

Analysis of *Tamarindus (Tamarindus Indica L.)* Value Chain in Uganda: Identification of Opportunities and Constraints to Its Commercialization and Domestication

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Abstract

This study analyzed the value chain of *T. indica* in Uganda with the motive of identifying opportunities and constraints to its commercialization and domestication. The study traced the movement of *T. indica* products from producing to non producing districts in the year 2009. Marketing margins for producers and traders along the value chain were computed and their determinants identified using multiple OLS regression technique. Women were the dominant players in the *T. indica* value chain. Major constraints to *T. indica* production and marketing were seasonality in supply, low demand, high transportation costs, and lack of proper storage facilities. Average marketing margins for producers were significantly lower than that of traders with traders in non producing districts outperforming their counterparts. Marketing margins of producers were significantly influenced by sales volume, amount of land holding, distance to market, variety sold and district. Whereas marketing margins obtained by traders depended on their sales volumes, trading experience, and district. Overall, a small but growing market for *T. indica* products exists in Uganda and opportunities for expansion lie in smoothening supply through proper postharvest handling and value addition. Thus, *T. indica* producers and traders need to be trained on postharvest handling and value addition.

Keywords: *Tamarindus indica*, value chain, marketing margins, commercialization, domestication, indigenous fruit trees, Uganda

1. Introduction

Uganda is richly endowed with indigenous fruit trees species such as *Tamarindus indica* (Katende et al 1999). *Tamarindus indica* is a tropical fruit tree of Leguminosae family, which under favourable conditions can reach a height of 20-25 meters. It is the most widely distributed and appreciated ornamental fruit tree in the tropics and occurs widely in tropical Africa, where it is frequently planted as a shade tree. Timber from *T. indica* is used for many purposes including making furniture, mortars, and other products because they are hard and durable. Leaves and fruits of *T. indica* are essential for medicinal uses to cure diseases. Tamarind is used as a raw material for manufacturing several industrial products, such as tartaric acid, *T. indica* juice concentration, *T. indica* juice, jam, *T. indica* kernel powder, syrup, candy, champoy and many others uses (Gunasena and Hughes 2000).

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In West Africa, the products from indigenous trees such as *T. indica* are marketed locally on a small scale, as a means of generating cash to supplement subsistence needs (Falconer, 1990 and Arnold, 1996). Some of these products also enter regional trade in neighboring countries such as Gabon, Nigeria, Equatorial Guinea and Central African Republic (Ndoye 1995). Ndoye also found that in Cameroon, *T. indica* products were being sold to acquire cash to cater for basic households needs and pay school fees.

In Uganda, *T. indica* grows in various agro-ecological zones in north eastern, and northern regions, and in Luwero and Moyo districts (Katende et al. 1999). Local communities in these areas have a long tradition of using indigenous fruit trees such as *T. indica* as an essential component of rural livelihoods (Buyinza et al. 2010, Buyinza and Senjonga 2008, Okullo 2005). *Tamarindus indica* is a very important fruit tree in these areas as a source of food (used for making porridge, local bread, juice), fuel wood, charcoal, construction materials, and income. Recently, value added *T. indica* products have been developed and market tested with positive results, namely: jam, marmalade, sauce, tam-chilli (Masette et al. 2015). However, its economic potential has not been fully exploited as in other tropical countries where markets for its products are highly developed. Most of the *T. indica* trees in Uganda have continued to be harvested indiscriminately from the open woodland. More and more of these trees are being destroyed for charcoal production or to create land for agricultural expansion in northern and eastern Uganda (Agea et al. 2010).

While Kusters et al. (2006) argue that commercialization of wild forest trees leads to their overexploitation and mismanagement, it is also evident that if an indigenous wild fruit tree is commercialized, the increased revenue from its sales will lead to its domestication by farmers (Agea et al. 2010). Marketing of *T. indica* products offers a great potential for the improvement of incomes of many rural producers, especially women. The main *T. indica* product marketed is pulp or mature pods. Producers sell *T. indica* products, to consumers via direct or indirect marketing channels. However, no known study has attempted to analyze the performance of the value chain of *T. indica* products in Uganda. Yet, conducting such a study will lead to the identification of marketing opportunities and constraints for the benefit of all the stakeholders promoting the commercialization and domestication of *T. indica* products in Uganda.

