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Assessment of NSPRI Technological Innovations' Adoption Among Users in Nigeria

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ABSTRACT

The dearth of users' feedback is the bane of innovation, improvement and popularization of NSPRI designed and developed postharvest technologies. Hence, this study sought to boost the improvement of NSPRI Technological innovations such as NSPRI Fish-Smoking-Kiln (NSK), Parabolic-Shaped Solar Dryer (PSSD), Iced Fish Box® (IFB), Hermetic Steel Drum (HSD) and Stackable-Ventilated Plastic Crate (SVPC) through feedback from the users. The study employed interview schedule to obtain primary data from 1049 beneficiaries of NSPRI disseminated technologies purposively selected from thirteen (13) out of the twenty-four (24) States where the technologies were distributed and promoted. Descriptive statistics (frequency count, percentages, and mean) and inferential statistics were used for data analysis. Results revealed that HSD has the highest (27.7%) number of users, while 3.27%, 21.26%, 24.12% and 23.64 of the respondents used SVPC, IFB®, PSSD, and NSK respectively. About 41.2% and 26% of users of the SVPC and IFB® reported that the quality of commodities during transit was maintained for an average of 13 and 24 hours, respectively. The utilization of all the technologies improved users' income and increased their capacity to meet market demand. The majority of the users (VPC: 100%, IFB®:92.7%, NSK: 51.3%, PSSD: 74.9%, HSD: 86.9%) are willing to pay for the technology, albeit at varying amounts. Despite the relative advantages of the postharvest technologies as indicated by beneficiaries, several areas for improvement were highlighted for all the technologies except the IFB®. The NSK and IFB® had adoption rates of 56.45% and 50.22%, respectively while the PSSD, and HSD and SVPC had less than 50% adoption.

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1. Introduction

Postharvest losses of agricultural commodities continue to pose a significant challenge to food security, economic sustainability, and rural livelihoods. Abbas *et al.* (2018); Enyiukwu *et al.* (2020); Khidir, *et al.* (2024) opined that postharvest loss in Nigeria is about 20-40% and it accounts for roughly nine billion dollars annually. This apparently is one of the obstacles to sustainable agricultural development, particularly in light of the nation's rapidly increasing human population (Sawicka, 2020). Over the years, the Nigerian Stored Products Research Institute (NSPRI), as a leading provider of agricultural postharvest solutions in Nigeria, has developed and disseminated technologies that have made significant

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contributions to reducing food losses in the postharvest sub-sector. In recent years, technological innovations have become pivotal in enhancing agricultural productivity and sustainability across the globe (Ajayi and Oyinbo, 2018). In Nigeria, the adoption of these innovations by stakeholders in the agricultural sector, particularly by users of technologies developed by the Nigerian Stored Products Research Institute (NSPRI), presents a crucial area of study. NSPRI, as a leading research institution in Nigeria, continually develops and disseminates technologies aimed at improving post-harvest handling, processing, and storage of agricultural commodities (NSPRI, 2023). The adoption of technological innovations by users within the Nigerian agricultural landscape is influenced by a myriad of factors ranging from socio-economic conditions to institutional support and technological characteristics (Afolami, 2018). Understanding the adoption patterns and challenges faced by users of NSPRI technologies is essential for assessing the effectiveness of these innovations in enhancing agricultural practices and promoting food security.

Hence, to ensure the efficiency, effectiveness, and relevance of these technologies, feedback was gathered from end users for improvement of existing technologies and future innovations development. In view of this, this study established the level of utilization of promoted NSPRI technologies; identified the gaps in use of the promoted technologies; assessed the promoted technologies' adoption rate and reported stakeholders' recommendations for improving the promoted technologies. The findings provide information on how these technologies have improved the livelihood security through reduction of postharvest losses and income generation to the beneficiaries. It will also help the Institute to leverage on the strong points of these technologies, improve on their deficiencies, as well as increase its adoption rate for sustainable development. The specific objectives of this study are to: examine the operational impact of the technological innovation on the users; assess the economic impact of NSPRI Technologies on the users; and evaluate the adoption rate of the technologies among the users.

