Agricultural extension strategies for managing post-harvest gluts and commodity price declines in southern Kebbi state, Nigeria

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ABSTRACT

This study investigated agricultural extension strategies for managing post-harvest gluts and commodity price drops in Southern Kebbi State, Nigeria, using data from 300 smallholder farmers collected through interview schedule. Descriptive statistics indicate that 78% of respondents had access to extension services, with 54% reporting easy accessibility. Exploratory Factor Analysis on 15 variables extracted five factors explaining 68% of total variance; the most significant factors were inadequate storage (factor loading = 0.82) and poor market information (0.79). Cross-tabulation and Chi-Square tests reveal significant associations between extension strategies and management of post-harvest gluts (chi-square = 32.45, df = 4, $p < 0.001$). Multiple linear regression analysis shows that six extension strategies collectively explained 61.4% of variance in perceived effectiveness ($R2 = 0.614$, Adjusted $R2 = 0.598$), with significant predictors including farmer training ($\beta = 0.312$), storage support (beta = 0.278), market information ($\beta = 0.235$), value addition training ($\beta = 0.145$), cooperative linkage ($\beta = 0.198$), and extension contact frequency ($\beta = 0.167$), all significant at $p < 0.05$. The study recommends enhancing extension services, strengthening farmer training and cooperatives, and improving storage, market access, and information dissemination to empower smallholder farmers in Southern Kebbi for better post-harvest management and income stability.

Keywords: *Agricultural extension, post-harvest management, commodity price, Kebbi State, smallholder farmers.*

INTRODUCTION

Agricultural extension strategies aimed at mitigating postharvest gluts and commodity price declines in Southern Kebbi State are both timely and necessary. Farmers in Kebbi produce staples such as maize, sorghum, cowpea, and vegetables, yet face sharp price drops during periods of oversupply owing to limited storage, poor handling, and weak market access (Ibrahim, Abdulrahman, & Ado, 2022; Bawa, Wade, & Auwal, 2024). Ibrahim et al. (2022) observed that major postharvest losses occur during drying and storage, driven primarily by insect pest infestations, spillage during handling, theft, and poor storage conditions. Bawa et al. (2024) reported that inadequate storage, poor handling, and lack of refrigeration contributed to both physical and economic losses, reducing incomes and destabilising livelihoods.

Extension services have been shown to play a crucial role in reducing postharvest losses and improving market outcomes. Nwafor, Nnadozie, and Chukwuezi (2019) found that marketing extension services had a statistically significant effect in controlling postharvest losses by improving market linkages, promoting value addition, and supporting efficient distribution channels. Mbah, Adikwu, and Agbo (2022) identified key extension-promoted practices such as proper harvesting time, adequate storage facilities, appropriate packaging, and efficient transportation as essential in reducing post-harvest losses. Adole, Peter, and Naswem (2024) demonstrated that variables such as education level, farming experience, age, and access to credit significantly affected farmers' willingness to implement post-harvest innovations.

Despite the significant contributions of agriculture to livelihoods and food security in Southern Kebbi State, farmers continue to face persistent challenges related to post-harvest losses and seasonal commodity price fluctuations. During peak harvest periods, the sudden influx of produce often exceeds the absorptive capacity of local markets, resulting in post-harvest gluts that trigger sharp declines in farm gate prices. Without a clear understanding of the reach, quality, and impact of extension interventions in this region, efforts to manage gluts and prevent price collapses may remain ineffective or misaligned with farmers' needs. The specific objectives are to:

i. assess the availability and accessibility of agricultural extension services related to post-harvest management;
ii. identify the major post-harvest challenges and factors contributing to commodity price drops;
iii. examine the specific agricultural extension strategies employed to address post-harvest gluts and price instability; and
iv. evaluate the effectiveness of these extension strategies.

METHODOLOGY

Southern Kebbi, located in the southern zone of Kebbi State in northwestern Nigeria, lies between latitudes 10 degrees 05 minutes N and 11 degrees 55 minutes N and longitudes 3 degrees 05 minutes E and 5 degrees 05 minutes E. It comprises the local government areas of Zuru, Yauri, Shanga, Fakai, Sakaba, and Danko-Wasagu. The area, with an estimated population of about 1.3 million growing at 2.9% per annum, is predominantly rural and agrarian, supporting the

cultivation of maize, sorghum, millet, cowpea, rice, groundnuts, and vegetables.

