Adoption of Improved Fish Preservation Technologies in Northwestern Nigeria

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Summary

A study was conducted to determine the status of awareness and adoption of disseminated improved post-harvest fisheries technologies among fish processors in the northwestern zone of Nigeria using structured questionnaire to obtain information from fish processors and secondary data collected from the Agricultural Development Projects (ADPs) and some Research Institutes in the selected states. A multi-stage sampling technique was adopted in the selection of four states in the zone (Kaduna, Kano, Katsina and Kebbi). Data was analyzed using descriptive statistics and Pearson's correlation. The variables were tested at 5% level of significance.

Results of data analysis showed that about 66% of respondents were in the economically active age group of 21-40 years and the mean age was 32 years. About 89% were males; 83.7% had only koranic education, while 28.7% had between 6-10 years processing experience and equally 28.7% had over 20 years processing experience. The mean year of experience was 17.5 years. Only about 43.1% of respondents were aware of improved fish smoking kilns disseminated in the zone, with about 32% adopting one kiln or the other. Improved smoking kilns disseminated include Chokor, Altona, Burkinabe, and Watanabe. Major constraints to adoption of improved fish processing and preservation technologies in the zone include scarcity of improved kilns, high cost of kilns when available, difficult technical features of the kilns and insufficient awareness creation by the ADPs. Results of Pearson's correlation analysis on socio-economic factors influencing adoption showed that year of experience (r, 0.02), extension contacts (r, 0.03), access to credit (r, 0.01) and "contact farmers status" (r, 0.00) were significant (P≠ 0.05) in positively influencing the adoption of Chokor oven. Burkinabe kiln's adoption was significantly (P≠ 0.05) and positively influenced by age (r, 0.04), acquisition cost (r, 0.02) and access to credit (r, 0.02). Altona kiln's adoption on the other hand was significantly (P≠ 0.05) and positively (r, 0.00) influenced by the educational achievement of processors.

The study concluded that concerted policies by government geared towards post-harvest loss

Résumé

Adoption de technologies améliorées de conservation des poissons dans le nord-ouest du Nigeria

Une étude a été entreprise pour déterminer le statut de conscience et l'adoption des technologies après la diffusion de techniques améliorées de conservation des poissons parmi les transformateurs dans la zone du nord-ouest du Nigeria. Un questionnaire structuré a été utilisé pour obtenir l'information des transformateurs de poissons, des projets de développement agricole (ADPs) et de quelques instituts de recherche dans les états choisis. Une technique d'échantillonnage à plusieurs étages a été adoptée dans quatre états de la zone (Kaduna, Kano, Katsina et Kebbi). L'analyse des données s'est faite en utilisant des statistiques descriptives et la corrélation de Pearson. Les variables ont été testées au niveau 5%.

Les résultats de l'analyse de données ont montré que environ 66% des répondants étaient dans la catégorie d'âge économiquement active de 21-40 ans et l'âge moyen était de 32 ans. Environ 89% étaient des hommes; 83,7% ont seulement l'éducation coranique; 28,7% ont entre 6-10 ans d'expérience et également 28,7% ont une expérience de 20 ans. La durée moyenne d'expérience était 17,5 ans. Seulement environ 43,1% de répondants étaient au courant de la diffusion des fours améliorés dans la zone, avec environ 32% adoptant un four ou l'autre. Les fours améliorés disséminés comprenaient Chokor, Altona, Burkinabe, et Watanabe. Les contraintes principales à l'adoption des fours améliorés sont la pénurie des fours améliorés, le coût élevé des fours si disponibles, la difficulté des dispositifs techniques et l'insuffisante conscientisation par l'ADPs. Les résultats de l'analyse de la corrélation de Pearson sur les facteurs socio-économiques influençant l'adoption ont montré que l'expérience (r, 0,02,), la vulgarisation (r, 0,03), l'accès au crédit (r, 0,01) et le statut de fermiers de contact (r, 0,00) étaient significatifs (P≠ 0,05) en influençant franchement l'adoption du four Chokor. L'adoption du four Burkinabe était de manière significative (P≠ 0,05) et franchement influencée par l'âge (r, 0,04), le coût d'acquisition (r, 0,02) et l'accès au crédit

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reduction in fisheries must aim at making the designing of improved kiln appropriate to the clienteles' needs so as to increase fish protein supply in the zone and improve the production level, income level, and standard of living of fish processors.

