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Adoption of improved postharvest fisheries technologies among fish processors in Lagos state, Nigeria

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Abstract: This study assessed the adoption of improved postharvest fisheries technologies (IPFT) among fish processors in Lagos State, Nigeria. Validated interview guide was used to elicit information from 90 fish processors selected from12 fishing communities through the multistage sampling procedure. Data collected were analyzed with the use of frequency, percentage,and mean and regression analytical technique. Results reveal that majority of the fish processors(83.3%) were between 21 and 50 years old, mostly female (90.0%), married (87.8%) and had at least primary education (74.4%) with a mean fish processing experience of 4.39 years. All (100%) of the fish processors were aware of fisheries extension services and were visited either forth nightly (61.1%) or on a monthly basis (38.9%) and sourced processing information through the extension agents (74.4%).*Esusu* and cooperative societies were the source of credit to 43.3% and 38.9% of the fish processors, respectively. Mean daily processed fish and monthly income were 13.42kg and N39.977.78, respectively. Awareness and trial of most of the technologies were reported to be high among the fish processors, while the subsequent adoption of such technologies was moderate with most technologies discontinued. Age ($t = -0.214$, $p<0.01$), and interest rate ($t = -0.234$, $p<0.05$) significantly determined the adoption of IPFT. This study concludes that adoption of IPFT is a function of socioeconomic characteristics, and effectiveness of extension service. It therefore recommended that efforts should also be made by extension agents at persuading the fish processors to adopt previously rejected and discontinued IPFT through organising of results and methods demonstrations to fish processors in groups and cooperative societies.
Keywords: Technology adoption, *Esusu*, Fish handling, Postharvest, Improved technologies

INTRODUCTION

In developing countries, a major perennial issue militating against food insecurity is postharvest losses and this is more pronounced in fisheries. Once fish is harvested from the natural (water) environment, rapid deterioration of products set in especially under the hot tropical environment (Okunade and Bolorunduro, 2014).Fish is among the food items that are highly perishable due to their composition of high moisture content (Hodges *et al.,* 2010). Hence, subjecting fish to processing immediately after the fish is caught is crucial so as to extend the shelf-life of fish until it gets to the consumers' tables. In Nigeria, fish handlers (including fish processors) rely heavily on traditional and local postharvest technologies that are not effective in preventing microbial spoilage of harvested fishes (Tabor, 2000; Nkeme *et al.*, 2013). Donye *et al.* (2013) noted that a means to reducing postharvest losses in agriculture is through the adoption of affordable agricultural innovations. Therefore, effectively minimizing postharvest losses in fisheries demands the introduction and use of improved postharvest fisheries technologies in the areas where fishes are highly produced within the country. Improved postharvest fisheries technologies have been disseminated to the grassroots through the extension activities of the Agricultural Development Programmes (ADPs) of the States within the country (Jegede and Bolorunduro, 2002).

However, postharvest fisheries technologies are faced with varied level of adoption with some of the technologies receiving no adoption at all, while others received low to moderate levels of adoption in Lagos and other states of Nigeria. The varying levels of adoption of improved technologies is attributed to fish production/processing characteristics of the fisher folks and effectiveness of extension service delivery and research (Tawari, 2006). This is also because postharvest handlers of fish are characterized by poverty, subsistence level of operation, lack of access to information on improved technologies, inadequate finance to procure proven technologies among others. Tawari and Davies (2009) asserted that the economic status of the fisher folks plays a significant role in the adoption of new techniques. Davies (2005) andTawari (2006) also added educational attainment to the list of factors that favour the adoption of new technologies.

In Lagos State, different improved postharvest technologies have been introduced to fish farmers, fisher folks and fish processors over the years by the Lagos State Agricultural Development Authority (LASADA) which serves as the extension department/unit of the State Ministry of Agriculture. Prominent among the introduced technologies are the Chokor, Altona, Magbon-Alade, Waltanable and Burkinable smoking kilns. Despite the introduction of these technologies for more than one decade, fish processors in fishing communities within the State were noted to be in use of the traditional processing technologies. In areas where the technologies were adopted, the adoption has been noticed to be both slow and of low rates. Although, sufficient empirical

data exists on the adoption of improved fish production technologies, there is a dearth of information on the adoption level of improved postharvest fisheries technologies.

