorunduroet al., 2005).

Currently, less effort is put into the mechanization of fish processing as traditional methods are commonly used and some of these traditional fish processing methods are associated with contaminations which are mainly injurious to consumers (George et al., 2014). It is believed that if the fish losses from postharvest activities could be reduced to the barest minimum, the gap between demand and supply of fish could be closed implying that the impact of governments' efforts through programmes/projects aimed at increasing domestic fish production could be meaningfully felt by the people especially the poor ones. To achieve this, effective and efficient management practices that could reduce postharvest fish losses has to be put in place. Bolorunduroet al. (2005) noted that post-harvest losses could be reduced by simply improving the handling and processing methods. Davies (2005) also submitted that the development of appropriate fish machinery and technologies that employ effective production, handling, harvesting, processing and storage cannot be over-emphasized, especially in the age when aquaculture development is fast gathering momentum in Nigeria. In line with this view, the federal government of Nigeria in collaboration with international agencies (such as WHO and FAO) as well as state governments has funded research institutes to invent and develop improved processing and preservation technologies. Extension agencies are also instituted to disseminate research outputs, usually improved fish processing and preservation technologies to the end users (fish processors). This, according to Bolorunduro and Adesehinwa (2007), is because the development of improved technologies must be backed up with efficient dissemination to enhance its adoption.

Several technologies developed by research institutes have been disseminated to fish processors and other fish handlers in the different fishing communities across the nation over the years. Lagos State is one of the States that received most attention in terms of disseminating the improved fish postharvest technologies. It is therefore imperative to examine the fish processors' awareness and level of adoption of improved fish processing technologies in Lagos State, Nigeria. This is necessary because disseminating the technologies may probably create fish processors' awareness of the technologies which may not stimulate their interest in the technologies not to talk of facilitating their adoption of the disseminated technologies. Adoption of the disseminated technologies could then be a measure of the effectiveness of the extension service used in disseminating the technologies in Lagos State by Lagos State Agricultural Development Agency (LASADA), Federal Institute of Industrial Research, Oshodi (FIIRO) and NIOMR. Previous studies posited that these institutes had used different means for the transfer of the developed technologies. For instance, Odediran (2011) reported that about 70% of developed fish processing technologies by FIIRO were transferred to the fish processors in Lagos State through organized training programmes while NIOMR was reported to have transferred 56 and 40% of their technologies on fish processing through demonstrations and exhibitions respectively. To achieve this, the study specifically described the socio-economic and characteristics of the fish processors; identified the processing methods commonly used by the fish processors; identified the processing equipment types used by the fish processors;determined the fish processors' awareness of different improved processing technologies; and determined the adoption levels of the different improved fish processing technologies.

METHODOLOGY

Description of the study area

The study area is Lagos State in the southwest geopolitical zone of Nigeria. Lagos State lies approximately on longitude 2°42" and 3° 22"taste of the Greenwich Meridian and between the latitude 6° 22" and 6° 42" North of the Equator.It has an estimated population of 17,552,940 persons (LASG, 2012). It is bounded in the North and East by Ogun State and in the West and South by Republic of Benin and Atlantic Ocean respectively (Oyediranet al., 2016). Although the State is primarily Yoruba speaking, it attracts people of other

ethnic groups within the country and foreign neighboring countries (Adefuye, 1987). Fishing is the main industry of the indigenous population of the selected communities. The fishing villages are scattered with various forms of water bodies; lagoons, rivers, creeks and swamps. By virtue of its location in Nigeria, Lagos and the environments are veritable fishing area. Most of inhabitants of the selected communities, therefore, derive their livelihood from fishing as an income generating activity.

Sampling procedure and sample size

Four riverside fishing communities in Lagos State were purposively selected based on the fishing and fish processing activities of the areas. The selected fishing communities were Badagry, Eti-Osa, Epe and Ikorodu. About 50% of the fish processors from each of the fishing communities were then randomly selected for this study thereby yielding sample sizes that are proportionately chosen from each of the communities. This gives a total of 112 fish processors to whom copies of structured interview guide were administered to. Lists of fish processors were compiled with the assistance of extension agents attached to these fishing communities. A trial survey was also conducted to pre-test and modify the interview guide.