2. Materials and Methods

2.1 The Study Area

The study was conducted in three of the four regions of Uganda namely: Eastern, in the district of Soroti and Tororo; Northern, in the district of Gulu, Moyo and Kitgum; and Central, in Kampala district. Moyo, Kitgum and Soroti districts were selected as they comprise the main *T. indica* growing and consuming areas. On the other hand, Gulu, Tororo and Kampala districts were selected because they are major destination markets for *T. indica* products, especially their urban areas.

2.2 Sampling Method and Sample Size

A multi-stage purposive sampling method was used to select *T. indica* producers in the study districts (Moyo, Kitgum, and Soroti). In the first stage, one county was purposively selected from each district and in the second stage 2 sub-counties were purposively selected from one county making a total of 6 sub-counties for the study. In the last stage, 15 *T. indica* producers were randomly selected with the help of sub-county agricultural field officers and local chiefs. This made a total sampled size of 90 *T. indica* producers. Likewise, a two-stage purposive sampling method was used to select tamarind traders in the study districts (Moyo, Kitgum, Soroti, Kampala, Gulu, and Tororo). In the first stage, three urban/sub-urban markets were purposively selected from each district making a total of 14 markets for the study. In the second stage, 4 or 5 traders were randomly selected from each market. And, a total of 64 *T. indica* traders were sampled for the study.

2.3 Data Collection

Two sets of pre-tested, semi-structured questionnaire were used to collect data from *T. indica* producers and traders. Data were collected using formal and informal interviews, key informants interviews, observations, and focus group discussions with governmental and non-governmental organization operating in the study area. Data was collected on socio-economic characteristics of producers and traders, *Tamarindus indica* product prices, marketing costs, opportunities, and constraints to *T. indica* products marketing.

2.4 Data Analysis

In this study, the value chain approach was followed. Value chain analysis for a particular commodity/product involves a systematic assessment and examination of all the value-adding stages of its value chain (Schmitz 2005). Marketing margin is a commonly used measure of the performance of a marketing system or value chain of any commodity since it represents the associated marketing costs such as transport, storage, processing, wholesaling, retailing, and advertising. Under competitive market conditions, the market margins are the result of demand for marketing services and equal to the minimum cost of services provided plus normal profit (Wohlgenant 2001).

Therefore, the marketing margin obtained by a producer or trader was determined as difference of selling and buying unit prices for particular *T. indica* products. As in previous studies, marketing margins associated with *T. indica* producers and traders were hypothesized to be linearly related to distance to the market, sales volume, variety, and type of product (Marsh and Bretser 2004; Awono 2002; Scarborough et al. 1993; and Wohlgenant and Mullen 1987). Other factors that were assumed, to influence marketing margins obtained by *T. indica* chain key players included their socio-economic characteristics and the district they were operating in.

In order to identify the factors influencing marketing margins obtained by *T. indica* producers (producers), a multiple OLS regression techniques was used as specified below:

$$mm_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_{13} X_{13} + \varepsilon$$

Where:

mm_i = marketing margin for *T. indica* product in Ush/kg obtained by producer *i*.

X_1 = Distance to the market (km).

X_2 = Annual sales volume (kg).

X_3 = Dummy for variety sold (1 = sweet; 0 = sour).

X_4 = Dummy for type of product (1 = pulp; 0 = otherwise).

X_5 = Dummy for district (0 = Moyo; 1 = Soroti; 1 = Kitgum).

X_6 = Education level of producer (years).

X_7 = Occupation of producer (1 = farming; 0 = otherwise).

X_8 = Annual household income (Ush).

X_9 = Experience in *T. indica* trade (years).

X_{10} = Sex of producer (0 = female; 1 = male).

X_{11} = Age of producer (years).

X_{12} = Number of trees domesticated.

X_{13} = Average household landholding (acres).

β_0 = Intercept.

$\beta_1 - \beta_{13}$ = Coefficients.

ε = error term.

Similarly, factors influencing marketing margins obtained by *T. indica* traders were also identified using a multiple OLS regression technique as specified below:

$$mm_j = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_{10} X_{10} + \varepsilon$$

Where:

mm_j = marketing margin for *T. indica* product in Ush/kg obtained by trader *j*.

X_1 = Annual sales volume (kg).

X_2 = Dummy for variety sold (1 = sweet; 0 = sour).

