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Socioeconomic and Institutional Drivers of Compliance with Sweet Potato Post-Harvest Handling Standard Operating Procedures in North-Western Nigeria

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ABSTRACT

Compliance with recommended post-harvest handling practices is essential for reducing sweet potato losses and improving smallholder value-chain efficiency. However, farmers' ability to comply with Standard Operating Procedures (SOPs) may be shaped by socioeconomic and institutional conditions. This study examined the socioeconomic and institutional factors influencing farmers' compliance with sweet potato post-harvest handling SOPs in North-Western Nigeria. A cross-sectional survey was conducted among 418 sweet potato farmers in Kano and Jigawa States using a structured questionnaire. Descriptive statistics were used to summarise respondents' characteristics, while binary logistic regression was employed to identify factors influencing compliance. The logistic regression model was statistically significant (chi-square = 89.26, $p < 0.001$), with a Nagelkerke R-squared of 0.238 and classification accuracy of 72.5%. Extension contact, access to credit, land tenure security and association membership positively influenced SOP compliance, while age, education, farming experience, farm size and labour availability were not significant. The findings suggest that compliance with post-harvest handling SOPs is shaped more by institutional and structural support than by farmers' demographic characteristics. The study recommends strengthening extension delivery, expanding post-harvest credit, promoting farmer associations and improving land tenure security to enhance compliance and reduce sweet potato post-harvest losses.

Keywords: Credit access; extension contact; farmer associations; land tenure security; post-harvest handling; SOP compliance; sweet potato.

I. INTRODUCTION

Sweet potato (Ipomoea batatas), as an important root and tuber crop, plays a vital role in food security, nutrition, income generation and rural livelihoods in many developing countries (Agbowuro et al., 2025; Ajiboye et al., 2024). The crop is grown principally by the smallholder farmers in Nigeria for subsistence and market (Egwuonwu & Ozor, 2020; Onubogu et al., 2022). It is easily grown on marginal soils, has a short production cycle, and yields high-quality nutrients which makes it significant for low-income farmers and food systems in the rural areas (Anyanwu et al, 2025; Bamiro et al, 2023).

Although it is a critical food crop in the country, sweet potato production is limited by the occurrence of postproduction losses which include poor harvesting, inadequate curing, weak storage, rough handling and inefficient transportation system (Barau et al., 2023; Bamiro et al., 2023; Ajiboye et al., 2024). To minimize these losses, recommended post-harvest handling SOPs are provided to guide farmers in the appropriate harvesting, curing, transportation and storage operations (FAO, 2008; Abewoy 2021). Nevertheless, even when recommended practices exist, this does not necessarily result in compliance, especially in the context of resource-limited farmers with limited institutional support (Adedire et al., 2023; Aduo, 2025).

Farmers' SOPs compliance could be affected by both individual farmers and institutional factors (Adeola et al., 2019; Adjei-Nsiah et al., 2019). Farmers' age, level of education, farming experience, size of farms, and their labour availability are some of the factors that could

influence their production behaviour (Amusa et al., 2022; Aneneokeakwa et al., 2021), while access to extension contact, credit, association membership and land tenure security could affect whether farmers have the information, resources, incentives and support needed to implement recommended practices (Ejechi, 2023; Sanusi et al., 2016). Thus, it is not only a matter of what farmers know, but also the enabling environment that they find themselves in (Aighewi et al., 2020; Aluko et al., 2025).

While post-harvest loss studies in root and tuber crops have been conducted and have enriched the literature with evidence of magnitude and causes of losses in these crops, the factors influencing farmers' compliance with the recommended post-harvest good practices (SOP) of handling have received less attention (Bamiro et al., 2023; Ejechi, 2023). However, the gap could be significant as farmers could be aware of the importance of good handling practices, but may not act as a result of lack of extension services, credit or secure land tenure, farmer-group networks or access to basic post-harvest facilities (Barau et al., 2023; Onubogu et al., 2022). Thus, to develop interventions that can enhance compliance and decrease sweet potato PHL, it is important to identify the socioeconomic and institutional factors that influence compliance.It is therefore essential to understand the socioeconomic and institutional factors influencing compliance to design effective interventions that can enhance compliance and reduce sweet potato PHL (Adeola et al., 2019; Sanusi et al., 2016).

