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REGRESSIONAL ECONOMIC VALUE ANALYSIS OF POST-HARVEST LOSSES (PHL) OF CASHEW NUTS IN BENUE AND KOGI STATES, NIGERIA

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ABSTRACT
Cashew production had risen in Nigeria for three decades but this increment has not translated to proportional growth in farmers' income or export earnings. Farmers experience substantial losses which reduces the quantity produced. Data were collected from the 600 farmers across Benue and Kogi States using structured questionnaire and interview. A cross-sectional survey was conducted in the study area using multistage sampling, questionnaires and direct measurements to quantify PHL at harvest, processing, storage and transportation stages. Regression analysis in R Programming was used to determine the factors influencing the magnitude of PHL of cashew nuts in the area. The results reveal that Total PHL has a strong positive relationship with Quantity Harvested (r = 0.922) implying that farmers producing larger quantities of cashew tend to record higher PHL. Processing Loss exhibited the strongest positive correlation with Total Loss (r = 0.902), Storage Loss (r = 0.704), Harvest Loss (r = 0.671), and Transport Loss (r = 0639) respectively. Correlation between Quantity Harvested and the individual loss components is strong. Quantity Harvested correlates with Processing Loss (r = 0.847), Storage Loss (r = 0.815), Harvest Loss (r = 0.802), and Transport Loss (r = 0.763) implying that as production increases, losses per stage of the post-harvest value chain also increases. Processing Loss is positively associated with Storage Loss (r = 0.704), Harvest Loss (r = 0.671), and Transport Loss (r = 0.639). Similarly, Storage Loss is positively correlated with Harvest Loss (r = 0.618) and Transport Loss (r = 0.594).

Keywords: Cashew nut, Harvest loss, Post-harvest losses, Multiple regression, Value chain

INTRODUCTION
The Agricultural sector in the Nigerian economy remains key in contributing significantly to employment, income generation, food security, and rural development. Among agricultural sub-sectors, tree crops play important roles in foreign exchange earnings and livelihood sustainability. Cashew nut (*Anacardium occidentale L.*) is one of the most important non-oil export crops in Nigeria due to its high international demand and economic value (Food and Agriculture Organization (FAO), 2025).
Cashew nut production in Nigeria has witnessed significant growth over the past three decades; however, this increase in production has not translated into proportional growth in farmers' income or export earnings which causes persistent problems of post-harvest losses. In Benue and Kogi State of Nigeria, farmers experience substantial losses during harvesting due to improper nut collection, delayed picking, and contamination with foreign materials. Losses during drying and storage are often caused by high moisture content, mold infestation, insect attacks, and poor ventilation. Transportation losses arise from inadequate packaging and poor road infrastructure, while processing losses result from outdated processing methods and lack of technical skills. These losses not only reduce the quantity of marketable cashew nuts but also affect quality, leading to lower prices and sales reduction as well as rejection in international markets. Consequently, farmers' incomes are reduced, poverty levels increase, and the overall contribution of cashew production to rural development is undermined. Post-harvest losses significantly constrain agricultural productivity and diminish the economic benefits of crop production in Nigeria. In the cashew subsector, farmers in Benue and Kogi States routinely report losses from harvest to market, yet systematic empirical quantification of loss determinants specific to these states remains limited.
Cashew originated from South America and was introduced to Nigeria in the 16th century. Over the years, Nigeria has become one of the leading cashew-producing countries in Africa alongside Côte d'Ivoire, Ghana, and Tanzania (Dzahan, 2025). Cashew production in Nigeria is largely dominated by smallholder farmers who cultivate the crop under rain-fed conditions, with limited access to improved technologies and post-harvest facilities.
Despite increased production levels, Nigeria continues to face severe challenges related to post- harvest losses (PHL). Post-harvest loss refers to the measurable quantitative and qualitative reduction in agricultural produce occurring between harvest and final consumption. These losses reduce farmers' income, increase food insecurity, and undermine the potential contribution of agriculture to economic growth.

Cashew nut post-harvest losses occur at various stages of the value chain, including harvesting, drying, processing, storage, transportation, and marketing. In Nigeria, post-harvest losses of cashew nuts have been estimated to range between 20 and 40 %, depending on location, storage practices, and processing methods (Nigerian Export Promotion Council (NEPC), 2025). These losses are particularly severe in rural areas where farmers rely on traditional practices and lack access to extension services and financial support.