2. Literature review

Research and extension are well organized systems that design and disseminate technological innovations to end-users using different communication channels (Worley and Fuhrman, 2022). Feedback is a critical part of effective communication. It is viewed as the end-user's reaction to technological innovation by the communicator (Dong, 2020). Hence, feedback is required to complete the communication cycle of technology dissemination. Oyetoro and Akinbode (2010); Kukhareva et al. (2022) describe feedback as the process of relating information from end-users back to research/laboratory/workshop after having adopted an innovation earlier disseminated. Information gathered through feedback is reported to Research and Development for the improvement of existing technologies or the development of new ones (Marion and Fixson, 2021). These improvements made to agricultural technologies based on feedback have led to a significant enhancement in user satisfaction (Kimano *et al.,* 2010). The information shared by stakeholders about their experiences with the utilization of these technologies would provide insight into the overall performance of the technologies disseminated.

3. Research Methodology

This study adopted questionnaire/interview guide as instrument to collect data from relevant stakeholders in Thirteen (13) out of the twenty-four (24) States that NSPRI technologies were

distributed and promoted. The selected States are: Abia, Akwa Ibom, Borno, Ebonyi, Edo, Ekiti, Kogi, Kwara, Lagos, Nasarawa, Niger, Ogun and Osun. This cut across almost all the six geopolitical zones of the country. Interview guide which includes both open ended and close ended questions was employed to collect data from a total of 1049 respondents. Descriptive statistics (frequency count, percentages, and mean) as well as inferential statistics were used to analyze the collected data. The Agricultural Development Projects (ADPs) of each State provided the list of the beneficiaries and also led the enumerators to the beneficiaries. A total of 1,049 respondents were sampled and interviewed in-line with technology benefited based on the information available from the beneficiary list of NSPRI/ADPs empowerment and popularization program.

4. Result and Discussions

The use of NSPRI technologies across the nation were critically examined, analysed and presented in Table 1 to Table 4 and Figure 1.

Distribution of NSPRI Technology Users

The distribution of users of NSPRI Technologies interviewed across the country is presented in Table 1 below.

Table 1. Distribution of Technology by number of Respondents interviewed

Technology	Technology Classification	Frequency	Percentage
Plastic Crate	Transportation	34	3.24
Iced Fish Box	Transportation	223	21.26
Parabolic-Shaped Solar Dryer	Processing	253	24.12
Fish Smoking Kiln	Processing	248	23.64
Hermetic Drum	Storage	291	27.74
Total		**1049**	**100.0**

Source: Field Survey, 2025

Table 1 shows the distribution of the disseminated NSPRI technologies to the beneficiaries across the thirteen States of study. However, for transportation technologies, iced fish box (21.26%) was more than plastic crates (3.23%). Also, parabolic-shaped solar dryer (24.12%) had more users interviewed than its fish smoking kiln (23.64) counterpart used for processing, while hermetic drums, being the only storage technology in this study had the highest respondents in all with 27.74%.

Socio-Economics Characteristics

The Table 2 presents the Socio-economic characteristics of this respondent used in this study. It is shown from that 74.7% of the respondents were female while 25.3% were male. Majority (34.3%) of the users' age range from 41yeras to 50years. It is also observed that their households majorly range from 6 to 10 members (51.8%) and closely followed by 5 and below with 43.3% per household.

Table 2. Percentage distribution by Socio-Economics Characteristics of the technology's users

