Determinants of Value addition to Plantain among small-scale Farmers in Kwara State, Nigeria

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Abstract

Value addition has been reported as a panacea for poverty among small-scale farmers. However, the factors that determine its use among plantain farmers are unclear. Therefore, this study focuses on the variables that affect plantain value addition among small-scale farmers in Kwara State, Nigeria. Using a three-stage sample procedure, a structured questionnaire was used to elicit information from 120 plantain farmers—44 value adders and 76 non-value adders. Descriptive statistics and the Heckman two-stage model were used to analyze the data. The majority of the plantain value adders (70.5%) were female, whereas the majority of non-value adders (81.6%) were male. About 56.8% of the value adders processed plantain into plantain flour, while 29.6% were engaged in the production of both roasted plantain and plantain chips. The Heckman two-stage model's outcome showed that the decision to add value to plantain is influenced by the availability of processing equipment, gender, farm size, access to training, and proximity to market while the amount of value added to plantains was positively influenced by processing equipment, farm size, education level, access to training, and plantain output. The study further revealed that poor processing facilities, inadequate finance, and a low level of awareness (mean = 3.6) were the most identified constraints faced by the farmers. The study therefore recommends that farmers should endeavor to process plantain flour, as it is seen to be more profitable and economical.

Keywords: Non-value adders, processing, value added products, value adders.

Introduction

The herbaceous plant known as plantain (Musa spp.) is grown in sub-Saharan Africa's humid forests and mid-latitude region (8). Approximately 60% of the world's plantains are produced in Central and West Africa, which also produce 40% and 42% of the crop, respectively. Research showed that Nigeria produces around 2.8 million metric tons of plantains each year (15). Plantains are a major staple food crop and an important means of livelihood among the farming households in Nigeria. Plantain is produced both for household consumption and for cash, which can be transformed into various products that can be marketed. (18) reported that in West Africa, the plantain production business has a great prospect in the areas of employment opportunity, GDP, national income, rural development, economic growth, as well as poverty alleviation. However, plantain is a perishable seasonal crop with a short shelf life and considerable losses both during and after harvesting (19). Therefore, these prospects can be harnessed through value addition, as this will reduce postharvest losses, lengthen the plantain's shelf life, and increase the processors' profit. (22) report that adding value to plantains involves converting the raw plantains into a refined and more marketable form that is more usable overall. This indicates that the initial state of raw plantains has been purposefully altered to enhance their quality and extend their shelf life. According to (20), the plantain value chain, especially the processing part, is a worthwhile and lucrative endeavor that all unemployed youngsters in Nigeria can partake in. Plantains can be processed in a variety of ways, and the finished products can be kept or preserved for later use. The process involves several stages, including washing, peeling, slicing, salting, frying, and packaging. During this process, value can be added to plantains (7) to produce a variety of products to be available to consumers throughout the year (16), in spite of the seasonality of the crop.

Primarily, the stagnation of livelihood in developing countries has been linked to the low levels of value addition to agricultural produce (9). In Nigeria, despite the prospects of value addition, most plantain farmers are still poor and encounter high levels of postharvest losses. Therefore, this study aimed to describe the socio-economic characteristics of the farmers, identify their various value-added products of plantains, examine the factors influencing value addition and the amount of value added to plantains, and identify the constraints militating against plantain value addition among them.

Material and Methods

Study Area

The study was conducted in Kwara State, Nigeria. It is located in north-central Nigeria, which is part of the country's middle belt. Kwara State, which has a population of roughly 2.37 million, is located between latitudes $7^0$45'–$9^0$30'N and longitudes $2^0$30'–$6^0$25'E. It has a total land area of 36,825 square kilometers. Internationally, the state borders the Republic of Benin, as well as the states of Osun, Niger, Kogi, Ekiti, and Oyo. The state is made up of sixteen Local Government Areas (LGAs)—Asa, Baruten, Edu, Ekiti, Ifelodun, Ilorin east, Ilorin south, Ilorin west, Irepodun, Isin, Kaima, Moro, Offa, Oke ero, Oyun, and Pategi—and has an average temperature that ranges from 300 to 350 degrees Celsius.

