Effect of Standard Fish Processing Practices on Livelihood Status of Fish Processors in Delta and Edo States, Nigeria

Tunde R. Olaitan*[1], Micheal O. Oyelakin[2], Oluwasanjo B. Owojaiye[3], Victoria I. Adeoti[1], James T. Adeoti[1], and Sunday A. Aderele[1]

[1]Research Outreach Department, NSPRI Sapele Outstation, Sapele, Delta State
[2] Perishable Crop Department, NSPRI, Km 3, Asa Dam Road, P. M. B. 1489, Ilorin
[3] Research Outreach Department, NSPRI, Km 3, Asa Dam Road, P. M. B. 1489, Ilorin

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CORRESPONDING AUTHOR
Tunde R. Olaitan
Research Outreach Department, NSPRI, Sapele, Delta State, Nigeria
aztunde2004@gmail.com
+234-806-596-6192

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Abstract

Usage of improved fish processing methods appears to be relatively low compared to traditional methods. Hence, this research aimed to investigate the effect of the utilisation of Standard Fish Processing Practices (SFPP) on the livelihood status of fish processors in Delta and Edo States. Users and non-users of SFPP were sampled. Sampling of users involved a random selection of 70% from the trained 90 fish processors per state to give a sample size of 63 respondents per state and 126 users for the two states, while the snowballing technique was employed to select 63 non-users per state and 126 non-users for the two states to give a total sample size of 252 respondents for the research. Data used for this research were sourced using an interview schedule and analysed using descriptive statistics and a t-test. The results revealed that the majority (77.8%) of SFPP users had a high livelihood status, whereas a high percentage (63.5%) of non-users had a low livelihood status. Additionally, users of SFPP reported a better health status (19.95±3.29) compared to non-users, who had a poorer health status (52.50±8.15). Additionally, the majority (96.8%) of SFPP users were food secure, while 86.5% of non-users were food insecure. Vulnerability to poverty was low for 90.5% of SFPP users, whereas 80.0% of non-users showed high vulnerability to poverty. The study concluded that the usage of SFPP has significantly improved the livelihood status of fish processors in the study area. The study therefore recommends that agricultural extension agencies strengthen their efforts to disseminate SFPP to non-users.

Keywords:
Fish processors, Livelihood status, NSPRI, Processing, SFPP

Introduction

Due to its crucial role in maintaining aquatic ecosystems and ensuring global food security, fish production is considered a major agricultural sector in food production worldwide. It is regarded as a crucial agrarian technique that can effectively combat poverty by reducing nutritional deficiencies on a global scale (Kaleem, 2021). It is interesting to note that fish is a significant source of animal protein and plays a crucial role in household diets, livelihoods, and economic development in many nations and regions worldwide (FAO, 2020). According to a report from the Food and Agriculture Organisation (FAO, 2020), Nigeria's aquaculture sector has been the fastest-growing subsector within the agricultural industry, expanding at an average annual rate of 13.6% since 2000, and has made a significant contribution to the country's economic development.

Nigerians consume between 11.2 kg and 13.3 kg of fish annually, which accounts for approximately 40% of their protein intake (Adeleke, 2020; Subasinghe et al., 2021; Ajayi et al., 2022; Simus et al., 2022; Kingsley et al., 2022). However, protein consumption in Nigeria is lower than the average for countries in southern Africa. Crucially, compared to other animal protein sources, fish is less expensive (Babatunde,

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2021). Numerous processing technologies have been introduced due to the high perishability of fish and the need for careful handling to prevent spoilage (Nkeme & Frank, 2022).

According to more recent studies, traditional processing methods, including mud ovens, drum and pit ovens, sun-drying, salting, and smoke-drying, remain predominant in Nigerian fish preservation. Notably, smoke-drying continues to be the most frequently used method (Fasuan et al., 2021). Smoking not only facilitates moisture removal but also deposits phenolic compounds with antimicrobial effects, helping to prolong shelf life in tropical conditions (Oladeji et al., 2023). Recent regional assessments have shown, however, that while traditional smoke-drying reduces microbial loads, it often fails to meet safe moisture content thresholds, thereby enabling fungal spoilage during storage in open markets (Oladeji et al., 2023). Studies have identified xerophilic fungi, such as Aspergillus, Mucor, Fusarium, and Rhizopus, contaminating smoke-dried fish within a week of storage, posing significant food safety risks (Iriobe & Awoyale, 2021).