(r, 0,02). L'adoption du four Altona, d'autre part, était de manière significative (P≠ 0,05) et positivement (r, 0,00) influencée par la formation accomplie des transformateurs.
L'étude a conclu que les politiques concertées par le gouvernement orientées vers la réduction après la moisson des pertes de poissons capturés doivent viser à rendre disponible des fours améliorés appropriés aux besoins des clientèles afin d'augmenter l'offre de protéine de poisson dans la zone et d'améliorer le niveau de production, le niveau de revenu, et le niveau de la vie des commerçants de poissons.

Introduction

Post-harvest losses in fish products are a major bane of the Nigerian fish industry especially at the artisanal level. Whereas artisanal fisheries is responsible for over 60% of total domestic production annually, the magnitude of losses in this sector has been estimated at 30-50% of total catches (7, 11, 14). This range of figure is alarming when one considers the fact that Nigeria presently meets only 60% of her total fish need and spends scarce foreign exchange in importing frozen and canned fish to supplement the deficit. The artisanal fisheries of Nigeria are endemic to these post-harvest losses. Apart from the subsistence operation in catching fish, in most cases bacterial infection set in on the fish flesh as a result of injuries sustained in the traps and nets – open wound, and stress from struggling accelerating the deterioration of fish. The time interval between catching and preparation for preservation further aggregates the problem. The commonest methods and practices for traditional processing and preservation of fish products include smoke-drying, sun-drying and fermentation.
Successive governments in Nigeria over the years recognized the need to reduce the extent of losses to the barest minimum. Knowing the limitations of traditional preservation equipments and the inadequacy of other methods used in processing and preservations, Research Institutes were funded to generate and package technologies to tackle the problems. Improved technologies were developed and disseminated on some aspects of post-harvest fish handling. Grass root extension delivery was also carried out by the ADPs to disseminate such technologies. It is therefore significant to evaluate the levels of awareness and adoption of the technologies by fish processors in the zone. This will enhance recommendations and policy formulations in attempts to reduce post-harvest losses of fish products. The broad objectives of the study were to study the personal characteristics of the respondents, identify the improved fish curing technologies available in the zone, identify possible constraints to adoption and determine the factors influencing the adoption.

Methodology

The study was conducted in 4 states (Kaduna, Kano, Katsina and Kebbi) out of the seven states that make up the north-west agro-ecological zone of Nigeria. Primary data were collected from fish processors using structured questionnaires. A total of 3 ADP zones in each of the 4 states were purposively selected. One Local Government Area (LGA) of intensive fishing activities was randomly selected from each

Table 1
Distribution of respondents by personal characteristics

Characteristics	Distribution	
	Frequency	Percentage (%)
Age (years)		
< 20	15	4.8
21 - 30	79	25.2
31 - 40	129	41.2
41 - 50	40	12.8
51 - 60	38	12.1
> 60	12	3.8
Mean= 32		
Sex		
Male	278	88.8
Female	35	11.2
Educational qualification		
None	16	5.1
Koranic	262	83.7
Primary	31	9.9
Secondary	3	0.9
Post secondary	1	0.3
Experience (years)		
1 - 5	48	15.3
6 - 10	90	28.7
11 - 15	51	16.3
16 - 20	31	9.9
> 20	90	28.7
Mean= 17.5		

of the zone. Between 25 to 30 questionnaires were administered in each LGA. The overall total number of questionnaires usefully completed, retrieved and used for analysis was 313 i.e. 76 (Kaduna) 92 (Kano) 70 (Katsina) and 75 (Kebbi).
Secondary data were obtained from the records of the ADPs and some Research Institutes. Data were collected between April and July 1999. Both descriptive statistical tools (frequencies and percentages) and Pearson's correlation (16) were used in the data analysis.

Results and discussion

Personal characteristics of respondents
Table 1 shows that the ages of respondents across the zone range from less than 20 years to over 60 years.

About 66% of the respondents were between 21-40 years, 24.9% were between 41-60 years, 4.8% were below 20 years, and only 3.9% were above 60 years. The main age was 32 years. Comparable works on women fish processors in Ghana (3) showed that active age of respondents (fish processors) were between 21-40 years. 88.8% of the respondents were males while only 11.2% were females. The result is in agreement with studies by various authors (1, 4, 5) in which they reported that males dominated the fish post-harvest enterprises in northern Nigeria. This was due to religious and cultural limitations imposed on majority of women that restrict their roles purely to confines within household. About 84% of fish processors in the zone acquired only koranic education, indicating that majority were illiterates. Educational level have significant roles to play in influencing the adoption decision of respondents as more enlightened and educated people tend to be more dynamic in response to technological innovations and changes (2). From the total sample of fish processors interviewed, 28.7% had between 6-10 years experience in the business. The same percentage was reflected for those with over 20 year's experience. The mean year of experience was 17.5 years. The number of years of experience of a fish processor could be an important factor in predicting adoption behavior.

