

ANALYSIS OF INVESTMENT DECISIONS IN SWEET POTATO VALUE
ADDITION AMONG FARMING HOUSEHOLDS IN BENUE STATE, NIGERIA

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Abstract

The study investigated investment decisions in sweet potato value addition among farming households in Benue State, Nigeria. Specific objectives were to describe the socioeconomic characteristics of sweet potato farming households; identify value-added products; analyse factors influencing the investment decision to add value and analyse factors influencing the level of value addition. Systematic multi-stage sampling yielded a sample of two hundred respondents. Data were collected via structured questionnaires and analysed using descriptive statistics, logit regression, and multiple linear regression in SPSS. Significant factors influencing the decision to invest in value addition were sex, farming experience, extension contact, and cooperative membership. Only farm output ($t = 3.34$, $p < 0.01$) and amount of credit received ($t = 2.46$, $p < 0.05$) significantly influenced the level of value addition. The null hypothesis of no significant factors influencing investment decision was rejected ($LR \chi^2 = 52.98$, $p < 0.01$; Pseudo $R^2 = 0.5121$). Similarly, the null hypothesis of no significant factors influencing the level of value addition was rejected ($F = 5.66$, $p < 0.01$; $R^2 = 0.6983$). It is recommended that governments and financial institutions develop tailored flexible loan products that are aligned with agricultural production cycles. In addition, farmer cooperatives should be strengthened to enhance collective bargaining power and facilitate easier access to group credit. Furthermore, subsidies or low-interest loans should be provided for the acquisition of small-scale processing equipment such as peelers, dryers, and slicers.

Keywords: sweet potato, value addition, investment decision, logit model, credit access, benue state

Introduction

Sweet potato (*Ipomoea batatas* L.) is a versatile, drought-resistant, high-yielding tuber crop with a short maturity period (3–5 months) that adapts well across ecological zones. Globally, there are over 600 species in the genus *Ipomoea*, and 13 of these are in the sub-section *batatas* (Stathers et al., 2018). It ranks as the second most important tuber after Irish potato. It is an important staple food crop worldwide due to its high yield and widespread adaptation (Okeke et al., 2020). Originating in tropical America (Yang et al., 2024), it reached Africa via Portuguese and Spanish explorers and was introduced to Nigeria around 1694–1698.

However, sweet potato is nutritionally rich. The crop can be considered promoting nutritional security particularly in agriculturally backward areas. Besides carbohydrates, it is a rich source of lipid, protein, carotene and calcium (Ocholi et al., 2017) OFSP roots are rich in proteins, dietary fiber, complex carbohydrates, calcium, iron, and vitamins A, C, and B. (Abewoy et al., 2024). According to Oke and Workneh (2019), Sweet potato is rich in dietary fiber and have high water content and also provide 359 kJ energy with low total lipid content, which is only about 0.05 g per 100 g. In addition, sweet potatoes also are high in minerals such as potassium, calcium, magnesium, sodium, phosphorus, and iron.

Nigeria produces approximately 4.03 million tonnes annually on 1.7 million hectares (FAOSTAT, 2019). Sweet potato is called ‘uto nduku’ in Igbo, ‘dankalin turawa’ in Hausa while Yoruba call it ‘odunkun dun’.

In Benue State, the average sweet potato yield figure is about 9.8 tonnes/ha for local varieties. However, when farmers adopt improved, high-yielding varieties—like NRSP/05/007C—and good agronomic practices (GAP), the yield increases significantly to between 13.89 t/ha and 14.23 t/ha, (Chimaroke et al., 2022; Iorliam et al., 2017,). Sweet potato is referred to as *Ogegehin* in Idoma language, *Imana* in Igede and *Atsaka* in Tiv language. Sweet potato is processed into *epe* (Idoma language) which is utilized in gruel (*kunu*) processing for both household and market purposes.

Agricultural economy in Nigeria is still largely characterized by production and direct sale of agricultural outputs in its raw form with very little capacity for transformation of produce from its raw form to other value-added products (Ezeudu & Obimbua (2024)). This results in post-harvest losses, low incomes, and missed opportunities for economic diversification away from oil. Value addition is important for the agricultural sector in Nigeria to be able to actualize the economic agenda of different governments towards increasing agricultural Gross Domestic Product and diversification of economic activities away from the oil sector (Animbaet al., 2024). Value addition can help farmers to claim part of the unexploited profit going unclaimed in the manufacture of food, fiber and industrial or other product from agricultural produce (Nnanna et al., 2015).

