Effectiveness of Perceived Usefulness of Solar-Powered Cold Storage Systems for Agricultural Produce Preservation in Remote Areas of Southwest Nigeria

Onaolapo A. A.[1],Abdul-Hameed T. A.[2], *Aliu Z. A.[3], Tijani O. M.[4] & Tijani S. A.[5]
[1]Department of Agricultural Technology, Federal Polytechnic Ayede, Oyo State
[2,4]Department of Electrical/Electronics Engineering, Federal Polytechnic Ayede, Oyo State
[3]Department of Office Technology and Management, Federal Polytechnic Ayede, Oyo State
[5]Department of Business Administration and Management, Federal Polytechnic Ayede, Oyo State

Corresponding Author: aliza@federalpolyayede.edu.ng

Abstract

This research assesses the performance of solar-powered cold storage systems (SPCSS) for agricultural produce preservation among smallholder farmers and traders in the remote region of Southwest Nigeria, highlighting perceived usefulness in influencing adoption and effectiveness. Using mixed-methods research, the study combined survey research among 400 smallholder farmers and traders with 20 key informant interviews involving operators, cooperative leaders, and agricultural extension officers. Awareness, adoption, perceived usefulness, and challenges were respectively captured with structured survey questionnaire on the Likert scale using the 4-point rating scale. Semi-structured interviews investigated contextual understandings. Quantitative data were examined using descriptive statistics, regression analysis, and ANOVA on SPSS v.26 and thematic content analysis on qualitative data. Results indicate that SPCSS are perceived extensively to be useful in minimizing spoilage, extending shelf life, and maximizing the income received by farmers. Regression analysis validated the finding that these perceived usefulness indicators strongly predict adoption and effectiveness ($R^2 = 0.48$, $p < 0.001$), and further confirmed affordability and maintenance challenges to negatively affect effectiveness. ANOVA results on perception also highlighted significant perception variations among the various stakeholder groupings wherein operators and leaders of cooperatives are more upbeat compared to farmers and traders. Results concur with more recent research undertaken on the continent and on the Asian continent on the potential of SPCSS to emphasize more the financial and institutional hurdles to sustained utilizations. Recommendations include innovative models to finance SPCSS and capacity building initiatives to cover inclusive governance structure and integration with agricultural and renewable energy policies to enhance increased adoption and long-term sustainability.

Keywords: *solar-powered cold storage, perceived usefulness, post-harvest loss, technology adoption, agricultural preservation, Southwest Nigeria*

1. Introduction

Agriculture is still the pillar upon which the economy of Nigeria is balanced, employing almost 70% of the rural labor and greatly supporting food sufficiency, poverty eradication, and household livelihoods. While the sector is at the center stage, it is challenged much more by post-harvest losses. Research has quantified the sector to be losing between 30–50% worth of its perishable agricultural produce yearly due to improper preservation, limited and substandard infrastructure to handle these storages, and inefficient cold chaining mechanisms (FAO, 2022; Yusuf & Adepoju, 2023). Such wastages do not only deplete farmers' income but also escalate food insecurity further, constrain the accessibility to fresh produce at friendly prices and compromise the efforts to attain Sustainable Development Goals (SDGs) on hunger eradication, poverty eradication and sustainable consumption and production. Most critically is the state prevailing within Southwest Nigeria where the region is famous for its highly blossoming horticulture, fisheries and livestock industry but greatly restricted due to unpredictable power supplies and inefficient infrastructure within the rurality (Akinbile *et al.*, 2021).

