Profitability of *Tamarindus Indica* and its Suitability for Agroforestry Tree for Sustainable Household Incomes in Kano State, North-West Nigeria

Idahosa, E. [1], Anegbeh, P. O.[1], Uzunuigbe E.[2], Emokhare Q. I.[3] and Eguagie, E. [4]

[1]Research Outreach Department, Rubber Research Institute of Nigeria, Iyanomo, P. M. B. 1049, Benin City, Edo State, Nigeria.
[2]Research Operations Department, Rubber Research Institute of Nigeria, Iyanomo, P. M. B. 1049, Benin City, Edo State, Nigeria.
[3]College of Agriculture, Iguoriaki, Edo State, Nigeria.
[4]Planning, Monitoring and Evaluation Department, Rubber Research Institute of Nigeria, Iyanomo, P. M. B. 1049, Benin City, Edo State, Nigeria.
*Corresponding author's email: paul_anegbeh@yahoo.com

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ABSTRACT

The study investigated the profitability of tamarind processing and marketing and its suitability for agroforestry tree for households' incomes in Kano State in North-Western Nigeria. Specifically, it examined the socio-economic characteristics of processors and marketers, determined cost structure, revenue, profitability, assessed market structure, estimated profit efficiency, and identified constraints limiting the subsector. A multi-stage sampling technique was used to select 171 processors and marketers. Descriptive statistics, gross margin, Herfindahl-Hirschman Index (HHI) and stochastic profit frontier were used as analytic techniques. Results indicated that Tamarind processing was male-dominated (72.93%), while marketing was largely female-driven (57.89%). Older processors (mean = 45.25 years) than marketers (38.68 years) were observed. Most were married (88.72% and 76.32%, respectively). Educational levels varied, with many processors having Quranic or secondary education (29.32% each), while marketers were better educated (55.26% secondary, 34.21% tertiary). More of the Processors were married than the Marketers. Average household size was larger among processors (11.28) than marketers (6.18) were. Business experience was higher among processors (17.38 years) compared to marketers (9.00 years). Profitability analysis showed that in Kano, raw materials accounted for 52.83% of total variable costs (TVC), followed by transportation (22.85%). With a TVC of ₦1,235,960.76 and revenue of ₦2,436,789.00, gross margin stood at ₦1,200,828.24, indicating high profitability. Kano processors had mean efficiency of 0.8794, indicating operations at 88% of maximum profit, while marketers had lower efficiency (0.6098). Efficiency was enhanced by education and household size, but reduced by rent, age, and business experience. Key constraints included inadequate capital, price fluctuations, and lack of storage facilities, with high transport costs and poor road networks significant in Kano. Overall, tamarind processing and marketing are profitable ventures in the study areas, though with varying efficiency and profitability margins. Education levels of the household size were the variables observed to increase efficiency of the processors, while source of tamarind and business experience were the variables increasing the efficiency of the marketers.

Keywords: *Estimated profit efficiency, marketers, processors, revenue, socio economics, Tamarind*

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INTRODUCTION

It is recognized that a large number of unexplored woody species with potential use in agroforestry on acid soils exist in the wild throughout Nigeria (Anegbeh 1998) including *Vitellaria paradoxa* known as Shea butter tree (Idahosa *et al*., 2024), and Tamarind, *Tamarindus indica* L. (Sanogo *et al*., 2023). The Tamarind tree, *Tarmarindus indica* L., is a priority local or indigenous forest tree in the Sahel. It is a multi-purpose tree (agroforestry tree) of African origin that grows in many parts of the tropical and sub-tropical regions of the world. The tree is known as *guno* in Hausa, *tsamiya* in *Kanuri*, and *etikeni* in Igala. It is an important source of income for many rural families. It is still in the wild, and recently, the Federal Government of Nigeria showed a renewed interest for its research and development, conservation and management in different landscapes and it became one of the mandate tree crops of the Rubber Research institute of Nigeria (RRIN). *Tarmarindus indica* is a traditional African food tree native to Burkina Faso, Central African Republic, Chad, Eritrea, Ethiopia, Gambia, Guinea, Guinea-Bissau, Kenya, Madagascar, Mali, Mozambique, Niger, Nigeria, Senegal, Sudan, Tanzania, Uganda and Zimbabwe. It is also found in India, Southeast Asia and the America. It can grow up to 30 m and mature in 7 - 10 years. It can live up to 200 years and it can remain productive for over 60 years. The fruit has a hard-shell enclosing pulp that surrounds the seeds (Plate 1).