Recognizing the fact that non-adoption or low adoption rate of improved postharvest fisheries technologies will lead to increasing postharvest losses of fish even with the adoption and utilization of improved fishing technologies; this study sought toexamine the adoption of improved postharvest fisheries technologies among fish processors in Lagos State, Nigeria. The specific objectives of the study were to describe the socioeconomic and fish processing characteristics of the fish processors, examine fish processors' access to extension services, and to determine the level of adoption of the different postharvest fisheries technologies by the fish processors in Lagos State. The study also tested a hypothesis to identify the determinants of the adoption of improved postharvest fisheries technologies.

METHODOLOGY

The study was conducted in Lagos State which is located in the south-western part of Nigeria on the narrow coastal plain of the Bight of Benin and lies approximately on Longitude $20^{o}42'$E and $3^{o}22'$E respectively and between Latitudes $6^{o}22'$N. It covers a total land area of 4,000km^2, out of which 30.0% is water. The State has a marine shoreline of about 180km and extends inland about 32 km (at its farthest points) from the shoreline. Due to the availability of the water resources, fishing becomes one of the major occupations of the residents of Lagos State especially those in riverine fishing communities. Some community members especially women are also engaged in fish processing, marketing and trading.

Multi-stage sampling procedure was used for the selection of 96 fish handlers from Lagos State. Stage 1 involved the random selection of two extension blocks each from the three agricultural extension zones in Lagos State to give a total of 6 out of the 16 extension blocks in the State.In stage 2, two extension cells were selected using simple random sampling methods from each of the chosen blocks to give a total of 12 cells/fishing communities.This was followed by selection of 50% of the fish handlers from each of the 12 cells through the simple random sampling technique based on the sampling frame obtained from the frontline extension agents in charge of the circles. This gave a total of 96 fish handlers that were interviewed for this study. However, 90 of the responses were found to be useful for data analysis.

A pretested and validated interview schedule was used to elicit information on the specific objectives of the study from the 96 fish processors in Lagos State. The level of adoption was determined through the awareness, trial, adoption and discontinuance stages of adoption. Collected data were analysed using descriptive (frequency, percentage and mean) and inferential statistics (regression analysis).

RESULTS AND DISCUSSION

Socioeconomic characteristics of fish processors - Table 1 reveals that the highest proportions (41.1% and 35.6%) of the fish processors were in the age brackets of 31-40 and 41-50 years, respectively, while 16.7% of the fish processors were older than 50 years. The mean age of the fish processors was 41.93 yearsand this implies that the fish processors were young and in active stage of their lives. According to Ande (2008), this population depends on themselves and can also be depended on. By implication, the fish processors are mature and responsible enough to make sound decisions on whether to adopt or reject a technology. This may explain why most of the introduced postharvest technologies were adopted by the fish processors. Age has been reported in previous studies (George *et al.*, 2014; Bolorunduro *et al.*, 2005; Fabiyi and Hamidu, 2011) as an important variable in the adoption of technologies among farmers.Majority (90.0%) of the fish processors were female, while only 10.0% of the fish processors were male indicating that fish processing in the study area is dominated by women. Low involvement of men in fish processing was also reported by George *et al.* (2014)which agrees with the assertion of Bolorunduro (2003) who noted that women were primarily responsible for postharvest activities in the fisheries sector of Nigeria. A study in Northwestern Nigeria however reported that men were primarily involved in postharvest activities in the fisheries sector (Bolorunduro *et al.,* 2005). This implies that people's involvement in fish processing is gender biased in Nigeria depending on the prevalent religious and cultural beliefs that dictate which work is accepted by men and women.