Cold storage has been worldwide accepted as an innovative technique to minimize post-harvest losses and enhance the shelf life of fresh produce. However, in Nigeria, traditional cold storages exist only within urban areas and are either operated using unreliable grid electricity to produce electricity or costlier fossil fuels. For the rural and remote areas where the majority of smallholder farmers are concentrationally dwelling, the facilities remain out of reach due to capital-intensive and operational costs (Odeyemi & Olatunji, 2022). Lack of accessible and reliable cold chain infrastructure compels farmers to dispose of produce shortly after harvesting at unfavorable farm-gate prices or spoil it. Such acts sustain poverty cycles, wastages, and inefficient agricultural value chains. With the intention to alleviate the problem stated earlier, solar-powered cold storagesystems (SPCSS) prove an attractive intervention through the utilizations of the high solar radiation available within the tropical region of Nigeria to ensure decentralization and cost- and environmentally-friendly preservation technologies (Arora *et al.,* 2021; Hassan *et al.,* 2023).

One advantage of solar-powered cold storage is its twin benefit: it diverts dependency away from precarious grid electricity and also emits less carbon compared to diesel-powered cold storage. And finally, farmers get more time between harvesting and sales to sell to better markets by extending the freshness period. Pilot projects around Africa and the Indian subcontinent by ColdHubs and India's Ecozen among others have proven the potentiality these technologies represent to save up to 40% post-harvest losses, raise farmers' income by double figures and make the food system more resilient (ColdHubs, 2022; Muthoni & Gitau, 2021). Nevertheless, the adoption rate and sustained use remain low and marginal in the case of Nigeria in spite of these apparent benefits. One key determinant is the end-users' perceived usefulness. The Technology Acceptance Model highlights the fact that the more an individual believes the technology improves performance and yields tangible gain, the more likely the individual is to adopt and habitually use the technology (Venkatesh *et al.,* 2023). Translating to the agricultural sector, the question is whether farmers believe solar cold storage to be an efficient means to save them on spoilage through its effectiveness to reduce wastage and save on expenditure and procure improved income.

The Southwest state of Nigeria is a key case study to understand these processes. High agricultural output exists in perishable crops and fish and also has the problem of inefficient preservation measures that cause large-scale seasonally related gluts and wastage. Rural areas in the Ondo, Ekiti, Osun, and Oyo States are especially susceptible because road links are inefficient, cold chain distribution is absent, and electricity supplies are irregular (Oluwafemi & Alabi, 2022). Though solar-powered cold storages have been developed by the private sector companies, co-operatives and donor-funded projects, evidence regarding the efficacy and usefulness perceived by farmers along the AgSARS continuum is not substantial. Whether farmers find the systems credible and reliable and whether the systems do make any difference by reducing post-harvest loses are still questions. What is also inhibiting widerscale uptake is not clearly answered by Bolarinwa *et al.* (2023).

Previous research on agricultural innovation in Nigeria has commonly highlighted inputs like fertilizers, irrigation, and mechanization but has paid remarkably little attention to renewable energy-based preservation technologies. Where cold storage has been the subject of discussion, attention is often directed to large-scale logistical systems more than to decentralized farm-centered solutions. Furthermore, the majority of studies take on the technical or engineer's view with little consideration to the socio-behavioral aspects of technology acceptance (Ezeanya & Eze, 2021). However, the effectiveness of innovations like SPCSS has its success not only through the technical efficiency but also through farmers' beliefs about the usefulness and affordability and the ability to conform to the local settings. This shortfall calls for the socio-technical evaluation where the users' perception is related to the empirical measures of effectiveness. This study thus seeks to appraise the efficacy of perceived usefulness of solar-powered cold storage systems in the preservation of agricultural produce among smallholder farmers in the remote areas of Southwest Nigeria. Of particular interest is an examination of farmers' awareness level, adoption rates, and usefulness perception; an appraisal of the extent to which SPCSS minimizes spoilage and Shelley life extension; and an identification of challenges that undermine sustained use. By bringing together quantitative survey data with qualitative information provided by farmers and key stakeholders themselves, the study sheds more light on the potential of renewable energy innovations to remediate endemic post-harvest problems among rural Nigeria's farmers. Finally, the research hopes to guide policy, practice, and investments that can spur SPCSS adoption faster and reduce more the wastages associated with post-harvest losses and thereby boost the livelihoods and income of smallholder farmers commensurate with the national agricultural transformation agenda and the SDGs. Though agriculture has the high potential to be the driver of growth and development