Plate 1: Tamarind fruits

The pulp of tamarind is the edible part, and from it comes the juice. Tamarind juice is loved throughout West Africa, mainly for its sourness, the characteristic pulp, and the aroma. The edible fruit pulp is sour and can be eaten raw. The fruits are rich in protein and antioxidants, containing 40 percent more protein than the same serving size of avocado pear (*Persea americana*). It is popular for flavouring tea, curries and rice. It is also used for drinks, jams, juices and sweets, and also as poultice to reduce fever and as a laxative. The fruit of *Tamarindus indica* is marketed worldwide in sauces, syrups and processed foods. The species is used as fodder for livestock and to enhance soil fertility for conservation. It is used to make furniture, carvings and household objects. The economic benefits of the tree species could have a direct positive effect on food and nutrition security for producers, processors, and marketers. Regarding shade or shelter, the extended crown of the tamarind offers shade so that it is used as a 'rest and consultation tree' in villages. It is resistant to storms and can be used as a windbreak. Its dense shade, broad spreading crown and allelopathic effects make it commonly used for firebreaks, as no grass will grow under the trees.

The production, together with processing and marketing of tamarind is growing due to increasing demand for natural preservatives and flavors in food and cosmetics. The production and processing of tamarind into products like pulp, juice, oil, and gum powder can provide profitable small-scale industry opportunities in Nigeria. India is the world's largest producer of tamarind, producing over
200,000 tonnes annually (Jimoh and Onabanjo, 2012). In Nigeria, tamarind fruit is usually consumed fresh and the seed discarded. Tamarind pulp has a unique sour taste due to the natural occurrence of sugars and plant acids together. The rural dwellers utilize the pulp in beverage production, using ancient processing techniques (Chimsah *et al*., 2020). The traditional processing methods are cumbersome, slow, non-hygienic and highly subjective, often resulting in non-uniform products whose acceptability is restricted to certain parts of the country. Tamarind is underutilized because of the inadequate research efforts directed towards it (Adeola and Aworh, 2010).

Despite the growing demand for tamarind products in Northern Nigeria, many small-scale processors and traders in the region are yet to optimize its profitability and harness its full agroforestry potential to contribute significantly to household income etc. The lack of comprehensive data on tamarind production, processing, marketing, and consumption patterns in the region, coupled with limited understanding of the factors influencing its profitability, hinders the development of effective strategies to improve the livelihoods of tamarind-dependent households. This study aimed to address this knowledge gap by conducting a profitability analysis of tamarind processing and marketing.

Moreover, while tamarind processing and marketing have the potential to improve household income, empirical studies assessing their profitability and

economic impact are scarce. Most research efforts in Nigeria have focused on staple crops such as maize, rice, and sorghum, with little attention given to underutilized crops like tamarind (Adeola and Aworh, 2010).

Objectives of the study

The general objective of this study was to examine the profitability of Tamarind processing, and marketing in Northern Nigeria: A Case Study of Kano State. Specific objectives were:

1. To describe the socio-economic characteristics of the processors and marketers of Tamarind in the study area;
2. To determine the cost structure, revenue, and profitability of Tamarind processing and marketing;
3. To assess market structure of tamarind products in the study area;
4. To determine the contributions of Tamarind to households incomes in the study area;
5. To estimate the profit efficiency of the processors and marketers of Tamarind in the study area;
6. To identify constraints limiting Tamarind processing and marketing in the study area.

METHODOLOGY

Study Area

The study was carried out in Kano State, situated in the Northern region of Nigeria, which is the most populous State in Nigeria, with an estimated population of 15,462,000 as at 2021 as reported by the National Bureau of Statistics (NBS, 2021; 2023). It is located between Latitudes 10°33'N and 12°34'N and Longitudes 7°34'E and 9°30'E (NIMET, 2021). Kano City serves as the capital and it is Nigeria's second most populous urban center after Lagos.

Sampling procedure and sample size

A multistage sampling procedure was employed to select the study sample.

Step 1

Kano State was purposively selected due to the high levels of Tamarind processing and marketing activities.

Step 2

Within the State, purposive sampling was used to select four (4) Local Government Areas (LGAs) with the most significant tamarind processing and marketing activities.

Step 3

Subsequently, one (01) community each was selected using a simple random from a local government area making it four communities/villages in the State. Yamanes formula was used to determine the number of respondents to be allocated to the State from the sample frame (Table 1).

Yamanes formular states:

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

n = sample size
N = Estimated Sample Size
e = margin error (5% or 0.05)

Kano Sample Size;

N = 300 processors and marketers (ADP Kano)
n =?
$n = 300 \div 1 + 300(0.05)^2$
n = 171(Kano)

Step 4

Proportionate sampling percentage was used to determine the number of respondents per community.

$$\mathbf{n_i = (N_i \div N)n}$$

Percentage = $(N_i \div N) \times 100$.

Where N_i = population of the subgroup
N = Total population

Kano = $\left(\frac{171}{384}\right) x\ 100$ = 42.75 (43%) for the 4 LGAs

Data collection

Data for the analyses were collected from primary source, through the administration of structured questionnaire, using the multi-stage sampling technique to select 384 respondents for the study. Data were collected on variables, such as, the demographic characteristics of the respondents including sex, age, marital status, level of education, family size, experiences and economic variables, such as annual income and their expenditure on Tamarind processing and marketing.