In terms of marital status, the highest proportion (87.8%) of the fish processors was married. The marital status of thefish processors imposes responsibility of housekeeping, child bearing and rearing. This also implies that they might have children and other dependants, thereby, requiring that they make additional income. In pursuit of this additional income, the fish processors are likely to adopt technologies that have the potential to improve their living condition through increased income. This is because household size has been found to be an important variable that influenced the adoption of improved technologies according to Atala *et al.* (1992) and Nkeme *et al.*(2013) who reported that the

larger the household size, the higher the adoption rate of Chokor kiln technology.Table1 also shows that one-quarter (25.6%) of the fish processors had no formal education, 37.8% and 35.6% of the fish processors attained elementary and secondary educational levels, respectively. With this level of education, it could be easy for them to understand and implement instructions from extension agents on new postharvest technologies. This could therefore aid their adoption of such technologies. This assertion is in line with positions of Fabiyi and Hamidu (2011) and Atala (1944) cited by Bolorunduro (2005) who noted that educational level have significant role to play in the adoption decision of respondent. Atala (1984) further reiterated that more enlightened and educated persons tend to be more dynamic in response to technological innovations.

Table 1 further reveals that more than three-quarters (78.8%) of the fish processors had between 1 and 5 fish processing experience with a mean fish processing experience of 4.39 years indicating that the fish processors have not been into fish processing for a long time and are thereby expected to easily adopt new and promising postharvest technologies since they do not have much years of experience to rely upon.Olaoye (2010) noted that experiences played prominent role in any farming enterprise. This assertion was based on the findings of earlier studies (Nkeme *et al.,* 2013) on related topic that relationship between processing experience and adoption of improved technologies (such as Chokor Smoker kiln) was positive. Asiedu-Darko (2013) also posited that farmers' knowledge and experience play vital roles in the dissemination and adoption of new technologies.

More than half (52.2%) and 47.8% of the fish processors practiced fish processing on full time and part times bases, respectively implying that anyone could be engaged in fish processing. This means that fish could be sustainably supplied in the study area as postharvest losses could be easily reduced. Also, the type of postharvest technologies required by those who engage in fish processing could be different from that needed by those who operate on part-time basis. It was also found from the study that 42.2% of the fish processors were also involved in trading and farming in addition to fish processing implying that fish processors had more than one means of livelihood aside from fish processing especially those that operated on part-time basis.Table 1 also reveals that, close to two-thirds (65.6%) of the fish processors were members of cooperative societies. The membership of social organizations such as cooperative societies could be an indication that credit facilities could be sourced from the cooperative societies. Olaoye *et al.* (2014) also reported that most fish farmers were members of cooperative societies. The cooperative society is also a means through which extension agents could reach out to the fish processors for group demonstration of technologies.These assertions are based on the submission of Atala *et al.* (1992) and Fabiyi and Hamidu (2011) who identified social participationas one of the socioeconomic characteristics that may influence the adoption of improved technologies.

Infrastructure such as school buildings (63.3%), perennial water source (52.2%)and smoking kiln/shed (87.8%) were available to most of the fish processors. This is an indication that the fish processors' children might have access to school and therefore fish processors are not likely to use their children in form of child labour. Furthermore, more than three-quarters (78.9%) of the fish processors also sourced fresh fish from fishermen/traders. Other sources of fish for processing were middlemen, cold stores and cooperative societies. This implies that the most prominent source of fish for processing was fishermen which indicate that the fish processors were not likely to procure fish at exorbitant prices since they buy directly from the fishermen at cheap prices.

Table 1: Socioeconomic characteristics of fish processors in Lagos (n= 90)

Socioeconomic characteristics	Frequency	Percentage	Mean
Age (Years)			
21-30	6	6.7	
31-40	37	41.1	41.93 years
41-50	32	35.6	
51-60	13	14.4	
>60	2	2.2	
Sex			
Male	9	10.0	
Female	81	90.0	
Marital status			
Single	2	2.2	

Socioeconomic characteristics	Frequency	Percentage	Mean
Married	79	87.8	
Widowed	6	6.7	
Separated	3	3.3	
Educational attainment			
No formal education	23	25.6	
Elementary education	34	37.8	
Secondary education	28	31.1	
Tertiary education	5	5.6	
Fish processing experience (Years)			
1-5	71	78.8	
6-10	13	14.4	4.39 years
>10	6	6.7	
Mode of processing			
Full time	47	52.2	
Part time	43	47.8	
Secondary occupation			
Trading	38	42.2	
Farming	38	42.2	
Vocational practice	14	15.6	
Membership of cooperative societies			
Yes	59	65.6	
No	31	34.4	
***Available infrastructures**			
School buildings	57	63.3	
Hospital/health centre	28	31.1	
Bank	5	5.6	
Market	0	0.0	
Perennial water source	47	52.2	
Electricity	41	45.6	
Cold store	25	27.8	
KVA generating set	8	8.9	
Smoking kiln/shed	79	87.8	