Measurement of key variables

Socio-economic characteristics were measured at nominal, ordinal, interval and ratio levels. Age and fish processing experience were measured at ratio level in years and then categorized to ordinal level. Household size and educational level were measured at interval and ordinal levels respectively while sex, occupation, marital status, religion and membership of cooperative societies were measured at nominal level. Awareness and adoption of improved fish processing technologies were measured at nominal level.

Data analysis

Collected data were entered into the SPSS version 17.0 after coding for data analysis. The data were then subjected to descriptive statistics such as frequency distribution, mean, mode and percentage. The results were presented in distribution tables, pie and bar charts.

RESULTS AND DISCUSSION

Table 1 shows the results of the socio-economic characteristics of the fish processors in Lagos State, Nigeria. More than half (53.6%) of the fish processors were within the 31-40 years age bracket while 2.7 and 1.8% of the fish processors were 30 years old or younger and older than 60 years of age respectively. The mean age of the fish processors was 41.52years old and implies that the fish processors were generally in their active and productive age groups. Persons within the age group are also likely to adopt new technologies as early as possible based on their readiness to try out new things. Also, majority (79.5%) of the fish processors were reported to be married while others were either never married (single), widowed or divorced and this is an indication that fish processing in Lagos state were dominated by married persons who have additional responsibilities associated with marriage. It could also be implied that marriage is highly cherished in Lagos State especially among the sampled fish processors.

Close to two-thirds (64.3%) of the fish processors were females while the remaining (35.7%) were males. This implies that fish processing is dominated by females. This is in consonance with the position of Obasohan et al. (2012).The dominance of females in fish processing also implies that the fish processors are likely to adopt improved fish processing technologies since according to Abolagba and Osifo (2004), fish processing and other economic activities in fisheries are energy sapping and tedious. The result also indicated that males are now getting involved in fish processing as against the earlier submissions that fish processing is the exclusive responsibility of women in fishing communities while men only engaged in fishing and other related agricultural activities. About 53.6 and 31.3% of the fish processors had household sizes of 4-6 and 7-9 persons per household. The mean household size was also found to be approximately 6 persons and this implies that the fish processors could get assistance from family members as cheap source of labor at little or no cost implication, if the family members were mainly adults. On the other hand, large household sizes could be a burden on the fish processors if the family members are dependants such as children and aged persons as more will be expected from the fish processors most importantly if they are the bread winners of their households.

Close to half (48.2%) of the fish processors had no formal education while only about 35.7% had their highest level of education to be primary education. Kolawole et al. (2010) also reported that majority of the fish processors in Southwestern Nigeria had only primary education. This illustrates that majority of the fish processors were either uneducated or had low level of educational background. This could be attributed to the lack of opportunity to go to school especially to female persons and also because the educated persons might consider fish processing as traditional and menial (Obasohan et al., 2012).

The low level of education could have negative impact on their awareness and subsequently the adoption of

Table 1. Socioeconomic characteristics of the fish processors in Lagos State (n = 112).

Socioeconomic variable	Frequency	Percentage (%)	Mean
Age			
≤30	3	2.7	
31-40	60	53.6	41.52 years
41-50	24	21.4	
51-60	23	20.5	
>60	2	1.8	
Marital status			
Single	11	9.8	
Married	89	79.5	
Divorced	5	4.5	
Widowed	7	6.3	
Sex			
Male	40	35.7	
Female	72	64.3	
Household size (persons)			
1-3	12	10.7	6 persons
4-6	60	53.6	
7-9	35	31.3	
>9	5	4.5	
Level of education			
No formal education	54	48.2	
Primary education	40	35.7	
Secondary education	14	12.5	
Tertiary education	4	3.6	
Occupation			
Fish processing only	39	34.8	
Fish processing and fish farming	73	65.2	
Fish processing experience (years)			
1-10	34	30.4	
11-20	41	36.6	21.48 years
21-30	21	18.8	
31-40	14	12.5	
>40	2	1.8	
Religion			
Christianity	55	49.1	
Islam	54	48.2	
Traditional	3	2.7	
Membership of association			
Women group association	28	25.0	
Farmers' union/cooperative	42	37.5	
Traders' association	8	7.1	
Community association	20	17.9	
None	14	12.5	