This study builds on the literature on post-harvest losses and small farmer farming by demonstrating that the way to deal with sweet potato post-harvest practices through SOPs is determined more by the support systems of the institutions farmers belong to than by their demographic. Recognizing that compliance is driven by access to credit, association membership, land tenure security through identification of extension contact.

The study gives practical evidence on the institutional access points that can be utilized by sweet potato smallholder farmers to improve their post-harvest handling practices. This study thus aimed at investigating the socio-economic and institutional challenges affecting farmers' compliance to the recommended sweet potato post-harvest handling SOPs in North-Western Nigeria.

II. LITERATURE REVIEW

Sweet potato is one of the crops that has been important to many smallholder farmers in Nigeria as it helps to provide food for households, nutrition and household income. Much of its value, however, can be lost after harvesting, if it is not handled with care, if the roots are poorly cured, if it is handled roughly in transportation or storage or is stored under conditions that are unsuitable. Recommended post-harvest handling Standard Operating Procedures (SOPs) are therefore of importance as they direct the farmers to minimize damage and ensure the quality of sweet potato roots from harvesting to storage and marketing.

But, if the recommended practice is known, it does not necessarily follow that it is possible to be implemented by the farmers. A farmer may know the reason for proper harvesting, curing, sorting, packaging, and good storage practices, but due to limited resources (financial, extension contact, access to farmer groups, insecure land tenure, or lacking of basic post-harvest facilities) he or she may not be able to follow through. This has resulted in SOP compliance being a technical, socioeconomic and institutional challenge.

The focus of previous studies of sweet potato and other root and tuber crops has been largely on the extent of post-production losses, constraints on production, and the issues in the value chains. These studies are helpful but do not adequately account for the reasons for noncompliance in some farmers and compliance in others when it comes to applying the recommended post-harvest practices.

The factors that affect compliance are important because if loss reduction is to be effective, the farmers' situation that leads to compliance with the recommended practices must be identified.

Socio-economic factors like age, farmers' education, farming experience, farm size, availability of labour may affect the behaviour of the farmers, but may not be sufficient to guarantee compliance. In smallholder systems it might be more important. Extension contact can provide farmers with practical demonstrations and technical guidance; credit can facilitate the acquisition of tools, storage materials and transport facilities; farmer associations can facilitate farmer-to-farmer knowledge sharing and the facilitation or organization of collective action; and secure land tenure can help to incentivize farmers to invest in longer-term post-harvest improvements.

Diffusion of Innovations Theory and value-chain perspective are the theories used in guiding the study. They conclude that the information and communication, social influence and institutional support provided at the sweet potato harvesting, curing, transportation and storage stage are the key factors that influence the sweet potato post-harvest handling SOPs adherence by the farmers.

III. MATERIALS AND METHODS

Study Location and Sampling

The research was carried out in Kano and Jigawa States of the North-West geopolitical zone of

Nigeria which are important sweet potato producing States (Barau et al., 2023; Bamiro et al., 2023). Smallholder farming, seasonal rainfall, long dry season and reliance on crop production for livelihood are the characteristics of the area (Onubogu et al., 2022; Sanusi et al., 2016).

The cross-sectional study design was used in a quantitative analytical approach (Ejechi, 2023; Adeola et al., 2019). This was achieved using a multi-stage sampling technique (Barau et al., 2023; Onubogu et al., 2022). The two States, Kano and Jigawa, were selected because of their involvement in the production of sweet potato. Selected LGA's were selected from both the states, with the sweet potato farmers selected for administration of the questionnaires.

A total of 450 questionnaires were administered of which 418 were valid for analysis; 210 farmers in Kano State and 208 farmers in Jigawa State were considered (Barau et al., 2023). Structured questionnaire was used to gather primary data from the sweet potato farmers during the harvest period of 2024 (Ejechi, 2023; Bamiro et al., 2023). The questionnaire was used to collect data on the socioeconomic characteristics of the farmers, institutional factors and adherence to the recommended SOPs for sweet potato post-harvest management practices. It was assessed for content validity and quantified using trained enumerators (Adeola et al., 2019; Sanusi et al., 2016).

Measurement of Variables

Farmers' compliance with the recommended SOP in managing post-harvest of sweet potato was the dependent variable (Barau et al., 2023; Bamiro et al., 2023). Compliance were coded as either 1 (compliant) or 0 (non-compliant) farmer (Ejechi, 2023; Adeola et al., 2019). A weighted compliance index of 50% or greater was considered "compliant" while a weighted compliance index of less than 50% was considered "non-compliant. The adoption rate cut-off point of 50% was considered as a middle ground between those who adopted 50% or more of the recommended practices and those who adopted less than 50% (Barau et al., 2023).