Measurement of variables

Labour – man/days was measured for both family and hired labour used in Tamarind collection and processing. One man-day equals approximately eight hours thus the

Table 1: Sampling Frame and Sample Size.

States under study	Sample Frame	LGA's selected	Numbers of Communities selected	Numbers of respondents to select	Estimated population
Kano State	300 marketers and processors (ADP Kano State)	Madobi, Dawakin -Tofa , Kano-South and Kano-Central	04	44.5% respondents from each community using proportionate sampling (171)	300

average male adult worked 8 hours a day (Akinbode et al., 2011). The actual total hours devoted to farm work was converted to male adult equivalent by multiplying those of male by a weight of one (1.00), and those of female adult by 0.75 and those of children by 0.5 or an assumption that average working condition/contribution prevail (Akinbode *et al*., 2011). Average yield of Tamarind was measured in Kg, Capital was measured in Naira, according to Akinbode and Ojo (2017), while gathering and processing period were measured in days. Average price per kg of Tamarind was measured in Naira, annual revenue from Tamarind sales was measured in Naira and experience was measured in years.

Data analysis

Data were analyzed using descriptive and inferential statistics tools such as Frequency counts, Percentage, Mean, Gross margin, budgetary analysis, multiple regression.

Objective One: To describe the socio-economic characteristics of the respondents.

This was analyzed using descriptive statistics, which include: Frequency distributions and percentages (for categorical variables such as gender, education level, and marital status).
Measures of central tendency (mean, median) and dispersion (standard deviation) (for continuous variables such as age, household size, experience in tamarind processing, and income levels).

Objective Two: To determine the Cost Structure, Revenue, and Profitability of Tamarind Processing and Marketing Gross Margin Analysis: (Total Revenue - Total Variable Cost) to assess profitability, Gross Margin Analysis.

This method measures the difference between total revenue and variable costs. It is useful for short-term financial evaluation and determining operational efficiency (Adeoye *et al*., 2018).

Objective Three: To assess market structure of Tamarind Products, Herfindahl-Hirschman Index (HHI) was used. This index measures market competitiveness.
An analysis of small ruminant markets in Benin, West Africa, found an HHI indicating effective competition, with markets being unconcentrated and free from significant entry barriers. Market Conduct: Descriptive analysis of pricing, sales channels, and marketing strategies

Objective five: To estimate the profit efficiency of the processors and marketers. The stochastic frontier model was used.

Profit model:

$$\text{Profit} = Bo+B_1X_1+B_2X_2+\ldots BnXn$$

Where:

Profit = Gross margin, from tamarind processing/marketing. (Y)
$X_1,X_2,\ldots,Xn$ = independent variables (e.g., cost of inputs raw materials, labour (family labour and hired labour), transportation, packaging , utility access to credit, market price, and experience in business, etc.)
X_1 = cost of raw materials
X_2 = cost of family labour
X_3 = cost of hired labour
X_3 = cost of transportation
X_4 = cost of packaging
X_5 = cost of Utility (water, electricity, fuel)
X_6 = Equipment use
X_6 = Business experience
X_7 = Access to credit
X_9 = Sex
Bo = intercept
Bn = coefficient measuring the effect of each factor.
E = Error term
Inefficiency model was used to estimate the determinants.

Objective six: To investigate constraints limiting Tamarind processing and marketing in the study area.

This constraint was investigated by using 4-points likert-type scale (Likert, 1932). Likert scaling is a bipolar scaling method, measuring either positive or negative response statements. The response to the various problems or constraints will be served in such a way that the response indicating the most serious constraints was given the highest scale (that is, 4). As a four-point scale, the response was grouped into 4, that is;

Very serious (VS) = 4

Serious (S) = 3
Not serious (NS) = 2
A problem = 1
Not a problem (NP) = 0
For a given constraint, the scores on each item was summed-up and divided by the total number of responses to obtain the mean and any of the constraints with the mean greater than 2.5 was regarded as serious.

RESULTS AND DISCUSSIONS

Socioeconomic Characteristics of the Processors and Marketers of Tamarind in Kano State
Table 2 shows the summary of socioeconomic characteristics of the Processors and Marketers of Tamarind in Kano State.

Sex

The sex distribution in Figures 1 and 2 show a higher male dominance among the Processors (72.93%), while females dominate the marketing segment (57.89%). This gendered occupational segregation aligns with findings of Bwala *et al*., (2023), who noted that women in northern Nigeria are more involved in agro-product marketing than the males due to flexible schedules and cultural acceptability. Conversely, the processing domain often requires technical input and is capital intensive, areas typically dominated by men due to greater access to resources (Adekola and Olajide**,** 2019).

Age

The mean age of processors (45.25 years) is significantly higher than that of marketers (38.68 years), indicating that older individuals are more involved in the processing business (Table 2). This might reflect the need for greater experience and asset accumulation for processing activities. Marketers, on the other hand, may require less capital and infrastructure, making the sector more accessible to younger individuals (Aliyu and Mukhtar, 2021).