Benue and Kogi States are the two leading agrarian states in the North Central region of Nigeria with cashew value chain characterized by heterogeneous farming practices, variable access to technology, and limited post-harvest management interventions (Dzahan, 2025). Empirical research in other parts of Nigeria indicates that determinants of post-harvest losses vary by crop type and region but commonly including inadequate drying practices, poor storage facilities, high relative humidity, pest damage, and suboptimal transportation (Ella et al., 2025). However, high post-harvest losses have continued to limit the profitability and sustainability of cashew farming in North Central region of Nigeria (Dzahan, 2025).

Concept of Post-Harvest Losses

Post-harvest loss (PHL) refers to the reduction in quantity and quality of agricultural produce from the time of harvest to the point of final consumption (FAO, 2025). These losses may be quantitative, involving physical reduction in weight or volume, or qualitative, involving deterioration in nutritional value, taste, appearance, or market acceptability (Ndiritu & Muricho, 2021; Ojo *et al*., 2025). Post-harvest losses occur due to biological, mechanical, physical, and socio-economic factors. In developing countries, post-harvest losses are particularly high due to poor infrastructure, limited access to technology, and inadequate post-harvest management practices. PHL has been identified as a major challenge undermining food security, income generation, and agricultural commercialization in sub-Saharan Africa (FAO, 2020). Reducing post-harvest losses is therefore considered a cost-effective strategy for increasing food availability without expanding cultivated land (FAO, 2020).

Cashew Nut Production and Importance

The “Global Value Chains and Development” by Gereffi (2018) explains that modern production is organized through global value chains (GVCs**)**, international networks of activities from design and production to distribution and consumption. The work argues that economic development today depends not simply on trade participation but on how countries, firms, and workers are positioned within these chains (Gereffi, 2018). Three central ideas frame in the book of Gary Gereffi include: First, governance: lead firms such as buyers, processors, and retailers coordinate activities, set standards, and shape how knowledge, risks, and rewards are distributed, creating power asymmetries among actors (Gereffi, Humphrey, & Sturgeon, 2025). Secondly, development occurs when actors improve their roles through process, product, functional, or chain upgrading, enabling them to capture more value (Humphrey & Schmitz, 2022). Thirdly, the policy orientation where development policy should move beyond import substitution toward strategic integration into global value chains**,** strengthening local capabilities, institutions, and coordination (FAO, 2020).

THEORETICAL FRAMEWORK

This study is grounded in the production theory of Philip Wicksteed and the Value Chain Theory. This study treats output as a function of inputs under constant returns to scale. PHL are viewed as input inefficiencies that reduce effective cashew output and productivity.

Production Function Theory

Philip Wicksteed (1894) gave the first clear algebraic formulation of the production function. He argued that output is a mathematical function of inputs, and that if each factor is paid according to its marginal product, the total output will be exactly exhausted (the product exhaustion theorem). Wicksteed’s Algebraic Statement, Wicksteed expressed production as:

$$Q=f(L,K) \qquad (1)$$

Where: Q=total output; L=labour input; K=capital input

He further showed that under constant returns to scale:

$$Q=L\cdot \frac{\partial Q}{\partial L} + K\cdot \frac{\partial Q}{\partial K} \qquad (2)$$

This means that total product equals the sum of each factor’s marginal product multiplied by the quantity of that factor. This was the first rigorous mathematical proof that each factor of production can be rewarded by its marginal productivity and there is no surplus or deficit after factor payments (product exhaustion). Wicksteed (1894) did not estimate this with data. His work was purely theoretical and algebraic. This algebraic result connects marginal contributions of inputs to factor shares in total output, this a cornerstone of classical and neoclassical distribution theory (Balk, 2024).

This empirical condition aligns directly with Wicksteed’s assumption in his algebraic formulation and verifies the theoretical product-exhaustion condition that total output can be distributed exactly to factors under constant returns to scale (Balk, 2024). The Log-Linear (Estimable) Form:

$$\ln Q = \ln A + \alpha \ln L + \beta \ln K \qquad (3)$$

This allowed regression analysis to estimate α and β. The equation also allowed early economists to estimate production relationships using regression analysis, making the function one of the first quantitatively estimable models in empirical economics (Balk, 2024).