in Nigeria, post-harvest losses still eat away at the outcome and livelihoods of farmers, particularly isolated members of the rural communities of Southwest Nigeria. Cold storages remain urban-centered and are out-of-reach to small-scale farmers due to expensive costs, bad infrastructure, and an unreliable power supply. One innovative solution has been the solar-powered cold storage system (SPCSS) to provide the decentralized and renewable energy-based preservation of perishable produce. Yet the success is not only reliant on the technical effectiveness but also on the perceived usefulness by farmers. Pilot projects evidence suggests that where SPCSS can add to the life on the shelves and save the waste, adoption is still not significant and has induced awareness on the affordability and long-term sustainability. Where systematic appraisal has not been conducted to understand how perceived usability has impacts on adoption and success outcome leaves the critical gap among the academic materials and the policy forums on the post-harvest innovation.

This research endeavors to bridge this gap by exploring the efficacy of SPCSS preservation of agricultural produce among the remotely located farmers in Southwest Nigeria using perceived usefulness. Concretely, the research hopes to gauge farmers' awareness and level of adoption of SPCSS; measure usefulness perception to minimize spoilage and enhance shelf life and income gain; and determine the challenges faced that discourage sustainable utilizations. Accordingly, the study is guided by the following queries: What is the awareness and adoption level of farmers regarding SPCSS? How far do farmers view SPCSS to be useful to cut down post-harvest losses? Is the technology improving the preservation and marketability of produce? What constraints inhibit the effective adoption and utilizations? By responding to these queries, the study brings evidence to inform scale strategies on solar-powered cold storage wants to cut down post-harvest losses and enhance the food security among the rural areas.

2. Literature Review

Post-harvest loss (PHL) has long been identified as a binding constraint on smallholder livelihoods and food system resilience in low- and middle-income countries. In Nigeria—where horticulture, fisheries, and small livestock make up a significant proportion of rural income—losses on perishables are ubiquitous due to heat, humidity, microbial activity, bruising during handling, and transit between market and field. Estimating these losses to be around 30–50% each year due to inefficient preservation, lack of proper storing infrastructure, and inefficient cold chain infrastructure (FAO, 2022; Yusuf & Adepoju, 2023), studies predict severe consequences on the livelihoods of smallholder farmers. Conceptually, the "cold chain" resolves these frictions through a continuum of temperature-controlled steps: precooling on- or near-farm, chilled aggregation and storing, chilled transport and temperature-compliant retailing. However, in remote locations, grid unreliability, cost volatility of fuels, and scattered production nodes make traditional cold chains unaffordable or logistically unviable (Akinbile *et al.,* 2021). This backdrop has spurred interest in solar-powered cold storage systems (SPCSS): decentralized, PV-powered cold rooms (with battery banks and/or thermal storage), which stabilize temperatures for fruits and vegetables, cheese and other milk derivatives, meat and meats/lamb/meat poultry and poultry meat, and fish and shellfish at the community scale (Odeyemi & Olatunji, 2022).

At the system core, SPCSS generally integrate four subsystems: (i) generation (photovoltaic modules sized to daily cooling loads and insolation patterns); (ii) storage—either electrochemical (batteries) or thermal (ice banks/phase-change materials, PCMs) to fill evening and cloudy intervals; (iii) cooling and control (DC high-efficiency compressors, variable-speed drives, thermostats, IoT sensor/logger for remote monitoring); and (iv) enclosure and insulation (hygienic finishes with polyurethane panels, controlled air exchange). System choices—battery-dominated versus PC rominant; walk-in rooms versus chest units by the module; DC micro-grid versus AC hybrid—impact capital cost, levelized cost of cooling, maintenance intervals, temperature stability, and lifespan (Arora et al., 2021 and GIZ, 2022). At Southwest Nigeria locations, elevated solar irradiance and high ambient temperatures tip the scale energetically towards solar cooling, but dusty climates, voltage transients (for hybrid units), and limited O&M infrastructures make reliability challenging absent strong after-sales support, spareshold, and training (Obayomi & Fasina, 2023).