Although the National Root Crops Research Institute (NRCRI) and Agricultural Development Programmes have disseminated processing technologies, adoption remains low among farmers. Existing studies address variety performance, efficiency, or gender participation in value addition elsewhere in Nigeria, but none specifically analysed investment decisions in sweet potato value addition in Benue State. This gap justifies the present study.

Objectives of the study: the broad objective was to analyse investment decisions in sweet potato value addition among farming households in Benue State.

Specific Objectives

- i. describe socioeconomic characteristics of sweet potato farming households.
- ii. identify value-added products in the study area.
- iii. analyse factors influencing the investment decision to add value.
- iv. analyse factors influencing the level of value addition.

Materials and Methods

Study Area

Benue State lies in Nigeria’s Southern Guinea Savannah (latitudes 6°30’N–8°10’N, longitudes 6°35’E–8°10’E), with 1,500 mm annual rainfall, distinct wet (April–October) and dry seasons, and 33,955 km² land area across 23 LGAs divided into three agricultural zones. Current reality (2023–2025): Agriculture employs 30–34% of Nigeria’s workforce, still the largest single sector but far less than past estimates, (National Bureau of Statistics NBS, 2024). Benue State was chosen for the study because it is one of Nigeria’s major sweet potato producing regions. Benue State also provides a diverse representation of farming practices and varieties, with local names and traditional processing methods deeply embedded in the culture.

Sampling: Multi-stage procedure:

First, all three zones was purposive selected due to high sweet potato concentration.

Second, two LGAs were selected per zone based on production intensity (Katsina-Ala & Vandeikya – Zone A; Makurdi & Guma – Zone B; Otukpo & Apa – Zone C).

Third, twelve farming communities were selected based on production intensity; and fourthly, 200 respondents were determined by Yamane's formula (Adam, 2020). from a population of 402 sweet potato farmers:

$$n = \frac{N}{1 + N(e)^2}$$

where N = 402, e = 0.05, yielding n = 200.

Table 1: Sample Size Determination Plan

Agric. Dev. Zone	LGAs	SWP farming villages	Population (N)	Sample size (n=5%)
Zone A	Vandekya	Mbayor	31	15
		Mbatyough	19	10
	Kastina-ala	Amaafu	25	12
		Tordonga	58	29
Zone B	Makurdi	Kua	40	20
		Bambam	20	10
	Guma	Mbadede	61	30
		Mbakyaha	27	14
Zone C	Otukpo	Adoka	56	28
		Anmoda	28	14
	Apa	Olegar	16	8
		Efesor	21	11
Total	6	12	402	200

Source: Benue State Agricultural and Rural Development Agency BARNADA, (2024)

In line with Daniel (2012), the proportion of the sweet potato farmers in the population are reflected in the sample as given by the formula specified as follows:

The formula is: $n = \frac{N}{1 + N(e)^2}$ -----(1)

n = sample size, N= population size

$$n = V_{\{swpf\}} + K_{\{swpf\}} + M_{\{swpf\}} + G_{\{swpf\}} + O_{\{swpf\}} + A_{\{swpf\}}$$

Where:

- (V_{swpf}) = Vandeikya sweet potato farmers
- (K_{swpf}) = Katsina-Ala sweet potato farmers
- (M_{swpf}) = Makurdi sweet potato farmers
- (G_{swpf}) = Guma sweet potato farmers
- (O_{swpf}) = Otukpo sweet potato farmers
- (A_{swpf}) = Apa sweet potato farmers

This expression simply shows that the total sample size (n) was proportionally distributed across the six LGAs based on their farmer populations.

The actual sample size was then determined using Yamane's formula:

$$n = \frac{N}{1 + N(e)^2}$$

with (N = 402) and (e = 0.05), giving:

$$n = \frac{402}{1 + 402(0.05)^2} = 200$$

So, the sampling proportion was 5% (0.05), and the distribution equation above ensured each LGA's farmers were represented proportionally in the final sample.

Data Collection

Primary data was collected via structured questionnaires and administered by trained enumerators in 2024.

Data Analysis

1. Socioeconomic characteristics of sweet potato farming households
 - Tool used: Descriptive statistics (frequencies, percentages, means).
2. Identify value-added products in the study area
 - Tool used: Descriptive statistics (frequency distribution, percentages).
3. Analyse factors influencing the investment decision to add value
 - Tool used: Logit regression model (binary logistic regression).
 - Hypothesis tested:
 - Null (H_0)
 - Alternative (H_1)
4. Analyse factors influencing the level of value addition
 - Tool used: Multiple linear regression.
 - Hypothesis tested:
 - Null (H_0)
 - Alternative (H_1)

Model specification

Logit Model

Functional Form: The logit model expresses the probability $P(Y=1)$ $P(Y = 1)$ using the logistic function:

$$P(Y=1|X) = \frac{e^{\beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_k X_k}}{1 + e^{\beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_k X_k}} \quad (3)$$

This expresses the probability that a farmer decides to add value ($Y = 1$) given the explanatory variables $X_1, X_2, \dots, X_k$.