The state's economy is based primarily on agriculture. The primary crops grown there are rice, bananas, plantains, yams, cassava, and maize, most of which are produced by small-scale farmers who use manual labor, primitive tools, local seeds, fertilizers, and sometimes-used agrochemicals (3).

Sample Technique and Sample Size

A three-stage sampling procedure was employed for the study. Because they are the primary plantain-producing areas in Kwara State, Ekiti and Oyun Local Governments were purposefully chosen for the first stage. Four communities were then randomly selected from the specified LGAs for the second stage. The third and last stage involved choosing 15 plantains at random from each community. The study involved 120 plantain producers in total.

Table 1. Classification of the three-stage sampling technique

S/N	1st Stage	2nd Stage	3rd Stage
	LGAs	**Communities**	**Respondents**
1	Ekiti	Osi	15
		Oke-opin	15
		Epe-opin	15
		Isare-opin	15
2	Oyun	Erin Ile	15
		Ipee	15
		Igosun	15
		Ilemona	15
Total	2	8	120

Source: Author, 2022

Data collection

To collect the primary data, a well-designed questionnaire was employed, and it was given to a sample of respondents.

Data Analysis

The analytical techniques employed were descriptive statistics, Heckman two-stage selection model and Likert-type scale.

Heckman Two-stage Selection Model

This was used to investigate the factors that influence value addition and the amount of value added to plantains. Farmers made decisions about whether to add value or not based on their assessment of the utility they would likely receive. The farmers' behaviour that led to a particular decision was therefore modeled in a logical sequence, beginning with the decision to add value and continuing with a decision about how much value addition to make. Since the farmers' utility maximization behaviour cannot be observed, the decision made by the farmers was assumed to represent the farmers' utility maximization behaviour. Based on the nature of these decisions, it is justified to use the Heckman two-stage selection model whose estimation involves two stages. A probit model was used to evaluate whether or not to add value in the first step. The decision to add value is discrete; one either adds value or they don't, which is why this model was chosen. Moreover, the probit model was used because the investigation is predicated on the assumption of a normal distribution. The two-stage strategy is justified by the fact that deciding to start the value addition process usually comes before deciding how much plantain value

addition (or value-added plantain) to undertake. The probit model used in the first stage is as specified in Equation 4 below:

$$Prob(Yi = 1| \int_{-\infty}^{X'\beta} \varphi(t)dt = \varphi(X'\beta) \quad (1)$$

For value-adding households, Yi is an indicator variable equal to unity, φ(.) is the standard normal distribution function, βs are the parameters to be estimated, and Xs are the choice determinants. Yi takes a value equal to 1 and 0 otherwise, depending on whether household j's utility from value addition is greater than 0. It follows therefore, that:

$$Yi* = \beta iXi + Vi \quad (2)$$

Where Y_i^* is the latent level of utility the household gets from value addition and $V_i \sim N(0,1)$

Given this assumption, it follows that:

$$Y_i = 1 \text{ if } Y_i^* > 0 \text{ and } Y_i = 0 \text{ if } Y_i^* \leq 0 \quad (3)$$

Empirically, the model can be represented as follows:

$$Y = \beta_j X_i + \epsilon_i \quad (4)$$

Where Y is the probability of a household adding value given farm, farmer and market and institutional characteristics X_i and ϵ_i is the error term.