From an innovation-adoption perspective, the writing increasingly places rural cold storage not merely as an engineering artifact but as a socio-technical system embedded within behaviors, norms, and market logics. Three theoretical families are particularly pertinent. First, Technology Acceptance Models (TAM) posit perceived usefulness (to what degree users believe the technology will enhance performance) and effort expectancy/ease of use frame intention and sustained use and intention and sustained use (Venkatesh *et al.,* 2023) Second, Diffusion of Innovations theory places strong emphasis on relative advantage (e.g., reduced losses, improved prices), compatibility (compatibility with harvest calendars, product mix, cooperative behaviors), complexity, trialability (facility to pilot through by the crate), and observability (manifest benefits to colleagues) (Rogers, 2020; Juma *et al.,* 2022) Third, Resource-Based and Dynamic Capability perspectives remind us that pieces of equipment hardly ever produce advantage by themselves; related assets—cold-chain literacy, hygienic handling, trickle and turn-in and price strategies—defy farmers to turn cooling access to permanent income gains (Barney, 2020; Ndirangu & Otieno, 2021) Such lenses all come together on an overarching proposition for remote Nigeria's cold storage adoption and effectiveness will depend at least to an equivalent degree on user perception, capability, and institutions versus hardware efficiency.

Empirically, increasingly copious documentation reports solar cold storage pilot projects and business models on the African and South Asian continents. Community "cooling-as-a-service" (CaaS) models—paying daily or per-crate rates—reducing upfront expenses and permitting seasonable users to synchronize payments with peak harvesting phases—have been developed (GIZ, 2022; Okonkwo & Chukwu, 2023). Lease-to-own and cooperative ownership variations also appear, usually

packaged with aggregation, sorting, and market linkage services. Impacts are repeatedly reported by studies to include spoilage reductions and Marketable Shelf Life extensions by tomatoes, leafy vegetables, peppers, mangoes, and fish, and by improved bargaining power and smoother price realization (Muthoni & Gitau, 2021; ColdHubs, 2022). Impactor heterogeneity is however accentuated: impacts are greatest where steady thoroughput ensures high capacity utilization where users get right the pre-cooling and hygiene and where governance structure thwarts elite grab on the access slot (Ezeanya & Eze, 2021; Hassan *et al.*, 2023).