Awareness and adoption of improved kilns and pre-processing recommendations
Limitations imposed on traditional fish smoking kilns necessitated the need to either improve on their technical design and efficiency or introduce new kilns that are not common to artisans. Traditional kilns are labour intensive, have long smoking duration, risky to operate with small holding capacity. In attempts to reduce the high post-harvest losses, research agencies introduced improved kilns and some recommendations on fish handlings. The ADPs in the zone were able to disseminate information on such technologies. Figure 1 shows the levels of awareness and adoption of the four improved smoking kilns spread across the zone among fish processors.
These improved fish preservation technologies, for which adoption levels of respondents were measured, include Altona, Watanabe, Burkinable and Chokor smoking kilns (17).

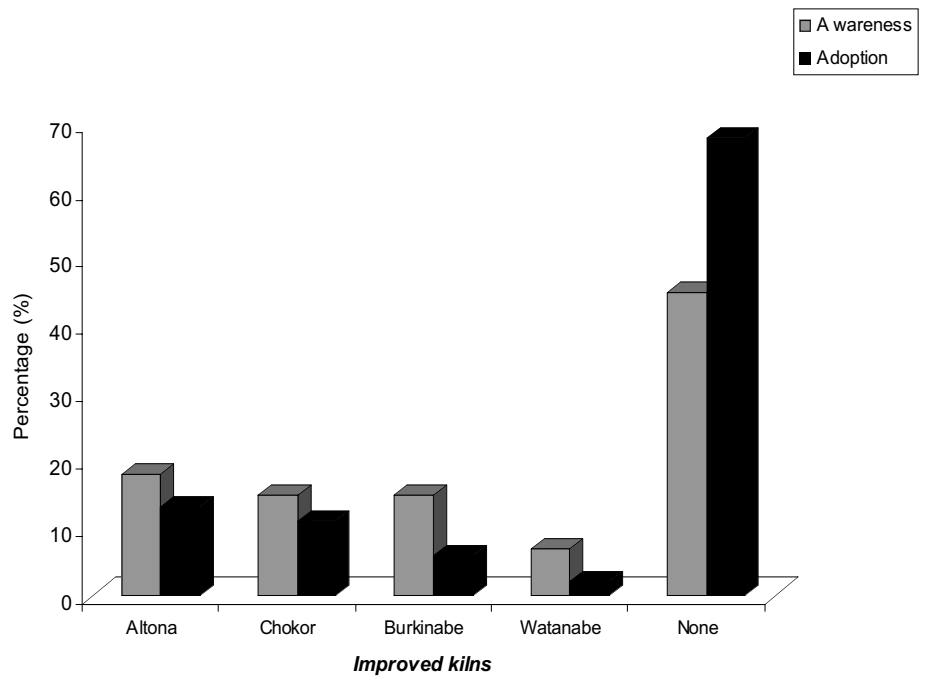

Figure 1: Distribution of Respondents by Awareness and Adoption levels of Improved fishsmoking kilns in the zone.

Table 2
Distribution of respondents by awareness and adoption levels of disseminated pre-processing handling practices

Practices / Problems	Awareness level		Adoption level	
	Frequency	Percentage (%)	Frequency	Percentage (%)
Handling Practices				
Gilling/beheading	170	54.3	117	37.4
Scaling	235	75.1	165	52.7
Splitting	115	36.7	82	26.2
Gutting/Evisceration	190	60.7	185	59.1
Washing	190	60.7	154	49.2
Salting/Brining	165	52.7	131	41.8
Cutting into chunks	189	60.4	149	47.6
Partial decomposition	105	33.5	83	26.5

Altona kiln is an improved smoking kiln made of cement blocks with the dimensions of 1.5 x 1.25 x 3.65 m. The top is sealed with a slab of concrete perforated at the centre to form a chimney. Three wire mesh trays are located impart, below which is the hearth. A metal steel door flushes over the smoking chamber and the fireplace. Smoking is carried out by burning wood in the hearth.