X_3 = Dummy for type of product (1 = pulp; 0 = otherwise).

X_4 = Dummy for district (1 = producing district; 0 = non-producing district).

X_5 = Education level of trader (years).

X_6 = Occupation of trader (1 = non farming; 0 = otherwise).

X_7 = Average annual income (Ush).

X_8 = Experience in *T. indica* trade (years).

X_9 = Sex of trader (0 = female; 1 = male).

X_{10} = Age of trader (years).

β_0 = Intercept.

$\beta_1 - \beta_{10}$ = Coefficients.

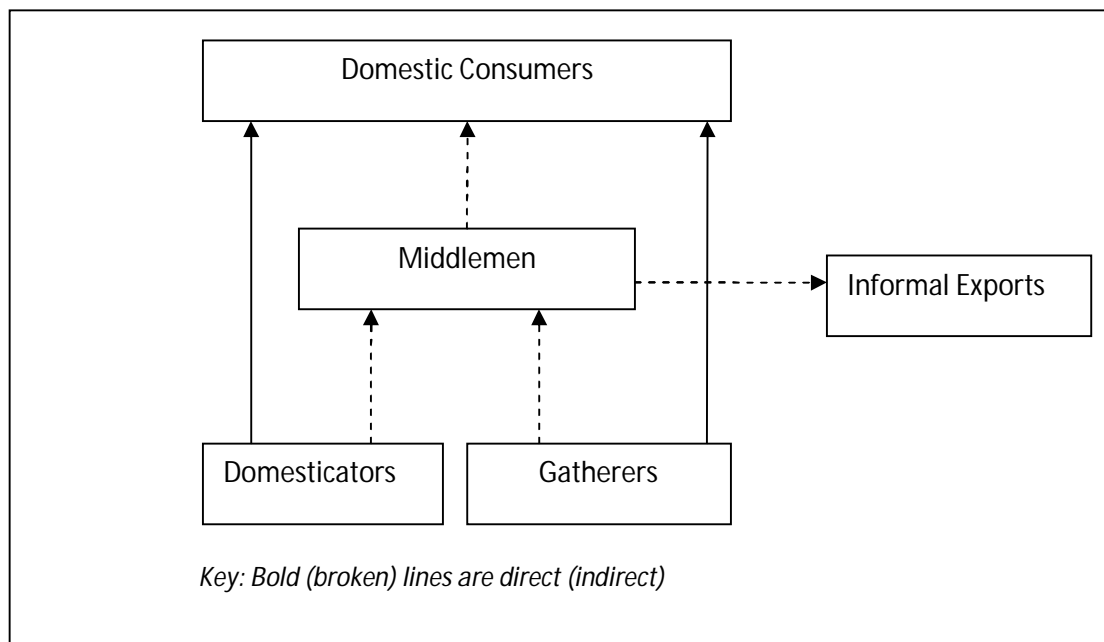
ε = error term.

3. Results and Discussion

3.1 The *Tamarindus indica* value chain in Uganda

Figure 1 below shows the existing value chain or marketing channels of *T. indica* products in Uganda. Up the marketing chain, producers (domesticators or gatherers) sell *T. indica* products from their own homes, local (village) markets, or even in urban markets. Producers sell *T. indica* products directly to consumers or indirectly to consumers via middlemen. Some middlemen sell *T. indica* products in urban markets within the producing districts while others take them to distant markets in non-producing districts such as Gulu, Kampala, and Tororo. There is also minimal informal cross-border trade of *T. indica* at the Sudan border in the north and the Kenya border in the east, by some traders.

Figure 1: The value chain of *T. indica* in Uganda



3.2 Characteristics of *T. indica* producers and traders

Table 1 indicates that both women and men were equally involved in production of *T. indica* with the majority of them falling within the productive age brackets of 36-59 years, although in Soroti and Moyo, younger respondents (18-35 years) were also highly involved. They had little education and low incomes implying that trade in *T. indica* offered them an opportunity to diversify their income. The majority of the respondents were smallholder farmers with highest average land holding of about 9.5 acres reported in Kitgum and lowest (4.1 acres) in Moyo. While they were also gatherers of wild fruits, they had on average domesticated at least two *T. indica* trees in their land or backyard.