Furthermore, because they lack access to productive resources such as funding, advanced technology, extension services, training, and other necessary resources, fish processors are only able to handle a small number of fish each day, resulting in low income (Ike-Obasi & Ogubunka, 2019). Olaitan et al. (2024) reported that users of traditional processing methods experienced lower livelihoods and less stable incomes compared to users of improved fish processing practices. Additionally, the heat and smoke released by conventional dryers can lead to respiratory problems. Furthermore, the skin, eyes, and fingerprints of certain individuals are also affected (FAO, 2020). As a result, the fish's economic value declines, and the processors lose revenue that they could have earned in both domestic and international markets.

Hence, some modern fish processing technologies have been introduced due to the limitations of traditional methods. The Standard Fish Processing Practices (SFPP), which include the Improved NSPRI fish smoking kiln, are among the main post-harvest technologies developed and disseminated by the Nigerian Stored Products Research Institute (NSPRI) to reduce post-harvest losses in Nigeria (Adegbola et al., 2020). This technology is designed for efficient fish drying, comprising a combustion chamber, an oil collector, and a drying chamber equipped with drying trays. Charcoal, gas, and electricity are the three primary heat sources that can be used for a fish smoking kiln.

There are different capacities to choose from, 25 kg, 50 kg, etc. The use of NSPRI improved smoking kilns ensures the production of high-quality fish with internationally acceptable levels of polycyclic aromatic hydrocarbons; the oil collected during drying is beneficial in many ways, especially in the pharmaceutical industry (NSPRI, 2021).

Considering those mentioned earlier, it is expected that this study will reveal how Standard Fish Processing Practices (SFPP) impact the livelihoods of both SFPP users and non-users in the study area. Specifically, ascertain the livelihood status of SFPP users and non-users; assess respondents' perceived health status; assess the food security status of SFPP users and non-users; determine the vulnerability of users and non-users to poverty; and evaluate the intensity of SFPP usage among processors.

This study limited its scope to users of standard fish processing practices introduced by the Nigeria Stored Products Research Institute (NSPRI**)** and processors who use traditional/crude fish processing methods defined in this study as non-users of SFPP.

Hypothesis of the study

There is no significant difference in the livelihood status of users and non-users of SFPP.

Methodology

Study area

Delta State is a state that produces both agriculture and oil. With a population of 4,112,445, it is in the South-South geopolitical region of Nigeria. With an estimated land area of 762 square kilometres (294 square miles), the capital city of the state is Asaba, situated near its northernmost point. The state's total land area comprises 16,842 square kilometres. The state features a broad coastal belt interspersed with streams and rivulets, which encourage fish value chain activities, especially fish processing, a significant economic activity.

Edo State, with Benin City as its capital, is a state in Southern Nigeria. It's known for its cosmopolitan nature, with a large population of diverse ethnicities, including the Bini, Esan, Owan, and Etsako. The state's landmass is 19,187 square kilometres, and it's located between latitudes 5.44° and 7.34° North and longitudes 5.4° and 6.45° East.

The state has a diverse fish value chain activities blending traditional and modern fish processing technologies.

Population of the study

The study population consisted of all fish processors, including both users and non-users of Standard Fish Processing Practices in Delta and Edo States. The users of Standard Fish Processing Practices are the beneficiaries of training/capacity building of SFPP by NSPRI in Delta and Edo States in 2017, while non-users of SFPP are fish processors that make use of traditional/artisanal technologies; to show the effect of SFPP, non-users of SFPP were also considered to serve as a control, since there was no baseline data.