In the second phase, the extent of value addition equation includes the Inverse Mills Ratio (IMR) as a regressor to account for any selection bias. The decision to add value comes before the decision to add value because it was expected that the degree of value addition would be self-selected in the sense that only a small number of farmers would desire to do so. Thus, self-selection turns into an empirical problem. This problem was addressed in part by the study's endogenous handling of the decision to add value, which took into consideration any possible problems with sample selection. In order to evaluate the factors influencing the degree of value addition, the target equation uses the Mills ratio from the chosen equation as an independent variable. This process begins with the estimation of the factors influencing the decision to add value.

$$E(Z_i \mid Y = 1) = f(xi\,\beta) + \gamma\lambda + u_i \quad (5)$$

Where λ̂ is the estimated IMR, x is a vector of independent variables influencing the extent of value addition, β is a vector of the corresponding coefficients to be estimated, and Zi is the (continuous) extent of value addition measured by the proportion of value added plantain output. Zi can therefore be stated as follows:

$$Z_i^* = \beta_i X_i + \gamma\lambda + u\,i \quad (6)$$

Where Z_i^* is only observed if the farmer is undertaking value addition (Y = 1), hence $Z_i = Z_i^*$.

Empirically, this can be represented as:

$$Z_i = \beta_i X_i + \gamma\lambda + u_i \quad (7)$$

Where ui is the error term, Xi is the inverse Mills Ratio determined in step 1 of the Heckman model, and Zi is the amount of value addition given the farm and farmer characteristics. Next, equations 4 and 7 were jointly estimated in STATA using the Heckman two-stage technique. Table 2 lists the variables that were employed in the two-stage Heckman selection model.

Table 2. Description and measurement of variables to be used in the model

Variables	Description	Unit of Measurements
Valadd	Farmers add value or not	Dummy (adding value=1, else=0)
Amtvaladd	Amount of plantain value added	Naira
Proequip	Availability of value addition equipment	Dummy (yes=1, no=0)
Age	Age of respondents	Years
Gender	Gender of respondents	Dummy (male=1, female=0)
Edulevel	Level of respondent's education	Years
Output	Plantain output	Tons
Credacess	Access to credit	Dummy (access=1, otherwise=0)
Hhsize	Household size	Number
Coopmen	Membership of cooperative	Dummy (access=1, otherwise=0)
Frmsize	Total farm size	Hectares
Training	Access to training	Dummy (access=1, otherwise=0)
Offhrsday	Hours spent on daily off-farm activity	Hours
Extacess	Access to extension service	Dummy(access=1,otherwise=0)
Marktdist	Distance to nearest market	Kilometres

Results and Discussion

Socio-economic Characteristics of Respondents

Table 3 shows the socio-economic characteristics of the respondents. The majority of the plantain value adders were female, which constituted 70.5%, and the majority of the non-value adders interviewed were male, which constituted 81.6%. This suggests that plantain processing is a female-dominated production. In its pooled form, the male that engaged in value addition constituted 62.5%, whereas the female constituted 37.5%. This suggests that plantain production is dominated by the male. This therefore agrees with the findings of (21) that the male dominated the field of plantain production while the female dominated the processing and marketing fields.

When the farmers' ages were combined, almost half (46.7%) fell between 41 and 50, meaning that many of them were in their prime and could effectively use the resources at hand to produce the most plantains possible. The result showed that most (72.7% and 84.2%) of value adders and non-value adders were married, respectively. This suggests that most farmers are likely to use family labor in farming production activities. This is consistent with the pooled result that shows married farmers made up 80% of the results, which is consistent with the findings of (10) in his study.

A household size of 6–10 people was reported for more than half (54.5%) of the value adders and 1-2 people for 59.2% of non-value adders. Given that the size of the family will affect the quantity of hired labor used for value addition, this means that the farmers will probably appreciate family labor.

In terms of the respondents' educational status, 6.8% of the plantain value adders had no formal education, and 43.2% had secondary education, while in contrast, for the non-value adders, 10.5% had no formal

education, and 44.7% had secondary education. This suggests that the majority of members of both categories are literate, capable of deciphering information and identifying trends in the market. The aggregated data showed that 44.2% of the farmers had completed secondary school, suggesting that the majority of plantain farmers are well educated and capable of implementing innovative ideas to improve plantain yield (1).