Nigerians replicate these universal trends with unique frictions. On the supply side, panel and inverter import dependence increases capex; foreign-exchange volatility and customs clearance increments widen timelines; and off-rural O&M capacity is spotty (Adeyemi *et al.*, 2022). On the demand side, small farmers often lack working capital to finance purchase price plus pay-per-use fees and thus make them prominent at harvest time; decisions are influenced by liquidity requirements, aversion to risk and price uncertainty, and spot price offers by middlemen. Gender also affects access: women control retail trade and retailing of perishables but lack discretion over shared assets and thus decreased control over shared-cooling slots by assets (Aina & Olajide, 2021). Trust and governance of shared assets also decisively affect sustained involvement with evidence that mismanaged assets quickly depreciate on farmers' involvement by assets put-in place (Bolarinwa *et al.*, 2023). Most importantly, many assessments still put more emphasis on the performance index (kWh and temperature curves) and under-estimate perception avenues—usefulness and usefulness familiarity and fairness and convenience—of sustained pickup by users themselves (Oluwafemi & Alabi, 2022). Another body of literature studies variant or supplementary low-energy alternatives including evaporative coolers, zero-energy rooms, and better crates. They can be stepping stones to cold chains but usually disappoint for cold-stable requirements commodities like fish or milk (World Bank, 2021). Effective programs combine proper handling procedures (harvest on cool hours, sorting and sanitizing and packaging) and cooling availability and coordination with the logistics to condense time-to-market (Akinwande *et al.*, 2022). For fisheries, solar ice plants and hybrid cold storages at landing areas have been promising but need to be attended to regarding corrosion and sanitizing and market regulation (Olawale & Ibrahim, 2023). Amongst these across settings, writings come together on determinants of perceived usefulness: technological reliability (uptime, temperature constancy), economic relevance (loss minimization, price increases, income after commission), convenience and accessibility (travel time, operating hours, fairness in booking), capability and supports (education and maintenance, responsiveness), institutional setting (community governance, inclusion of women/youths), and risk/trust (fear of stealing, rupture, hidden expenses) (Arora et al., 2021; UNIDO, 2022). At the methodological level, research recommends mixed indicators of effectiveness with technically oriented measures mixed with farmer calculus on decisions. Rather than presenting energy coefficients only, credible assessments report PHL minimization, shelf-life increment, revenue shifts, smoothing volatilities (avoiding distress sales), and rates of utilizations. At the perception end, Likert scales that are validated measure usefulness, ease of operability, facilitating and continuance intention with statistical models relating the former to objective measures (Ndirangu & Otieno, 2021; Venkatesh *et al.*, 2023). One key finding from the literature on the productive use of energy (PUE) is that the investments in cooling will be rewarding once embedded within market systems—buyer contracts, price data, shared logistics—not individually. Research demonstrates that where SPCSS operators package market linkage, finance, and digital scheduling, farmers find more usefulness and facilities get more use (Hassan *et al.*, 2023; UNIDO, 2022). By themselves and where markets are thin, individual facilities stand to be under-used and garner dislikes.

Sustainability considerations also matter. While SPCSS reduce diesel dependence and carbon emissions, issues of battery replacement, refrigerant management, and lifecycle disposal remain underexplored (Odeyemi & Olatunji, 2022). Long-term effectiveness thus hinges on lifecycle stewardship and institutional support for O&M, financing, and technician training. Despite progress, gaps remain. Few studies explicitly disentangle perceived usefulness from observed effectiveness, limiting understanding of how farmer perceptions mediate adoption. Evidence is limited by commodity type and season, overlooking how thermal loads and price dynamics vary. Equity and inclusion particularly gender and wealth differences in access are underexplored. Finally, institutional durability of cooperative and cooling-as-a-service models under real-world shocks remains poorly documented. The literature supports the promise of SPCSS to reduce losses and improve farmer incomes, while cautioning that effectiveness is mediated by perceptions, institutions, and market linkages. For remote areas of Southwest Nigeria, a rigorous evaluation that centers perceived usefulness and links it to both preservation outcomes and livelihood indicators can fill this critical gap. This study advances the literature by integrating technology adoption theory with empirical measures of effectiveness, offering evidence for scaling SPCSS in ways that are technically, socially, and economically sustainable.

4. Methodology

This research used a mixed-methods approach to determine the efficacy of solar-powered cold storage facilities (SPCSS) among smallholder farmers and other actors at the produce interfaces along the upstream and downstream value-chains in six purposively sampled Local Government Areas (LGAs) among Oyo, Osun, Ondo, Ekiti, Ogun, and Lagos States. With Yamane's (1967) formula at 5% margin of error and 95% confidence level, the sample size worked out to be 400 farmers and 20 key informants (operators, extension agents, and leaders) on purposive sampling basis to gain qualitative insights. Using a structured questionnaire on a 4-point Likert scale to measure awareness, adoption, usefulness, and effectiveness along with awareness and effectiveness and semi-structured interviews guides to gain deeper insights. Expert judgment designed the validity and the reliability with Cronbach's alpha = 0.82. Enumerators trained to administer the instruments in English and Yoruba to accommodate the

respondent. Quantitative data were analysed using SPSS v.26 through descriptive statistics, regression analysis to ascertain the association between usefulness and effectiveness and ANOVA to test group difference. Qualitative interviews transcripts underwent thematic analysis through NVivo and the finding triangulated survey finding. Ethic approval and consent and ensure only on confidential basis.