Sampling procedure and sample size

Users and non-users of SFPP were sampled for the study. The process for the Selection of users involved a random selection of 70% from the trained 90 fish processors per state to get a sample size of 63 respondents for each state and 126 users for the two states, while snowballing sampling technique was employed to select 63 non-users for each state to give a sample size of 126 non-users for the two states and a total sample of 252 respondents for the research. Primary data for this study were collected through the administration of an interview schedule.

To attain the objectives stated for the study, descriptive and inferential statistics were employed to analyse the data collected. The statistical tools used are frequency, percentage, mean, standard deviation, and the t-test.

The livelihood score, subsequently divided into low and high livelihood status, was calculated by adding the standardised scores of livelihood assets and activities. The livelihood assets score was calculated as the total of the scores for social, human, financial, physical, and natural capitals.

Social capital: Patronage, reciprocal relationships with family and friends, neighbourhood interaction, trust between business partners, and relationships among members of occupational groups were among the social capital items and benefits that were evaluated on a three-point scale of low, average, and high. The results were then combined based on the scores that were obtained.

Human capital: The level of human support that both users and non-users possess was assessed based on both internal and external human capital. Human capital items, such as the number of workers, their educational background, skill level, physical strength, experience level, and accessibility level, were later combined based on the scores they received and classified as either low or high human capital.

Financial capital: Items such as bank and cooperative savings, formal and informal remittances, and the ability to obtain loans from both formal and informal sources were used to gauge the amount of financial support that users and non-users possess. Following the compilation of their answers, the scores were subsequently divided into two categories: low financial capital and high financial capital.

Physical capital: A four-point scale, ranging from None to Good, was used to assess the level of physical support that both users and non-users have for various aspects, including building type, drinking water supply, toilet type, and home ownership.

Natural capital: The amount of natural capital that both users and non-users possess was assessed for various natural capital elements, including land ownership, water supplies, and rivers for fishing. The scores that were received were then combined into low and high categories.

A four-point rating system, ranging from "never" to "often," was used to gauge the level of household food security among SFPP users and non-users. There were fourteen negative questions. According to FANTA's Household Food Insecurity Access Scale (HFIAS) of the United States Agency for International Development (USDA, 2012), they are based on the anxiety that users and non-users have about food, changes in the amount of food that adults and children consume, and the anxiety that results from reducing food intake for adults and children. Those who scored between 14 and 35 were classified as having high food security, and those who scored between 36 and 56 were classified as having low food security.

The changes in labour availability, labour affordability, debt, commodity prices, patronage, household unity, household health, and the number of fish processed, as reported by Fischer (2010), were used to assess the degree of poverty vulnerability among SFPP users and non-users. The score ranged from a minimum of 8 to a maximum of 24. Based on their scores, respondents were further divided into two groups: those with scores of 8–16 were considered to have high vulnerability to poverty, while those with scores of 17–24 were considered to have low vulnerability to poverty.

The perceived health status of SFPP users and non-users was measured on a five-point Likert scale of Never, Rarely, Sometimes, Often, and Always for disease symptoms like eye itching, nasal discharge, joint pain, weakness, diarrhoea, sleepless night,

breathing problems, dizziness, appetite loss, weight loss, profuse sweating, head ache, joint discomfort, stomach upset and internal body heat. Respondents with a score of 14-35 were categorised as having a good perceived health status, while those with a score of 36-56 were classified as having a poor perceived health status.

Intensity of usage of standard fish processing practices

The respondents were provided with the list of standard fish processing practices. These are the selected good and healthy fish for processing, comprising seven items. The degutting of fish involves five items, smoking dry fish using the NSPRI fish smoking kiln with six items, and packaging with composite packaging material, totalling 21 practices. Usage was measured at an ordinal level on the scale, as respondents were asked to indicate their usage level based on a four-point Likert-type scale (Never, Rarely, Sometimes, Always), and were scored 1, 2, 3, and 4, respectively. However, the individual processor's score on usage was obtained and further classified into four levels of usage (very low, Low, high, and very high).

