Journal of Economic Studies (JES)
Department of Economics,
Nnamdi Azikiwe University, Awka,
Anambra State, Nigeria.

Web: www.nauecojournals.com *ISSN 1119-2259*

SWEET POTATO VALUE-ADDITION ACTIVITIES, MARKETING CONSTRAINTS AND HOUSEHOLD INCOME IN KADUNA STATE, NIGERIA

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ABSTRACT

Sweet potato value addition provides opportunities for improving household income, but its contribution is often constrained by weak processing, storage and marketing systems. This study examined sweet potato value-addition activities, marketing constraints and household income among 97 sweet potato-producing households in Kaduna State, Nigeria. Data were analysed using descriptive statistics, Pearson chi-square, Ordinary Least Squares (OLS), median quantile regression and ANOVA. Results showed that flour (63.92%) and chips (42.27%) were the dominant value-added products, while only 8.25% of households used improved storage facilities. Marketing challenges were reported by 68.04% of respondents, although chi-square results showed no significant association between processing activities and marketing constraints. The OLS model explained 17.1% of income variation, while employment scale had a positive and significant association with median household income (β = 1.000, p = 0.017). The study concludes that value addition alone is insufficient to improve household income without improved processing capacity, storage and market linkages. Strengthening sweet potato enterprises requires integrated value-chain interventions that enhance technology access, market coordination and operational scale.

Keywords: *Sweet potato; value addition; marketing constraints; household income; value chain; Kaduna State.*

JEL Classification Codes: *Q12, Q13, Q18, D13*

1.0 Introduction

Sweet potato (*Ipomoea batatas L.*) is an important root crop in sub-Saharan Africa because of its contribution to food security, nutrition and rural livelihoods. The crop is adaptable to diverse production conditions, requires relatively low external inputs and provides opportunities for income generation through processing and marketing (Low, 2011; Low et al., 2017). Beyond fresh root consumption, sweet potato can be transformed into products such as flour, chips, snacks and

other processed foods, creating opportunities for value addition, employment and improved household welfare (Mmasa & Msuya, 2012; Sugri et al., 2017).

Despite these opportunities, sweet potato value chains remain constrained by post-harvest losses, limited storage facilities, inadequate processing technologies and weak market linkages. These challenges reduce households' ability to obtain better returns from sweet potato production and processing (Stathers et al., 2018; Mmasa & Msuya, 2012). Although value addition is widely promoted as a pathway for increasing income among smallholder households, its contribution to livelihood improvement depends on access to processing technologies, markets, infrastructure and institutional support (Kaplinsky & Morris, 2001; Trienekens, 2011; Barrett et al., 2012; Sugri et al., 2017). Although, participation in processing activities may not translate into higher household earnings where marketing constraints and limited operational capacity persist.

Existing studies have examined sweet potato production, nutritional benefits and value-chain development, with emphasis on the crop's contribution to food security, commercialization and rural livelihoods (Low, 2011; Low et al., 2017; Stathers et al., 2018). However, limited empirical evidence exists on how household-level value-addition activities are associated with marketing constraints and income outcomes, particularly in Nigeria. Previous studies have shown that sweet potato processing and commercialization opportunities are often influenced by access to appropriate technologies, storage facilities, market linkages and institutional support (Mmasa & Msuya, 2012; Sugri et al., 2017). In Kaduna State, where households participate in production, processing, storage and marketing activities, there is limited evidence on the nature of value-addition practices undertaken, the constraints faced by participants and the income outcomes associated with participation in the value chain. Examining these issues jointly is important because promoting processing in isolation may generate limited economic benefits where supporting infrastructure, transportation systems, processing equipment and market coordination remain inadequate (Kaplinsky & Morris, 2001; Trienekens, 2011; Mmasa & Msuya, 2012).

This study therefore addresses this gap by examining sweet potato value-addition activities, marketing constraints and household income among sweet potato-producing households in Zaria, Chikun and Jema'a Local Government Areas of Kaduna State, Nigeria. Specifically, it assesses the types of value-added products produced, identifies marketing challenges faced by households, examines the association between processing activities and marketing constraints, and determines the

factors associated with household income from sweet potato activities.