Variable	Parameters	Transportation Technologies		Processing Technologies		Storage Technology (Hermetic Drum)	Pooled
		Plastic Crates	Iced Fish Box	Parabolic Shaped Solar Dryer	Fish Smoking Kiln		
Gender	Male	35.3	22.4	34.4	16.1	26.1	25.3
	Female	64.7	77.6	65.6	83.9	73.9	74.7
Age	20 years Below	0	0.5	0.8	0.8	0	0.5
	21-30years	20.6	7.7	8.0	9.3	5.2	8.2
	31-40years	41.2	27.7	21.9	25.8	20.4	24.4
	41-50years	17.6	36.8	31.5	37.9	34.6	34.3
	51-60years	20.6	21.8	27.9	18.1	31.5	24.9
	61years and above	0	5.5	10.0	8.1	8.3	7.7
Total Household Size	5 and below	61.8	43.7	50.0	39.5	38.4	43.3
	6-10	38.2	52.3	46.4	52.8	56.7	51.8
	11-15	0	2.7	3.2	7.7	3.8	4.3
	16-20	0	0.9	0.4	0	1.0	0.6
	21 and above	0	0.5	0	0	0	0.1
Marital Status	Single	14.7	6.3	9.1	4.4	2.4	5.7
	Married	79.4	78.9	80.6	87.9	85.9	83.4
	Widowed	5.9	11.2	8.7	7.3	9.6	8.9
	Divorced	0	1.3	0.4	0	1.7	0.9
	Separated	0	2.2	1.2	0.4	0.3	1.1
Years of Experience	10 years and below	61.8	62.8	38.5	63.3	48.5	53.0
	11-20years	17.6	26.9	30.6	23.4	32.0	28.1
	21-30years	2.9	6.3	20.2	9.7	11.3	11.7
	31-40years	11.8	3.1	7.9	3.2	6.2	5.4
	41-50years	5.9	0.9	2.4	0.4	2.1	1.6
	Above 50years	0	0	0.4	0	0	0.1
Level of Education	No formal education	0	14.3	14.6	12.1	10.3	12.3
	Primary	11.8	15.7	18.2	14.1	17.9	16.4
	Secondary	26.5	22.9	24.5	29.0	30.6	27.0
	Vocational	8.8	5.8	6.7	3.6	4.8	5.3
	OND/NCE	23.5	17.0	18.2	15.7	15.5	16.8
	HND/BSC	17.6	20.6	13.4	22.6	17.9	18.5
	MSC	11.8	3.1	3.6	2.0	3.1	3.2
	PhD	0	0.4	0.8	0.8	0	0.5
Membership of Association	No	20.6	16.1	15.0	6.0	7.9	11.3
	Yes (1 society)	79.4	83.9	85.0	94.0	92.1	88.7

Source: Field Survey, 2025

Furthermore, 83.4% of the respondents were married; majority had formal education with secondary education level being the highest (27%). Most of the actors (88.7%) belong to at least one association. 53% of these respondents have experience in their various fields for at least ten years.

Impact Assessment

The results of the impact of NSPRI technologies on the users across the country are presented in Table 3.

It is shown from the Table 3 that 96.2 %, 50%, 99.5%, 94%, and 91.9% of the users of Hermetic Drum, Plastic Crates, Iced Fish Box, Parabolic-Shaped Solar Dryer and Fish Smoking Kiln technologies respectively have been using it for 3 months and below. Mainly, the users of Hermetic Drum (98.2%), Plastic Crates (50%), Iced Fish Box (91.9%), Parabolic-Shaped Solar

Dryer (92.1%) and Fish Smoking Kiln (94.8%) received the technologies as a gift from Government through NSPRI. However, 45.8% (Hermetic Drum), 73.5% (Plastic Crates), 64.4% (Parabolic-Shaped Solar Dryer), 47.6% (Fish Smoking Kiln) of the users all used the technology for both personal and group purposes, while the majority (48%) of Iced Fish Box users used it for personal purposes. Meanwhile, the level of utilization is majorly 61.0% (Hermetic Drum), 55.9% (Plastic Crates), 63.2% (Iced Fish Box), 71.9% (Parabolic-Shaped Solar Dryer), and

78.2% (Fish Smoking Kiln) for both subsistence and commercial purposes.

It is also revealed that 74.6% (Hermetic Drum), 76.5% (Plastic Crates), 69.1% (Iced Fish Box), 66.8% (Parabolic-Shaped Solar Dryer) and 68.5% (Fish Smoking Kiln) of the users have had contact to extension agent with at least 5 visits except for the users of Fish Smoking Kiln who had 68.5% visit (between 6 and 10) of extension agents.

Further, as shown in the Table 3, all the users of these technologies observed positive improvements in their income. The Table shows average weekly income increment of ₦24,800.00, ₦12,096.25, ₦15,636.10, ₦17,803.58, ₦14,868.48 from ₦23,033.33, ₦19,623.47, ₦20,197.51, ₦20,555.16, ₦20,954.35 to ₦47,833.33, ₦31,719.72, ₦35,833.61, ₦38,358.74, ₦35,822.83 for stackable ventilated plastic crate, iced-fish box, Parabolic-shaped Solar Dryer, NSPRI Fish Smoking Kiln and Hermetic drum respectively.