Some (38.6%) of the value-added farmers had between 6 and 15 years of farming experience, and 44.7% of non-value-added farmers had 16-35 years of farming experience. When combined, the 16–25 years of agricultural experience show that the plantain farmers have gained a great deal of experience and are probably aware of the most appropriate and cooperative strategies to increase yield. More than half (55.3%) of the non-value adders had off-farm revenue-generating activities, while the majority (65.9%) of value adders had no such activity. This implies that the majority of value adders rely solely on their value addition ventures or output for long-term viability, as they lack alternative sources of income. The combined data revealed that most plantain farmers (52.5%) rely on value-added production, which is consistent with the conclusions stated by (13).

The majority of the farms (81.8% of value adders and 90.8% of non-value adders) were between one and five hectares in size. The combined result showed that most (81.5%) farmers, who are primarily small-scale and perhaps constrained by the resources at hand, had farms of a certain size. Few (15.9% of plantain value adders and 6.6% of non-value adders) had access to agricultural extension services. According to (12), it was also noted that 90% of the farmers lacked access to extension services, which may have contributed to their ignorance of newer technologies.

Most (77.3%) of the value adders and 57.9% of non-value adders were members of cooperatives. From the pooled data, it was revealed that 65.0% of the farmers were members of cooperatives, indicating that the farmers joined mostly to enjoy the benefits like group lending, trainings, purchasing of inputs, and also providing finance in order to enhance production. Also, all the value adders and about 96.1% of the non-value adders had an average value of assets above N300,000, while 97.5% of the plantain farmers had an average value of assets above N300,000.

Table 3. Socio-economic characteristics of the respondents in the study area

Variables		**Value Adders (n_1=44)**		**Non Value Adders (n_2=76)**		**Pooled Data (n_3=120)**	
	Category	**Freq.**	**%**	**Freq.**	**%**	**Freq.**	**%**
Gender	Male	13	29.5	62	81.6	75	62.5
	Female	31	70.5	14	18.4	45	37.5
Age (years)	<=30	6	13.6	9	11.8	15	11.5
	31-40	21	47.7	16	21.1	37	30.8
	41-50	16	36.4	40	52.6	56	46.7
	51-60	1	2.3	8	10.5	9	7.5
	Above 60	0	0.0	3	4.0	3	2.5
Marital status	Married	32	72.7	64	84.2	96	80.0
	Single	5	11.4	8	10.5	13	10.8
	Divorced	5	11.4	1	1.3	6	5.0
	Widowed	2	4.5	3	4.0	5	4.2

Household size	<=5	20	45.5	45	59.2	65	54.2
	6-10	24	54.5	31	40.8	55	45.8
Education level	No formal	3	6.8	8	10.5	11	9.2
	Primary	4	9.1	10	13.2	14	11.7
	Secondary	19	43.2	34	44.7	53	44.2
	Tertiary	18	40.9	24	31.6	42	35.0
Farming experience (years)	<=5	3	6.8	0	0.0	3	2.5
	6-15	17	38.6	15	19.7	32	26.7
	16-25	10	22.7	34	44.7	44	36.7
	26-35	12	27.3	22	29.0	34	28.3
	Above 35	2	4.6	5	6.6	7	5.8
Off-farm day	Yes	15	34.1	42	55.3	57	47.5
	No	29	65.9	34	44.7	63	52.5
Farm size (hectares)	<=5	36	81.8	69	90.8	105	81.5
	6-10	8	18.2	7	9.2	15	12.5
Access to agricultural extension service	Have access	7	15.5	5	6.6	12	10.0
	No access	37	84.1	71	93.4	108	90.0
Membership of cooperative	Member	34	77.3	44	57.9	78	65.0
	Non-member	10	22.7	32	42.1	42	35.0
Average value of asset (Naira)	50-100	0	0.0	2	2.6	2	1.7
	101-300	0	0.0	1	1.3	1	0.83
	Above 300	44	100.0	72	96.1	117	97.5