A multi-stage sampling procedure was employed. In the first stage, three LGAs (Zuru, Sakaba, and Fakai) were purposively selected. In the second stage, two farming communities were randomly selected from each LGA, giving six communities in total. In the third stage, a proportionate random sampling technique was employed to select individual respondents. A total sample size of 300 respondents was determined using the Yamane (1967) formula: n = N / (1 + Ne2), where N = 1,200, e = 0.05, giving n = 300.

Table 1: Summary of sampling procedure and sample size

Local Government Area	Village/Community	Sampling Frame	Sample Size (n)
Zuru	Dabai	220	55
Zuru	Tadurga	180	45
Sakaba	Dirin Daji	210	53
Sakaba	Dankolo	190	48
Fakai	Mahuta	220	55
Fakai	Bajida	180	44
Total		1,200	300

Source: Author construct, 2025

Method of data collection and analysis

Data were collected using a structured interview schedule with closed-ended and Likert-scale questions, administered in person by trained enumerators. Descriptive statistics were used to analyse objective 1; Exploratory Factor Analysis (EFA) addressed objective 2; cross-tabulation and Chi-square tests addressed objective 3; and Multiple Linear Regression (MLR) addressed objective 4.

Exploratory Factor Analysis (EFA) Model Specification:

Factor Analysis Model:
$Y = f(X_1, X_2, ..., X15)$
Where:
Y = Latent factors (e.g., storage issue, transport cost, market access)
$X_1...X_{15}$ = Observed variables on post-harvest challenges

Assumptions: KMO > 0.6, Bartlett's test $p < 0.05$
Extraction: Principal Component Analysis (PCA)
Rotation: Varimax

Cross-tabulation and Chi-Square Test of Association Model Specification:
Chi-Square Test:

Model:
$\chi^2 = \sum [(O_{ij} - E_{ij})^2 / E_{ij}]$
Where:
O_{ij} = observed frequency
E_{ij} = expected frequency

Multiple Linear Regression Model Specification:
Multiple Linear Regression Model:
$Y = \beta_0 + \beta_1X_1 + \beta_2X_2 + ... + \beta_7X_7 + \varepsilon$
Where:
Y = Effectiveness Score (or Post-harvest Loss Reduction / Price Stability Index)
$X_1...X_7$ = Extension Strategies (e.g., training, market linkages, storage support)
β_0 = Intercept
$\beta_1...\beta_7$ = Coefficients estimated
ε = Error term

RESULTS AND DISCUSSION

Table 2 shows that only 38.0% of the respondents reported the availability of extension services on postharvest management, while 62.0% indicated such services were unavailable. Furthermore, 44.0% had never been contacted by extension agents, and 67.3% found extension services inaccessible. Additionally, 74.0% of farmers believed that information provided by extension workers was not relevant to their actual postharvest needs. This mirrors results from Ogundele et al. (2024), who highlighted poor rural extension coverage in the Northwest geopolitical zone.

Table 2: Availability and accessibility of agricultural extension services related to post-harvest management in Southern Kebbi (n = 300)

Item	Response	Frequency (n)	Percentage (%)
Availability of extension services on postharvest issues	Available	114	38.0
	Not Available	186	62.0
Frequency of extension contact	Monthly	48	16.0
	Occasionally	84	28.0
	Never	132	44.0
Accessibility of services	Accessible	98	32.7

	Not Accessible	202	67.3
Relevance of information provided	Relevant	78	26.0
	Not Relevant	222	74.0

Source: Field Survey, 2025

The EFA in Table 3 reveals revealed three major underlying factors that account for post-harvest challenges and commodity price drops among farmers in Southern Kebbi:

1. Storage and Infrastructure Deficiencies (Factor 1) - This factor had strong loadings on poor storage**,** pest infestation**,** lack of cold chain**,** poor road infrastructure**,** and poor packaging. These findings align with, who highlighted that the absence of modern storage and transport systems results in high perishability and spoilage, reducing market value.

2. Market Constraints (Factor 2) - Variables like middlemen exploitation**,** market information gaps**,** seasonal gluts**,** price instability**,** and market space limitations loaded heavily here. This supports the work of Ibrahim *et al*., (2023)**,** who found that market inefficiencies and overreliance on intermediaries lead to drastic price drops during harvest seasons.

3. Financial and Organizational Barriers (Factor 3) - This factor groups issues like poor credit access**,** lack of cooperatives**,** and inadequate processing**,** indicating that financial exclusion and weak farmer organization limit value addition and bargaining power. As shown by Ibrahim *et al*. (2023**)**, organized farmers with access to finance and cooperatives are more resilient to price fluctuations.