Source: Field survey, 2013 * Multiple response

Access to extension services and information

Table 2 reveals that all (100.0%) of the fish processors were aware of extension services and 61.1% of the fish processors had extension visits on forth night basis, while the remaining (38.9%) were visited on monthly basis. Higher proportions (27.8% and 66.7%)of the fish processors were contacted very regular and regular basis, respectively. Close to three-quarters (74.4%) of the fish processors sourced information from extension agents, while radio and television were the sources of information on fish processing by 23.4% of the fish processors. This means that although all the fish processors were aware of extension services, they were not visited by extension agents at the same rate implying that information on improved postharvest technologies were not disseminated to the fish processors at the same time. This further implies that fish processors would be adopting technologies at different levels.Fabiyi and Hamidu (2011) also found that awareness of a technology is a variable that determines that adoption of such technology. Bolorunduro *et al.* (2005) also noted that fish processors' contact was an important variable in the adoption of improved postharvest fisheries technologies. It was also deduced that extension agents were the major source of information for fish processing.

Table 2: Fish processors' access to extension services

Variables	Frequency	Percentage
Awareness of extension service		
Yes	90	100.0
No	0	0.0
Number of extension visits per year		
Forth nightly	55	61.1
Monthly	35	38.9
Quarterly	0	0.0
Never	0	0.0
Frequency of contact		
Very regular	25	27.8
Regular	60	66.7
Not regular	5	5.6
***Sources of information for fish processing**		
Extension agents	67	74.4
Other farmers	7	7.8
Radio	21	23.4
Television	21	23.4

Source: Field survey, 2013 * Multiple response

Processing characteristics of the fish processors

Table 3 reveals that about sixty percent of the fish processors earned a monthly income higher than N4,000.00 while more than one-quarter (28.9%) of the fish processors earned between N21,000.00andN40,000.00 with a mean monthly income of N39,977.78k. Table 3 also reveals that the highest proportions of the fish processors financed their fish processing activities from*Esusu*(43.3%)and cooperative societies (38.9%). About 42.2% of the fish processors were reported in Table 3 to have acquired more than N20, 000.00credits in the last production season. Equal proportions (28.9%) of the fish proportions had credits of N1,000.00 – N10,000.00 and N11,000.00 – N20,000.00 with a mean credit of **N**15,563.64k. Majority (82.2%) of the fish processors took credits at interest rates of between 1 and 10%. The mean interest rate with which the fish processors took credits was 4.4%. Table 3 further reveals that the highest proportions (46.7%) of the fish processors processed between 1 and 10kg, while 27.5% and 25.6% processed more than 20kg and 11-20kg, respectively. The mean quantity of fish processed on a daily basis was 13.42kg. These findings were pointers to the fact that fish processing is being done at small scale and subsistence level.

Also, close to two-thirds (62.2%) of the fish processors lost 10% or less of fresh fish between harvest/purchase and processing, while the remaining 37.8% lost more than 10%. Table 3 also shows that 34.4% and 71.1% of the fish processors market their processed fish at processing sites and local fish markets, respectively. Processed fish was also marketed at urban markets by 32.2% of the fish processors. Fresh fish was sourced from landing sites and middlemen by 70.0% and 25.6%, respectively. Table 3 also reveals that fishes were being sold in sizes by 80.0% of the fish processors, while 61.1% of the fish processors sold their produce by hand in 200 pieces.The study therefore revealed that although local market was the major site for marketing processed fish, marketing fishes were done in more than one site which indicates that processed fish could be found readily available to different consumer types at different times and places.Sourcing of fish directly from the fishermen at landing sites also indicates that fresh fishes were easily sourced, at cheaper prices since it does not involve additional costs that would have been added if they passed through the traders/middlemen.