Watanabe kiln is a modified Altona kiln connected to a fire-box by an asbestos pipe 0.5 m long and 0.35 m in diameter. The fire box has dimensions of 0.8 x 0.5 x 1.0 m. Fish is smoked by burning wood in the fire box and the smoke passes through the tunnel into the smoking chamber. During smoking, the door of kiln must be closed to conserve heat and smoke in the smoking chamber.

Burkinabe smoking kiln is constructed in the form of a box with variable dimension. Five sheets of corrugated iron sheet nailed to plank frames covering the sides of the kiln. Fish is placed on wire mesh trays in the kiln while smoke is supplied by burning wood from a full drum length which is cut open to serve as the smoking chamber at the base of the kiln.

Chokor oven is a kiln originated from Ghana in Chokor village from where it derived its name and it is an improvement over the traditional smoking kiln. It is typically rectangular in shape and has a mud, cement or brick wall of internal dimensions of 0.7 x 0.7x 0.7 m. The top of the wall must be flat to enable the wooden-framed trays to rest snugly against them. It has two chambers with each having a centrally placed stoke hole of 38 cm high and 38 cm wide.

Awareness levels were Altona (18%), Chokor (15%), Burkinabe (15%) and Watanabe (7%). Only a total of 34% of respondents had adopted one kiln or the other. These include Altona (13%), Chokor (11%), Burkinabe (6%) and Watanabe (2%). Non-adopters of any of the kilns were in the larger majority (68%). Pre-handling practices are actions taken upon the fish to prepare them for smoking, sun-drying or alternatively to promote the quality of products and by implication their appeal to consumers. Adoption of pre-processing handling technologies would increase the quality of products, monetary value of products and their shelf life. Disseminated technologies include gilling, scaling, splitting, gutting, washing, salting, cutting into chunks and partial decomposition etc. In table 2, about 54% of processors in the zone were aware of the practice of gilling/beheading to allow blood flow out of the fish; this is practiced for large fish and in case of processors that fry fish-all sizes. However, only about 37% adopted it. Scaling involves the removal of fish scales to improve product consumption.

About 53% of processors in the zone adopted this practice as against about 75% awareness level. These were mostly fresh fish and fried fish vendors. Splitting, gutting, washing, salting of products, cutting into chunks and partial decomposition had about 37%, 61%, 61%, 53%, 60% and 34% awareness levels respectively with adoption levels at about 26%, 59%, 49%, 42%, 48% and 27% in that order.

Constraints to adoption of improved technologies

Reasons advanced for poor adoption of the (improved) kilns by the respondents include high cost of kilns (29.7%), scarcity of kilns (30.3%), difficult technical features of the kilns (21.7%), operational difficulties (27.1%), lack of clear relative advantages over traditional kilns (11.5%) and insufficient awareness creation (44.7%) (Table 3).

For the pre-processing recommendations, the major problems of processors in adopting them were additional cost input (35.8%) extra time input (19.8%) inconvenience due to swamps of flies and oviposition (34.8%) and untidy environment created (44.7%).

Table 3
Distribution of respondents by constraints encountered in the adoption of disseminated technologies

Constraints	Distribution	
	Frequency	Percentage (%)
Improved Kilns		
1. High cost	93	29.7
2. Scarcity of kilns	95	30.3
3. Difficult technical features	68	21.7
4. Operational difficulties	68	21.7
5. No relative advantage	36	11.5
6. In sufficient awareness creation	140	44.7
Pre-processing recommendations		
1. Additional cost input	112	35.8
2. Extra time input	62	19.8
3. Inconvenience of operation	109	34.8
4. Untidy environment creation	140	44.7

Adoption of post- processing fish quality improvement recommendations

The study probed into specific recommendations that EAs taught the fish processors to enhance the quality of fish products. Targeted technologies were degutting, salting, drying/smoking, packaging and quick processing. Figure 2 shows that only 15.3% of processors were aware of gutting recommendation with only 14.1% adopting; 12.5% were aware of recommendation on salting as against 5.4% adoption.

Hard smoke-drying was recommended to increase the shelf-life of fish with 26.5% of respondents aware and equal proportion adopting. About 16.1% of respondents were aware of packaging technology and only 15.9% adopted. Immediate processing of fresh fish as a recommendation to reduce the activities of microbes had 20.7% awareness and 18.8% adoption. A larger majority (41.8%) of respondents were unaware of any recommendation on quality improvement. The low awareness and adoption levels of disseminated fish smoking kilns and processing recommendations indicate the poor state of technology dissemination by the ADPs in the zone. The economic down-turn in the country has affected most government agencies (including the ADPs) in performing their job schedules.