Table 1: Characteristics of *T. indica* producers in northern and eastern Uganda

Characteristic	District			Total (N=90)	χ^2 /F-stat
	Kitgum (n=30)	Moyo (n=30)	Soroti (n=30)		
Sex (% respondents)					1.466
Male	58.6	42.3	50.0	50.6	
Female	41.4	57.5	50.0	49.4	
Education (% respondents)					31.85***
None	20.7	11.5	33.3	22.4	
Primary	75.9	30.8	60.0	56.5	
Secondary	3.4	53.8	6.7	20.0	
Tertiary	0.0	3.8	0.0	1.2	
Age (% respondents)					19.03***
18-35years	3.4	46.2	46.7	31.8	
36-59 years	72.4	46.2	30.0	49.4	
60+ years	24.1	7.7	23.3	18.8	
Occupation (% respondents)					4.23
Farming	100	93.1	100	97.8	
Non-Farming	0.0	6.9	0.0	2.2	
Income (Ush/year)	353,077	395,155	338,793	359,719	0.288
Trading experience (years)	7.76	3.56	6.93	6.15	2.93*
Land ownership (acres)	9.52	4.05	5.20	6.56	8.91***
Number of <i>T. indica</i> trees on farm	2.80	1.17	2.27	2.09	2.50*

Note: Significance levels: *** (1%) and * (10%). Exchange rate: 1 US\$ = Ush1780.

Table 2 indicates that the majority of *T. indica* traders were women. Traders from producing districts were engaged in farming as their main source of livelihood, while those from non-producing districts were instead engaged in non-farming activities as their main source of livelihood. This difference in engagement seems to imply that *T. indica* traders in producing districts still take farming as a full-time activity while those in non-producing districts are largely part-time farmers. Perhaps, that is why the average annual household income of *T. indica* traders in non-producing districts was significantly higher than that of their counterparts operating in producing districts. The study further reveals that majority of those engaged in *T. indica* trade are in productive age bracket of 36-59 years.

Table 2: Characteristics of *T. indica* traders in Uganda

Characteristic	Type of District		Total (N=64)	χ^2 /F-stat
	Producing(n=32)	Non-Producing (n=32)		
Sex (% respondents)				
Male	14.8	34.6	24.5	2.805*
Female	85.2	65.4	75.5	
Education (% respondents)				
None	33.3	15.4	24.5	3.21
Primary	48.1	61.5	54.7	
Secondary	18.5	19.2	18.9	
Tertiary	0.0	3.8	1.9	
Age (% respondents)				
18-35 yrs	29.6	23.1	26.4	1.207
36-59 yrs	55.6	69.2	62.3	
60+ yrs	14.8	7.7	11.3	
Occupation (% respondents)				
Farming	66.7	26.9	47.2	8.396***
Non-Farming	33.3	73.1	52.8	
Trading experience (years)	8.37	5.50	6.96	2.038
Income (Ush/year)	422,778	1,924,800	1,144,904	8.865***

Note: Significance levels: *** (1%) and * (10%). Exchange rate: 1 US\$ = Ush1780.

The study results above seem to reveal that the marketing system for *T. indica* products was dominated by women. This situation might be attributed to the fact that women have a high incentive to trade in wild fruit products because their husbands usually allow them to control the money that is obtained from their sales as was the case in south central Africa (Packham, 1993). Another study concerning the production and marketing of shea nuts in Uganda has given three reasons explaining high women involvement in the sector: labour intensiveness, low returns to labour, and possibility to conduct the work near home while avoiding labour conflicts with domestic chores (Ferries et al. 2001). Thus, the development of *Tamarindus indica* value chain in Uganda is important as it contributes to the livelihoods of rural poor and particularly the women who are the main retailers of non timber forest products (Awono et al. 2002).

3.3 Marketing of *T. indica* by Producers

There was a significant difference in sources of *T. indica* across the producing districts (Table 3). This is probably due to the difference in level of domestication in the different districts. The major market outlet for producers was the village market followed by along the road. However, the other two market outlets (town market and on the farm) appeared equally important as shown by producer patronage distribution. The main *T. indica* product marketed was mature pods or pulp although in Soroti, trade in young leaves and immature pods existed during off-season. This is clearly an indication that *T. indica* market is undeveloped with low quality *T. indica* products.