The mean interest rate of 4.40% is an indication that fish farmers were able to pay back the credits obtained within the shortest period of time. The fish processors' ability to pay back credits on time might also be attributed to the small size of loans the fish processors were able to acquire. Esusu and cooperative societies were also found to be the main sources of credits for fish processing thereby implying that fish processors relied heavily on their personal savings and cooperative societies they belonged to instead of getting loans through the agricultural and commercial banks. Reasons for this may be because the informal means of sourcing credits may be more lenient with fish processors in terms of loan recovery, collateral and interest rates than the formal institutions which require more strict measures such as landed properties as collateral, sureties and guarantors, higher interest rates, etc. The

dependence on the informal credits is however a reason for the continued subsistence level of processing which has a negative impact as far as ensuring the sustainable supply of processed fish in the study area.This is why Ihimodu (2003) and Ochomma (2008) claimed that credit is necessary in agriculture as it enhances agricultural productivity (Tawari and Davies, 2009). The failure of many development interventions such as the Green Revolution Project was also attributed to lack of finance among other factors (Tawari, 2006).

Table 3: Processing characteristics of the fish processors in Lagos state (n = 90)

Variables	Frequency	Percentage	Mean
Monthly income			
≤20,000.00	10	11.1	
21,000.00-40,000.00	26	28.9	N39,977.78
>40,000.00	54	60.0	
***Major sources of finance**			
Agricultural bank	8	8.9	
Esusu	39	43.3	
Cooperative societies	35	38.9	
Commercial bank	2	2.2	
Non-Governmental Organizations	3	3.3	
Personal savings	10	11.1	
Credit obtained in the last production season (N)			
0.00	10	11.1	
1,000.00 -10,000.00	26	28.9	
11,000.00 -20,000.00	26	28.9	**N**15,563.64
>20,000	38	42.2	
Interest rates (%)			
1-10	74	82.2	
11-20	3	3.3	4.40%
>20	3	3.3	
Quantity of fish processed daily (kg)			
1-10	42	46.7	
11-20	23	25.6	13.42kg
>20	25	27.5	
***Quantity lost between fish purchase and processing (%)**			
≤10	56	62.2	
11-20	25	27.8	
>20	9	10.0	7.67%
***Site of fish marketing**			
Processing sites	31	34.4	
Local fish markets	64	71.1	
Urban markets	29	32.2	
***Sources of fish for processing**			
Landing sites	72	80.0	
Neighbouring towns/states	11	12.2	
Middlemen	23	25.6	
***Form of selling fish**			
Use of weighing scale (kg)	18	20.0	
Hand (200 pieces)	55	61.1	
Sizes	72	80.0	

Source: Field survey, 2013 * Multiple response

With respect to the type of fish species processed, Figure 1 reveals that higher proportions of the fish processors processed *Clarias spp.* (95.6%), *Tilapia spp.* (94.4%), *Gymnarcus niloticus* (51.1%), *Sardinella maderensis* (71.1%), *Ethmalosa fimbriata* (74.4%), *Heterotis niloticus* (52.2%), *Chrysicththys nigrodigitatus* (54.4%) and *Ilisha Africana* (66.7%).