Procedure to determine the intensity of usage

- Maximum score = 84 (100%) (4-point scale x 21 items), which is the highest score of 4 points on the scale x 21 items.
- Minimum = 21 (25%), which is the lowest score of 1 point on the scale, multiplied by 21 items.
- The difference is 63 (84 minus 21).
- 63 divided by 4 (intended number of grouping) = 15.75 score interval

Decision: 21 –36 = very low, 37– 52 = Low, 53 – 68 = high, 69-84= very high

Results and Discussion

Demographic characteristics of the respondents

The age distribution (Table 1) indicates that the average age of SFPP users was 44.3 years, while non-users averaged 45.4 years. These figures are comparable with previous reports of older age profiles among fish processors, and they align with the characterisation of the 41–50 year bracket as a productive and economically active segment of the population (Oke & Kehinde, 2019). Recent assessments of fish-value-chain actors also show that processing remains concentrated among mid-to-older adults who rely on traditional preservation methods and are gradually adopting improved technologies (Agbabiaka & Okeke, 2024)

A large majority of both SFPP users (67.5%) and non-users (68.3%) were female, reinforcing the long-standing pattern that fish processing is predominantly a female occupation in the study area. This gender composition echoes findings from earlier studies (Adegbola et al., 2020; Alabi et al., 2020; Akinboye, 2024), which reported a preponderance of women among small-scale fish processors and adopters of improved smoking kilns in Nigeria. Contemporary evaluations continue to show female dominance in processing activities while also documenting targeted extension and technology-design efforts to suit women processors' needs (Odunayo et al., 2022)

Most respondents in both groups were married (89.0% of users and 95.2% of non-users). Marriage often increases household financial responsibilities and motivates individuals to engage in fish processing as a primary or supplementary income source for family upkeep, a pattern consistent with previous investigations of fishmongers and processors in Nigerian coastal and riverine communities, as reported by Agbabiaka & Okeke (2024).

The average household size was similar for both users (mean 6.2 for users and 6.1 for non-users). Household members can act as accessible labour and reduce processing costs, potentially increasing output and market activity; conversely, larger households may strain family budgets and limit the capital available for expanding processing operations. This average household size aligns with previous studies, such as Adegbite & Oluwalana (2021), which reported an average of roughly six persons per household among fish processors.

Aggregate livelihood status

The result of the aggregate livelihood status, as shown in Table 2, indicates that the majority (77.8%) of SFPP users, with a mean of 186.5±15.26, have a high livelihood status. In contrast, the majority (63.5%) of non-users, with a mean of 143.3±12.28, have a low livelihood status. The result implies that the use of SFPP has been positively related to the livelihood status of the respondents compared with non-users of SFPP. This is in line with Bakari et al. (2023), who stated that the use of improved fish processing and preservation activities contributes largely to the improvement of living standards.

Level of perceived health status

According to the means on perceived health status in Table 4, the majority of users of SFPP show a high health status (19.95±3.29) compared with non-users,

who have a low health status (52.50±8.15). This provides further evidence that traditional processing methods pose serious health risks not only to consumers of the products but also to users of the technology. This concurs with Emel (2020), who reported on the health hazards and challenges of traditional fish processing methods.