Factors affecting fish processing technologies adoption

Technologies adoption is always influenced by certain factors. Generally in agriculture, favourable factors of production recommendations' adoption include profitability, compatibility and viability of such technologies (among others). In this study, certain socio-economic factors of respondents (variables) were tested on the adoption of improved fish smoking kilns (Chokor, Burkinabe, and Altona) disseminated in the zone. Watanabe kiln was excluded in the analysis because it had the least levels of awareness (7%) and adoption (2%) as a result of the constraint listed in table 3. Results of the Pearson's correlation analysis are presented in table 4.

The variable was tested at 5% significant level. For all significant variables, the correlation co-efficients '*r*' were very weak ($r < 0.4$), showing weak positive correlation with the dependent variables (adoption of the kilns). Adoption of Chokor oven was significantly related ($P \neq 0.05$) to the processors years of experience ($P \neq 0.05$, r, 0.02), extension contact ($P \neq 0.05$, r, 0.03), access to

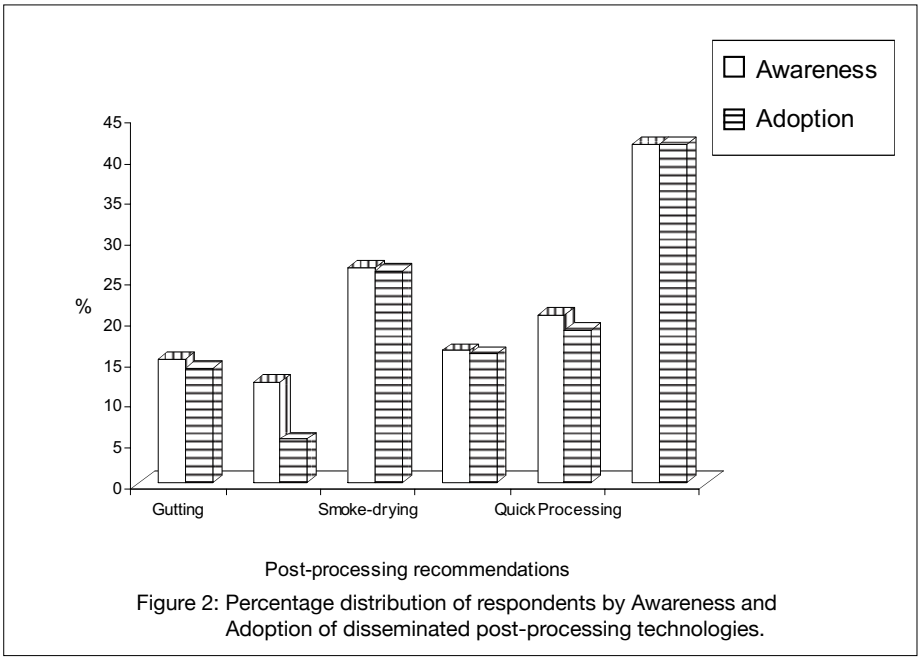

Figure 2: Percentage distribution of respondents by Awareness and Adoption of disseminated post-processing technologies.

credit (P≠ 0.05; r, 0.01), and contact farmers' status (P≠ 0.05; r, 0.00). The implication of the significantly related years of experience of processors to adoption of Chokor kiln is that the more experienced a processor is the more likely the tendency to adopt Chokor kiln. The significant correlation of extension contacts to adoption of Chokor kiln indicate that with more visits and demonstration on construction and operation of the kiln, there is the likelihood that awareness and adoption levels would be increased among processors. Baryeh *et al.* (3) in a study on women fish processors in Ghana discovered that extension contacts was significantly related to the adoption of post-harvest fisheries technologies. Although one of the advantages of Chokor kilns is that of relatively low cost of construction, a processors access to credit would strongly influence the acquisition and usage of the kiln. Olayide *et al*. (13) viewed credit inadequacy as a major constraint to adoption of agricultural technologies. The significant positive correlation of Chokor kilns adoption with contact farmer's status of a processor was the *a priori* expectation since such farmers receive more visits from extension agents and are often the first beneficiaries of introduced innovations.