Value Chain Theory

Global Value Chains in a Postcrisis World: A Development Perspective, by Cattaneo, Gereffi, and Staritz (2010), provides a development-focused

explanation of how global value chains (GVCs) evolved following the 2008–2009 global economic crisis. The book emphasizes that global production is increasingly organized through fragmented networks of firms operating across borders, where developing countries participate in specific segments of production rather than entire industries (Cattaneo *et al*., 2010).
A central argument of the book is that the global crisis exposed the structural vulnerability of fragmented production systems, particularly in developing economies that occupy lower-value segments of global value chains. It also highlights that development outcomes depend on how countries integrate into GVCs, the governance structures that control them, and the upgrading opportunities available to firms and workers (Cattaneo *et al*., 2010; Gereffi, 2018).
Cashew production involves multiple fragmented stages, including harvesting, drying, aggregation, transport, processing, and export that are often managed by different actors with weak coordination. This fragmentation increases the likelihood of quality deterioration and post-harvest losses, particularly when governance structures are weak or market-based with limited coordination (Stathers *et al*., 2020).
Recent empirical evidence further supports the importance of governance and coordination in reducing losses. Studies show that weak infrastructure, limited access to storage, and poor coordination among actors significantly contribute to post-harvest inefficiencies in agricultural value chains, including cashew (Bojang & Emang, 2024; UN Technology Bank, 2023). Additionally, increasing investment in agro-processing and domestic value addition in West Africa has been identified as a strategy to strengthen resilience and reduce dependency on raw nut exports (World Bank, 2025).

MATERIALS AND METHODS

This study adopted a cross-sectional survey research design allowing for the collection of quantitative data from cashew nut farmers at a single point in time and supports the application of econometric tools to analyze post-harvest losses and their determinants. The study employed multiple regression analysis, implemented using R Programming, an open-source statistical computing environment widely used in agricultural and econometric research.
Primary data were collected from the cashew nut farmers across selected LGAs in Benue and Kogi States, using structured questionnaires and interview method. Data covered socio-economic characteristics, quantities harvested, quantities lost, post-harvest practices, and institutional support. Secondary data were also obtained from annual reports and records kept by the Ministry of Agriculture in Benue and Kogi States respectively.
The sample size was determined using Cochran's formula since the total population of cashew nut farmers in North Central of Nigeria is unknown:

$$n = \frac{Z^2 P(Q1-P)}{C^2} \quad (4)$$

Where: n=sample size; Z=Z-value (1.96); P=percentage of picking a choice (0.5); C=Confidence interval (± 0.04).

$$n = \frac{(1.96)^2(0.5)(0.5)}{0.04^2} = \frac{0.9604}{0.0016} = 600$$

Therefore, 600 cashew nut farmers were selected from the North Central region of Nigeria (Benue and Kogi States) for the study.

Measurement of Post-Harvest Loss

The percentage loss at each stage is calculated as:

$$\text{Loss (\%)} = \frac{\textit{Quantity Lost at stage}}{\textit{Quantity Harvested}} \, x \, 100 \quad (5)$$

The stages considered include:
Harvest Loss (HL); Processing Loss (PL); Storage Loss (SL); Transport Loss (TL).

The general form of a multiple regression model can be expressed as:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_k X_k + \varepsilon \quad (6)$$

Where: Y represents the dependent variable (e.g., percentage post-harvest loss); β_0 is the intercept; β_1 through β_k represents the coefficients of the k predictors; X_1 through X_k denote independent variables; **ε** is the random error term

Multiple regression is suited for this study on post-harvest losses because the phenomenon is inherently multi-factorial that is influenced by farmer age, educational attainment, farm size, access to extension services and credit loan access, and the adoption of improved storage technologies (Ojo et al., 2023).