2.0 Literature Review

The relationship between agricultural value addition and household income can be explained through the value chain perspective, which views agricultural production as a sequence of interconnected activities involving input supply, production, processing, storage, distribution and marketing (Porter, 1985; Kaplinsky & Morris, 2001). The framework suggests that value is created not only at the production stage but also through improvements in product quality, processing, market coordination and access to consumers. In agricultural systems, value-chain upgrading through improved technologies, product transformation and stronger market linkages can enhance competitiveness and increase the share of value captured by smallholder households (Kaplinsky & Morris, 2001; Trienekens, 2011). However, the ability of households to benefit from value addition depends on access to productive resources, infrastructure, institutions and market opportunities (Barrett et al., 2012; Reardon et al., 2009). Thus, while processing activities may create opportunities for higher returns, their contribution to household income is influenced by the broader environment in which value-chain actors operate.

The sustainable livelihoods perspective complements the value-chain approach by explaining how rural households use available assets and livelihood strategies to improve economic wellbeing (Chambers & Conway, 1992; Scoones, 1998). The framework emphasises that household outcomes depend on access to different forms of capital, including natural resources, physical assets, financial resources, human skills and social networks. Within this perspective, participation in sweet potato processing and marketing represents a livelihood strategy through which households seek to diversify income sources, reduce post-harvest losses and improve resilience. However, households with limited access to processing equipment, storage facilities, credit, labour and market information may be unable to fully exploit value-addition opportunities (Ellis, 2000; Barrett et al., 2012). Therefore, understanding household income from sweet potato activities requires examining not only whether households participate in value addition but also the constraints affecting their ability to transform these activities into improved economic outcomes.

Sweet potato provides an important example of how value-chain development can contribute to rural livelihoods. The crop is widely recognised for its contribution to food security, nutrition and income generation, particularly among smallholder farming households in sub-Saharan Africa (Low, 2011; Low et al., 2017; Stathers et al., 2018). Its adaptability to diverse production environments, relatively low production requirements and flexible harvesting period

make it an important livelihood crop for resource-constrained households (Woolfe, 1992; Lebot, 2009). Beyond fresh root consumption, sweet potato can be transformed into products such as flour, chips, snacks and other processed foods, thereby increasing shelf life, reducing post-harvest losses and creating opportunities for market diversification (Mmasa & Msuya, 2012; Sugri et al., 2017). Studies from Africa indicate that processing and commercialization of sweet potato can improve household food security and income when supported by appropriate technologies, market linkages and institutional arrangements (Low et al., 2017; International Potato Centre, 2019).

Empirical studies, however, show that the benefits of sweet potato value addition are strongly influenced by the structure and performance of the broader value chain. Mmasa and Msuya (2012), in their assessment of sweet potato value-chain linkages in Tanzania, found that processing activities created opportunities for rural enterprise development but were constrained by limited processing technologies, weak coordination among actors and inadequate market support. Similarly, Karuga et al. (2005) examined sweet potato value addition and market linkages in Kenya and found that processing and market-oriented activities created opportunities for improving returns to farmers. However, limited access to appropriate technologies, weak market linkages and challenges in organising supply constrained the ability of smallholders to fully participate in higher-value markets. These findings demonstrate that participation in processing alone may not guarantee improved household welfare because the benefits of value addition depend on complementary resources, effective coordination and functioning markets.

Study from Ghana and other African countries further highlights the importance of processing and market development in improving sweet potato value-chain outcomes. For instance, Sugri et al. (2017) examined sweet potato value-chain opportunities in Northern Ghana and found that processing, improved market coordination and stronger linkages among value-chain actors could enhance income and food-security outcomes. However, they noted that inadequate processing capacity, weak market access and limited commercialization remained major barriers. Similarly, Andrade et al. (2016) emphasized that expanding sweet potato utilization beyond household consumption requires investments in product development, consumer awareness, processing technologies and market systems. This suggests that value addition should be considered as part of a broader commercialization strategy rather than as an isolated household activity.

The role of post-harvest management has also received considerable attention in sweet potato value-chain research. Fresh sweet potato roots are highly perishable, and inadequate storage systems can result in significant losses, reduced

product quality and forced sales immediately after harvest. Stathers et al. (2018) emphasized that improved post-harvest handling, storage and processing technologies are essential for strengthening sweet potato value chains in sub-Saharan Africa. More recent research by Stathers et al. (2024) demonstrated that developing commercial-scale storage solutions remains critical for reducing deterioration and improving market flexibility, particularly in tropical production environments. These findings suggest that storage capacity influences not only post-harvest losses but also households' ability to delay sales and obtain better market returns.

