

AKSUJAEERD 8(3): 131 – 143, 2025 AKSU Journal of Agricultural Economics and, Extension and Rural Development.

© Department of Agricultural Economics and Extension, Akwa Ibom State University, AKSU, Nigeria, August.

ASSESSMENT OF PACKAGING PRACTICES USED BY VALUE CHAIN ACTORS IN ENHANCING AGRO-PRODUCT MARKETABILITY IN FEDERAL CAPITAL TERRITORY, NIGERIA

Inyang, H. B.

Department of Agricultural Economics and Extension, Faculty of Agricultural Sciences,
National Open University of Nigeria, Kaduna, Kaduna State, Nigeria

Corresponding Author's Email: hinyang@noun.edu.ng GSM: 08163759057 Orcid Account:
<https://orcid.org/0000-0001-8467-2266>

Abstract

The study assessed the packaging practices employed by value chain actors to enhance the marketability of agro-products in the Federal Capital Territory (FCT), Nigeria. A multi-stage sampling technique was used to select 222 respondents from Kuje and Kwali Area Councils. Data were collected through validated questionnaires and interview schedules and analysed using descriptive statistics, a 4-point Likert scale type rating scale, binary logistic regression, and binomial tests. Results showed that respondents were predominantly male (69.37%), married (72.97%), while the average age was 36.81 years, signifying that the respondents were within economically active age groups, with most operating small to medium farm sizes. About 52% of the respondents widely perceived packaging to reduce post-harvest losses, extend shelf life, preserve product quality, and enhance market value. Respondents also demonstrated strong willingness to adopt modern packaging technologies, with over 84% indicating high readiness. Major challenges to adoption included high cost of packaging materials (Mean = 3.55, standard deviation (SD) = 0.58), limited access to credit (Mean = 3.55, SD = 0.56), inadequate technical knowledge (Mean = 3.32, SD = 0.63) and poor infrastructural support (Mean = 3.01, SD = 0.66). Logistic regression results revealed that age (1%), education (0.5%), farm size (0.5%), household size (1%), cooperative membership (0.5%), and access to extension services (1%) significantly influenced the types and forms of packaging used. The study concludes that although modern packaging is recognized as essential for improving agro-product marketability in the FCT, adoption is hindered by financial, technical, and infrastructural constraints. It recommends strengthened extension support, improved access to credit, subsidised packaging materials, and targeted capacity building to enhance adoption of improved packaging technologies. Based on the above findings, it is recommended that government agencies, private-sector stakeholders, and development partners introduce subsidies, grants, or tax incentives to reduce the high cost of modern packaging inputs. Also, financial institutions should design flexible, low-interest credit schemes specifically for farmers, processors, and marketers.

Keywords: farmers, processors, marketers, packaging, agro-products, willingness, modern technologies

Introduction

Packaging goes beyond merely covering a product; it functions as a vital component that performs protective, informational, and promotional roles, effectively linking producers to consumers (Srivastava, Ramakanth, Akhila and Gaikwad, 2022). Within agricultural value chains, appropriate packaging preserves product quality, extends shelf life, supports efficient handling and transportation, provides safety and usage details, and shapes consumers' perceptions and purchasing decisions (Du *et al.*, 2025). For

agro-products such as fruits, vegetables, cereals, tubers, dried goods, and processed foods, proper packaging is essential for transforming raw produce into marketable commodities and improving access to profitable markets (Raṭu *et al.*, 2023).

Urban consumers, in particular, place high value on hygiene, convenience, and product appearance, and are often willing to pay premium prices for products whose packaging signals safety and quality (Mahmoud, Tsetse, Tulasi, & Muddey, 2022). Mahmoud *et al.* (2022) further

noted that institutional and retail outlets such as supermarkets and hotels frequently require standardized packaging to enhance logistics, storage, and traceability. Despite these advantages, many producers and traders in the FCT still rely on traditional and inadequate packaging materials like sacks, baskets, open crates, and non-food-grade plastics. Such practices contribute significantly to post-harvest losses through bruising, moisture infiltration, pest attacks, and contamination (Sugri, Abubakari, Owusu and Bidzakin, 2021). Sugri *et al.* (2021) also emphasized that poor packaging accelerates spoilage of perishable products, hampers long-distance transportation, and undermines consumer confidence due to unattractive presentation and lack of labeling. In the case of processed agricultural products, inadequate packaging reduces shelf life and limits branding opportunities, restricting access to formal markets (Zdulski, Rutkowski & Konopacka, 2024).

Packaging plays a key role in adding value to agro-products by enabling grading, labeling, and the creation of premium or convenience products, which enhance product appeal, reduce waste, and improve access to formal and export markets. In contrast, poor packaging restricts producers to low-value informal markets with unstable prices and limited profits. Packaging also communicates essential regulatory and safety information, helping build consumer trust, especially as food safety awareness grows. However, many small-scale farmers and processors lack the knowledge, skills, and resources needed to meet these packaging and labeling standards. The use of improved packaging is shaped by various socioeconomic factors such as scale of production, cost and accessibility of materials, and producers' level of awareness (Asim *et al.*, 2022). Although high-quality packaging can be expensive, some informal market actors perceive it as unnecessary. Environmental concerns, including plastic waste and pollution also highlight the need for sustainable alternatives like biodegradable materials and reusable containers within the FCT.