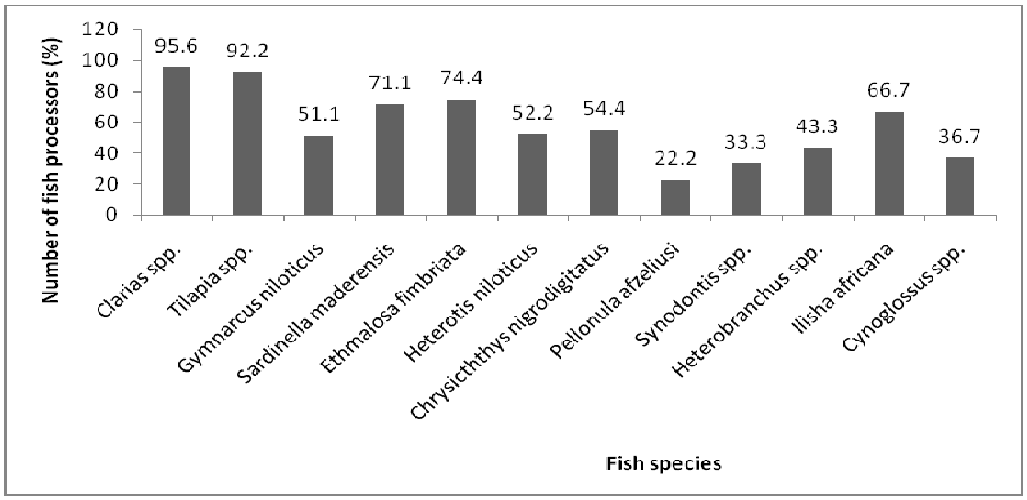

Figure 1: Fish species processed by fish processors in Lagos state

Levels of adoption of improved postharvest technologies

The awareness, trial, adoption or rejection and discontinuance of the various improved post-harvest technologies by the fish processors is as presented in Table 4 under the fresh fish handling technologies, processing technologies, preservation technologies and fish storage technologies.

Fresh fish handling technologies: As found in Table 4, almost all the fish processors were aware of killing fishes by piercing the head with needle or other sharp objects immediately after capture (91.1%), cutting the fish and removing the gills (94.4%), washing the fish in clean running water (97.8%), stowing the fish on ice in insulated boxes (95.6%) and conveying the fish to landing sites as soon as possible (96.7%). Table 4 further shows that almost all the fish processors that were aware of these handling techniques have tried and adopted the different technologies. However, significant proportions of those that had adopted the technologies were also reported in Table 4 to have discontinued killing fishes through piercing after capture (68.9%), cutting the fish and removing the gills (47.8%) and conveying the fish to the landing sites (41.1%). These findings indicated high levels of awareness, trial and adoption of the different fish handling technologies but levels of discontinuance were also generally high with these technologies with the exception of washing the fish in clean running water, and stowing the fish on ice in insulated boxes which were not highly discontinued. By implication, washing fish in cleaning water and stowing the fish on ice were still the most commonly used fish handling technologies in Lagos State.

Fish processing technologies: Table 4 reveals that majority of the fish processors were aware of using de-scaler for scale removal (98.9%), de-gilling, de-fining, de-spining, de-gutting and cutting fish into pieces (96.7%), washing in clean water/salted water (98.9%) and packaging in polythene /polypropylene bags (84.4%). Trial and adoption of the different fish processing technologies were also done by almost all those who were aware of the technologies. However, 34.4% of the fish processors discontinued using de-scaler for scale removal and packaging in polythene /polypropylene bags, while 28.9% discontinued de-gilling, de-fining, de-spining, de-gutting and cutting fish into pieces. Washing in clean water/salted water was discontinued by only 6.7% of the fish processors. The findings also showed that the fish processors had high levels of awareness, trial and adoption of all the fish processing technologies and the technologies were also highly discontinued with the exemption of washing in clean/salted water (brine). Hence, washing in brine generally was the most commonly used fish processing technology in the study area.

Table 4: Percentage distribution of fish processors' level of adoption of improved fish handling and processing technologies in Lagos (n = 90)

Improved Post-Harvest Technologies	Aware(%)	Tried(%)	Adopted (%)	Discontinued (%)
Handling of fresh fish				
Kill the fish immediately after capture by piercing the head with a needle/ sharp object to ensure instant death	91.1	88.9	88.9	68.9
Cut the fish immediately & remove the gills/	94.4	94.4	94.4	47.8

Improved Post-Harvest Technologies	Aware(%)	Tried(%)	Adopted (%)	Discontinued (%)
cut off the head				
Wash the fish in clean running water	97.8	94.4	91.1	11.1
Stow the fish on ice in insulated boxes/in the absence of ice stow in a clean box with lid,	95.6	74.4	74.4	23.3
Convey the fish as soon as possible to the landing sites for further preservation/ sales	96.7	94.4	94.4	41.1
Fish processing				
Using of de-scaler/sharp knife for scale removal	98.9	95.6	94.4	34.4
De-gilling, De-fining, De-spining, De-gutting and cutting fish into pieces	96.7	94.4	94.4	28.9
Washing in clean water/salted water (brine)	98.9	96.7	93.3	6.7
Packaging in polythene /polypropylene bags for use.	84.4	80.0	80.0	34.4