Marketing constraints represent another important determinant of whether value addition translates into improved household income. Agricultural value-chain studies show that smallholder producers and processors often face challenges related to transportation costs, poor market information, inadequate infrastructure, unstable prices and limited bargaining power (Barrett et al., 2012; Reardon et al., 2009). In the case of sweet potato, USAID-KAVES (2015) identified inadequate storage, weak transportation systems, limited market information and poor coordination among value-chain actors as major constraints affecting commercialization. Similar observations were reported by Mmasa and Msuya (2012), who found that weak market connections reduced the ability of processors to capture higher returns from sweet potato products. These studies imply that the economic contribution of value addition depends not only on the ability to process products but also on the capacity of households to access reliable and profitable markets.

Although existing studies provide important insights into sweet potato production, processing and commercialization, several gaps remain. First, much of the available literature focuses on general value-chain development, nutrition improvement or production challenges, with limited attention to how specific household-level value-addition activities relate to income outcomes. Second, limited empirical evidence exists on whether participation in particular processing activities influences households' exposure to marketing constraints. Third, previous studies have rarely examined how value addition, marketing challenges and operational characteristics jointly influence household income at the local level, particularly in Kaduna State, Nigeria.

This study contributes to the literature by integrating the value-chain and livelihood perspectives to examine sweet potato value addition, marketing constraints and household income among households in Kaduna State. Unlike studies that focus mainly on production or processing opportunities, this study considers the interaction between household processing choices, marketing conditions and income outcomes. By doing so, it provides evidence on

whether value addition activities are associated with improved household economic performance and identifies the constraints that may limit the contribution of sweet potato enterprises to rural livelihoods.

3.0 Methodology

3.1. Research Design and Study Area

The study employed a cross-sectional survey design to examine sweet potato value-addition activities, marketing constraints and household income in Kaduna State, Nigeria. The design was appropriate because information on processing, post-harvest practices, market conditions, employment generation and income was collected from participating households at one point in time. Accordingly, the analysis identifies statistical associations among the variables and does not make causal claims (Creswell & Creswell, 2018; Setia, 2016). The study was conducted in Zaria, Chikun and Jema'a Local Government Areas (LGAs) of Kaduna State. These LGAs were selected because sweet potato production and downstream activities, including processing, storage and marketing, are undertaken by households in the areas. Their inclusion also permitted a spatial comparison of income outcomes across different agroecological and market settings within the state.

3.2. Population, Sampling and Data Collection

The target population comprised households involved in sweet potato production or at least one related value-chain activity in selected communities in the three LGAs. For the purpose of the study, a household referred to persons living together, sharing meals and operating under a household head, with at least one member participating in sweet potato production, processing, storage or marketing. A multistage sampling procedure was adopted. First, Zaria, Chikun and Jema'a were purposively selected because of the prominence of sweet potato production and value-chain activities. Second, sweet-potato-producing communities were identified with the assistance of community leaders and agricultural extension personnel. Third, households were randomly selected from community lists of sweet potato producers. Ninety-seven valid questionnaires were obtained and retained for analysis. Analyses involving the scale of employment generation were based on the available valid responses to that item (Cochran, 1977).

Primary data were collected during the 2025 field survey using a structured questionnaire administered to household heads or responsible adult members. The instrument elicited information on socioeconomic characteristics, value-addition activities, post-harvest storage, marketing constraints, employment creation and weekly income from sweet potato activities. The questionnaire combined binary, categorical and ordered-response items. Binary responses were coded 1 for "Yes" and 0 for "No," while ordered variables were coded in ascending order

of intensity or magnitude (Creswell & Creswell, 2018).

3.3. Measurement of Variables

The outcome variable was weekly household income from sweet potato activities. Income was recorded as an ordered five-category variable ranging from 1 for earnings below ₦5,000 per week to 5 for earnings above ₦20,000 per week, with intermediate categories representing progressively higher income bands. Because the questionnaire captured income categories rather than exact revenue and cost figures, the variable was interpreted as household income performance and not as an accounting measure of net profit.