Although studies in developing countries consistently show that proper packaging enhances product value, minimizes losses, and improves market access, these outcomes are often

shaped by local contexts. In the Federal Capital Territory (FCT), where modern urban markets operate alongside traditional market systems, the impact of packaging on marketability may vary across different agro-products and among various market participants. In light of this, the study assessed the packaging practices adopted by value chain actors (farmers, processors, and marketers) in enhancing the marketability of agro-products in the FCT, Nigeria. On a specific note, this study was carried out to: identify the socio-economic characteristics of the farmers, processors and marketers in FCT, evaluate the role of packaging in reducing post-harvest losses and enhancing the shelf life and overall value of agro-products, assess the willingness of value chain actors (farmers, processors, and marketers) in the FCT to adopt modern packaging technologies for agro-products and identify the major challenges faced by producers and traders in adopting improved or modern packaging materials and technologies in the study area.

Hypotheses of the study

H_{0i}: Socio-economic characteristics of the value chain actors have no significant influence on the types and forms of packaging used for agro-products.

H_{0ii}: Value chain actors that are willing to use modern packaging technologies on agro-products are not significantly different from those not willing.

Methodology

The study was carried out in Federal Capital Territory (FCT), Abuja. Though FCT was established in 1976, it became functional /operational in 1991 and it represents the Capital seat of Nigeria. The FCT has six area councils which include: Abaji, Kwali, Kuje, Bwari, Gwagwalada and Abuja Municipal Area Council. It occupies a land area of 8000 Km², located in the savannah region with an estimated population of approximately 4,026,000 people as at 2024 (Kenneth, 2025). The FCT lies between Latitude and Longitude 9.07° N and 7.339°E respectively. Okwuokenye *et al.* (2024) acknowledged that the soil in FCT is made up of parent materials that are coarse sandy loam in the basement complex to silt clay in nature. Okwuokenye *et al.* (2024) also

stated that FCT is underlain mainly by the differentiated crystal rocks of the pre-Cambrian to early Paleozoic basement complex and cretaceous sedimentary formation. The area's temperature range could be as high as 37°C and above and this occurs between March – May. It can as well be as low as 15°C during the cold season and this is usually between July – August. The average rainfall of FCT is 1632mm and it occurs between April – October. FCT has a guinea savannah forest with shrubs growing in-between. The area is also endowed with many mineral deposits like clay, feldspar, tin, gold, iron, ore, etc.

The original inhabitants of the town are the Gbagyi speaking people and the paramount ruler is the

Esu who is otherwise known as Sa-bwaya. In terms of the occupation of the people, they are mainly Civil Servants while others are farmers growing crops like maize, onion, rice, millet, beans, etc. The farmers in their locality are into the rearing of animals like cattle, sheep and goats.

Sampling Techniques

The sample size of the study was selected through multi-stage random sampling technique. The first stage involved random selection of two Area Councils, (ACs). They were Kuje and Kwali LGCs out of the six LGCs (Kuje, Kwali, Abaji, Municipal, Bwari and Gwagwalada LGCs) of the FCT. The second stage involved the random selection of two towns from each of the area councils, thus making four selected towns. Kuje and Gaube towns were randomly selected from Kuje, LGC while Yangoji and Dafa were randomly selected from Kwali LGC. Finally, sixty Value chain actors of agricultural products were randomly selected from each of the towns. This resulted in a total of 240 respondents being selected, 222 completed responses were found suitable for analysis and used in the study.

Sources of Data

Data for this study were sourced from primary source only, through the use of questionnaires and interview schedules.

Validation of Research Instruments

The instruments were validated using the face and content validity approach. This process involved

presenting the research instruments to lecturers in the field of Agricultural Economics and Extension for expert review. They carefully examined and critiqued the instruments to ensure that the data to be collected would effectively address the study's objectives and hypotheses.

Analytical Techniques

The study applied descriptive and inferential statistics to analysed the objectives and hypotheses of the study. Descriptive statistics (percentages, means, and mode) were used to analyze the socio-economic characteristics of value chain actors and to assess the willingness of farmers, processors, and marketers in the FCT to adopt modern packaging technologies for agro-products. The role of packaging in reducing post-harvest losses and enhancing the shelf life and overall value of agro-products and major challenges faced by producers and traders in adopting improved or modern packaging materials and technologies were analysed using 4-point Likert type rating scale. The scale ranged from strongly agreed (coded 4), agreed (coded 3), disagreed (coded 2) and strongly disagreed (coded 1). It produced a mean score of 2.50 (obtained as $4 + 3 + 2 + 1 = 10 / 4 = 2.50$). In analysing the role of packaging in reducing post-harvest losses and enhancing the shelf life and overall value of agro-products, a mean score of ≥ 2.50 indicated that farmers, processors, and marketers agreed that the item constituted an important role of packaging. Similarly, in assessing the challenges faced by producers and traders in adopting improved or modern packaging materials and technologies, factors with mean scores of ≥ 2.50 were regarded as major constraints. In both situations, means with < 2.50 implied that the factors were not respectively agreed by the respondents to function as role of packaging in reducing post-harvest losses and enhancing the shelf life and overall value of agro-products and major challenges faced by producers and traders in adopting improved or modern packaging materials and technologies.