Table 1: Demographic Characteristics of the respondents

	Edo (n=63) Users (f(%))	(n=63) Non-users (f(%))	Delta (n=63) Users (f(%))	(n=63) Non-users (f(%))	Pooled (n=126) Users (f(%))	(n=126) Non-users (f(%))
Age						
≤ 30	2 (3.2)	3 (4.8)	2 (3.2)	1(1.6)	4(3.2)	4 (3.3)
31-40	24 (38.1)	13 (20.6)	5 (8.0)	14 (22.2)	33 (26.2)	27(21.4)
41-50	27 (42.9)	29 (46.0)	32 (50.8)	33 (52.4)	59 (46.8)	62(20.6)
≥51	10 (15.8)	18 (28.6)	24 (38.0)	15(23.8)	30 (23.8)	33 (32.8)
Mean (SD)	45.4±7.34	44.3±7.67	44.2±8.02	46.3±6.54	44.3±8.25	45.4±6.96
Gender						
Male	25(15.7)	35(55.6)	16(25.4)	5 (7.9)	41 (32.5)	40 (31.7)
Female	38(60.3)	28 (44.4)	47(74.6)	58 (92.1)	85 (67.5)	86 (68.3)
Marital Status						
Single	2(3.2)	4 (6.7)	2 (3.2)	0	4(3.3)	4 (3.2)
Married	56(88.9)	58 (92.1)	59 (93.6)	62(98.4)	115 (89.0)	120 (95.2)
Divorced	2 (3.2)	0	0	0	2(1.9)	0(0.0)
Widowed	3 (4.7)	1 (1.2)	2 (3.2)	1(1.6)	5 (5.7)	2 (1.6)
Household size						
≤ 5	47(74.6)	10(15.9)	11(17.4)	3(4.7)	58(46.1)	13(10.3)
6-10	10(15.9)	49(77.8)	50(79.4)	58(92.1)	60(47.6)	107(85.0)
≥ 11	6(9.5)	4(6.3)	2 (3.2)	2(3.2)	8(6.3)	6(4.7)
Mean (SD)	5.5±1.57	6.8±1.55	6.9±1.53	6.5±1.65	6.2±1.61	6.1±1.64

Source: Field Survey, 2025.

Table 2: Summary of respondents' aggregate livelihood status

Obtained score	Level	Users		Non-Users	
		Frequency	Percentage	Frequency	Percentage
65 – 175	Low	28	22.2	80	63.5
176 – 286	High	98	77.8	46	36.5
Total		126	100.0	126	100.0
Mean±SD		186.5±15.26		143.3±12.28	

Source: Field Survey, 2025.

Table 3: Distribution of respondents according to perceived health status

	Health challenges	Users		Non-Users	
		Mean	SD	Mean	SD
1	Weakness	2.21	0.51	3.68	0.31
2	Eye itching	1.46	0.42	4.13	0.38
3	Nasal discharge	1.90	0.79	2.45	0.24
4	Diarrhoea	1.76	0.46	2.01	0.29
5	Sleepless night	1.86	0.49	3.35	0.39
6	Breathing difficulty	1.58	0.72	1.48	0.46
7	Dizziness	1.60	0.82	2.97	0.77
8	Loss of appetite	1.89	0.52	2.19	0.44
9	Loss of weight	1.83	0.67	2.29	0.51
10	Profuse sweating	1.84	0.57	2.05	1.89
11	Head ache	2.12	0.51	3.38	0.59
12	Joint pain	2.16	0.64	3.50	0.92
13	Stomach upset	1.80	0.74	3.01	1.78
14	Internal body heat	1.72	0.57	2.67	0.51

Source: Field survey, 2025

Food security status

The results in Table 6 show the food security status of the respondents, According to the mean analysis, the majority of SFPP users have high food security (24.09±7.35), while the majority of non-users of SFPP have low food security with a mean of 49.92±6.32. The finding also aligns with that of Rahman et al. (2020), who reported that modern fish processing technology will increase the food security status of processors.

Table 4: Distribution of respondents by level of perceived health status

Obtained score	Status	Users		Non-Users	
		Frequency	Percentage	Frequency	Percentage
14 – 35	Low	07	5.2	104	82.5
36 – 56	High	119	94.8	22	17.5
Total		126	100.0	126	100.0
Mean±SD		19.95±3.29		52.50±8.15	

Source: Field Survey, 2025.