Sweet potato value addition was operationalised through household participation in processing sweet potatoes into flour, chips, snacks, cake, potato "perp," moi-moi, vegetables from sweet potato leaves and multiple products. Each activity was represented by a binary indicator. Post-harvest practices were measured by natural storage in a cool and dry place, use of improved storage facilities, immediate processing after harvest and the use of combined storage methods.

Marketing constraints were measured using a general indicator of whether the household experienced selling difficulties and separate indicators for low market demand, lack of transportation, low selling prices, limited market access, lack of processing machines, poor processing methods and the simultaneous occurrence of multiple constraints. Employment generation was captured by a binary indicator of whether sweet potato activities created employment and an ordered measure of employment scale classified as low, moderate or high. Age and educational attainment of the household head were included as household controls, while LGA identified the respondent's location.

Table 3.1: Operational definition and measurement of variables

Variable	Operational definition	Measurement
Weekly income	Income obtained per week from sweet potato production and related value-chain activities.	Ordered scale: 1–5
Value addition	Processing into flour, chips, snacks, cake, potato "perp," moi-moi, vegetables or multiple products.	1 = Yes; 0 = No
Post-harvest practices	Natural storage, improved storage, immediate processing and combined storage methods.	1 = Adopted; 0 = Otherwise
General marketing constraint	Whether the household experienced difficulty selling sweet potatoes or processed products.	1 = Yes; 0 = No
Specific constraints	Low demand, transport problems, low prices, limited market access, inadequate machinery or poor processing methods.	Separate binary indicators
Employment generation	Whether sweet potato activities created employment opportunities.	1 = Yes; 0 = No

Employment scale	Reported scale of employment generated through sweet potato activities.	1 = Low; 2 = Moderate; 3 = High
Education	Highest educational attainment of the household head.	Ordered categories
Age	Age category of the household head.	Ordered categories
Location	Local Government Area of residence.	Zaria, Chikun or Jema'a

Source: Researchers' Compilation, 2025

3.4. Analytical Strategy

Data were analysed using STATA version 15. The analytical procedure combined descriptive statistics, Pearson's chi-square tests, Ordinary Least Squares (OLS) regression, one-way Analysis of Variance (ANOVA) and median quantile regression. Statistical significance was assessed at the 1%, 5% and 10% levels (StataCorp, 2019).

3.4.1 Descriptive and Bivariate Analysis

Frequencies and percentages were used to describe the prevalence of individual processing activities, storage practices and marketing constraints. Means and standard deviations were used to summarise the ordered income and employment-scale variables. Pearson's chi-square test of independence was then applied to determine whether participation in each processing activity was associated with the incidence of marketing challenges. For each processing option, the null hypothesis stated that the processing activity and marketing constraints were statistically independent (Agresti, 2013).

$$\chi^2 = \Sigma_i \Sigma_j [(O_{ij} - E_{ij})^2 / E_{ij}] \quad (3.1)$$

In equation 1, O_{ij} denotes the observed cell frequency and E_{ij} denotes the expected cell frequency under the null hypothesis of independence. Rejection of the null hypothesis indicated a statistically significant association between the processing activity and the likelihood of reporting marketing difficulties.

3.4.2 Household Income Model

OLS regression was used to estimate the average association between marketing constraints, employment characteristics and weekly household income from sweet potato activities. The empirical specification is specified below:

$$INC_i = \beta_0 + \beta_1 MKT_i + \Sigma_j \gamma_j C_{ji} + \delta_1 EMP_i + \delta_2 SCALE_i + \theta_1 EDU_i + \theta_2 AGE_i + \varepsilon_i \quad (3.2)$$

where INC_i is the weekly income category of household i; MKT_i is the general marketing-constraint indicator; C_{ji} represents the set of specific marketing constraints; EMP_i indicates whether sweet potato activities generated employment; $SCALE_i$ measures the level of employment generation; EDU_i and AGE_i represent the educational attainment and age

category of the household head; and ε_i is the stochastic error term. The coefficients were interpreted as associations with movement across the ordered income score. OLS was therefore treated as a linear approximation rather than as evidence of a causal effect or an exact monetary change (Wooldridge, 2020).