Inferential statistics, such as binary logistic regression and Binomial test statistics were used to analysed hypotheses one and two. Binary logistic regression was used to test hypothesis one

which stated that: the types and forms of packaging used for agro-products by value chain actors in FCT is not significantly influenced to their socio-economic characteristics.

The model is expressed as shown below:

$$Y_i = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \dots + \beta_n X_n + \mu_i \quad (1)$$

Where:

Y_i = Adoption of modern packaging technologies (Yes = 1; No = 0)

α = The constant term in the model

$\beta_1 \dots \beta_n$ = The coefficients of the regressors

$X_1 \dots X_n$ = i^{th} term of the explanatory variables

μ_i = The error term

The variables in the model were specified as;

Y = Adoption of modern packaging technologies (Yes = 1; No = 0)

X_1 = Gender (dummy: male = 1; female = 0)

X_2 = Age (years)

X_3 = Education (Pri. educ. = 1, sec. educ. = 2 and tertiary educ. = 3)

X_4 = Marital status (single = 1, married = 2, divorced = 3 widowed = 4)

X_5 = Farm size (hectares (ha.))

X_6 = Farm experience (years)

X_7 = Household size (number of persons living and feeding together)

X_8 = Membership to farmer cooperative society (yes = 1; no = 0)

X_9 = Access to extension services (yes = 1; no = 0)

Hypothesis 2 (Value chain actors are not willing to use modern packaging technologies on agro-products was analysed using Binomial test statistics. This test determines whether the proportion of respondents willing to adopt modern packaging technologies differs significantly from those unwilling.

The formula for binomial distribution is given as:

$$b(x; n, p) = \binom{n}{x} p^x (1 - p)^{n-x} \quad (2)$$

Where:

b = binomial probability;

x = total number of successes (willing and unwilling to use modern packaging technology);

p = probability of success on an individual trial;

n = number of trials

For the Binomial model, the explicit (probability mass) form is written as:

$$P(X = x) = \binom{n}{x} p^x (1 - p)^{n-x}, x = 0, 1, 2, \dots, n \quad (3)$$

where:

X = random variable representing the number of successes

n = fixed number of trials

x = number of successes observed

p = probability of success in each trial

$1 - p$ = probability of failure

$$\binom{n}{x} = \frac{n!}{x!(n-x)!} = \text{binomial coefficient}$$

Explicit expansion of the components

$$\binom{n}{x} = \frac{n!}{x!(n-x)!} \quad (4)$$

So, the full explicit form becomes:

$$P(X = x) = \frac{n!}{x!(n-x)!} p^x (1 - p)^{n-x} \quad (5)$$

This is the standard explicit binomial probability model used in statistical and agricultural research (e.g., modeling adoption vs. non-adoption, success/failure outcomes).

Results and Discussion

Socio-economic Characteristics of the Respondents of the Study

Socio-economic characteristics of respondents that were analysed in this study include: gender, marital status, age, education, household size, farm size, farming experience, cooperative membership, and access to extension services, and they are presented in Table 1.

The results on gender distribution of the value chain actors show that the majority (69.37%) were males and 30.63% were females. This indicates that agricultural production in the study area is skewed towards the males, although women also participate significantly, likely in supportive or small-scale roles. This may be connected to the Islamic religion practiced by a good number of people which does not permit the appearance of female in the public. The majority of the respondents (72.97%) were married, while smaller proportions were single (13.96%), divorced (8.11%), and widowed (4.96%), respectively. The result implies that farming in

the area is dominated by those who are married and this suggests that most respondents have family responsibilities, which may influence their farming decisions and labour availability within households. The observed male dominance and prevalence of married farmers in the FCT are consistent with the findings of Onyemekihian *et al.* (2023).

The age distribution revealed that the largest proportion (42.79%) of the respondents were within 31–40 years of age. About 27.93% were less than 31 years while 29.28% were more than 40 years old. The average age was 36.81 years which suggests a relatively young and active farming population, which implies most respondents were in their productive and

economically active years, indicating high labour potential and openness to innovation in agricultural practices. Regarding education, most (44.60%) of the respondents attained primary education, about 28.38% had secondary education, while 14.41% had post-secondary education, with about 12.61% having no formal education. The result simply indicates that most respondents had the basic education, which enhances their ability to adopt improved farming technologies and management practices. This result is consistent with the findings of Okwuokenye *et al.*, (2024), who observed that farmers within the area have requisite knowledge to handle farm challenges and adapt farm innovations.