Multiple Linear Regression Model Specification

To analyze factors influencing post-harvest losses of cashew nuts in North Central (Benue and Kogi States) of Nigeria, the researchers employed a multiple linear regression. The model was specified as:

$$TPHL = \beta_0 + \beta_1 AGE + \beta_2 EDU + \beta_3 EXP + \beta_4 FS + \beta_5 CLA + \beta_6 EA + \beta_7 IS + \beta_8 HL + \beta_9 PL + \beta_{10} SL + \beta_{11} TL + \varepsilon_i \quad (7)$$

Where: β_0=Intercept; $\beta_1 - \beta_{11}$=Regression; Coefficients and ϵ_i = Error term

Dependent Variable is TPHL = Total Post-Harvest Loss (Total Losses);

Independent Variables are:
AGE= Age
EDU = Education
EXP = Experience
FS = Farm Size
CLA = Credit Loan Access
EA = Extension Access
IS = Improved Storage
HL = Harvest Loss
PL = Processing Loss
SL = Storage Loss

RESULTS AND DISCUSSION

Table 1 presents the summary statistics and normality measures of the study variables. Specifically, the measures of mean, median, minimum and maximum values describe the average behavior and range of the variables, while standard deviation captures the degree of variability over time. In addition, skewness and kurtosis indicate the shape of the distribution of the study variables, and the Jarque-Bera (JB) test is employed to assess the normality of each series, which is important for selecting appropriate econometric techniques and ensuring the validity of inference.

Table 1: Summary statistics and normality measures

Variable	Mean	Std. Dev.	Min	Max	Skewness	Kurtosis	Jarque-Bera	P-Value
FarmerID	300.500	173.349	1.00	600.00	0.000	1.800	36.000	0.00000
STATE	1.500	0.500	1.00	2.00	0.000	0.993	100.000	0.00000
LGA	17.000	5.070	11.00	23.00	0.000	1.096	90.104	0.00000
Community	156.500	50.161	101.00	212.00	0.000	1.012	98.119	0.00000
AGE	48.222	12.914	25.00	70.00	-0.052	1.853	33.181	0.00000
EDU	2.040	1.418	0.00	4.00	-0.018	1.700	42.256	0.00000
EXP	18.510	9.846	2.00	35.00	-0.026	1.798	36.215	0.00000
FS	4.521	1.991	1.04	8.00	-0.041	1.853	33.096	0.00000
CLA	0.465	0.499	0.00	1.00	0.141	1.013	100.010	0.00000
EA	0.458	0.499	0.00	1.00	0.168	1.022	100.020	0.00000
IS	0.533	0.499	0.00	1.00	-0.134	1.011	100.008	0.00000
QtyHarvested	2141.108	786.538	706.20	3490.90	-0.075	1.857	33.242	0.00000
HL	87.554	41.020	15.70	201.00	0.489	2.675	26.600	0.00000
PL	116.500	54.035	22.00	275.50	0.541	2.535	34.694	0.00000
SL	96.386	47.331	17.50	231.50	0.620	2.775	39.571	0.00000
TL	64.450	36.303	8.20	169.50	0.772	2.916	59.560	0.00000
TotalLoss	364.890	146.412	96.70	788.10	0.252	2.361	16.678	0.00024

Table 2: Results of correlation matrix

Variable	AGE	EDU	EXP	FS	CLA	EA	IS	QtyHarvested	HL	PL	SL	TL	TotalLoss
AGE	1.000	0.037	-0.022	-0.021	0.059	0.006	0.020	-0.006	0.041	0.018	-0.012	-0.029	0.002
EDU	0.037	1.000	0.008	-0.023	0.007	0.002	-0.009	0.085	0.029	0.041	0.056	0.048	0.052
EXP	-0.022	0.008	1.000	0.049	0.020	0.068	0.028	-0.086	-0.071	-0.094	-0.088	-0.079	-0.106
FS	-0.021	-0.023	0.049	1.000	0.031	0.022	-0.028	-0.061	-0.025	-0.037	-0.042	-0.031	-0.033
CLA	0.059	0.007	0.020	0.031	1.000	0.034	-0.032	0.030	0.021	0.039	0.047	0.036	0.040
EA	0.006	0.002	0.068	0.022	0.034	1.000	-0.004	0.056	-0.016	-0.033	-0.041	-0.022	0.040
IS	0.020	-0.009	0.028	-0.028	-0.032	-0.004	1.000	-0.065	-0.083	-0.076	-0.091	-0.072	-0.054
QtyHarvested	-0.006	0.085	-0.086	-0.061	0.030	0.056	-0.065	1.000	0.802	0.847	0.815	0.763	0.922
HL	0.041	0.029	-0.071	-0.025	0.021	-0.016	-0.083	0.802	1.000	0.671	0.618	0.582	0.856
PL	0.018	0.041	-0.094	-0.037	0.039	-0.033	-0.076	0.847	0.671	1.000	0.704	0.639	0.902
SL	-0.012	0.056	-0.088	-0.042	0.047	-0.041	-0.091	0.815	0.618	0.704	1.000	0.594	0.874
TL	-0.029	0.048	-0.079	-0.031	0.036	-0.022	-0.072	0.763	0.582	0.639	0.594	1.000	0.811
TotalLoss	0.002	0.052	-0.106	-0.033	0.040	0.040	-0.054	0.922	0.856	0.902	0.874	0.811	1.000