3.4.3 Median Quantile Regression

Median quantile regression was estimated as a robustness check because agricultural income data may be heterogeneous, skewed and sensitive to atypical observations. Whereas OLS estimates associations at the conditional mean, median regression evaluates the income category of the typical household and is less sensitive to extreme values. The model was expressed as: (Koenker & Bassett, 1978; Koenker, 2005).

$$Q_{0.50}(INC_i \mid X_i) = \alpha_0 + \alpha_1 MKT_i + \Sigma_j \lambda_j C_{ji} + \alpha_2 EMP_i + \alpha_3 SCALE_i \quad (3.3)$$

where $Q_{0.50}(INC_i \mid X_i)$ is the conditional median of weekly income given the vector of explanatory variables. Consistency between the OLS and median-regression results was taken as evidence that the findings were not driven solely by the distributional properties of the income measure.

3.4.4 Spatial Differences in Household Income

One-way ANOVA was used to test whether mean weekly income differed across Zaria, Chikun and Jema'a LGAs. The null hypothesis was that the three LGA means were equal, while the alternative hypothesis stated that at least one mean differed. Bartlett's test was used to assess the equality-of-variances assumption underlying the ANOVA comparison. A statistically insignificant F-statistic indicated that income conditions were broadly similar across the three locations (Bartlett, 1937; Montgomery, 2017).

4.0. Results and Discussion

The results are presented under three themes: value-addition and post-harvest practices, marketing constraints, and household income. All estimates are based on the 2025 field survey of 97 sweet-potato-producing households in Zaria, Chikun and Jema'a Local Government Areas.

Table 4.1: Sweet potato value-addition activities

Value-added product	Yes (n)	Yes (%)	No (n)	No (%)
Sweet potato flour	62	63.92	35	36.08
Chips	41	42.27	56	57.73
Snacks	25	25.77	72	74.23
Potato cake	11	11.34	86	88.66
Potato perp	8	8.25	89	91.75

Leaves used as vegetables	28	28.87	69	71.13
Moi-moi	5	5.15	92	94.85
Combination of processing activities	25	25.77	72	74.23

Source: Field Survey, 2025.

From Table 4.1, sweet potato flour was the dominant value-added product, reported by 63.92% of households, followed by chips (42.27%). The use of leaves as vegetables accounted for 28.87%, while snacks and participation in multiple processing activities each accounted for 25.77%. More specialised products, including potato cake, potato perp and moi-moi, attracted relatively limited participation. The distribution indicates that value addition was established in the study area but remained concentrated in products requiring modest capital and simple processing technology.

Table 4.2: Post-harvest storage practices

Storage method	Yes (n)	Yes (%)	No (n)	No (%)
Natural storage in a cool, dry place	56	57.73	41	42.27
Improved storage facilities	8	8.25	89	91.75
Immediate processing after harvest	43	44.33	54	55.67
Combination of storage methods	13	13.40	84	86.60

Source: Field Survey, 2025.

From Table 4.2, the result shows that storage practices were largely traditional in the study area. More than half of the households relied on cool and dry places, whereas only 8.25% used improved storage facilities. Immediate processing after harvest was reported by 44.33%, suggesting that processing also served as a response to perishability and limited storage capacity. The low adoption of improved storage restricts households' ability to delay sales and respond to favourable prices.

Table 4.3: Incidence of marketing challenges

Response	Frequency	Percentage (%)
Experienced marketing or selling challenges	66	68.04
Did not experience marketing or selling challenges	31	31.96
Total	**97**	**100.00**

Source: Field Survey, 2025.

From Table 4.3, marketing difficulties were reported by 68.04% of respondents. This high incidence suggests that value-addition activities operated within a generally weak marketing environment characterised by limitations in processing equipment, transportation, market access and selling conditions.

Table 4.4: Processing activities and marketing challenges

Processing activity	Pearson chi-square	p-value
Flour	2.086	0.149
Chips	0.236	0.627
Snacks	0.243	0.622
Potato cake	0.125	0.723
Potato perp	0.123	0.726
Leaves used as vegetables	0.972	0.324
Moi-moi	0.347	0.556
Combination of processing activities	0.000	0.996

Source: Authors' calculations from Field Survey, 2025. Note: significance evaluated at 5%.

In the same vein, the result from Table 4.4 shows that none of the processing activities was significantly associated with the incidence of marketing challenges. The p-values ranged from 0.149 for flour processing to 0.996 for participation in multiple processing activities. Thus, households undertaking value addition were not less exposed to marketing difficulties than non-participating households. This indicates that the constraints were systemic rather than specific to a particular processing option.