Log-Odds Transformation: It can also be written in terms of log-odds (logit transformation):

$$\ln \left(\frac{P(Y=1)}{1-P(Y=1)} \right) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_k X_k$$

where

Y = decision to add value,

$X_1, X_2, \dots, X_k$ = Predictor (independent) variables,

β_0 = Intercept term

$\beta_1, \beta_2, \dots, \beta_k$ = Coefficients for each predictor variable,

$P(Y=1)$ = Probability of the event occurring

This shows the relationship in terms of **log-odds**, where the coefficients (β) represent the change in the log-odds of investing in value addition for each unit change in the predictor variables.

Multiple Regression (Linear)

Linear function:

$$Y = b_0 + b_1 X_1 + b_2 X_2 + b_3 X_3 + b_4 X_4 + b_5 X_5 + b_6 X_6 + b_7 X_7 + \varepsilon_i \quad (4)$$

where:

- Y = level of value addition (kg output processed)
- b_0 = intercept

- $b_1, b_2, \dots, b_7$ = regression coefficients
- $X_1, X_2, \dots, X_7$ = independent variables (sex, age, marital status, household size, education, farming experience, cooperative membership, etc.)
- ε_i = error term

Core Variables for Investment Decision (Logit Model)

- Gender (X_1) – dummy (1 = male, 0 = female)
- Farming experience (X_6) – years in farming
- Extension contact (X_{10}) – number of visits
- Cooperative membership (X_7/X_{11}) – dummy (1 = yes, 0 = no)

Core Variables for Level of Value Addition (Multiple Regression)

- Farm output (X_{14}) – tons/hectare
- Amount of credit received (X_{18}) – Naira

Results

Socioeconomic Characteristics of Sweet Potato Farmers

Respondents were 56.5 % male, 80 % married, and highly literate (39 % tertiary, 25.5 % secondary). Mean age was 43 years (48.5 % ≥ 46 years). Main income source was food-crop farming (62.5 %); 64 % engaged in off-farm employment. Only 38.9 % belonged to cooperatives and 30.9 % accessed credit. Mean household size was 6.36 persons; mean farming experience 16 years (though 86.5 % had <10 years in sweet potato); mean farm size 2.67 ha; mean annual farm income ₦545,215 (95 % earned $< \text{₦1 million}$).

Table 2: Selected Socioeconomic Characteristics (n=200)

Characteristic	Category	Frequency	%	Mean
Sex	Male	113	56.5	–
	Female	87	43.5	–
Age (years)	≤ 21	3	1.5	43
	22 – 31	36	18.0	
	32 – 41	64	32.0	
	≥ 42	97	48.5	
Source of income	food crop farming	125	62.5	
	Cash crop farming	38	19.0	
	Livestock keeping	25	12.5	
Cooperative membership	Member	77	38.9	–
	Non-member	121	61.1	
Credit received ₦	$\leq 50,000$	70	35.0	–
	51,000 – ₦150,000	85	42.5	
	$\geq 151,000$	45	22.5	150,000
Farming experience (yrs)	$\leq 10y$	173	86.5	16
	11 – 15y	16	8.0	
	16 – 20y	8	4.0	
Farm size (ha)	≤ 1.0	78	39.0	2.67
	1.1 – 6.0	105	52.5	
	≥ 6.1	17	8.5	
Farm output t/ha	Low yield (≤ 10 t/ha)	60	30.0	
	Medium yield (11–14 t/ha)	95	47.7	
	High yield (≥ 15 t/ha)	45	22.5	
Annual income (₦)	≤ 10	190	95.0	545,215
	11 – 15	3	1.5	
	16 – 20	4	2.0	
	≥ 21	3	1.5	

Source: Computed from Field survey data, 2024, Every variable adds to 100%

Value-Added Products

The result of value-added products is presented in Table 3 showing the distribution of the respondents. Most farmers in the study area processed sweet potato into flour (34%) and chips (22.5%), followed by cake (19%), potato balls (11%), gruel (10.5%), and puree (6.5%). Flour and chips were the most common value-added products because they require minimal equipment and simple traditional processing methods such as peeling, slicing, and sun-drying. These techniques make them accessible to smallholder farmers with limited resources.