improved fish processing technologies, especially if the technologies had been disseminated in forms that could not be easily understood by the fish processors. Furthermore, Table 1 reveals that close to two-thirds (65.3%) of the fish processors combined fish processing with fishing while about 34.7% were exclusively into fish processing. This indicates that most of the fish processors do not purchase fresh fish but rather process their fish catches. This could therefore translate to more work and more profit for the fish processors.

The highest proportion of the fish processors had fish processing experience of 11-20 years while 1-10 and 21-30 years of experience were possessed by 30.0 and 18.8% of the fish processors respectively. The mean fish processing experience of the fish processors was calculated as 21.48 years which is an indication that fish processing was started by the respondents as early as they were 20 years old. This also implies that the fish processors possessed tangible years of experience in fish processing which could enhance their awareness and adoption of improved fish processing technologies. This is because they will be able to decide whether to adopt a technology or not based on their experiences on the existing technologies vis-à-vis the new ones. Table 1 also reveals that majority (about 87.5%) of the fish processors belonged to at least one social association. The highest proportion (37.5%) of the fish processors were members of farmers' union/cooperative societies while 25.0 and 17.9% of the fish processors belonged to women group and community associations respectively. The fish processors' membership of social associations could be beneficial to raise their awareness and adoption of technologies as the fish processors could be reached by extension workers through their respective social organizations. Membership of farmers' unions and cooperative societies could also facilitate the fish processors' access to credit facilities because financial institutions prefer to assist farmers in groups than individual farmers.

Processing methods used by the fish processors

Figure 1 reveals that close to half (48.2%) of the fish processors were making use of the smoking (salted) method while more than one-quarter (28.6%) made use of smoking (peppered) for processing fishes. Other processing methods used by the fish processors include frying (13.4%) and drying (9.8%). This implies that salting (either salted or peppered) was the most commonly processing method used by the fish processors in the selected study locations. This agrees with the submissions of Kolawoleet al. (2010) and Abolalagba and Osifo (2004) who identified smoke-drying and salting as the most commonly used methods of fish processing and preservation in Nigeria. Hot-smoking and salting were also reported by George et al.(2014) as the most used processing technique among fish processors in Lagos State. This further corroborates Davies and Davies (2009) who reported that most of the fish processors in Nigeria employed traditional techniques that have been in use for many years.

Types of processing equipment used

As shown in Figure 2, about 59.8 and 25.0% of the fish processors made use of drum and mud ovens respectively. However, smoking kiln, electric dryer, solar dryer and gas oven were not commonly used by the fish processors. Previous studies also reported that traditional ovens such as cut out ovens and mud ovens were in use by the fish processors in Lagos State (Adesehinwa and Bolorunduro, 2007; George et al., 2014; Obasohan et al., 2012). This implies that most of the fish processors were using the traditional equipment while the modern processing equipment were not used by them. The use of traditional equipment is an indication that fish processing in the State is basically subsistence in nature as traditional equipment are attributed with limited handling practices, inefficient procedures, deficient product quality and short shelf life of fish products (Ajang et al., 2010).

Awareness of improved fish processing technologies

Figure 3 reveals that at least 9 out of 10 (90.18%) of the fish processors were aware of at least one improved fish processing technology while about 9.82% were not aware of any of the fish processing technologies. This is an indication that improved fish processing technologies have been disseminated to the fish processors through several channels.

Table 2 reveals that 68.8, 50.9and 41.1% of the fish processors were aware of charcoal fish smoking kiln, solar dryers and kerosene dryers respectively while only about 17.0 and 0.9% of the fish processors were aware of gas fish dryers and electric fish dryers respectively. This result implies that although there is a general high level of awareness of improved fish processing technologies, the level of awareness varies from one technology to another. This somehow agrees with the findings of Nkeme et al. (2013) who reported a high level of awareness of Chokor smoker kiln technology which is an improved technology. In this study, the level of awareness of the technologies could then be said to be moderate.