Table 3. Percentage distribution by Impact of the technology on the livelihood of beneficiaries

Variable	Parameters	Transportation Technologies		Processing Technologies		Storage Technology
		Plastic Crates	Iced Fish Box	Parabolic-Shaped Solar Dryer	Fish Smoking Kiln	Hermetic Drum
How long have you been using this technology	3 months and below	50.0	99.5	94.0	91.9	96.2
	4-6months	44.1	0.5	6.0	6.9	2.1
	7-9months	5.9	0	0	1.2	1.7
Mode of acquisition	given by government	50.0	91.9	92.1	94.8	98.2
	Purchased	44.1	0.4	2.8	1.2	1.4
	hired/leased	5.9	7.6	5.1	4.0	0.3
Mode of utilization	Personal	20.6	48.0	7.9	14.1	32.6
	Group	5.9	20.2	27.7	38.3	21.6

Variable	Parameters	Transportation Technologies		Processing Technologies		Storage Technology
		Plastic Crates	Iced Fish Box	Parabolic-Shaped Solar Dryer	Fish Smoking Kiln	Hermetic Drum
	Both	73.5	31.8	64.4	47.6	45.8
Level of technology utilization	Subsistence	20.6	7.2	9.9	4.0	22.4
	Commercial	23.5	29.6	18.2	17.7	16.6
	Both	55.9	63.2	71.9	78.2	61.0
Contact with extension agent	No	23.5	30.9	33.2	31.5	25.4
	Yes	76.5	69.1	66.8	68.5	74.6
Number of extension visit	5 and below	92.3	85.1	89.3	31.5	89.9
	6-10	7.7	14.9	10.7	68.5	10.1
has utilization of this technology improved your income	No	11.8	4.5	4.7	82.4	36.8
	Yes	88.2	95.5	95.3	17.6	63.2
weekly income before utilization of technology	₦10,000 and below	23.3	60.6	51.9	49.3	52.2
	₦10,001-₦20,000	50.0	21.6	23.2	29.6	20.1
	₦20,001-₦30,000	13.3	3.8	9.5	5.4	9.2
	₦30,001-₦40,000	6.7	.9	3.7	1.8	4.3
	₦40,001-₦50,000	0	3.3	4.1	5.4	3.3
	₦50,001 and above	6.7	9.9	7.5	8.5	10.9
	Mean	*₦23,033.33*	*₦19,623.47*	*₦20,197.51*	*₦20,555.16*	*₦20,954.35*
weekly income during use of technology	₦10,000 and below	0	31.9	25.7	24.7	28.3
	₦10,001-₦20,000	16.7	36.2	29.9	35.0	21.7
	₦20,001-₦30,000	30.0	11.7	15.4	15.2	14.7
	₦30,001-₦40,000	10.0	3.8	5.4	2.2	8.2
	₦40,001-₦50,000	16.7	2.3	7.5	5.8	8.2
	₦50,001 and above	26.7	14.1	16.2	17.0	19.0
	Mean	*₦47,833.33*	*₦31,719.72*	*₦35,833.61*	*₦38,358.74*	*₦35,822.83*
	Income difference	₦24,800.00	₦12,096.25	₦15,636.10	₦17,803.58	₦14,868.48

Source: Field Survey, 2025

Adoption rate

The adoption rates of the various technologies of focus were analyzed and presented in Table 4 and Figure 1.

Table 4. Adoption rate of NSPRI Technologies

Parameter	Plastic Crates	Iced Fish Box	Fish Smoking Kiln	Parabolic-Shaped Solar Dryer	Hermetic drum
No of user when first given	34	341	358	3002	3011
No of user at present	34	685	822	4933	4463

Source: Field Survey, 2025

Table 4 shows the number of users of each technology at the initial time they were disseminated and the number of users as at the time the feedback data was collected. The Table shows there is increase in the number of users for all the technologies disseminated except for plastic crates, which were giving to individuals only and opportunity to access more was not available before the time of data collection.