The explanatory variables that were analyzed were age, years in school, years in farming, farm size, available labour, contacting extension, availability of credit facilities, association membership and land tenure security (Onubogu et al., 2022; Sanusi et al., 2016; Ejechi, 2023). The variables of interest, namely age, education, farming experience, farm size, labour availability, extension contact relationships were measured as continuous variables, while access to credit, association membership and land tenure security were measured as binary variables (Adeola et al., 2019; Amusa et al., 2022).

Statistical Analysis

The dependent variable in the present study was binary (SOP compliance) and therefore binary logistic regression was used in the study (Adeola et al., 2019; Ejechi, 2023). This was not appropriate as OLS regression can result in predictions outside of the 0-1 range and has certain assumptions regarding continuous outcomes that were not relevant to the binary outcomes (Barau et al., 2023).

The estimated probability of a farmer following the recommended post-harvest handling SOPs from binary logistic regression can be interpreted as presented by Sanusi et al (2016) and Onubogu et al (2022) using odds ratios.

Statistical Analysis

Binary logistic regression was used because the dependent variable, SOP compliance, was dichotomous (Ejechi, 2023; Adeola et al., 2019). Ordinary least squares regression was not appropriate because it can generate predicted values outside the 0-1 range and violates important assumptions when applied to binary outcomes (Barau et al., 2023).

Binary logistic regression estimates the probability that a farmer complies with recommended post-harvest handling SOPs and allows interpretation using odds ratios (Sanusi et al., 2016; Onubogu et al., 2022).

ln[P_i / (1 - P_i)] = beta_0 + beta_1Age_i + beta_2Education_i + beta_3FarmSize_i + beta_4Experience_i + beta_5Extension_i + beta_6Credit_i + beta_7Tenure_i + beta_8Labour_i + beta_9Association_i + epsilon_i

[1]

Where P_i is

P_i is the probability that the farmer I follows the SOPs, 1 – P_i is the probability that the farmer I does not follow the SOPs, beta_0 is the constant to be estimated, beta_1 to beta_9 are the estimated coefficients for the explanatory variables, and epsilon_i is the error term. The higher the odds ratio, the higher the likelihood that the variable is associated with compliance; the lower the odds ratio, the lower the likelihood that the variable is associated with compliance. IBM SPSS Statistics version 26 was used to estimate the model.

Ethical Considerations

Ethical aspects were respected during the data collection process. Participants were told about the study, that participation was completely voluntary and that the information they gave would be handled confidentially. Reporting and

administration of a questionnaire was on informed consent and anonymous reporting basis.

IV. RESULTS

Socioeconomic and Institutional Characteristics of Respondents

The socioeconomic profile of the respondents provides background information on the compliance of the farmers with the farmers' post-harvest handling SOPs (Adisa et al., 2024; Akwiwu & Promise, 2026). The respondents were mostly male with majority of the farmers in the economically active age group (Aluko et al., 2025; Bamiro et al., 2023). The level of formal education was mostly low with respondents recording mostly up to primary education, Qur'anic education and adult education (Nwaobiala et al., 2025; Olajide & Olonibua, 2019). The membership of the co-operatives was also limited and most of the farmers had been using manual labour (Adisa et al., 2024; Bamiro et al., 2023). The patterns suggest that the study area was predominantly smallholder farmers that may be influenced by access to practical training and credit, farmer groups, and land security, among others, instead of formal education (IFDC, 2025; Raji, 2026).

Table 1
Socioeconomic and institutional characteristics of respondents

Variable	Category/measure	Result
Age	30 years or below	24.2%
	31-40 years	29.4%
	41-50 years	26.1%
	Above 50 years	20.3%
	Mean age	38.82 years
Gender	Male	96.4%
	Female	3.6%
Marital status	Married	66.7%
	Single	20.1%
	Widowed	9.3%
	Divorced	3.8%
Education	Primary	39.5%
	Qur'anic	28.0%
	Adult education	22.0%
	Secondary	6.2%
	Tertiary	4.3%
Farming experience	0-9 years	36.8%
	10-19 years	23.5%
	20 years and above	39.7%
Cooperative membership	Member	27.8%
	Non-member	72.2%
Type of labour	Manual	83.0%
	Mechanised	17.0%
Institutional access	Access to credit	37.3%
	Secure land tenure	64.8%

Source: Field survey, 2024.