Sources of awareness

According to the result in Figure 4, the highest proportion (36.63%) of the fish processors became aware of improved fish processing technologies through the activities of Lagos State Agricultural Development Agency (LASADA). About 31.25% of the fish processors became aware of the technologies through the media efforts of FIIRO while 11.88 and 16. 83% became aware through the NIOMR and friends respectively. This agrees with the report of Adesehinwa and Bolorunduro (2007) who stated that the Agricultural Development Project of LASADA and research institutes were at the forefront of information dissemination to fisher folks in Lagos State. This implies that significant efforts have been employed by government agencies at state and national levels for the dissemination of the improved fish processing

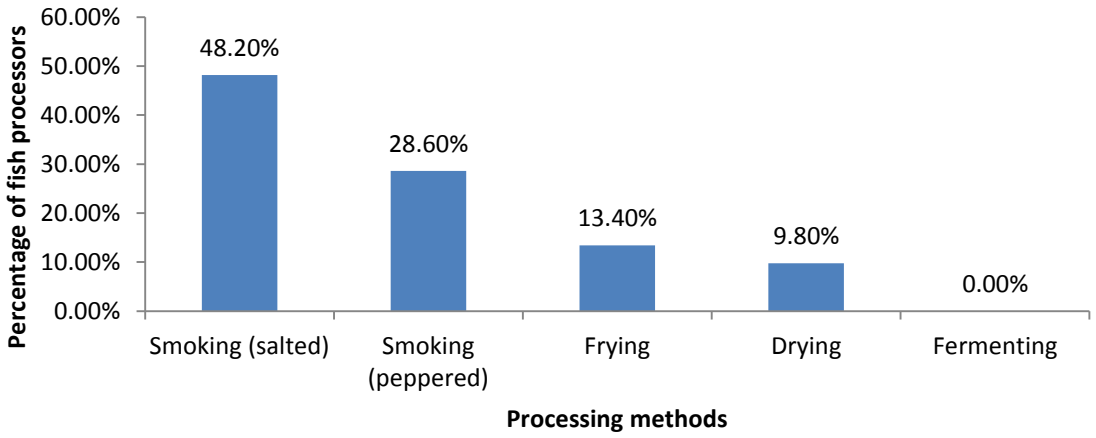

Figure 1. Prevalent processing methods used by the fish processors in Lagos State.

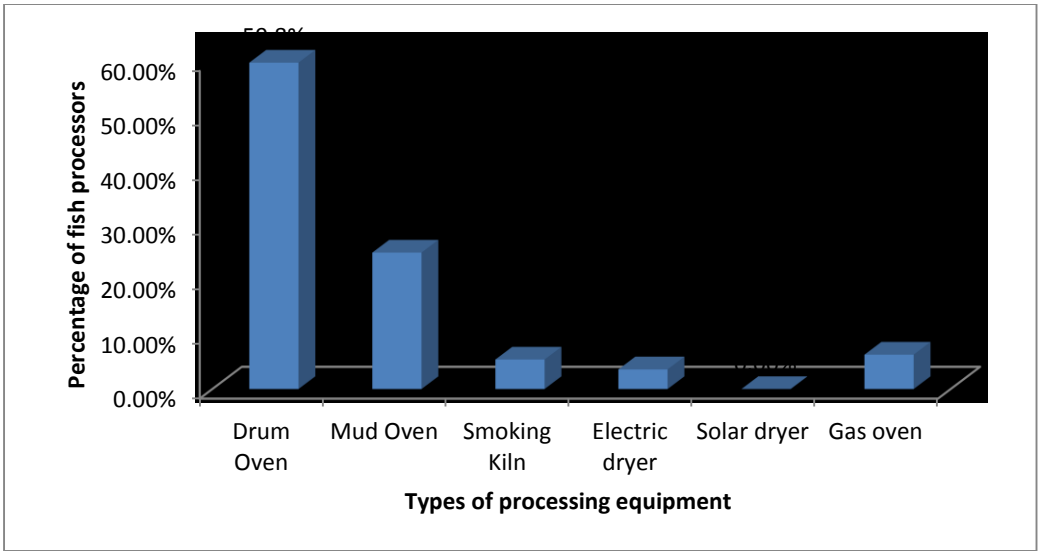

Figure 2. Processing equipment used by the fish processors.

technologies and this could be responsible for the high level of awareness demonstrated by the fish processors in Lagos State.