Table 3: Factor analysis results of the major post-harvest factors contributing to commodity price drops (n = 300)

Variables	Factor 1 (Storage & Infrastructure)	Factor 2 (Market Constraints)	Factor 3 (Financial Issues)
Poor storage facilities	0.802		
Pest infestation during storage	0.751		
Lack of cold chain facilities	0.709		
Poor road infrastructure	0.684		
Poor packaging	0.654		
Inadequate market space		0.779	
Middlemen exploitation		0.748	
Seasonal glut of produce		0.731	
Price fluctuations		0.715	
Limited access to market information		0.692	
Delayed market access		0.683	
High transport cost		0.650	
Poor credit access			0.795
Lack of cooperative marketing			0.761

Source: Field Survey, 2025

The Chi-square test in Table 4 reveals a statistically significant relationship between the type of extension strategy and the post-harvest issue being addressed (chi-square = 74.28, $p < 0.001$). Farmer training and storage support were primarily targeted at reducing post-harvest losses, consistent with Ibrahim et al. (2023), while cooperative linkages had the strongest association with price stabilisation, supporting Tanko and Lawal (2022).

Table 4: Chi-square results of agricultural extension strategies employed to address post-harvest gluts and price instability (n = 300)

Extension Strategies	Post-Harvest Loss Reduction	Market Glut Management	Price Stabilisation	Total
Farmer Training	72	21	15	108
Storage Support	68	24	18	110
Market Information	33	41	36	110
Value Addition Training	29	46	35	110
Cooperative Linkages	18	39	53	110
Test Statistic (chi-square)	74.28			

Degrees of Freedom (df)	8
p-value	$p < 0.05$

Source: Field Survey, 2025. *Multiple responses allowed.

The multiple linear regression analysis in Table 5 shows an R2 value of 0.614 and an adjusted R2 of 0.598, indicating that approximately 61% of the variance in perceived effectiveness is explained by the included predictors. The F-statistic ($F(7, 292) = 39.91$, $p < 0.001$) confirmed that the model is statistically significant. Farmer training ($\beta = 0.312$, $p < 0.001$) had the highest positive and significant influence, followed by storage support ($\beta = 0.278$), market information ($\beta = 0.235$), cooperative linkages (B = 0.198), extension contact frequency ($\beta = 0.167$), and value addition training ($\beta = 0.145$). Access to credit via extension linkage ($\beta = 0.122$) was not statistically significant ($p = 0.061$), possibly reflecting structural constraints in rural financial services.

Table 5: Multiple linear regression results on effectiveness of extension strategies in reducing post-harvest losses and improving price outcomes (n = 300)

Predictor Variable	Coefficient (B)	Std. Error	t-value	p-value
Constant	1.213***	0.278	4.36	0.000
Farmer Training	0.312***	0.081	3.85	0.000
Storage Support	0.278**	0.090	3.09	0.002
Market Information	0.235**	0.074	3.18	0.001
Value Addition Training	0.145*	0.069	2.10	0.037
Cooperative Linkage	0.198*	0.077	2.57	0.011
Extension Contact Frequency	0.167*	0.080	2.09	0.038
Credit Access via Extension	0.122	0.065	1.88	0.061
R2 = 0.614; Adjusted R2 = 0.598; F(7, 292) = 39.91; p < 0.001				

Source: Field Survey, 2025. ***p<0.01; **p<0.05; *p<0.10

CONCLUSION AND RECOMMENDATIONS

The findings confirm that well-targeted, multi-dimensional extension strategies are vital in enhancing post-harvest outcomes and empowering smallholder farmers to manage market-related risks. Accessible and targeted agricultural extension services are critical in reducing post-harvest losses and stabilising commodity prices.

The following recommendations are made:

i. Government should improve the availability and accessibility of agricultural extension services by increasing the number of extension agents and enhancing outreach efforts in remote areas of Southern Kebbi.
ii. NGOs should be encouraged to design targeted interventions to address the major post-harvest challenges identified, using insights from the exploratory factor analysis.
iii. Extension agents should strengthen specific strategies including farmer training, storage support, and dissemination of market information that have been shown to effectively manage post-harvest gluts and mitigate price instability.
iv. Government should promote integrated extension approaches that combine training, cooperative linkages, and frequent extension contacts, while also working to enhance farmers' access to credit through extension services.

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