Table 1: Socio-economic Characteristics of Respondents (n = 222)

Category	Characteristics	Freq.	%	Mean
Gender	Male	154	69.37	
	Female	68	30.63	
Marital Status	Single	31	13.96	
	Married	162	72.97	
	Divorced	18	8.11	
	Widowed	11	4.96	
Age (years)	≤ 30	62	27.93	
	31 – 40	95	42.79	
	41 – 50	39	17.57	
	≥ 51	26	11.71	36.81
Educational Status	No formal education	28	12.61	
	Primary education	99	44.60	
	Secondary education	63	28.38	
	Post – secondary educ.	32	14.41	
Household size	1 – 3	39	17.57	
	4 – 6	84	37.84	
	7 – 9	68	30.63	
	≥ 10	31	13.96	6.23
Farm size	1 – 3	117	52.70	
	4 – 6	83	37.39	
	≥ 7	22	9.91	3.72
Farm experience	1 – 7	34	15.32	
	8 – 14	59	26.58	
	15 – 21	97	43.69	
	≥ 22	32	14.41	15.01
Membership of cooperative society	Yes	194	87.39	
	No	28	12.61	
Access to extension services	Yes	53	23.87	
	No	129	58.11	

Source: Field survey, 2025; n = 222

About (38%) of the respondents had 4–6 members as their household size. This was followed by about 30.63%, 17.57%, and 13.96% with 7–9 members, 1–3 members and ≥ 10 members respectively. The mean household size was 6 persons, indicating that they had medium-sized households and implies that the respondents have access to family labour, which can support farm activities and reduce labour costs. This finding aligns with Onyemekihian *et al.*, (2023), who reported that households in the Federal Capital Territory (FCT) had an average of six members, with most respondents having between four and six persons per household. The majority (52.70%) of the respondents operated on 1–3 hectares, 37.39% had 4–6 hectares, while only 9.91% had 7 hectares and above. The average farm size of 3.72 hectares indicated that most respondents are small- to medium-scale farmers, which aligned with the dominance of smallholder farming in rural areas. This declaration was supported by Chiaka *et al.*, (2022) that farms up to 10 hectares in Nigeria are generally considered small-scale, with a significant majority of smallholders cultivating less than 2 to 5 hectares. The distribution of respondents' experience in farming shows that majority (43.69%) had 15–21 years of farming experience. About 41.90% and 14.41% had less than 15 and more than 21 years farming experience respectively. The average farming experience was of 15.01 years, implying that most respondents are well-experienced, which likely enhances their productivity and decision-making in farm management. This result is consistent with findings by Taramuel-Taramuel *et al.*, (2023), who noted that farming experience is an important asset that can enhance productivity, particularly when combined with access to modern technologies and extension services.

Majority of the respondents (87.39%) reported belonging to cooperative societies, while only 12.61% were non-members. This high level of participation suggests that most farmers

recognize the benefits of collective action, including improved access to extension services, credit facilities, farm inputs, and relevant information. This result is in line with the findings of Missiame *et al.*, (2023) that high participation in collective action benefits farmers through better market access, stronger bargaining power, lower input costs, and improved knowledge sharing. Despite this, extension service access is low, with only 23.87% receiving support. This aligned with Inyang *et al.* (2023), who reported that 71% farmers seldom receive visits, 9% received visits regularly or frequently, while 20% had never been visited by extension agents. Similarly, Mulungu *et al.*, (2025) affirmed that limited extension contact restricts farmers' access to modern practices.

Willingness of the Value Chain Actors to Adopt Modern Packaging Technologies for Agro-products

The results in Table 2 showed a strong overall willingness among farmers, processors, and marketers (value chain actors) in the FCT to adopt modern packaging technologies. More than half of the respondents (51.8%) indicated they were very willing, making this the dominant response and the modal category. An additional 32.88% were just willing, further reinforcing the generally positive attitude toward adoption. Only a small proportion expressed lower levels of willingness: 8.56% were averagely willing and 6.76% were fairly willing. Notably, no respondent indicated being not willing. Overall, the findings suggest a high level of readiness among value chain actors to embrace improved packaging technologies, which could support efforts aimed at reducing post-harvest losses and enhancing product quality in the FCT. This result was supported by Oyewole *et al.*, (2025) who ascribed the high readiness among value chain actors to embrace improved packaging technologies to be leveraged through strategic interventions focused on financing, collaboration, and education.

Table 2: Willingness of the Value Chain Actors to Adopt Modern Agro-product Packaging Technologies (n = 222)

Respondents' willingness	Frequency	Percentage	Mode
Very willing	115	51.80	
Just willing	73	32.88	
Averagely willing	19	8.56	
Fairly willing	15	6.76	
Not willing	-	-	Very willing
Total	222	100.00	

Source: Field survey, 2025

Role of Packaging in Reducing Post-harvest Losses

The role of packaging agro-products is presented in Table 3 and the results were arranged in the order of their mean weight. First amongst the roles was reduction of post-harvest losses (mean = 3.55), followed by extension of shelf life of the agro-products (mean = 3.25), and the preservation of product quality and enhancement of market value, both with a mean of 3.01. These corresponded to the first, second, and joint third most important roles of packaging agro-products. Appropriate packaging helps to minimize physical damage, contamination, and spoilage during handling, storage, and transportation as well reduce moisture content that could give rise to spoilage. Well-designed packaging materials protect products against mechanical injuries, moisture loss, pest infestation, and microbial contamination which are major causes of post-

harvest losses. Through proper packaging, a higher percentage of harvested produce reaches consumers in good condition, thereby reducing waste and boosting farmers' income. Additionally, effective packaging maintains the nutritional, sensory, and aesthetic qualities of agro-products, therefore ensuring that the product retains its appeal and meets consumer expectations. Furthermore, attractive, properly labeled, and informative packaging adds value to agro-products by improving their presentation and promoting brand identity that consequently enhances market value. This aligns with the findings of Wilfred and Onyeakusiobi (2017), who empirically demonstrated that attractive and informative packaging enhances perceived product quality, thereby directly influencing consumer choice and strengthening market competitiveness.