The socioeconomic profile provides important context for understanding farmers' compliance with post-harvest handling SOPs (Akwiwu & Promise, 2026; Alum et al., 2025). The low level of formal education suggests that written extension materials alone may not be sufficient for improving compliance (Adisa et al., 2024; Olajide & Olonibua, 2019). The high reliance on manual labour indicates that harvesting and handling remain physically intensive and may increase the risk of mechanical damage where recommended techniques are not followed (Aluko et al., 2025; Nwaobiala et al., 2025). Low cooperative membership may reduce farmers' access to group-based training, collective credit and shared post-harvest facilities (IFDC, 2025; Raji, 2026). These patterns suggest that improving SOP compliance requires practical training and stronger institutional support rather than dependence on farmers' individual characteristics alone (Adisa et al., 2024; Alawode et al., 2019).

Factors Influencing SOP Compliance

The binary logistic regression model was used to determine the socioeconomic and institutional factors influencing farmers' compliance with recommended sweet potato post-harvest handling

SOPs (Akwiwu & Promise, 2026; Nwaobiala et al., 2025).

The model was statistically significant, indicating that the selected variables reliably distinguished compliant farmers from non-compliant farmers (Bamiro et al., 2023; Aluko et al., 2025). The model chi-square was 89.26 and significant at the 1% level (Adisa et al., 2024). The Nagelkerke R-squared was 0.238, the Hosmer-Lemeshow test was not significant (chi-square = 7.842, p = 0.448), and the model correctly classified 72.5% of cases (Alum et al., 2025; Olajide & Olonibua, 2019).

Table 2
Binary logistic regression of factors influencing SOP compliance

Variable	B	S.E.	Wald	Sig.	Exp(B)
Extension contact	1.920	0.870	4.871	0.027**	6.820
Access to credit	1.620	0.917	3.122	0.077*	5.051
Land tenure security	0.412	0.158	6.846	0.009***	1.510
Association membership	0.122	0.049	6.158	0.013**	1.130
Age	-0.034	0.021	2.612	0.106	0.967
Education	0.142	0.089	2.543	0.111	1.153
Farm size	0.218	0.176	1.534	0.216	1.244
Farming experience	0.031	0.025	1.536	0.215	1.031
Labour	0.002	0.026	0.007	0.935	0.998
Constant	-1.284	0.642	3.998	0.046	0.277

***, ** and * denote significance at 1%, 5% and 10%, respectively. Model chi-square = 89.26 ($p < 0.001$); Nagelkerke R-squared = 0.238; Hosmer-Lemeshow chi-square = 7.842 ($p = 0.448$); classification accuracy = 72.5%. Source: SPSS output from field survey data, 2024.

V. DISCUSSION

The results of the regression analysis revealed that the institutional and structural factors played greater role in explaining compliance with SOP compared to the demographic factors (Adisa et al., 2024; Akwiwu & Promise, 2026).

Extension contact was the best predictor of compliance (Bamiro et al., 2023; Alum et al., 2025). The odds ratio of 6.820 imply that other factors being equal, farmers who had the highest number of extension contacts had the highest level of compliance with the post-harvest handling SOPs and were more likely to be successful. The extension contact will deliver a technical message to the farmers and demonstration and follow-up, which will enhance farmer compliance (Olajide & Olonibua, 2019; Raji, 2026). This is especially important during the post-harvest phase, where farmers might need to be shown recommended practices and provided with information on the same (Adisa et al., 2024; Alawode et al., 2019).

The availability of credit was also found to be a positive influence on the compliance of SOP (Akwiwu & Promise, 2026; Aluko et al., 2025). The odds ratio of 5.051 implies farmers who had access to credit were more likely to comply than those that did not have access to credit (Bamiro et al., 2023; Nwaobiala et al., 2025). The result shows that it is not just a knowledge issue, it's also a financial issue (Adisa et al, 2024; Raji, 2026).

Many recommended practices consist of investments in harvesting tools, containers, storage materials, curing facilities or transportation assistance (Alum et al., 2025; Olajide & Olonibua, 2019). Although farmers know the importance of such practices, they are unable to put them in practice because of their lack of financial resources (IFDC, 2025; Alawode et al., 2019).