4. Results and Discussion

Table 1: Descriptive Statistics of Farmers' Perceptions of SPCSS (n = 400)

Indicator	Mean ($\bar{x}$)	SD	Rank
SPCSS reduces post-harvest spoilage	3.21	0.77	1st
SPCSS extends shelf life of produce	3.18	0.81	2nd
SPCSS improves income from sales	3.11	0.85	3rd
SPCSS is affordable and accessible	2.89	0.92	5th
SPCSS increases bargaining power with buyers	3.05	0.88	4th
High cost and maintenance hinder use	3.24	0.83	Major Constraint

Scale: 1 = Strongly Disagree, 4 = Strongly Agree

The descriptive outcome reveals that farmers rate SPCSS as very effective to stop spoilage ($\bar{x}$ = 3.21) and increase shelf life ($\bar{x}$ = 3.18). Income increase also featured ($\bar{x}$ = 3.11), showing farmers appreciate delayed sales and minimized losses income. Affordability however ranked lower ($\bar{x}$ = 2.89), revealing accessibility and cost-of-operation fears. High cost and maintenance featured the strongest limitation ($\bar{x}$ = 3.24). These results are similar to ColdHubs (2022) and Muthoni & Gitau (2021), who linked solar cold storage to the elongation of tomato and vegetables by 2–4 days and the enhancement of farmers' bargaining power. Also, Hassan *et al.* (2023) monitored that although SPCSS minimizes losses, its high capital and maintenance costs stay the adoption impediment. This affirms market and technological usefulness is appreciated but financial sustainability is the major limitation within Southwest Nigeria.

Table 2: Regression Analysis: Relationship between Perceived Usefulness and Effectiveness of SPCSS

Predictor Variable	β	t-value	p-value	Interpretation
Spoilage reduction	0.311	4.92	0.000	Significant
Shelf-life extension	0.276	4.38	0.000	Significant
Income improvement	0.254	3.85	0.001	Significant
Accessibility/affordability	0.203	2.99	0.004	Significant
High cost/maintenance (negative)	-0.185	-2.76	0.006	Significant inverse
Model Summary	R^2 = 0.48, F(5,394) = 36.82, p < 0.001			Perceived usefulness explains 48% of variance in effectiveness

Regression analysis results indicate that spoilage minimization ($\beta = 0.311$, $p < 0.001$), shelf-life increase ($\beta = 0.276$, $p < 0.001$), and income increase ($\beta = 0.254$, $p = 0.001$) predict effectiveness of SPCSS strongly. Accessibility is also significant ($\beta = 0.203$, $p = 0.004$), but cost and maintenance significantly negatively affect the outcome ($\beta = -0.185$, $p = 0.006$). The equation accounts for 48% of the variance, affirming perceived usefulness significantly determines adoption and effectiveness. This is consistent with the Technology Acceptance Model (TAM) where perceived usefulness determines adoption (Venkatesh *et al.,* 2023). This is consistent with finding by Okonkwo & Chukwu (2023) who surveyed farmers in Nigeria and by Ecozen (2022) among farmers in India that farmers adopt solar cold storage where they perceive benefits clearly by minimizing losses and improving income. However, the negative impact of cost and maintenance is consistent with Odeyemi & Olatunji (2022) where they established that the absence of subsidies and the lack of the cooperative model led to farmers accepting SPCSS to be financially cumbersome although possessing the technical advantage.