Table 3: Role of Packaging in Increasing shelf Life of Agro-products (n = 222)

Role of packaging	Mean	Standard Deviation	Remark
Reduction of post-harvest losses	3.55*	0.58	Agreed
Extension of shelf life:	3.25*	0.53	Agreed
Preservation of product quality:	3.01*	0.61	Agreed
Enhancement of market value	3.01*	0.66	Agreed
Help to ease conveyance from one place to another	2.89*	0.72	Agreed
Prevention of contamination	2.81*	0.67	Agreed
Improving the attractiveness of the product	2.77*	0.64	Agreed
Improving the marketability of the product	2.62*	0.77	Agreed
Job creation to people in the value-chain	2.53*	0.79	Agreed
Help to display knowledge / skill	2.21	0.82	Disagreed

Source: Field survey, 2025; *Agreed mean ≥ 2.50

Other roles of packaging include: helping to ease conveyance from one place to another (mean = 2.89), prevention of contamination (mean =

2.81), improving the attractiveness of the product (mean = 2.77) and job creation to people in the value-chain (mean = 2.53). These later

mentioned roles ranked the 5th, 6th, 7th and 8th role achieved through packaging of agro-product. Packaging also improves the handling, stacking, and transportation of agricultural products. Suffice to say that effective packaging practices therefore contribute greatly to food security, profitability, and the overall sustainability of the agricultural sector. This assertion was supported by Tapsoba *et al.*, (2022) who mentioned that effective packaging is a critical component of the agricultural supply chain as it helps in improving handling and logistics and reduction of food loss and waste.

Challenges Faced by Respondents in Adopting Improved Modern Packaging Materials and Technologies

The use of improved or modern packaging materials and technologies in agricultural product marketing provides numerous advantages, including better product preservation, value addition, and increased market appeal. Despite these benefits, producers and traders encounter several obstacles that limit their ability to fully adopt these innovations. The main challenges identified in Table 4 include the high cost of packaging materials and equipment (Mean = 3.55, SD = 0.58), which ranked highest and indicates strong consensus that the expense of modern packaging technologies constitutes a major barrier to adoption among producers and traders. Similarly, limited access to credit and finance (Mean = 3.55, SD = 0.56) was identified as a significant constraint, as inadequate access to affordable credit facilities hinders investment in modern packaging technologies. The lack of adequate technical knowledge and skills (Mean = 3.32, SD = 0.63) also emerged as an important barrier, indicating that insufficient training and expertise limit the effective use of improved packaging systems. This affirmed Shoaib, H. (2025), finding that limited technical skills and knowledge among producers slow down adoption of modern agricultural technologies, including packaging innovations.

Furthermore, poor infrastructure and supply chain constraints (Mean = 3.01, SD = 0.66) were considered obstacles, as unreliable

power supply and poor transportation networks impede the use of advanced packaging technologies. The limited availability of local packaging materials (Mean = 2.87, SD = 0.61) also contributes to slow adoption, since modern packaging materials are often scarce in local markets. In addition, low consumer awareness and demand (Mean = 2.71, SD = 0.73) discourages producers from investing in improved packaging due to consumers' limited appreciation for packaging quality. Respondents further agreed that weak enforcement of regulatory and standardization issues (Mean = 2.63, SD = 0.77) and custom and tradition of the people (Mean = 2.54, SD = 0.69) hinder the adoption of modern packaging practices, as poor implementation of standards and cultural preferences for traditional methods reduce compliance and innovation. However, resistance to change by the people (Mean = 2.33, SD = 0.61) was not seen as a major constraint, suggesting that most respondents are open to adopting modern packaging technologies if other limiting factors are adequately addressed.

From the foregoing, it suffices to say that while improved packaging materials and technologies present significant opportunities for enhancing product quality, safety, and market competitiveness, their widespread adoption is most consistently constrained by financial limitations, inadequate technical knowledge, and poor infrastructural support. These specific barriers showed strong convergence with the findings of Alibekov *et al.*, (2024), who likewise identified high costs, lack of expertise, and infrastructural weaknesses as major factors restricting the adoption of modern packaging technologies. To enhance their effectiveness, it is crucial to address these constraints through comprehensive strategies that include establishing reliable testing and certification processes, subsidizing cost of packaging materials, providing linkage for finances, educating consumers on the benefits of modern packaging, therefore creating awareness and tackling misconceptions or resistance that may hinder market acceptance.