Adoption of improved processing technologies

Table 3 reveals that about 27.7, 22.3 and 19.6% of the fish processors have adopted the use of charcoal fish smoking kiln, solar dryer and kerosene dryer respectively while electric fish dryer and gas fish dryer were never adopted by any of the fish processors. This means that majority of the fish processors did not adopt the different improved fish processing technologies. Bolorunduro et al. (2005) also reported the low level of adoption of improved fish preservation technologies such as Altona, Chokor, Burkinable and Watanable smokers. The generally low level of adoption of the technologies also vary among the respondents as technologies with higher level of awareness were also adopted by more fish processors and this is an indication that high level of awareness is a key requirement for technologies to be adopted by most of the fish processors.

Fish processors' reasons for the non-adoption of improved fish processing technologies

Reasons for the non-adoption of improved fish processing technologies are presented in Table 4. The result reveals that close to 60% of the fish processors claimed that the improved technologies were not adopted by them because the fish processors had no access to the technologies and this could be attributed to the facts

that most of the technologies might have been presented to fish processors at research institutes or during workshops without providing means for the fish processors to access the technologies for their own

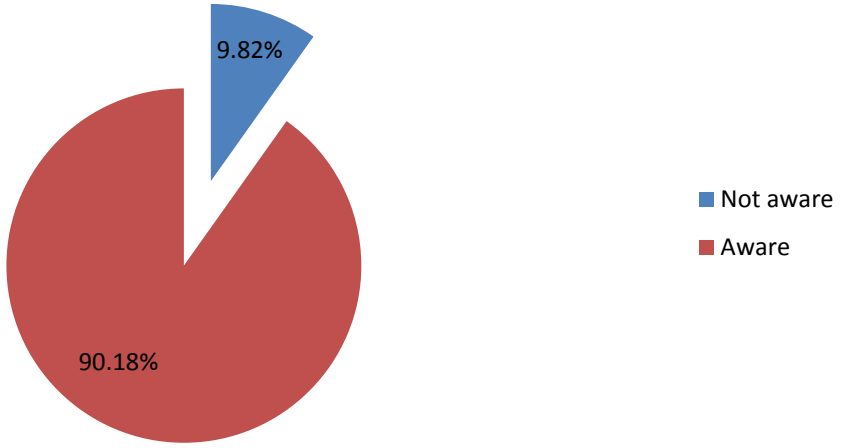

Figure 3. Awareness of improved processing technologies.

Table 2. Awareness of different types of improved fish processing technologies.

Types of improved fish processing technologies	Frequency	Percentage (%)
Charcoal fish smoking kiln	77	68.8
Electric fish dryer	1	0.9
Solar dryer	57	50.9
Kerosene dryer	46	41.1
Gas fish dryer	19	17.0