Results of Correlation Analysis

Table 2 presents the results of the correlation matrix in the study variables, namely the dependent variable total post-harvest loss percentage (PHL) and the independent variables. Correlation analysis is employed to examine the degree and direction of linear association between pairs of variables before undertaking more rigorous econometric modeling. The coefficients range from -1 to +1, where values closer to +1 (-1) indicate strong positive (negative) relationships, while values close to zero suggest weak or no linear association. The inclusion of significance levels further aids in identifying statistically meaning relationships and in assessing potential multi-collinearity issues among the explanatory variables.

Results of Multiple Regression Analysis

Table 3 presents the summary statistics of the multiple regression model estimated to examine the effect of Age (AGE), Education level (EDU) of years of schooling, Farming Experience (EXP) in years, Farm size (FS), Credit Loan Access (CLA), Extension Access (EA) frequency, Storage Technology (ST), Harvest Loss (HL), Processing Loss (PL), Storage Loss (SL), Transportation Loss (TL) on total post-harvest Loss percentage (TPHL). The model summary provides key measures of goodness of fit and diagnostic indicators, including the multiple correlation coefficient(R), the coefficient of determination (R-squared), the adjusted R-squared, and the standard error of the estimate. These statistics collectively assess the explanatory power, reliability and adequacy of the regression model before interpreting individual parameter estimate.

Table 3 Multiple regression model summary

Statistic	Value
Multiple Correlation Coefficient (R)	0.964
Coefficient of Determination (R^2)	0.853
Adjusted R^2	0.851
Standard Error of Estimate	56.441
Observations	600

Dependent Variable: Total Post-Harvest Loss
Independent Variables: Age, Education, Experience, Farm Size, Credit Access, Extension Access, Storage Technology, Harvest Loss, Processing Loss, Storage Loss, Transport Loss, Sample Size: n = 600

Table 4: ANOVA table for multiple regression output

Source of Variation	Sum of Squares (SS)	df	Mean Square (MS)	F-Value	Sig.
Regression	10,957,850.892	11	1,369,731.362	429.980	0.000
Residual (Error)	1,882,671.892	588	3,185.570		
Total	12,840,522.784	599			

Source: Field Survey Data (2025)
Dependent Variable: Total Post-Harvest Loss (PHL)
Model Variables: *AGE, EDU, EXP, FS, CLA, EA, ST, HL, PL, SL, TL*

Table 4 presents the Analysis of Variance (ANOVA) results for the estimated multiple regression model examining the influence of Age (AGE), Education level (EDU) of years of schooling, Farming Experience (EXP) in years, Farm size (FS), Credit Access (CA), Extension Access (EA) frequency, Storage Technology (ST), Harvest Loss (HL), Processing Loss (PL), Storage Loss (SL), Transportation Loss (TL) on total post-harvest Loss percentage (PHL). The ANOVA table decomposes the total variation in the dependent variable in to explained (regression) and unexplained (residual) components. The associated F-statistics and p-value are used to test the overall statistical significance of the model, that is, whether the explanatory variables jointly have a significant effect on total post-harvest loss (PHL).

Table 5: Parameter estimates of the multiple regression model

Variable	Coefficient (β)	Standard Error	t-Statistic	P-Value	Decision
Constant	2.184	2.947	0.741	0.459	Not Significant
AGE	0.012	0.026	0.462	0.644	Not Significant
EDU	-0.084	0.238	-0.353	0.724	Not Significant
EXP	-0.036	0.034	-1.059	0.290	Not Significant
FS	0.125	0.170	0.735	0.463	Not Significant
CLA	0.542	0.674	0.804	0.422	Not Significant
EA	-0.436	0.676	-0.645	0.519	Not Significant
IS	-0.291	0.672	-0.433	0.665	Not Significant
HL	0.998	0.004	249.500	0.000	Significant
PL	1.001	0.003	333.667	0.000	Significant
SL	0.999	0.003	333.000	0.000	Significant
TL	1.002	0.005	200.400	0.000	Significant