Fish preservation technologies: Table 5 shows that awareness was high among fish processors with respect to Chokor smoking kiln (81.1%), Magbon-Alade smoking Kiln (94.4%) and use of fine netting materials, fly-screens, sticky flytraps/swats and electrocutors during sun drying (86.7%), while awareness was moderate among the fish processors as regards Modified Altona Kiln (51.1%), Improved Banda smoking kiln (51.1%), Burkinabe smoking Kiln (53.3%), Solar-tent Dryer (62.2%) and box-type dryer (63.3%). Most of the fish processors tried the use of Chokor smoking kiln (68.9%), Magbon- Alade smoking kiln (76.7%) and use of fine netting materials (84.4%). More than half of the fish processors have also adopted Chokor (56.7%) and Magbon-Alade smoking kilns (56.7% and 70.0% respectively) and use of fine netting materials (84.4%). About 17.8% of the fish processors discontinued the use of fine netting materials while 14.4% and 27.8% also discontinued Chokor and Magbon-Alade smoking kilns respectively. This is an indication that awareness level varies among the fish processors with regards to the fish preservation technologies with Chokor and Magbon-Alade smoking kilns being the highest in terms of awareness. Trial and adoption of these technologies also varies.

Fish storage technologies: Table 5 also shows that majority of the fish processors were aware of the use of disinfectants (97.8%), use of fumigants (82.2%), use of jute bags and polythene bags (91.1%), use of raised platform to stack dried fish (95.6%) and application of anti-coagulant and rodenticide (90.0%), while awareness remained moderate with respect to the use of insulated ice container (56.7%) and use of correct bulk and shelf storage (48.9%). Almost all those that were aware of the technologies with high level of awareness also tried and adopted the different fish storage technologies. More than half of those that adopted the use of fumigants (61.1%) and application of anti-coagulants and rodenticides also discontinued them after adoption over years.

The high level of awareness with respect to almost all the postharvest fisheries technologies is in disagreement with the findings of Bolorunduro *et al.* (2005) who reported low levels of awareness across all the introduced improved kilns. Trial and adoption also followed at almost the same rate as adoption while discontinuance was also high among most of the technologies that were initially adopted by them. This might be attributed to the low level of fish processing experience of the fish processors which made them to adopt any promising idea or innovations. Such ideas or innovations were then discontinued when the expected result is not forthcoming. It could also be inferred from the study that use of fine netting materials, Magbon-Alade smoking kilns, use of jute bags, use of raised platform and washing fish in clean running water and salted water were the most commonly used improved postharvest fisheries technologies in Lagos State, Nigeria.

Table 5: Percentage distribution of fish processors'level of adoption of improved fish preservation and storagetechnologies in Lagos state (n = 90)

Improved Post-Harvest Technologies	Aware(%)	Tried(%)	Adopted (%)	Discontinued (%)
Fish preservation				
Modified Altona (Watanabe) Kiln	51.1	27.8	27.8	12.2
Altona Kiln	46.7	17.8	11.1	5.6
Modified Ivory-Coast Kiln	40.0	8.9	4.4	0.0