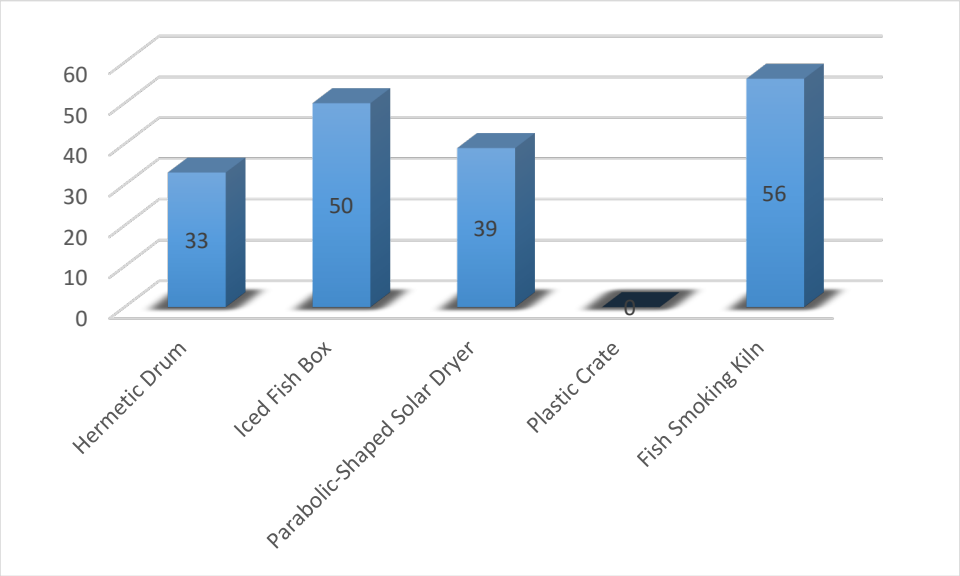

Figure 1: Adoption rate of NSPRI technologies

Furthermore, the adoption rate which helps to estimate the speed at which a new technology / innovation is acquired and used by targeted audience was critically estimated and presented in Figure 1. The chart shows that fish smoking kiln had the highest adoption rate with 56.45%, followed by iced fish box with 50.22%. Parabolic-shaped solar dryer and hermetic drum also have commendable adoption rate with 39.14% and 32.53% respectively.

5. Conclusions

Feedback from end users of postharvest technologies is crucial for sustainable and effective management of postharvest loss as it provides an insight into understanding the needs and preferences of users required for further improvement and sustained relevance of disseminated technologies. This study provided an insight into the level of utilization and areas for improvement of NSPRI disseminated storage, processing and transportation technologies. The users of these technologies are widely spread in both rural and urban areas, operating at both subsistence and commercial levels. The utilization of the technologies improved beneficiaries' income, and the majority of the stakeholders were willing to pay for the technologies and also recommend them to their counterparts. The disseminated technologies were efficiently utilized with a commendable rate of adoption.

Recommendations

The following recommendations were made based on the findings of this study. The study recommended that the identified areas of improving the disseminated postharvest technologies should be considered in subsequent design and development existing or new technologies. Since majority the users showed willingness to pay for these technologies' effort should be made in making it available at affordable prices. Subsequent distribution of technologies should be carefully supervised by NSPRI staff in collaboration with the ADP. Needs assessment of targeted beneficiaries prior to technology distribution should be conducted ensure utilization of distributed technologies. Beneficiaries should be trained on the correct use and maintenance of the technologies. The need for a proper record of beneficiaries' data for easy access in subsequent feedback surveys.

Policy Implications

1. Investment in Technology Design, development and Dissemination: If the study finds positive feedback indicating that disseminated post-harvest technologies are effective in improving crop yields, reducing losses, or enhancing food quality, policymakers may consider increasing investment in the dissemination of these technologies. This could include funding for training programs, infrastructure development, and extension services to reach more farmers.
2. The need to design and implement support programs to overcome the challenge of se barriers and encourage adoption among farmers.
3. Prioritizing investments in Capacity Building for Extension Service providers in disseminating post-harvest technologies. This could involve training programs to enhance their technical knowledge, communication skills, and outreach strategies.
4. Continuous and consistent feedback from end users of technologies through Monitoring and Evaluation to maximize the impact of technology dissemination efforts and support sustainable postharvest loss management.

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