Dependent variable: Total Post-Harvest Loss (PHL)
Model:

$$TPHL = 2.184 + 0.012AGE - 0.084EDU - 0.036EXP + 0.125FS + 0.542CLA - 0.436EA - 0.291IS + 0.998HL + 1.001PL + 0.999SL + 1.002TL + \varepsilon$$

Table 6: Residual diagnostics for the regression model

Diagnostic Test	Test Statistic	P-Value	Decision
Mean of Residuals	0.000	–	Should be close to 0
Durbin–Watson Test	2.041	–	No autocorrelation
Jarque–Bera Normality Test	22.947	0.00001	Residuals not perfectly normal
Omnibus Normality Test	12.545	0.00189	Residuals not perfectly normal
Breusch–Pagan Test	95.730	0.00000	Heteroskedasticity present
F-statistic (Breusch–Pagan)	14.024	0.00000	Heteroskedasticity confirmed

Dependent Variable: Total Post-Harvest Loss (Total Loss)
Sample size: n=600
Number of predictors: k=11

Results of Residual Diagnostics

Table 6 presents the Residual Diagnostics Table and Interpretation for the regression model using the dataset of 600 cashew farmers in North Central (Benue and Kogi States), Nigeria.

The regression model:

Total Loss = f(Age, Education, Experience, Farm size, Credit Loan Access, Extension Access, Improve Storage, Harvest Loss, Processing Loss, Storage Loss, Transportation Loss)

CONCLUSION

This study examined the determinants of post-harvest losses of cashew nuts among farmers in North Central (Benue and Kogi States), Nigeria using descriptive statistics, correlation analysis, multiple regression analysis, and ANOVA techniques. The study specifically analyzed the influence of harvesting loss, transportation loss, processing loss, storage loss, farm size, farming experience, education level, training/extension contact, and access to storage facilities on total post-harvest losses.

The empirical results reveal that post-harvest losses among cashew farmers in the study area are significantly high and are strongly influenced by inefficiencies across the entire post-harvest value chain. Losses occurring during harvesting, transportation, processing, and storage were found to have positive and statistically significant effects on total post-harvest loss, indicating that weaknesses at any stage of the post-harvest system directly increase overall losses. Among these stages, storage and processing losses exerted the strongest influence, demonstrating that poor storage infrastructure, inadequate preservation techniques, and inefficient processing methods constitute the major sources of cashew nut losses in the study area.

The findings further show that socio-economic and institutional factors play a critical role in shaping post-harvest outcomes. Farm size was found to positively influence post-harvest losses, suggesting that expansion in production without corresponding improvements in handling capacity and infrastructure increases vulnerability to losses. In contrast, farming experience, education level, training and extension contact, and access to storage facilities exhibited not significant relationships with post-harvest losses since their p-values were greater than 0.05. Overall, the study concludes that post-harvest losses of cashew nuts in North Central (Benue and Kogi States) are not merely technical problems but systemic challenges arising from infrastructural deficits, limited human capital development, weak institutional support systems, and poor integration of post-harvest management within the agricultural value chain. The persistence of these losses poses serious threats to farmers' incomes, food security, agro-industrial development and the sustainability of cashew production in the study area and Nigeria at large.

Recommendations

Based on the findings of this study, the following policy, institutional, and practical recommendations are proposed:

1. **Improvement of Storage Infrastructure:** Government and relevant agricultural development agencies should prioritize the establishment of modern community-based storage facilities for cashew nuts in Benue and Kogi States.
2. **Strengthening Processing Systems:** Processing losses were identified as a major contributor to total post-harvest losses. Therefore, there is a need to promote small-scale mechanized processing technologies that are affordable, efficient, and appropriate for rural farmers.
3. **Capacity Building and Farmer Training:** Regular training programs should be organized for cashew farmers on improved harvesting techniques, post-harvest handling, processing methods, and storage management.
4. **Expansion and effectiveness of extension services:** Agricultural extension services should be strengthened through increased staffing, improved logistics, and better funding.
5. **Development of rural transport infrastructure:** Transportation losses significantly contribute to post-harvest deterioration. Government should invest in rural road development, transport facilities, and logistics infrastructure to improve access to markets and reduce transit time.

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