Marital Status

The distribution of the marital status as depicted in (Figure 3) shows that the majority of both groups are married representing 88.72% (frequency = 118) of processors and 76.32% (frequency = 29) of marketers, thus, suggesting a level of social stability which could contribute to business continuity and reliability in informal trade settings. This is in tandem with the work of Oluwatayo and Ojo (2016). A small proportion of respondents identified as single or divorced, with divorced individuals constituting 15.79% (frequency = 6) among marketers compared to only 4.51% (frequency = 6) among processors. The presence of divorced individuals, especially in marketing, may reflect the sector's flexibility and lower entry barriers, allowing those facing social or economic disruptions to still participate in income-generating activities.

Educational Level

Educational levels reveal a contrast (Figure 4): while 29.32% of processors had secondary education and another 29.32% had only Quranic education, marketers had a much higher proportion with secondary (55.26%) and tertiary education (34.21%). This educational disparity may affect record-keeping, customer relations, and the ability to scale businesses among processors compared to marketers. This is in line with the position of Ibrahim and Abdullhai (2019) who stated that educational disparity leads to profit disparity.

Household Size

The average household size for processors (11) is almost twice that of marketers (6.), implying that processing households may face greater consumption pressures, possibly reducing the share of income retained for reinvestment. Larger households are a common feature in Northern Nigeria and are often linked to extended family systems (Akinola *et al.,* 2020).

Union Membership

Union membership is low across both groups (31.58% for processors and 21.05% for marketers), which may limit their access to collective bargaining, training, and financial services. Membership in associations is known to enhance access to credit, inputs, and markets (Adeoye *et al.,* 2022). Business experience (Table 2, Figure 5) shows that processors have more years in the business (mean = 17.38 years) compared to marketers (mean = 9.00 years). Experience generally correlates with better business acumen and efficiency in resource use (Lawal and Olaniyi, 2020). The source of tamarind for most participants was open market (Table 3), particularly among marketers (92.11%). This suggests limited direct access to wild or cultivated tamarind, potentially increasing input cost and affecting profitability. Increased domestication of indigenous and edible fruit trees (Anegbeh *et al*., 2005; 2006) or contract farming could improve value chain efficiency (Danbature and Gambo, 2021). Among processors, a significant portion (33.83%, frequency=45) still rely on wild sources, which may present sustainability concerns due to seasonal variability and over harvesting. This reliance on non-cultivated sources may also expose processors to supply shocks, particularly during periods of low fruiting or environmental stress, thus affecting production consistency.

Table 2. Summary of Socioeconomic characteristics of the Processors and Marketers in Kano State.

	Processors (n = 133)		Marketers (n = 38)	
	Frequency	**Percentage**	**Frequency**	**Percentage**
Sex				
Male	97	72.93	16	42.11
Female	36	27.07	22	57.89
Age				
≤30	16	12.12	7	18.42
31-40	28	21.21	19	50.00
41-50	48	36.36	8	21.05
51-60	28	21.21	4	10.53
>60	13	9.09	-	-
Mean	45.25		38.68	
Marital Status				
Married	118	88.72	29	76.32
Single	8	6.02	3	7.89
Divorced	6	4.51	6	15.79
Widow/widower	1	0.75	-	-
Educational Level				
0	20	15.04	2	5.26
6 years	17	12.78	-	-
12 years	39	29.32	21	55.26
16years	18	13.53	13	34.21
Quranic education	39	29.32	2	5.26
Household Size				
1-6	44	33.08	23	60.53
7-12	42	31.58	12	31.58
13-18	21	15.79	3	7.89
>18	26	19.55	-	-
Mean	11.28		6.18	
Membership of Union				
No	91	68.42	30	78.95
Yes	42	31.58	8	21.05
Business Experience				
≤10	42	31.58	27	71.05
11-20	55	41.35	8	21.05
21-30	23	17.29	1	2.63
31-40	7	5.26	2	5.26
>40	6	4.51	-	-
Mean	17.38		9.00	

Source: Field Survey, 2025

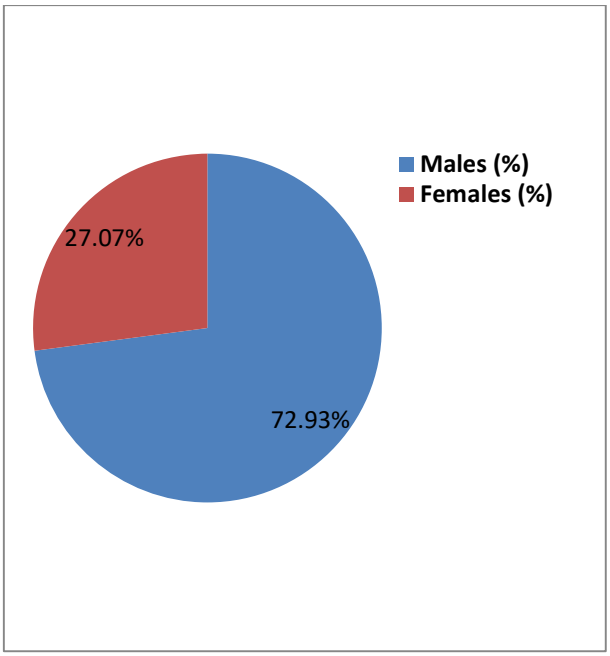

Figure 1: Sex distribution of Processors of Tamarind in Kano State.