The adoption of Burkinabe kiln was influenced by age of processors (P≠ 0.01; r, 0.04), the acquisition cost (P≠ 0.05; r, 0.02) and access to credit (P≠ 0.05; r, 0.01). For Burkinabe kiln, the significant positive correlation of age with adoption indicates that older processors might be inclined to adopt this kiln, due to a long period of awareness of its introduction. Vabi and Williams (15) had shown high adoption of agricultural technologies at middle ages, although Feder *et al.* (8) also indicated that in some instances, younger ages were associated with adoption of innovations. The significant positive correlation of acquisition cost and access to credit on adoption of Burkinabe, indicate that subsistence processors may not be able to acquire the technology without access to credit from formal and informal sources.

Altona kiln adoption was significantly and positively related to educational attainment (P≠ 0.05; r, 0.00). The kiln is a bit complex in construction and operation and this would need a knowledgeable and enlighten clientele to operate it. Some studies (2, 9) have found positive relationships between education and adoption of innovations.

Generally it can be asserted that age of clienteles, their years of experience in fish processing business, their educational level, access to credit, construction cost, extension contact and "contact farmers" status of processors would influence the adoption of fish processing technologies in the zone. This lends credence to results of studies by various authors (6, 10, 12) that certain personal characteristics of farmers, income level, cost and effectiveness of an extension approach greatly influence technology adoption.

Conclusion and recommendations

The northwestern zone of Nigeria is endowed with abundant inland fisheries resources.

Despite this fact, some constraints, which are multi-dimensional in nature, operate to hinder the realization of its full potentials in meeting the fish protein needs of the populace in the zone in particular and Nigeria in general. The institutional constraint is manifested in the poor awareness creation on improved technologies by the ADPs that could reduce post-harvest losses to the barest minimum. The operational constraints on the part of the processors are the lack of access to credit to transform them form subsistence operators to large-scale processors. On the part of Research Institutes and Extension Agencies there is a constraint of appropriateness (in terms of cost, technical features, availability and simplicity) of introduced smoking kilns and other recommendations. Constraints and problems should not be obstacles in attempts to reduce fish post-harvest losses, increase fish products availability to consumers and improve the income and living standard of fish processors in the zone. The objectives of government along these direction can only be achieved through concerted efforts to transform the operations and elevate the operators of the artisanal fisheries of the zone.

Table 4
Results of Pearson's correlation analysis of some socio-economic characteristics of respondents and adoption of improved fish smoking techniques

Independent variable / Dependent variable	Age	Sex	Education	Experience	Acquisition cost	Access to credit	Membership of cooperative	Extension contact	Contact farmer status	Kilns' availability
Adoption of Chokor	0.504	0.881	0.989	0.022*	0.171	0.006*	0.210	0.030*	0.003*	0.412
Adoption of Burkinabe	0.039*	0.620	0.8021	0.215	0.021*	0.010*	0.927	0.316	0.875	0.511
Adoption of Altona	0.709	0.620	0.005*	0.795	0.464	0.152	0.333	0.817	0.802	0.308

* Significant at 1% (P≤ 0.05)

The following are recommended measures to achieve these goals;

i. Research Institutes should ensure that improved fish smoking kilns developed are appropriate to fish processors operating environment. Indices of appropriateness are simplicity in operation, low and affordable cost, availability of the kilns and clear relative advantage over traditional kilns.

ii. Awareness levels for the smoking kilns were generally low. The ADPs being the grass-root extension agencies should create more awareness on post-harvest fisheries technologies. Extension strategies such as field days, agricultural shows, method demonstration and result demonstration are avenues for creating awareness on such technologies. Also the farm broadcast of ADPs on radio and television should include enlightenment on improved smoking kilns and other recommendations in attempts to meet government objectives of increased income to fish processors and reduction of post-harvest losses.

iii. Access to credit is an important facilitator in transforming small-scale operators to large-scale producers. Most fish processors in the zone have been operating under an economic environment that made them subsistent and sub-servient. The Agricultural Credit Guarantee Scheme of the Central Bank of Nigeria (administered by the Nigerian Agricultural Cooperative and Rural Development Bank and Commercial Banks) should pay more attention to granting credit to artisanal fisheries operators (including processors) under minimal conditions to encourage their access to credit and ensure that money loaned out are used for the purpose meant for.

iv. Fish processors should be formed into cooperatives to solve the problems of collateral when seeking loans from formal financial institutions. Cooperative operations certainly have overwhelming advantages over individual subsistence practices (educational enlightenment of members, enhancing their operational securities and offering assistances to members).

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