Table 4.5: Descriptive statistics for income, marketing constraints and employment

Variable	Obs.	Mean	SD	Min.	Max.
Weekly income category	97	2.701	1.569	1	5
General marketing/selling challenge	97	0.680	0.469	0	1
Low market demand	97	0.082	0.277	0	1
Lack of transportation	97	0.134	0.342	0	1
Low selling prices	97	0.134	0.342	0	1
Limited access to markets	97	0.052	0.222	0	1
Lack of processing machines	97	0.247	0.434	0	1
Poor processing methods	97	0.247	0.434	0	1
Multiple marketing challenges	97	0.206	0.407	0	1
Employment generation	97	0.814	0.391	0	1
Employment scale	87	1.747	0.651	1	3

Source: Field Survey, 2025. Binary variables were coded 1 = yes and 0 = no.

As for income category of the household, the mean weekly income-category score as shown in Table 4.5 was 2.70 on a five-point scale, with a standard deviation of 1.57, indicating moderate income and substantial variation across households. Sweet potato activities generated employment for 81.4% of respondents, although the mean employment-scale score of 1.75 shows that most operations remained small. Lack of processing machines and poor processing methods were the most frequently reported specific constraints, each with a mean of 0.247.

Table 4.6: OLS estimates of weekly income from sweet potato activities

Variable	Coefficient	Std. error	t-value	p-value
General marketing/selling challenge	0.583	0.550	1.06	0.293
Low market demand	0.804	0.652	1.23	0.227
Lack of transportation	-0.585	0.534	-1.10	0.277
Low selling prices	-0.295	0.520	-0.57	0.573
Limited access to markets	-0.066	0.740	-0.09	0.371
Lack of processing machines	-0.279	0.484	-0.58	0.566
Poor processing methods	-0.031	0.480	-0.06	0.948
Multiple marketing challenges	0.278	0.592	0.47	0.641
Employment generation	0.121	0.618	0.20	0.846
Employment scale	0.510	0.281	1.82	0.073*
Educational attainment	0.061	0.214	0.28	0.778
Age of household head	0.089	0.249	0.36	0.723
Constant	0.901	1.392	0.65	0.519

*Note: $R^2 = 0.171$; adjusted $R^2 = 0.037$; $F(12, 74) = 1.28$; $p = 0.251$; root MSE = 1.512. *p < 0.10.*

Source: Authors' calculations from Field Survey, 2025.

The OLS model estimated in Table 4.6 explained 17.1% of the variation in weekly income of the household, but its adjusted explanatory power was low and the model was not jointly significant. General and specific marketing constraints did not significantly explain income differences. Employment scale was the only variable approaching conventional significance, with a positive coefficient of 0.510 at the 10% level. This suggests that larger operations tended to occupy higher income categories, although the mean effect was modest.

Table 4.7: One-way ANOVA of weekly income across LGAs

Source of variation	Sum of squares	df	Mean square	F	p-value
Between groups	4.493	2	2.247	0.91	0.406
Within groups	231.837	94	2.466		
Total	**236.330**	**96**	**2.462**		

Source: Authors' calculations from Field Survey, 2025. Bartlett's test: $\chi^2(2) = 1.545$, $p = 0.462$.

Furthermore, the Mean weekly income in the study area as shown in Table 4.7 indicated that did not differ significantly across Zaria, Chikun and Jema'a LGAs. The Bartlett's test also failed to reject equality of variances. The result implies that income conditions and value-chain constraints were broadly similar across the three study locations.

Table 4.8: Median regression estimates of weekly income

Variable	Coefficient	Std. error	t-value	p-value	95% CI
General marketing/selling challenge	0.000	0.800	0.00	1.000	-1.593, 1.593
Low market demand	-1.000	0.951	-1.05	0.296	-2.894, 0.894
Lack of transportation	1.000	0.790	1.27	0.210	-0.574, 2.574
Low selling prices	0.000	0.751	0.00	1.000	-1.495, 1.495
Limited access to markets	-1.000	1.081	-0.93	0.358	-3.153, 1.153
Lack of processing machines	0.000	0.707	0.00	1.000	-1.408, 1.408
Poor processing methods	0.000	0.708	0.00	1.000	-1.410, 1.410
Multiple marketing challenges	1.000	0.818	1.22	0.225	-0.630, 2.630
Employment generation	0.000	0.910	0.00	1.000	-1.812, 1.812
Employment scale	1.000	0.410	2.44	0.017**	0.183, 1.817
Constant	1.000	1.171	0.85	0.396	-1.333, 3.333

Source: Authors' calculations from Field Survey, 2025. Quantile = 0.50; pseudo-R^2 = 0.142. **p < 0.05.