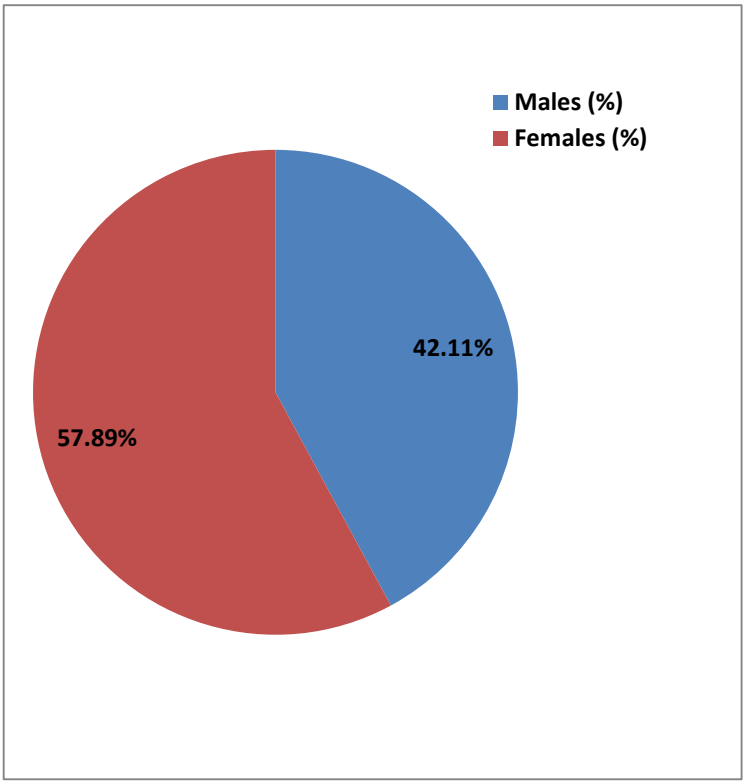

Figure 2. Sex distribution of Marketers of Tamarind in Kano State.