Land tenure security had a positive and significant influence on compliance (Akwiwu & Promise, 2026; Alawode et al., 2019). This suggests that farmers with a stable production system are more willing to make investments in post-harvest processing because they expect some returns from their investments in the future (Adisa et al., 2024; Bamiro et al., 2023). Furthermore, farmers who are not secure with their land may not be keen on upgrading their storage, curing or handling facilities because of their uncertainty about land rights (Raji, 2026; Nwaobiala et al., 2025).

Moreover, the association membership had a positive impact on compliance with SOP (Akwiwu & Promise, 2026; Adisa et al., 2024). At the association level, farming communities learn from each other, coordinate and share resources with each other (Olajide & Olonibua, 2019; IFDC, 2025). Group training and the sharing of experiences, improved access to credit facilities, and collective access to post-harvest resources

(Aluko et al., 2025; Bamiro et al., 2023) are some of the benefits farmers can reap.

It is noted that social capital has great influence on the post-harvest handling behaviour of farmers as a result of the importance of membership into the association (Nwaobiala et al., 2025; Raji, 2026).

Results of the non-significance of age, education, farming experience and size of farm and labour availability show that compliance of post-harvest handling SOPs on cocoa farm is not just farmer's demographic and farm level characteristics (Alum et al., 2025; Akwiwu & Promise, 2026). But these larger farmers and older farmers with education and experience may not be participating because of lack of extension support, credit, secure tenure or farmer groups (Adisa et al., 2024; Bamiro et al., 2023). This is significant since it implies that an intervention that only targets the characteristics of farmers should target strengthening institutional systems that support farmers to carry out the recommended practice (IFDC, 2025; Alawode et al., 2019).

Policy Implications

The results have 4 straightforward policy implications. The first is to improve the post-harvest handling extension services and reorientation of them to practical demonstration of handling post-harvest. Second, the credit supply of farmers will be expanded through post-harvest investment loans to farmers for purchasing tools and storage materials, crates and transportation facilities. Thirdly, farmer associations/cooperatives need to be encouraged to function as platforms for mutual learning, group trainings and group input purchases and access to common resources. Fourth, land tenure security should be strengthened to promote the investment of the farmers in long term post-harvest investments like curing and storage structures.

Limitations of the Study

There are a few constraints to this study. The first drawback of the cross-sectional design was that it only allowed for associations and not causal inferences about the relationships between the farmers' characteristics and their compliance with SOP. Secondly, farmers reported their own compliance, which can be subject to recall bias and/or social desirability bias. Thirdly, the research was conducted in Kano and Jigawa States; therefore, caution should be taken when generalizing the findings from other sweet potato producing zones with different agro-ecological, infrastructural and institutional contexts. Finally, the classification of farmers into the compliant and non-compliant group relies on compliance threshold set and further research could assess the robustness of the results with different thresholds.

VI. CONCLUSIONS

The socio-economic and institutional factors that influence the compliance of the sweet potato post-harvest handling SOPs by smallholder farmers in the North-Western Nigeria was the study focus. The results show that the institutional determinants and structures strongly influence compliance, while the individual demographic determinants do not have such a strong influence. No significant relationship between compliance and age, education, farming experience, farm size, labour availability emerged but a significant relationship with extension contact, access to credit, security of land tenure and participation in associations did emerge.

The study reveals that if the handling of sweet potato after harvest is to be improved, it is not enough to create awareness among the farmers. The farmers have a need for practical extension service, capital and farmer groups networks to adopt the recommended practices, along with better production condition. This means policies and programmes to reduce sweet potato post-harvest losses need to go beyond targeting farmers' personal qualities, and need to target institutional strengthening and access to resources.

Agricultural extension, it should be improved and reoriented and practical demonstration on the post-harvest handling should be conducted in local language. Credit products should be customised specifically for the post-harvesting investments like harvesting implements, storage, crates, curing facilities, transport and logistics support etc. Farmer associations and farmer co-operatives should be encouraged to provide farmers with a platform for peer learning, farmer co-operative borrowing, farmer input procurement, post-harvest facilities etc. The security of land tenure should also be enhanced to ensure that farmers invest in longer term post-harvest facilities. They should be implemented simultaneously and the synergy between information, resources and enabling institutions should be the one that leads to compliance.

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