Source: Field Survey, 2022

Various Value Added Products of Plantain

The types of plantain by-products produced in the research area by the value adders were displayed in Table 4. Among the main value-added products produced were plantains flour, roasted plantains (boli), and plantains chips. More than half (56.8%) of the respondents engaged in value addition, producing or processing plantains into flour. However, only 29.6% of the value adders were into roasted plantains and plantains chips. This indicates that plantain flour is the most processed plantain product in the study area, implying that it is more profitable to process plantains into flour compared with the roasted plantains and plantains chips. Knowledge of value addition, enough income or capital, availability of value addition equipment, and also a ready market for the products are factors that enabled the farmers to add value to plantains (5).

Table 4. Distribution of value added products of plantain in the study area (n_1 = 44)

Products	*Number of respondents	Percentage
Roasted plantain	13	29.6
Plantain flour	25	56.8
Plantain chips	13	29.6

Note: *Multiple responses were allowed
Source: Field Survey, 2022

Factors influencing Value Addition and Amount of Value Added to Plantain

Availability of processing equipment had a positive and significant correlation with practice of value addition. This suggests that farmers who own processing

equipment have a higher propensity to add value than farmers without processing equipment. Gender also had a positive significance on value addition practice; that is, value addition practices are more frequently used by women than by men. This aligns with the findings of (4), who found out that women's works are more in the agricultural produce processing industry than their male counterparts. The respondents' farm size was also positively and strongly correlated with the practice of value addition. This suggests that a household's likelihood of engaging in value addition increases with the size of the farm held by the respondent and vice versa. This may arise from the fact that larger farm owners often harvest more plantains, which influences their decisions to add value, whereas smaller farm owners spend more of their time on other off-farm pursuits and less time adding value. Training also had a significant relationship with the practice of value addition. This implies that plantain farmers that attend trainings and workshops will have a better understanding of the value of plantains and have an increased income through value addition. This aligns with the findings of (14), who concluded that farmers could gain knowledge and understand the necessary procedures needed to engage in value addition through training. (5) also noted that among the subjects taught to the farmers in his study were plantain production, processing, marketing, and ways for adding value to plantains. Additionally, market distance had a positive significance with the practice of value addition, meaning that farmers who live further from markets are more likely to add value because they may worry that their plantains will not be in good condition when they get to the market, which leads them to decide to add value (7).

Table 5 also showed that processing equipment, farm size, education level, training accessibility, and plantain output all positively impacted the respondents' amount of value addition. Availability of processing equipment was positively significant to the amount of value addition. This indicates that the greater the accessibility of processing equipment by the respondents, the more value is added to plantains (19). Education level positively correlated with the amount of plantain value added because people with formal education—primary, secondary, and tertiary—are more likely to add value to plantains than people without it. The value contributed to plantains increases with respondents' educational attainment. This could be because education enhances farmers' knowledge and decision-making towards innovation and better production (2; 11). Additionally, plantain yield positively influenced the amount of value addition. This indicates that when plantain production rises, surplus becomes available (17).

Table 5. Heckman two-stage result for the factors influencing value addition and the amount of value added to plantain

Variables	Target Equation				Selection Equation			
	Coefficient	Std.Error	Z	P>/z/	Coefficient	Std.Error	Z	P>/z/
Proequip	.6098747	.151774	4.02	0.000	2.423632	1.209134	2.00	0.050
Age	.0029375	.0083311	0.35	0.724	.0153322	.0247946	0.62	0.536
Gender	.2969439	.1381475	2.15	0.032	.0992591	.4101452	0.24	0.809
Offhrsday	-.0629382	.1372295	-0.40	0.646	.1938026	.3572522	0.54	0.587
Frmsize	.1656257	.0387109	4.28	0.000	.3598878	.1171268	3.07	0.002
Extacess	-.1245104	.2073853	-0.60	0.548	.1330612	.5847959	0.23	0.820