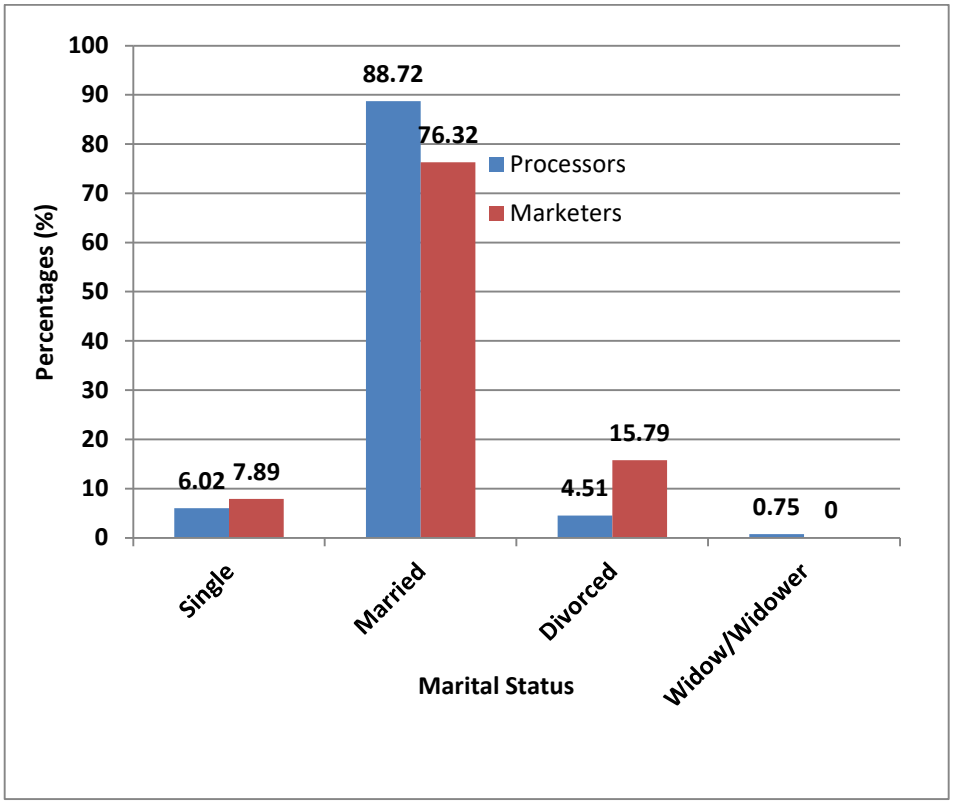

Figure 3. Marital Status of Processors and Marketers of Tamarind in Kano State

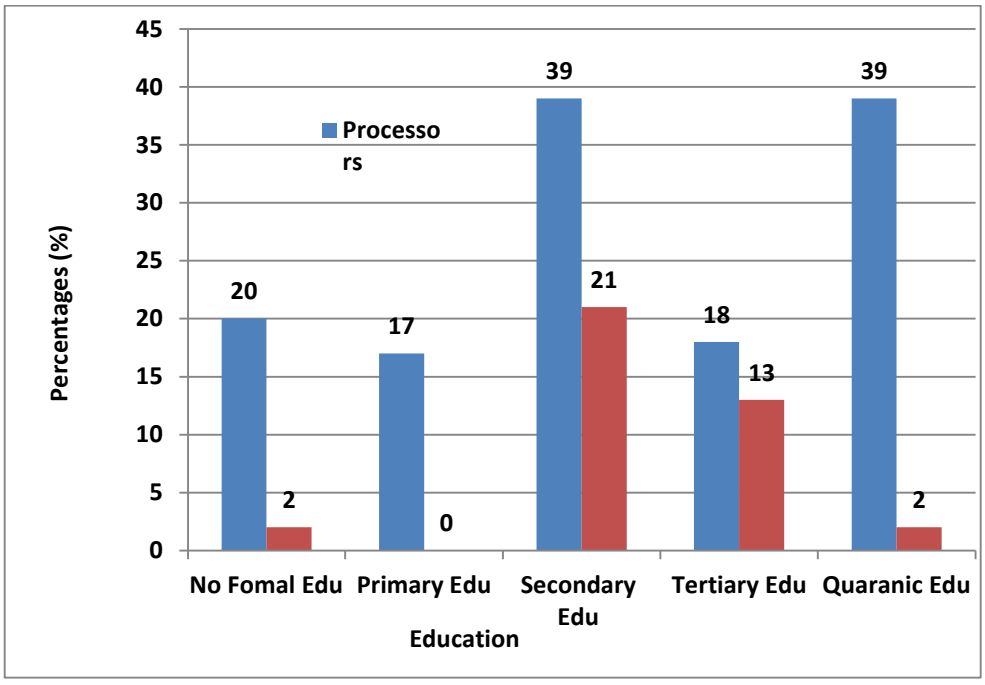

Figure 4: Level of Education of Processors and Marketers of Tamarind in Kano State.

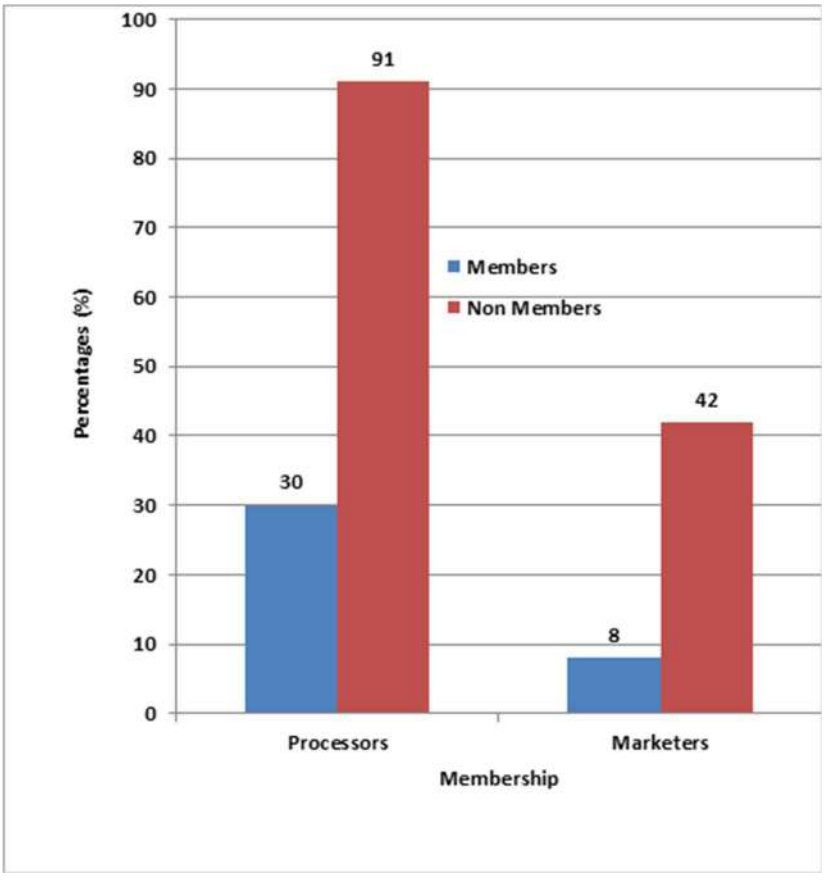

Figure 5: Membership of Union of Processors and Marketers of Tamarind in Kano State.