Table 4: Factors Limiting Respondents' Adoption of improved Modern Packaging Materials and Technology (n = 222)

Factors limiting adoption of modern packaging technology	Mean	Standard Deviation	Remark
High cost of packaging materials and equipment	3.55*	0.58	Agreed
Limited access to credit and finance	3.55*	0.56	Agreed
Inadequate technical knowledge and skills	3.32*	0.63	Agreed
Poor infrastructure and supply chain constraints	3.01*	0.66	Agreed
Limited availability of local packaging materials	2.87*	0.61	Agreed
Low consumer awareness and demand	2.71*	0.73	Agreed
Weak enforcement of regulatory and standardization issues	2.63*	0.77	Agreed
Custom and tradition of the people	2.54*	0.69	Agreed
Resistance to change by the people	2.33	0.61	Disagreed

Source: Field survey, 2025; *Agreed mean ≥ 2.50

Results of Socio-Economic Characteristics on Adoption of Modern Packaging Technologies

The Logistic regression results based on a binary specification of adoption (Yes = 1, No = 0), confirm that socio-economic characteristics significantly influence the likelihood of adopting modern packaging technologies as shown in Table 5. The model's explanatory power remained substantial ($R^2 = 0.7001$), indicating that about 70% of the variation in adoption decisions is accounted for by the socio-economic variables. The F-calculated value (118.11) exceeding the F-tabulated value (6.63) confirmed that the overall model is statistically significant. The results showed that age, household size, and access to extension services were significant at the 1% level, while educational level, farm size, and membership of cooperative society were significant at the 5% level in influencing adoption of modern packaging technologies.

Specifically: Age ($B = -4.3612$, $p = 0.001$) had a negative and significant effect, implying that younger respondents are more likely to adopt modern packaging technologies compared to older ones, reflecting generational differences in openness to innovation. This result agreed with findings of Gadanakis (2024) who acknowledged that some studies suggest younger generations of farmers may be more open to adopting new technologies and business models due to greater familiarity with digital tools and changing consumer demands. Educational level ($B = 2.7914$, $p = 0.025$) was positively significant, suggesting that higher education enhances awareness and willingness to adopt improved

packaging methods and embrace innovation. This finding is consistent with Ayanwale *et al.*, (2024), who observed that education raises awareness and strengthens farmers' readiness to utilize modern technologies in packaging their products. Farm size ($B = 0.7145$, $p = 0.011$) showed a positive relationship, indicating that larger farm operations are better positioned to invest in modern packaging. This result is in tandem with Bertolozzi-Caredio (2024), study that stated, there is a genuine association between having a larger farm/operation and the likelihood of adopting modern packaging technologies. Farmers with larger holdings are better positioned to invest in modern packaging equipment and materials.

Furthermore, Household size ($B = 0.3183$, $p = 0.000$) was positively significant, implying that larger households provide additional labor support that facilitates adoption of improved packaging practices. The result is in agreement with Mutungi *et al.*, (2023) that increased number of people in larger households provides additional labor support, making it easier to implement or manage "improved packaging practices. Membership of cooperative society ($B = 1.3947$, $p = 0.021$) positively influenced adoption, reflecting the role of cooperatives in providing shared resources, training and information that encourage modern packaging use. This finding is in line with the standpoint of Kalogiannidis *et al.* (2024) that cooperatives have a positive and significant influence on their members' adoption of modern practices, including improved post-harvest management and packaging. Access to

extension services ($B = 2.1284$, $p = 0.010$) was strongly significant at 1% level, highlighting the importance of institutional support and capacity building in promoting adoption of improved packaging practices. According to Mapiye and

Dzama (2024), these results highlight the critical role of education, institutional support, and resource availability in fostering the use of modern packaging technologies among producers and traders.

Table 5: Logistic Regression Results of Socio-Economic Characteristics on Adoption of Modern Packaging Technologies

Socio-economic variables	B-coefficient	Standard Error (SE)	t-statistics	Prob. Value
Constant	54.1192	4.0047	5.872	0.000
Gender	2.6681	1.8812	0.272	0.061
Age	-4.3612**	1.1724	-4.137	0.001
Educational level	2.7914*	0.6125	3.043	0.025
Marital status	3.3331	1.8310	1.001	0.457
Farming experience	0.9658	0.5871	1.991	0.583
Farm size	0.7145*	0.0147	3.022	0.011
Household size	0.3183**	0.0139	2.958	0.000
Membership of cooperative society	1.3947*	0.1120	1.663	0.021
Access to extension services	2.1284**	0.1942	5.251	0.010
<i>Pseudo R</i> ²	0.7112			
<i>R</i> ²	0.7001			
<i>F-cal</i>	118.11			
<i>F-tab</i>	6.63			

*Significant at 5% level; **Significant at 1% level

Value Chain Actors' Willingness to Adopt Modern Agro-product Packaging Technologies

The results in Table 6 shows the relationship between respondents' willingness to adopt modern agro-product packaging technologies. The result shows a very strong willingness among farmers, processors, and marketers to adopt modern packaging technologies. Out of 222 respondents, 203 (91.4%) scored above 20, indicating they are willing to adopt modern packaging, while only 19 (8.6%) were not willing. A one-sample proportion test was conducted using a test proportion of 0.50 (50%).

The probability level ($p = 0.000$) was highly significant, meaning the observed proportion of those willing to adopt modern packaging was significantly higher than the expected 50%. From the result, it could be inferred that there is overwhelming evidence that the majority of respondents were willing to adopt modern packaging technologies, and this willingness is statistically significant. This study supported the findings of Oyewole et al. (2025), who attributed the strong readiness of value chain actors to adopt improved packaging technologies to strategic interventions that emphasize financing, collaboration, and education.