Improved Post-Harvest Technologies	Aware(%)	Tried(%)	Adopted (%)	Discontinued (%)
Improved Banda Smoking Kiln	51.1	16.7	16.7	3.3
Burkinabe Smoking Kiln	53.3	12.2	8.9	0.0
Chorkor Smoking Kiln	81.1	68.9	56.7	14.4
Magbon- Alade Smoking Kiln	94.4	76.7	70.0	27.8
Kainji Gas Kiln (KGK)	46.7	12.2	7.8	6.7
Solar-Tent Drijer	62.2	35.6	31.1	6.7
Box type Dryer	63.3	26.7	24.4	10.0
Coca-cola Cooler that uses kerosene (Chiller)	37.8	11.1	11.1	6.7
Air blast and Plate Freezers	37.8	7.8	6.7	4.4
Usage of finenetting materials (60-100 meshes per square inch), fly-screens, sticky flytraps/swats & electrocutors, during sun-drying	86.7	84.4	84.4	17.8
Fish storage				
Use of disinfectant such as Dettol / Izal	97.8	96.7	96.7	30.0
Use of fumigants such as phosphine, phostoxim tablets andpyrethrum plus piperonyl butoxide	82.2	81.1	77.8	61.1
Use of Jute bags polypropylene sacks, imported cartons and head pans for bulk storage of dried fish	91.1	84.4	84.4	21.1
Use of raised platform to stack stored package dried fish against moisture and insect infestation	95.6	88.9	87.8	13.3
Application of anti-coagulant and rodenticide against rodents	90.0	88.9	88.9	54.4
Use of insulated ice container constructed with marine plywood	56.7	42.2	38.9	18.9
Use of correct bulk and shelf storage	48.9	23.3	20.0	5.6

Determinants of adoption of improved postharvest technologies

Table 6 reveals that age (t=-0.214) and interest rate (t=-0.234) negatively and significantly determined the adoption of improved postharvest technologies at 1% and 5% levels of significance, respectively. Other variables were positive but insignificant determinant of the adoption of improved postharvest technologies at 5% level of significance. The R square was found to be 0.0854 indicating that only about 8.5% of the adoption of improved postharvest fisheries technologies is explained by the independent variables.This implies that the older the fish processors are, the less they are likely to adopt improved fisheries technologies. Significant associations have been reported between age and adoption of improved technologies (Bolorunduro*et al.*, 2005; Feder *et al.,* 1985; Fabiyi and Hamidu, 2011).Also, if the interest rate on credits for fish processing is high, fish processors may not adopt most of the improved fisheries technology due to the fact that they may not be able to afford such technologies.It could therefore be inferred that adoption of improved technologies was high because the fish processors were youths and took loans at low interest rates.

Table 6: Regression analysis of Fish handlers' determinants of adoption of improved fishing technologies

	Unstandardized Coefficients		Standardized Coefficients	t-value
	B	Std. Error	Beta	
(Constant)	-276.665	1014.417		-.273
Age	0.749	3.498	0.077	-0.214*
Household size	0.306	4.611	0.122	0.066
Level of education	0.500	3.634	0.078	0.138
Co-operative society	-9.612	12.016	-0.586	-0.800
Daily quantity of fish processed (kg)	-1.982	2.766	-0.381	-0.717

	Unstandardized Coefficients		Standardized Coefficients	t-value
	B	Std. Error	Beta	
Extension visits	-3.041	8.186	-0.163	-0.372
Extension contact	-9.455	5.144	-0.642	-1.838
Income per month	-0.130	0.378	-0.030	-0.344
Credit accessible	-0.049	0.407	-0.011	0.437
Interest rate	-1.089	0.397	-0.278	-0.234**

Dependent Variable: Adoption; R = 0.924; R square=0.854; Adjusted R square= 0.470; Std Error of the Estimate= 5.139

CONCLUSION AND RECOMMENDATIONS

It could be inferred from this study that fish processing is dominated by married women who haveformal education, were members of cooperative societies and have little fish processing experience. From the processing characteristics of the fish processors, it could be concluded that fish processing is done at subsistence level. The fish processors were aware, tried and adopted most of the technologies. However, discontinuation was also high with respect to most of the adopted technologies. The study therefore concluded that adoption of improved postharvest fisheries technologies is strongly determined by the fish processors' age, and interest rate of acquiring credits

The study therefore recommends that agricultural and commercial banks should make credit facilities easily accessible to fish processors through reduced interest rates and affordable collateral. This can allow fish processors to borrow more to utilize for the adoption of improved postharvest fisheries technologies that will be required in the plan to expand business. Efforts should also be made by the extension agents at persuading the fish processors to adopt previously rejected and discontinued improved postharvest fisheries technologies. This could be achieved throughorganizing of results and methods demonstrations to fish processors in groups and cooperative societies.

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