Table 3: Sources, outlets and type of *T. indica* products sold by producers by district

Variable	District			Total (N=90)	χ^2 -stat
	Kitgum (n=30)	Moyo (n=30)	Soroti (n=30)		
Source of product (% respondents)					
Own farm	63.3	33.3	90.0	62.2	25.688***
Wild	30.0	66.7	10.0	35.6	
Buy	6.7	0.0	0.0	2.2	
Market outlet (% respondents)					
On the farm	13.7	23.3	8.0	15.0	21.341***
Along the road	30.0	31.7	13.3	25.0	
Village markets	31.7	25.1	55.3	37.7	
Town markets	8.3	8.7	50.0	22.3	
Type of product sold (% respondents)					
Young leaves	0.0	0.0	6.7	2.2	37.703***
Immature pods	0.0	0.0	43.3	14.4	
Mature pods/pulp	100	96.7	50.0	82.2	
Other	0.0	3.3	0.0	1.2	

Note: Significance levels: *** (1%).

3.4 Marketing of *T. indica* by Traders

The majority of the traders from both producing and non-producing districts were marketing *T. indica* occasionally, possibly exemplifying the seasonal availability of *T. indica* fruits (Table 4). A majority of traders were middlemen who bought their *T. indica* products from the market; however, there were also producers/gatherers that doubled as traders. In all the markets visited mature pods/pulp was the only *T. indica* product being sold. Further, most traders sold their *T. indica* products directly to consumers. Asked about the trend of demand for *T. indica* products, traders in non-producing districts were more optimistic than those in producing districts suggesting that the former were more knowledgeable about markets than the latter.

Table 4: *T. indica* traders' level of participation, supply sources and demand outlook

Variable	District		Total (N=64)	χ^2 -stat
	Producing (n=32)	Non-Producing (n=32)		
Participation level (% respondents)				
Always	18.5	14.8	16.7	0.318
Regularly	37.0	33.3	35.2	
Sometimes	44.4	51.9	48.1	
Source of products (% respondents)				
On-farm	3.7	22.2	13.0	7.198**
Wild	29.6	7.4	18.5	
Market	66.7	70.4	68.5	
Market outlets (% respondents)				
Wholesalers	11.1	18.5	14.8	1.567
Retailers	7.4	14.8	11.1	
Consumers	81.5	66.7	74.1	
Demand trend (% respondents)				
Increasing	37.5	85.7	64.9	9.498***
Constant	56.2	14.3	32.4	
Decreasing	6.2	0.0	2.7	

Note: Significance levels: *** (1%) and ** (5%).

3.5 Constraints to *T. indica* production and marketing

Four major production and marketing constraints in the *T. indica* value chain were seasonality in supply, low demand for the products, high transport costs, and poor storage facilities (Table 5). Seasonality in supply of mature pods forces trade in immature pods and young leaves/flowers in areas, such as Soroti, where these products are used in preparation of local bread from sweet potato flour throughout the year. In urban areas, demand for *T. indica* products is limited to consumers using it in preparation of porridge/bread and for medicinal purposes. Poor storage facilities led to losses due to attack of pulp by weevils and mould. High transport costs were met in accessing distant urban markets, especially in areas with poor roads. Other production and marketing constraints included destruction of trees by bush fire, difficulty of collecting fruits from the wild, fluctuating prices, and limited financial capital (Table 5).

Table 5: Constraints to *T. indica* production and marketing, %

Constraint	Producers (N=90)	Traders (N=64)
Seasonality in supply	76	53
Low product demand	33	45
High transport costs	20	27
Poor storage facilities	15	22
Other	16	20

3.6 Marketing Margins for *T. indica* Producers and Traders

Results of the marketing margin analysis indicate that *T. indica* producers on average obtained a net marketing margin of Ush 120/kg (US\$ 0.07) (Table 6). Margins obtained by producers varied by district. The highest net margins (Ush 159.57/kg or US\$ 0.09) were reported in Soroti while the lowest net margins (Ush 96.90/kg or US\$ 0.05) were obtained by producers in Moyo (Table 6), where *T. indica* trade seemed to be at its infancy stages.