Table 6: Categorization of marketers, processors and marketers' willingness to adopt modern agro-product packaging technologies

Variables	Category	N	Observed Proportion	Test Proportion	Prob. Level
Farmers, processors and marketers' willingness to adopt modern packaging technologies	Willing to adopt (score: >20)	203	0.914	0.50	0.000
	Not willing to adopt (score: ≤ 20)	19	0.086		
	Total	222	1.000		

Source: Field Survey, 2025

Conclusion and Recommendations

This study demonstrates that modern packaging technologies hold strong potential to transform agro-product marketability in the FCT, yet their adoption remains uneven and heavily shaped by socio-economic realities. The evidence shows that while willingness to adopt is high, actual uptake is constrained by cost, access to credit, technical capacity, and weak institutional support. Crucially, socio-economic characteristics such as education, farm size, household labor, cooperative membership, and extension services decisively influence adoption outcomes. The verdict is clear: without targeted interventions that reduce financial barriers, strengthen institutional support, and build technical capacity, the transition from traditional to modern packaging will remain slow despite farmers' readiness.

Recommendations

Based on the study findings, the following recommendations are proposed:

1. Improve access to credit and financing: Financial institutions should design

flexible, low-interest credit schemes specifically for farmers, processors, and marketers. Strengthening cooperatives and linking them to microfinance institutions will enable more actors to secure funding for investments in improved packaging technologies.

2. Enhance technical capacity through extension services: Extension programs should incorporate targeted training on modern packaging practices, equipment use, and quality standards. This will improve technical competence and promote broader adoption of modern packaging innovations.
3. Invest in critical infrastructure: Stakeholders should prioritize investments in stable electricity, efficient transportation systems, and adequate storage facilities, which are crucial for the effective use of modern packaging technologies.

References

- Alibekov, R. S., Urazbayeva, K. U., Azimov, A. M., Rozman, A. S., Hashim, N., & Maringal, B. (2024). Advances in Biodegradable Food Packaging Using Wheat-Based Materials: Fabrications and Innovations, Applications, Potentials, and Challenges. *Foods*, 13(18), 2964. <https://doi.org/10.3390/foods13182964>
- Asim, Z., Shamsi, I.R.A., Wahaj, M., Raza, A., Abul Hasan, S., Siddiqui, S.A., Aladresi, A., Sorooshian, S., & Seng Teck, T. (2022). Significance of Sustainable Packaging: A Case-Study from a Supply Chain Perspective. *Applied System Innovation*, 5(6): e5060117. <https://doi.org/10.3390/asi5060117>
- Ayanwale, M.A., Molefi, R.R. & Liapeng, S. (2024). Unlocking educational frontiers: Exploring higher educators' adoption of google workspace technology tools for teaching and assessment in Lesotho dynamic landscape. *Heliyon*, 10(9):e30049. doi: 10.1016/j.heliyon.2024.e30049. PMID: 38720751; PMCID: PMC11076904
- Bertolozzi-Caredio, D. (2024). The farm succession effect on farmers'

- management choices. *Land Use Policy*, 137, 107014. ISSN 0264-8377
- Chiaka, J. C., Zhen, L., Yunfeng, H., Xiao, Y., Muhirwa, F., & Lang, T. (2022). Smallholder Farmers' Contribution to Food Production in Nigeria. *Frontiers in Nutrition*, 28(9), 916678. <https://doi.org/10.3389/fnut.2022.916678> (doi.org in Bing) PMID: 35990334; PMCID: PMC9384864.
- Du, L., Huang, X., Li, Z., Qin, Z., Zhang, N., Zhai, X., Shi, J., Zhang, J., Shen, T., Zhang, R., & Wang, Y. (2025). Application of Smart Packaging in Fruit and Vegetable Preservation: A Review. *Foods*, 14(3), 447. <https://doi.org/10.3390/foods14030447>
- Gadanakis, Y. (2024). Advancing Farm Entrepreneurship and Agribusiness Management for Sustainable Agriculture. *Agriculture*, 14(8), 1288. <https://doi.org/10.1016/j.landusepol.2023.107014>
- <https://doi.org/10.3390/agriculture13081559>
- <https://doi.org/10.3390/agriculture14081288>.
- <https://doi.org/10.3390/app142311074>
- <https://www.researchgate.net/publication/37087258>... On 23rd June, 2025
- Inyang, H. B., Esheya, S. E. & Udoh, M. I. (2023). Analysis of the Profitability of Poultry Egg Production in Etim Ekpo Local Government Area, Akwa Ibom State, Nigeria. *Journal of Agriculture and Food Sciences*, 21(1), 40-53.
- Kalogiannidis, S., Karafolas, S., & Chatzitheodoridis, F. (2024). The Key Role of Cooperatives in Sustainable Agriculture and Agrifood Security: Evidence from Greece. *Sustainability*, 16(16), 7202. <https://doi.org/10.3390/su16167202>
- Kenneth, K. (2025). About Kano State Population In 2025. Kano State Government, Nigeria. NaijaDetails. Retrieved at: <https://naijadetails.com/kano-state-population/>. On 13th October, 2025
- Mahmoud, M.A., Tsetse, E.K.K., Tulasi, E.E., & Muddey, D.K. (2022). Green Packaging, Environmental Awareness, Willingness to Pay and Consumers' Purchase Decisions. *Sustainability*, 14(23), 16091. <https://doi.org/10.3390/su142316091>
- Mapiye, O., & Dzama, K. (2024). Strengthening research-extension-farmer-input linkage system for sustainable smallholder livestock farming in Africa: Progress and prospects. *Tropical Animal Health and Production*, 56(8), 363. <https://doi.org/10.1007/s11250-024-04210-9> (doi.org in Bing)
- Missiamé, A., Akrong, R., & Appiah-Kubi, G. D. (2023). Collective action and farm efficiency of male- and female-headed farm households in Ghana. *Cogent Social Sciences*, 9(2). <https://doi.org/10.1080/23311886.2023.2270844>
- Mulungu, K., Kassie, M., & Tschopp, M. (2025). The role of information and communication technologies-based extension in agriculture: application, opportunities and challenges. *Information Technology for Development*, 1-30. <https://doi.org/10.1080/02681102.2025.2456232>
- Mutungi, C., Manda, J., Feleke, S., Abass, A., Bekunda, M., Hoshle-Zeledon, I. & Fischer, G. (2023). Adoption and impacts of improved post-harvest technologies on food security and welfare of maize-farming households in Tanzania: a comparative assessment. *Food Security* <https://doi.org/10.1007/s12571-023-01365-5>. Retrieved at: (<https://www.sciencedirect.com/science/article/pii/S0264837723004805>)
- Okwuokenye, G.F., Inyang, H.B. & Onyenze, G.U. (2024). The role of backyard livestock farming towards alleviating the poverty status of households in Abuja, Nigeria. *Nigerian Journal of Agriculture, Food and Environment* 20(2), 185-196.
- Onyemekihian, F., Okwuokenye, G. F. & Jov, E. (2023). Assessment of the perceived income earned from poultry farming: implications for poverty alleviation among poultry farmers in Federal Capital