Table 3. Sources of Tamarind by the Processors and Marketers in Kano State.

	Processors (n = 133)		Marketers (n = 38)	
	Frequency	**Percentage**	**Frequency**	**Percentage**
Source of Tamarind				
Open market	88	66.17	35	92.11
Wild	45	33.83	3	7.89

Table 4: Estimates of the contribution of tamarind processing to household income.

	Coefficient	Robust Standard Error	t	P>t
Constant	2631.09	3198.41	0.82	0.421
Sex	10.1663	16.9795	0.60	0.556
Age	5.7044	5.2413	1.09	0.290
Educational level	15.2431*	7.8648	1.94	0.085
Household size	-1.4387*	0.8651	-1.66	0.091
Cost of raw materials	6.9179*	4.0119	1.72	0.076
Labour cost	-57.4015***	12.6705	-4.52	0.000
Transportation	-165.8708**	68.8403	-2.41	0.026
Rent	9.8043	16.0279	0.61	0.548
R-squared	0.6260			
Prob > F	0.0038			
F	41.29			
Number of observations	218			

***P< 0.01, **p< 0.05, *p< 0.1

Processors' contributions to household income in Kano state

The result of the estimates of the Ordinary Least Squares (OLS) regression presented in (Table 4) revealed the determinants of household income among tamarind processors in Kano State. The diagnostic statistics for the model are robust, indicating a reasonably good fit. The R-squared value of 0.626 suggests that approximately 63% of the variation in household income can be explained by the included explanatory variables in the model. The overall model is statistically significant at the 1% level (Prob > F = 0.0038), as indicated by the F-statistic (F = 41.29), confirming the joint explanatory power of the variables in predicting household income. Among the socioeconomic variables, the coefficient for educational level is positive and significant at the 10% level (β = 15.2431, *p* = 0.085), implying that education enhances household income derived from tamarind processing. This finding aligns with existing literature, which posits that higher education increases financial literacy, managerial skills, and access to market information, all of which are crucial for improving enterprise outcomes in agribusiness (Oluwatayo and Ojo, 2018; Ofem *et al*., 2023). Interestingly, household size shows a negative and statistically significant coefficient (β = -1.4387, *p* = 0.091). This suggests that larger households may exert pressure on income without a proportionate increase in labour efficiency or productivity. In subsistence economies, large households often divert income to consumption rather than reinvestment (Obayelu, 2010).

Among cost-related factors, the cost of raw materials is positively associated with household income and is significant at the 10% level (β = 6.9179, *p* = 0.076). This relationship may reflect the scale of operations with processors who invest more in raw materials likely to operate on a larger scale and thus generate higher income. However, it also hints at the capital-intensive nature of the business and the need for adequate financial support to scale up. Conversely, labour cost and transportation cost exert negative and statistically significant effects on household income. The coefficient for labour cost is large and significant at the 1% level (β = -57.4015, *p* = 0.000), while transportation cost is significant at the 5% level (β = -165.8708, *p* = 0.026). These negative signs suggest that rising expenses in these areas reduce net income from tamarind processing. These findings highlight two critical challenges in agribusiness profitability in Nigeria: high labour costs driven by manual-intensive processing methods and transportation inefficiencies due to poor rural infrastructure (Ogunniyi *et al*., 2020; Akinbami and Arene, 2018). Such costs significantly erode margins, especially for smallholders with limited capital buffers.

Marketers' contributions to households' incomes in Kano State

The Ordinary Least Squares (OLS) regression estimates in (Table 5) explore the determinants of household income derived from tamarind marketing in Kano State. This analysis is integral to understanding how demographic and economic factors shape the income-generating capacity of marketers in the tamarind value chain. The model diagnostics indicate a strong explanatory power. With an R-squared value of 0.690, approximately 69% of the variation in household income from tamarind marketing is explained by the independent variables in the model. The F-statistic (F = 61.66) is statistically significant (Prob > F = 0.0014), suggesting that the included variables jointly have a meaningful impact on household income.

Table 5: Estimates of the contribution of tamarind marketing to household income.

	Coefficient	Robust Standard Error	t	P>t
Constant	-273.7939***	10.7782	-25.40	0.000
Sex	-13.2209***	3.3875	-3.90	0.000
Age	1.4163	2.4005	0.59	0.556
Educational level	2.8966*	1.4831	1.95	0.053
Household size	1.3618***	0.2856	4.76	0.000
Cost of raw materials	0.2158	0.2614	0.83	0.410
Labour cost	-35.2454	33.2143	-1.06	0.290
Transportation	62.9730**	31.5500	2.00	0.048
Rent	8.8396	17.4356	0.51	0.613
R-squared	0.6900			
Prob > F	0.0014			
F	61.66			
Number of observations	164			

***P< 0.01, *p< 0.1

Among demographic variables, sex has a negative and statistically significant effect on household income from tamarind marketing (β = -13.2209, *p* = 0.000). This implies that male marketers earn significantly less than their female counterparts. This finding contrasts with typical patterns in agricultural commerce where men often dominate high-income segments. However, in the case of Tamarind, an important agroforestry tree for non-timber forest products (NTFPs), women tend to dominate local marketing activities due to traditional roles in food preparation and market vending (Arowosoge and Popoola, 2006; Gadzama *et al*., 2022). This gendered specialization may give women a comparative advantage in tamarind marketing, including stronger social networks, customer trust, and knowledge of local markets.