The median regression in Table 4.8 also confirmed that the marketing variables did not significantly distinguish income outcomes at the centre of the distribution. Employment scale was positive and statistically significant: a one-category increase in employment scale was associated with an approximately one-category increase in median weekly income, holding the included variables constant. The finding reinforces the importance of operational scale and productive capacity.

From the analysis, the dominance of flour and chips, together with limited participation in specialised products, shows that household value addition remains largely low-technology and small-scale. The very low use of improved storage and the reliance on immediate processing suggest that some processing is undertaken to reduce spoilage rather than as part of a fully commercialised strategy. This is consistent with Thiele et al. (2009), who identified perishability, seasonality and weak commercial processing as persistent constraints in African sweet potato value chains.

The non-significant chi-square results show that processing alone did not reduce households' exposure to marketing constraints. Processors and non-processors faced comparable difficulties, indicating that transportation, storage, equipment and market coordination were system-wide limitations. Similar evidence from Tanzania shows that sweet potato value chains may contain several product and marketing channels while remaining constrained by weak infrastructure and technology (Mmasa & Msuya, 2012). USAID-KAVES (2015) likewise identified storage, road, market-information and coordination deficits as major value-chain bottlenecks.

Income performance was more closely associated with the scale of operation than with any single marketing constraint. Employment scale was the only variable that was consistently positive across the OLS and median models and was statistically significant in the median specification. This supports the view that the income opportunities identified in sweet potato value-chain upgrading depend on productive scale, processing capacity and stronger market collaboration (Sugri et al., 2017). The absence of significant income differences across the three LGAs further suggests that the constraints were widespread rather than location-specific.

5.0. Conclusion and Policy Recommendations

This study examined sweet potato value-addition activities, marketing constraints and household income among sweet potato-producing households in Kaduna State, Nigeria. The findings show that value addition is already practiced among households, but activities remain concentrated in simple, low-capital processing options, particularly flour and chips. While processing provides opportunities for reducing post-harvest losses and expanding household livelihood activities, the limited adoption of improved storage facilities and processing technologies suggests that many households engage in value addition primarily as a coping strategy against perishability rather than as a fully commercial enterprise.

The study further shows that marketing constraints are widespread among sweet potato households. However, participation in specific processing activities was not significantly associated with reduced exposure to marketing challenges, indicating that these constraints are structural and affect processors and non-processors alike. The results suggest that improving value addition alone may not be sufficient to enhance household income unless complementary challenges related to storage, equipment, transportation and market coordination are addressed.

The income analysis indicates that household income performance was more closely associated with the scale of sweet potato operations than with individual marketing constraints. Employment scale was the only factor that consistently showed a positive relationship with income, suggesting that expanding the size and capacity of sweet potato enterprises may provide greater opportunities for improving household earnings. Furthermore, the absence of significant income differences across the study locations indicates that the observed value-chain challenges are widespread across Kaduna State rather than being restricted to specific areas.

In a nutshell, the study demonstrates that sweet potato value addition has potential for improving rural livelihoods, but the realisation of this potential depends on strengthening the supporting environment in which households

operate. A value-chain approach that combines processing development, market improvement and increased operational capacity is therefore necessary to transform household-level activities into sustainable income-generating enterprises.

Based on the findings, the study recommends the following:

i. Stakeholders should promote access to affordable processing equipment and technical training to improve product quality, processing efficiency and enterprise expansion.
ii. Improved storage facilities and post-harvest handling practices should be encouraged to reduce losses and enable households to better manage the timing of sales.
iii. Efforts should also be directed toward strengthening market linkages through farmer groups, market information systems and improved connections between producers, processors and buyers.
iv. Furthermore, access to credit, business support services and entrepreneurship training should be enhanced to enable households to expand their sweet potato enterprises and increase employment opportunities.
v. Development interventions should adopt an integrated value-chain approach that combines support for processing, storage, transportation and marketing rather than focusing on value addition alone.

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