Table 5: Distribution of respondents according to food security

	Food insecurity situation	Users		Non-Users	
		Mean	SD	Mean	SD
1	Food does not last	2.06	0.62	3.85	0.56
2	I cannot afford to eat balanced meals	1.80	0.63	3.76	0.59
3	I worry whether food will run out before it can be replaced	1.87	0.53	3.69	0.69
4	I cannot afford to feed the children a balanced meal	1.72	0.61	3.65	0.78
5	I rely on only a few kinds of low-cost food to feed the children	1.75	0.64	3.64	0.79
6	I cut the size of our meals because we do not have enough food	1.81	0.63	2.50	0.56
7	I skip meals because we do not have enough to eat	1.69	0.57	2.44	0.39
8	I lose weight because we do not have enough food to eat	1.77	0.62	2.43	0.60
9	The children skip meals because we do not have enough food	1.64	0.43	2.34	0.32
10	I cut the size of the children's meals because we do not have enough food	1.77	0.75	2.33	0.32
11	There would be no food of any kind to eat	1.69	0.57	2.17	0.46
12	I may not eat for a whole day because we do not have enough food	1.66	0.56	2.17	0.54
13	I get very hungry, but I would not eat because we do not have enough food	1.64	0.43	2.14	0.40
14	Children would not eat for a whole day because we do not have food	1.60	0.40	2.07	0.31

Source: Field survey, 2025

Table 6: Distribution of respondents by food security status

Obtained score	Security	Users		Non-Users	
		Frequency	Percentage	Frequency	Percentage
14 – 35	High	122	96.8	17	13.5
36 – 56	Low	4	3.2	109	86.5
Total		126	100.0	126	100.0
Mean±SD		24.09±7.35		49.92±6.32	

Source: Field Survey, 2025.

Vulnerability to poverty status

Results in Table 8 revealed that users of SFPP, with 90.5% of respondents and a mean of 16.35±6.21, are less vulnerable to poverty, whereas 80% of non-users, with a mean of 6.92±3.65, are more vulnerable to poverty. The result confirmed that using improved technology can raise respondents' standards of living and lessen their vulnerability to poverty. This result corroborates that of Bakari et al. (2023), who reported that rewarding fish processing value chain activities with improved fish processing technology and equipment yields positive outcomes.

Table 7: Distribution of respondents according to vulnerability to poverty

	No	Yes			Mean	SD
		Negative	Unchanged	Positive		
Users						
Patronage	10(7.9)	4(3.2)	2(1.6)	110(87.3)	2.34	0.42
Quantity of fish processed	14(11.1)	2(1.6)	2(1.6)	108(85.7)	2.33	0.43
Household health	25(19.8)	4(3.2)	10(8.0)	87(69.0)	2.07	1.65
Household unity	20(15.8)	2(1.6)	7(5.6)	97(77.0)	1.05	0.42
Labour affordability	9(7.1)	4(3.2)	8(6.4)	105(83.3)	1.84	0.69
Commodity prices	22(17.4)	2(1.6)	4(3.2)	98(77.8)	0.53	0.47
Labour availability	5(4.0)	4(3.2)	1(0.8)	116(92.0)	0.40	0.59
Indebtedness	9(7.1)	3(2.4)	1(0.8)	113(89.7)	0.80	0.42
Non-Users						
Patronage	10(7.9)	60(47.6)	12(9.5)	44(35.0)	1.70	0.49
Quantity of fish processed	6(4.8)	84(66.7)	13(10.3)	23(18.2)	1.62	0.46
Commodity prices	6(4.8)	86(68.2)	1(0.8)	33(26.2)	1.41	0.44
Household unity	61(48.4)	1(0.8)	21(16.7)	43(34.1)	1.37	0.67
Labour availability	26(20.6)	54(42.9)	5(4.0)	41(32.5)	1.23	0.52
Household health	70(55.6)	4(3.2)	18(14.3)	34(26.9)	1.53	0.65
Labour affordability	82(65.1)	3(2.4)	4(3.2)	37(29.3)	0.62	0.65
Indebtedness	90(71.4)	18(14.3)	7(5.6)	11(8.7)	0.32	0.54

Source: Field survey, 2025

Intensity of usage of standard fish processing practices

The results in Tables 9 and 10, showing the intensity of SFPP usage, indicated a very high level, with 91.4% of respondents scoring 69-84. The Intensity of usage of the improved fish processing technology is expected to improve the quality of processed fish leading to enhanced sales and livelihoods to the users, the results is in line with Onogwu et al., (2019) research work on "Economic Viability of Fish Smoking and Marketing: Evidence from Ibi, Taraba State, Nigeria," which reported that, a properly smoked fish merchants make a net return of 3.06 times for every N1.00 invested in the process.