- Territory, Abuja, Nigeria. *Nigerian Journal of Agriculture and Agricultural Technology (NJAAT)*. 3(1), 150 – 159.
- Oyewole, O.S., Raji, M.A, Kazeem, A.A., Ajao, T.O., Ibitoye, O., Abel, O.O., Solomon-Ibuwunwa, O.M., Famakinwa, J.O. & Adewumi, E.O. (2025). Smart technological innovations for postharvest loss reduction: A review, *FUDMA journal of sciences (FJS)*. 9(6),299 – 307.
- Rațu, R.N., Veleșcu, I.D., Stoica, F., Usturoi, A., Arsenoiaia, V.N., Crivei, I.C., Postolache, A.N., Lipșa, F.D., Filipov, F., Florea, A.M., Chițea, M.A., & Brumă, I.S. (2023). Application of Agri-Food By-Products in the Food Industry. *Agriculture*, 13(8), 1559.
- Shoaib, H. (2025). Key challenges & barriers to agricultural technology adoption. *Agricultural Technology Insights*. Retrieved from <https://www.agritechinsights.com>
- Srivastava, P., Ramakanth, D., Akhila, K., & Gaikwad, K. K. (2022). Package design as a branding tool in the cosmetic industry: Consumers' perception vs. reality. *SN Business Economics*, 2(6), 58. <https://doi.org/10.1007/s43546-022-00222-5> (doi.org in Bing)
- Sugri, I., Abubakari, M., Owusu, R.K. & Bidzakin, J.K. (2021). Postharvest losses and mitigating technologies: evidence from Upper East Region of Ghana. *Sustainable Futures*, 3, 100048,ISSN 2666-1888, <https://doi.org/10.1016/j.sftr.2021.100048>. (<https://www.sciencedirect.com/science/article/pii/S2666188821000071>)
- Tapsoba, L.D.S., Kiemde, S.M.A., Lamond, B.F. & Lépine, J. (2022). On the Potential of Packaging for Reducing Fruit and Vegetable Losses in Sub-Saharan Africa. *Foods*. 11(7), 952. doi: 10.3390/foods11070952. PMID: 35407038; PMCID: PMC8997940.
- Taramuel-Taramuel, J. P., Montoya-Restrepo, I. A., & Barrios, D. (2023). Drivers linking farmers' decision-making with farm performance: A systematic review and future research agenda. *Heliyon*, 9(10), e20820. <https://doi.org/10.1016/j.heliyon.2023.e20820> (doi.org in Bing)
- Wilfred, E. C., & Onyeakusiobi, T. V. (2017). Influences of packaging on consumers' choice of agricultural products in Enugu, Nigeria. *Turkish Journal of Agriculture - Food Science and Technology*, 5(5), 484–487. <https://doi.org/10.24925/turjaf.v5i5.484-487.1035> (doi.org in Bing)
- Zdulski, J.A., Rutkowski, K.P., & Konopacka, D. (2024). Strategies to Extend the Shelf Life of Fresh and Minimally Processed Fruit and Vegetables with Edible Coatings and Modified Atmosphere Packaging. *Applied Sciences*, 14(23), 11074.