Educational attainment exhibits a positive and marginally significant relationship with income (β = 2.8966, *p* = 0.053). This supports findings from earlier analyses on tamarind processing, where education enhances financial returns by improving record-keeping, negotiation skills, and market orientation (Oluwatayo and Ojo, 2018). Even at the lower threshold of significance, the role of education cannot be dismissed, especially in enhancing the marketing strategies of smallholders and rural traders. Household size shows a positive and highly significant relationship with income (β = 1.3618, *p* = 0.000). This suggests that larger households may offer more labour or shared resources for tamarind marketing, which can translate to higher income. Unlike processing, where household size may dilute income per capita, in marketing it may serve as an asset by providing unpaid or low-cost labour (Ogunniyi *et al*., 2020).

Transportation costs show a positive and statistically significant effect (β = 62.9730, *p* = 0.048), highlighting the importance of market access. Marketers who invest more in transport will likely reach more lucrative urban or cross-border markets that boost income. This aligns with findings that improved market access increases farm and marketing profitability (Akinbami and Arene, 2018). The significance of transport cost also points to the need for infrastructure development to facilitate rural market integration.

Conclusion

The study looked at the Contribution of Tamarind processing and marketing to Household Income in Kano State. The findings have shown that tamarind processing and marketing are economically viable ventures with considerable potential to contribute to rural income and employment generations. Evidently, the cost–benefit analysis shows that processing, together with marketing of *Tamarindus indica*, is financially viable and economically profitable. The results of the present study indicated that planting the underutilized species, using vegetatively propagated materials, as reported by Anegbeh *et al*., (2006), with food and cash crops in agroforestry systems might play an important role in food security, the resilience of small-scale farmers, and the improvement of biodiversity in the landscapes. However, the activities were constrained by several challenges, notably inadequate capital, poor access to improved processing and storage technologies, unstable market prices, and limited institutional support. The socioeconomic profiles of processors and marketers significantly influenced profitability, with factors such as education, experience, access to credit, and market information playing pivotal roles. The value chain analysis highlighted inefficiencies and gaps that, if addressed, could enhance value addition and increase returns for stakeholders. Despite the observed profitability, there is room for improvement through better financing mechanisms, capacity building, infrastructure development, and policy interventions. The Tamarind sub-sector presents untapped opportunities that, if adequately supported, could enhance livelihoods, reduce poverty, and stimulate agribusiness development in the studied regions Addressing the identified constraints through inclusive and sustainable approaches will be critical in maximizing the economic benefits of Tamarind processing and marketing.

Recommendations

Based on the findings of this study, the following policy

recommendations are proposed to enhance the processing and marketing of Tamarind in Kano State in order to achieve maximum profit:

1. Given the varying levels of educational attainments among processors and marketers, there is a need for targeted training and capacity-building programs that would cater to different educational backgrounds. Specifically, programs could focus on: Basic business management and financial literacy for those with little or no formal education; advanced training on tamarind processing and marketing techniques for those with secondary and tertiary education; Quranic education holders could benefit from training on modern business practices and entrepreneurship. These training would aim to enhance the skills and knowledge of processors and marketers, ultimately improving their productivity, efficiency, and profitability in the tamarind industry.

2. Given the high rent costs, there is a need for infrastructure support and access to affordable production spaces for tamarind processors. This could include: Establishment of dedicated agro-processing zones or industrial parks with subsidized rent and utilities; Provision of affordable and reliable energy sources, such as solar or biogas, to reduce reliance on private generators; Improvement in transportation infrastructure to reduce costs and enhance efficiency. By addressing these infrastructural challenges, processors can reduce their operating costs, improve their competitiveness, and increase their profitability in the tamarind industry.

3. Given the high marketing margin rate of approximately 55% in Kano State, it is recommended to strengthen market linkages and value chain integration for tamarind marketers. This could involve: Establishing partnerships among marketers, processors, and producers to improve access to raw materials and reduce costs; Enhancing market information systems to provide real-time data on prices, demand, and supply; Promoting value-added products and services to increase the competitiveness of tamarind products in the market.

4. Strengthening market linkages and value chain integration in order for Marketers to improve their efficiency, reduce costs, and increase their profitability in the tamarind industry.

5. Given that very serious problem of inadequate capital (19.55%) and lack of storage facilities (11.28%) are significant constraints, it is recommended that processors have access to adequate capital and storage facilities.

6. Awareness on the various uses (fruits, firewood, medicine, shade, fodder etc) and domestication for the conservation of tamarind tree are highly needed.

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