Puree recorded the lowest participation at 6.5% due to its rigorous processing requirements and low popularity among farmers. Similarly, only 10.5% processed sweet potato into gruel (kunu), largely because of the labour-intensive traditional method involved. Sweet potato flour can be used as a thickener in soups, gravies, snacks, and bakery products, while chips are gaining popularity in Nigeria for their affordability, nutritional value, and convenience as an urban snack. The Table 3 showing the distribution of the respondents according to sweet potato value added products is as follows:

Table 3: Distribution of Value-Added Products (multiple responses)

Product	Frequency	Percentage
Flour	68	34.0
Chips	45	22.5
Cake	38	19.0
Others (Potato balls)	22	11.0
Gruel (<i>Kunu</i>)	21	10.5
Puree	13	6.5

Source: field survey data, 2024, * multiple response recorded, hence percentage > 100

Factors Influencing Investment Decision (Logit Model)

The logit regression analysis of factors influencing investment decisions in sweet potato value addition among farming households revealed a model chi-square of 52.98, which is significant at the 1% level, rejecting the null hypothesis of no significant influencing factors. The Pseudo R^2 was 0.5121, indicating that the independent variables explain 51.21% of the likelihood of investing in sweet potato value addition. Key significant variables included sex, which had a negative coefficient significant at the 5% level and contrary to a priori expectation. This means male farmers are 26.52 percentage points less likely to invest in value addition compared to females, consistent with findings that female post-harvest processors are more involved in sweet potato processing activities.

Farm experience showed a positive coefficient significant at the 10% level, implying that more experienced farmers are more likely to engage in sweet potato value addition, aligning with prior studies linking experience, education, and association membership to value addition initiatives. Extension contact was also positive and significant at the 5% level, indicating that regular interaction with agricultural extension services strongly encourages participation in value addition practices, as supported by research on Kenyan sweet potato farmers which, in contrast, membership in farmers' associations or groups had a negative and significant coefficient at the 10% level, suggesting that such membership may sometimes reduce the likelihood of value addition due to inefficiencies, limited training, or internal conflicts within poorly managed groups.

Table 4: Factors Influencing Investment Decision in Sweet Potato Value Addition

Variable	Coefficient	Standard error	z	p> z	Marginal effect
Sex	-2.44**	1.00	-2.44	0.015	-26.52
Marital status	-0.85NS	1.23	-0.69	0.490	-9.25
Age	0.018NS	0.05	0.39	0.698	0.19
Household size	0.19NS	0.23	0.84	0.400	2.09
Farming experience	0.57*	0.33	1.73	0.083	6.14
Educational level	0.070NS	0.079	0.89	0.374	0.76
Annual farm income	6.53x10 ⁻⁷ NS	7.89x10 ⁻⁷	0.83	0.408	7.09x10 ⁻⁶
Off-farm employment investment	1.07NS	1.10	0.97	0.331	11.66
Extension contact	4.89**	2.28	2.14	0.032	53.11
Membership of cooperative	-2.42*	1.40	-1.72	0.085	-26.26
Credit access	0.93NS	1.23	0.76	0.448	10.12
Farm size	-0.46NS	0.37	-1.25	0.212	-5.05
Farm output	0.12NS	0.13	0.98	0.326	1.35
Farm output consumed	-0.0015NS	0.0034	-0.44	0.657	-0.017
Number of extensions Contact	-0.65NS	0.53	-1.23	0.218	-7.04
Training participation	-1.51NS	1.23	-1.22	0.221	-16.37
Constant	-3.20NS	2.12	-1.51	0.131	
LR Chi square	52.98***				
Pseudo R2	0.5121				

Source: Field survey data, 2024 *** = significant

@ 1%; ** = significant

@ 5%; * = significant

@ 10%; NS = not significant

Model $\chi^2 = 52.98$ ($p < 0.01$), Pseudo $R^2 = 0.5121$.

Significant variables (marginal effects):

- Sex (male): -26.52 % ($p < 0.05$) – males less likely to invest.
- Farming experience: +6.14 % per year ($p < 0.10$).
- Extension contact: +53.11 % ($p < 0.05$).
- Cooperative membership: -26.26 % ($p < 0.10$).

Factors Influencing Level of Value Addition (Multiple Regression)

The multiple regression analysis examined the socio-economic factor influencing the level of sweet potato value addition among farming households. Linear regression model was chosen because the study aimed to capture direct, proportional relationships between socio-economic factors (like income, education, or household size) and the level of sweet potato value addition. The regression model showed an R^2 of 0.6983, indicating that approximately 69.83% of the variation in the level of sweet potato value addition is explained by the independent variables included in the model. The F-value of 5.66 was highly significant at the 1% level,

leading to the rejection of the null hypothesis that there are no significant factors influencing the level of value addition in the study area. This confirms a strong overall fit of the model.