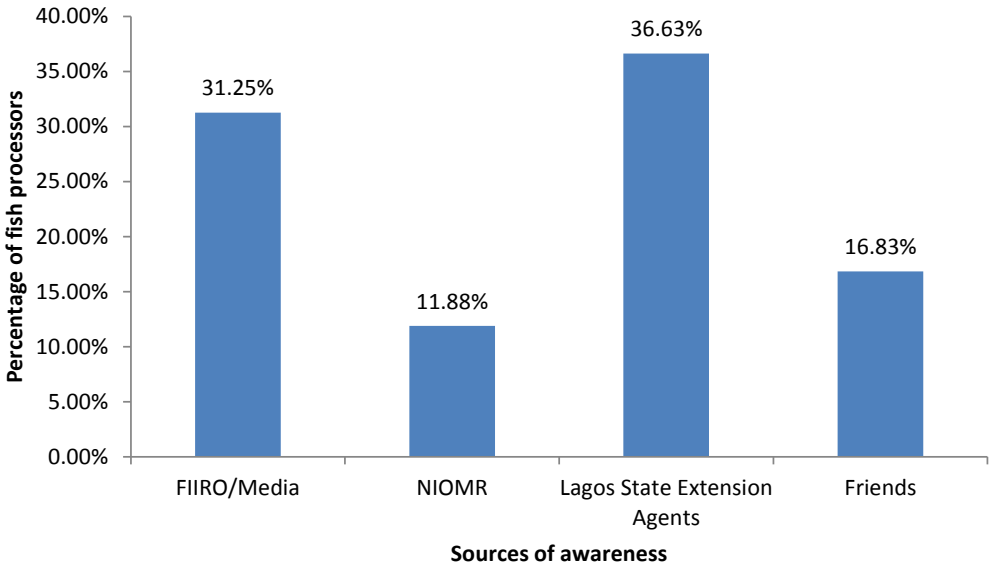

Figure 4. Sources of awareness of improved fish processing technologies.

commercial use. The high cost of procuring the improved fish processing technologies was also cited by 53.6% of the fish processors while explaining their reasons for the non-adoption of improved technologies. Also up to 50.9% of the fish processors claimed that the technologies were unavailable to them. The other reasons include that the technologies are not ideal for fish processing (38.4%) and the risk associated with the adoption of new innovations

(34.8%). This implies that the major reasons for the non-adoption of disseminated improved fish processing technologies were high cost and other factors such as non-availability and irrelevance of technologies for the

Table 3. Adoption of the different improved fish processing technologies.

Types of improved fish processing technologies	Frequency	Percentage (%)
Charcoal fish smoking kiln	31	27.7
Electric fish dryer	0	0.0
Solar dryer	25	22.3
Kerosene dryer	22	19.6
Gas fish dryer	0	0.0

Table 4. Reasons for not adopting technologies.

Reasons	Frequency	Percentages (%)
Lack of awareness of the technologies	19	17.0
Lack of interest in the technologies	25	22.3
The cost for procuring the improved technologies are too high	60	53.6
Complexity and/or difficulty in understanding improved technologies	30	26.8
The improved fish processing technologies are not compatible with existing practice	26	23.2
It is very risky to adopt the technologies	39	34.8
The technologies have no relative advantage over the traditional techniques of processing	24	21.4
Lack of access to the improved technologies	65	58.0
Non-availability of the technologies	57	50.9
The technologies are not ideal for fish processing	43	38.4

type of fish processing in the study locations. These could be attributed to the facts that almost all the technologies were developed by government-sponsored research institutes without putting the need of the users of the technologies into consideration. It has been submitted that for technologies to be adopted by farmers, it has to be demand driven through the bottom-up approach. It is the position of Nti et al. (2002) that lack of detailed cost and return analysis on developed technology; failure of technology to address the exact problems of fish processors; unavailability of and high cost of inputs; socio-cultural practices; and external influence are key factors limiting the rate of adoption of a technology. Nti et al. (2002) also believed that for any developed fish processing technology to be adopted, it should be less technical, consistent with the existing processing system, and easily learnt through observation. Adesehinwa and Bolorunduro (2007) also added durability, portability, labour saving and gender friendly to the list of technology characteristics that could facilitate the adoption of a technology.

Conclusion and Recommendations

It could be concluded from this study that the fish processors in Lagos State were primarily making use of traditional equipment such as mud and drum ovens for traditionally smoking of fish with either salt or pepper. The awareness of improved fish processing technologies by the fish processors is very high while the awareness of each of the technologies was moderate. The adoption of the improved technologies was also very low across all the improved fish processing technologies. The study concluded that the low level of adoption of improved fish processing technologies in the study area is a function of the effectiveness of extension services and characteristics of the technologies. It is therefore recommended that aside from raising awareness through demonstrations, trainings and exhibitions; the improved fish processing technologies should be made readily available and accessible by all fish processors. The cost for acquiring and maintaining the fish processing technologies should also be subsidized by government agencies.

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