Coopmen	.0012441	.1559459	0.01	0.994	.1027587	.0627271	1.64	0.101
Hhsize	-.249626	.0419591	-0.59	0.552	.0770707	.123675	0.62	0.533
Edulevel	.039882	.0782958	0.51	0.610	.7381015	.2474861	2.98	0.003
Training	.4718413	.1392716	3.39	0.001	1.034731	.4575489	2.26	0.024
Marktdist	4.830504	2.707913	1.78	0.074	.1334545	.0917109	1.46	0.146
Credacess	-.2011281	.1586917	-1.27	0.205	.412231	.2521924	1.63	0.102
Output					.4005625	.240374	1.67	0.096
_cons	9.138156	.5863874	15.58	0.000	-3.396193	1.699626	1.63	0.046
Rho					.8488891	.1819706		
Sigma					.5761364	.0600305		
Lambda					.4890759	.1459799		

Source: Field Survey, 2022

Constraints to Plantain Value Addition among Small Scale Farmers

Table 6 showed the problems limiting value addition among the respondents. Poor processing facilities (weighted score = 432) ranked first. This implies that the unavailability of processing equipment will hinder efficiency, which agrees with the findings of (6) that poor processing and storage facilities are the major constraints hindering plantain production in his study area.

The result also revealed that inadequate finance, low level of awareness, and low knowledge about new innovations ranked second, third, and fourth, respectively. This resulted in the farmers having little or no understanding about trying new methods or skills useful in value addition business (9). Another problem faced by the farmers was consumers' preference in adding value to plantains. This means that farmers were not always aware of the needs of the consumer at a specific time (17).

Table 6. Constraints to plantain value addition in the study area

Constraints	Strongly Agree	Agree	Disagree	Strongly Disagree	Weighted Score	Mean	Rank
Poor processing facilities	72(60.00)	48(40.00)			432	3.6	1st
Inadequate extension knowledge	59(49.17)	57(47.50)	4(3.33)		415	3.5	7th
Unavailability of credit facilities	55(45.83)	65(54.17)			415	3.5	7th
High perishability of plantain	50(41.67)	70(58.33)			410	3.4	8th
High incidence of plantain pest and diseases	49(40.83)	71(59.17)			409	3.4	9th
Inadequate finance	70(58.33)	50(41.67)			430	3.6	2nd
Consumer preferences	59(49.17)	61(50.83)			419	3.5	5th
Low knowledge about new innovations	61(50.83)	59(49.17)			421	3.5	4th
High cost of labour	59(49.17)	60(50.00)	1(0.83)		418	3.5	6th
Low level of awareness	68(56.67)	52(43.33)			428	3.6	3rd

Note: Figures in parenthesis are percentage
Source: Field Survey, 2022

Conclusion

The results of the study indicate that farmers who possessed processing equipment had a higher likelihood of adding value than those who did not, indicating that the equipment had an effect on the decision to add value. Gender was a factor in the choice to give plantains value since women participated in the activity at a higher rate than males. Additionally, the size of the farm affected the decision to add value; a larger farm indicated a higher possibility of value addition among the household, and vice versa. The ability to receive training facilitated the process of determining if a household would add value. It is advised that farmers attempt to process plantain flour rather than roasted plantains and plantain chips in light of the study's findings because it is more cost-effective and profitable. In addition to being able to share ideas and learn from one another in order to promote value-added operations, plantain farmers should have access to new skills through workshops, seminars, and fieldwork. Also, the government should assist in providing adequate financing and credit facilities to the plantain farmers at the right time and amount and at a reduced interest rate. On the other hand, government or private organizations should also ensure that the plantain farmers are aware of the program (Plantain Revolution Initiative) contributing to moving value addition towards poverty reduction, tackling food insecurities, and also creating more job opportunities for the youths, hence reducing unemployment. Also, measures like adequate processing and storage facilities should be made available by the government or private organizations to the plantain farmers to reduce post-harvest losses.

Conflict of interest

The authors have no conflict of interest.

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