Only two variables were found to significantly influence the level of sweet potato value addition: Sweet potato farm output and the amount of credit received. The coefficient for sweet potato farm output was 0.29 and significant at the 1% level, with a standard error of 0.086. This positive relationship implies that, all things being equal, a one-unit increase in sweet potato output leads to a 0.29-unit increase in the level of value addition. Higher output encourages farmers to diversify into value-added activities to mitigate risks associated with price volatility in the raw sweet potato market.

The coefficient of the amount of credit received was positive and significant at the 5% level. This indicates that as the amount of credit accessed by farmers increases, the level of value addition in sweet potato also rises. Credit enables farmers to finance essential inputs such as processing equipment, labor, and facilities, thereby supporting greater engagement in higher-value activities. This finding aligns with the earlier research by Ejechi (2023) on similar factors affecting value addition.

Table 5: Factors Influencing Level of Sweet Potato Value Addition

Variable	Coefficient	Standard error	t	p> z
Household size	0.11NS	0.19	0.59	0.557
Farming experience	-0.033NS	0.14	-0.23	0.816
Annual farm income	-9.29x10 ⁻⁷ NS	7.78x10 ⁻⁷	-1.19	0.239
Extension contact	2.17NS	2.29	0.95	0.348
Membership of Cooperative	-1.73NS	1.08	-1.61	0.115
Credit access	-1.28NS	1.15	-1.12	0.270
Farm size	-0.23NS	0.22	-1.03	0.310
Farm output	0.29	0.088	3.34	0.002***
Amount of credit Received	0.000015	5.87x10 ⁻⁶	2.46	0.018**
Constant	0.36NS	2.86	0.13	0.899
R square	0.6983			
Adjusted R square	0.5748			
F-value	5.66			

Source: Field survey data, 2024 *** = significant @ 1%; ** = significant @ 5%; NS = not significant

Adjusted R² = 0.5748, F = 5.66 (p<0.01). Only two variables were significant:

- Farm output: +0.29 units per unit increase (p<0.01).
- Amount of credit received: +0.000015 units per ₦1 (p<0.05).

Discussion

Males dominate production (56.5 %) but are less involved in value addition, consistent with cultural division of labour where women manage post-harvest processing (Ejechi, 2023; Kanojiya et al., 2023). Experienced farmers invest more due to accumulated knowledge and risk tolerance (Akinola et al., 2013; Mwaniki, 2015). Extension contact dramatically raises probability of value addition by providing technical and market information (Orinda et al., 2017). Surprisingly, cooperative membership reduced likelihood, due to weak focus on processing training or internal inefficiencies (Kaganzi et al., 2009).

Level of value addition is driven by higher output (enabling market diversification and economies of scale) and credit access (financing equipment and labour). This aligns with Ejechi (2023). Larger households and limited credit constrain scaling, while low incomes (<₦1 m) limit investment capacity.

Conclusion and Recommendations

The findings of the study revealed that sex, farming experience, extension contact, and membership in cooperatives were statistically significant determinants of the decision by farming households to engage in sweet potato value addition.

From the findings of the study, it emerged that there are several sweet potato value addition products produced in Benue State Nigeria. These value addition products include flour, puree, chips, cake, gruel, and potato balls (*puff, puff*). The value addition techniques are simple and traditional such as grading which is done according to size, colour and lack of bruises, packaging which is done in polythene bags and sacks, slicing and sun-drying, grinding sweet potato into flour, preparing additives and baking.

The study also found that sex, farm experience, extension contact, and membership of cooperative are significant factors influencing sweet potato value addition decision.

Findings of the study also shows that there were only two variables that influence the level of sweet potato value addition in the study area, farm output and amount of credit received. Among other factors that influenced sweet potato value addition in the study area are household size, credit access, land size and training.

The strategies to enhance both value addition decision and level of value addition of sweet potato among farmers in Benue state and Nigeria is to improve sweet potato farmers' access to credit. Government and financial institutions should develop tailored loan products with flexible repayment terms that align with agricultural cycles. Establishing farmer cooperatives or associations can enhance collective bargaining power and improve access to group-based credit schemes. Simplifying loan application processes and reducing collateral requirements can make credit more accessible, especially for small-scale farmers. Digital financial services, such as mobile banking, should be leveraged to reach rural areas.

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