Difference in the livelihood outcome of users and non-users of SFPP

Analysis of livelihood indicators (Table 11) reveals a statistically significant advantage for SFPP users over non-users ($p = 0.000$), with a mean difference of 6.6 units on the livelihood scale. This demonstrates that adoption of SFPP is associated with improved livelihoods among processors in the study area, thereby rejecting the null hypothesis of no difference. These findings are consistent with prior impact evaluations of improved processing technologies. For example, studies of the Modified Drum-Oven Technology and other improved kilns by Hassan et al. (2020) have reported notable gains in income and living standards among adopters.

Table 8: Respondents' vulnerability to poverty status

Obtained score	Vulnerability status	Users		Non-users	
		Frequency	Percentage	Frequency	Percentage
8 – 16	High	12	9.5	101	80.0
17 – 24	Low	114	90.5	25	20.0
Total		126	100.0	126	100.0
Mean±SD		16.35±6.21		6.92±3.65	

Source: Field Survey, 2025

Table 9: Intensity of usage of standard fish processing practices

SFPP practices	Edo mean	Delta mean	Pooled Mean
Selection of healthy fish	3.819	4.000	3.910
The body of the fish should be shining and bright	3.676	3.267	3.471
The belly of the fish should be firm	3.390	3.190	3.390
The eyes of the fish should be clear and bulging	3.390	3.343	3.367
The fish should smell seaweed	3.333	3.114	3.224

The gills of the fish should be pinkish in appearance	3.298	3.495	3.397
Processing of fish in a clean environment	3.933	3.962	3.948
Remove the guts and fins	3.829	4.000	3.914
Washing with clean water to remove slime and blood	3.886	4.000	3.943
Put/cut into the desired shape	3.638	4.000	3.819
Soak in 1% salt solution for 30 minutes	3.486	3.629	3.557
Drain in a sieve	3.743	4.000	3.871
Preheat the smoking kiln before loading	3.733	4.000	3.867
Lubricate the trays to avoid sticking	3.829	4.000	3.914
Monitor the smoking process to ensure even drying	3.971	4.000	3.986
Alternate the trays to promote uniform drying	4.010	3.962	3.986
Recharge the heat source (charcoal or gas) to ensure a steady heat supply during the dying process	4.019	4.000	4.010
Remove the products from the kiln once drying is considered complete and allow them to cool to room temperature.	3.838	4.000	3.919
The packaging material should offer protection against water and other environmental factors	3.905	4.000	3.952
The packaging material should have a see-through opening for viewing the products	3.829	3.771	3.800
Labelling of the product is provided	3.848	3.962	3.905

Table 10: Level of intensity of standard fish processing usage

Obtained score	Level	Frequency	Percentage	Mean (SD)
21 – 36	Very low	0	0.0	
37 – 52	Low	0	0.0	
53 – 68	High	18	8.6	
69 – 84	Very high	192	91.4	79.0(5.71)
Total		210	100.0	

Minimum-maximum possible score: 21 – 84

Table 11: Result of t-test analysis showing the difference in the livelihood status of users and non-users of SFPP

Levene's Test for Equality of Variances		t-test for Equality of Means						
							95% Confidence Interval of the Difference	
F-stat.	Sig.	T-stat.	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
2.47	0.01	4.67	251.01	.000*	6.6	0.7	5.23	7.98

Equal variance assumed
*Differs significantly at the 0.01 level

Conclusion and Recommendation

The study concluded that the usage of SFPP has significantly improved the livelihood status of fish processors in Delta and Edo States, Nigeria. Additionally, users of SFPP are more food secure, have a high perceived health status, and are less vulnerable to poverty. It is recommended that agricultural extension agencies should strengthen efforts to disseminate SFPP to non-users.

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