Table 3: ANOVA: Differences in Perceptions of SPCSS by Stakeholder Group

Stakeholder Group	N	Mean ($\bar{x}$)	SD	F-value	p-value	Interpretation
Farmers	250	3.05	0.82			
Cooperative leaders	60	3.22	0.79			
SPCSS operators	40	3.34	0.75			
Traders/Buyers	50	2.91	0.88	4.12	0.007	Significant difference
Total	400	3.15	0.81			Farmers/traders less positive than operators

Results from the ANOVA indicate significant difference between the various stakeholder groups ($F = 4.12$, $p = 0.007$). SPCSS operators ($\bar{x}$ = 3.34) and leaders of the cooperatives ($\bar{x}$ = 3.22) more favorably rated the systems, whereas traders ($\bar{x}$ = 2.91) and farmers ($\bar{x}$ = 3.05) provided more skeptical ratings. This is an indication of the gap between tech providers/main managers and the final users. Bolarinwa *et al.* (2023) also showed similar spaces where operators tend to overrate effectiveness against farmers under the constraint preventing affordability. Aina & Olajide (2021) further identified gender and fairness issues by citing the observation where women traders tend to realize minimal gains owing to the restrictions

on accessibility within the cooperatives. Such observations indicate that whereas the tech stakeholders foresee potential, the end users remain skeptical, and hence the significance to align the adoption models to the economic life farmers live.

The findings indicate that perceived usefulness is a strong predictor of effectiveness and specifically effectiveness in spoilage minimization, shelf life extension, and increased income. Nonetheless, adoption and sustainability are constrained by lack of affordability and maintenance difficulty. Such duplicity reflects what has also been observed elsewhere in the African and Asian realms where solar cold storage is technically effective but fails to scale without supportive financing, cooperative governance, and market linkages (UNIDO, 2022; Hassan *et al.*, 2023).

5. Conclusion and Recommendations

This research has assessed the performance of solar-powered cold storage systems (SPCSS) for preservation of agricultural produce among the small-holders farmers in the remote areas of Southwest Nigeria with special emphasis on the perceived usefulness influencing the adoption and performance. Results indicate that farmers and other stakeholders accept the usefulness of SPCSS among which is the minimization of spoilage, increased shelf life and increment of income. Regression analysis validated the perception to strongly affect the adoption and performance but the affordability and maintenance challenges negatively affect the performance. ANOVA results also confirmed the perceptual variations among the different group stakeholders where operators and cooperative leaders prove to be more optimistic compared to farmers and traders. Such results highlight the fact that although the SPCSS is technically viable and has potential to overcome the post-harvest challenges but its larger performance is moderated by the finances, institutions and social forces. Conclusively the research recommends SPCSS to be an attractive innovation to the post-harvest losses minimization and the enhancement of the livelihood among the rurally developed but its edge is not realized due to affordability barriers, maintenance limitation and unequalled accessibility. Based on the recommendation four areas are suggested. Firstly the targeted subsidies and innovative financing mechanisms i.e. the pay-as-you-use otherwise the cooperative ownership models to enhance the affordability. Second the scaling up the capacity building and the trainings to facilitate the farmers the competency to utilise and maintain the SPCSS effectively. Third the inclusive governance mechanisms to facilitate the equal accessibility to the SPCSS where mainly the women and the small-scale traders are marginalizing. Lastly the integration to policies is required where the SPCSS is to be linked to the wider agricultural transformation and the renewable energy plans to ensure the sustainability and the consistency to the food and the climatic resilience objectives of the Nigeria.

Acknowledgement

The research team sincerely appreciates the Tertiary Education Trust Fund (TETFund) for providing the enabling environment and financial support through the Institution-Based Research (IBR) Intervention Grant. The successful completion of this study was made possible by TETFund's unwavering commitment to promoting research and innovation in Nigerian tertiary institutions.

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Article inflow

Received: 5th October, 2025

Accepted: 30th November, 2025

Published 31st December, 2025