Table 6: Unit price, costs, and margins for *T. indica* producers by district

Item	District			Total (N=90)	F-stat
	Kitgum (n=30)	Moyo (n=30)	Soroti (n=30)		
Sales price (Ush/kg)	520.00	383.00	541.00	481.00	10.350***
Farm gate (Ush/kg)	316.00	229.00	294.00	280.00	3.630**
Gross MM (Ush/kg)	204.00	154.00	247.00	201.00	16.984***
Costs (Ush/kg)					
Transport	34.53	32.88	42.31	36.84	3.360**
Packaging	9.67	7.46	8.74	8.48	1.779
Labour	5.00	5.00	8.33	7.63	0.907
Loading	4.20	2.00	3.06	3.26	0.633
Off-loading	4.20	3.00	2.94	3.22	0.939
Sorting	15.00	5.00	15.94	17.74	0.965
Market dues	4.33	1.75	6.11	3.83	2.375
Total costs	76.93	57.10	87.43	81.00	
Net MM (Ush/kg)	127.07	96.90	159.57	120.00	

Note: Significance levels: *** (1%) and * (10%).
Exchange rate: 1 US\$ = Ush 1780.

In contrast, *Tamarinus indica* traders on average had a net marketing margin of Ush 801/kg (US\$ 0.45) with traders operating in non producing districts earning about double the profit earned by those in producing districts (Table 7). Furthermore, traders were getting much higher marketing margins than producers even though the former had a higher average unit marketing costs (Ush 95 /kg or US\$ 0.05) compared to producers (Ush 81/kg or US\$ 0.04).

Table 7: Unit price, costs, and margins for *T. indica* traders by type of district

Variable	District		Total (N=64)	F-stat
	Producing (n=32)	Non-producing (n=32)		
Sale price (Ush/kg)	973.59	1622.05	1297.82	8.143***
Purchase price (Ush/kg)	354.20	386.15	370.79	0.416
Gross MM (Ush/kg)	556.67	1235.96	896.31	9.268***
Costs (Ush/kg)				
Transport	14.63	25.19	19.91	9.752***
Packaging	9.56	17.00	13.50	9.826***
Labour	4.69	9.50	6.78	3.113*
Loading	1.87	3.50	2.52	8.323***
Off-loading	1.69	3.64	2.48	12.383***
Sorting	5.31	32.22	16.32	16.712***
License	7.48	52.29	27.53	25.28**
Market dues	2.07	11.94	5.89	4.090**
Total costs (Ush/kg)	44.57	155.28	94.92	
Net MM (Ush/kg)	512.1	1080.68	801.39	

Note: Significance levels: *** (1%), ** (5%) and * (10%).
Exchange rate: 1 US\$ = Ush 1780.

3.7 Factors affecting marketing margins for *T. indica* producers

Table 8 indicates that sales volume and land holding had a positive and significant influence on the marketing margins of *T. indica* producers while household income and distance to market had a significantly negative influence. Two dummy variables that had an effect on marketing margins of producers were variety of fruit sold and district of origin.

Table 8: Regression results showing factors affecting marketing margins of *T. indica*

Producers			
Variables	Coefficient	Standard error	t-value
Constant		431.231	3.342
District (Kitgum)	.373	393.647	1.888*
District (Soroti)	.583	204.849	5.675***
Sex of respondent (male)	.080	181.256	.831
Age of respondent (years)	.049	8.411	.428
Education level (years)	.141	242.361	1.269
Occupation (farming)	.199	822.176	1.542
Experience in tamarind trade (years)	-.049	15.995	-.437
Variety of fruit sold (sweet)	-.370	383.585	-1.959**
Number of trees domesticated	-.097	30.149	-1.056
Type of product sold (pulp)	.137	215.573	1.354
Distance to market (km)	-.173	8.863	-1.709*
Sales volume (kg)	.500	3.623	3.944***
Amount of land holding (acres)	.237	22.349	2.036**
Annual household income (Ush)	-.294	.000	-2.279**
<i>Number of observations</i>	<i>90</i>		
<i>Adjusted R²</i>	<i>0.381</i>		

Note: Significance levels: *** (1%), ** (5%) and * (10%). Exchange rate: 1 US\$ = Ush 1780.

The significantly positive influence of sales volume on the marketing margins of *T. indica* producers is probably because bigger sales volumes enabled *T. indica* producers to enjoy reduced unit marketing costs. A 1 kg increase in sales volume increased the marketing margin by up to 50%. These results are in agreement with theory and *a priori* expectation. Similarly, a study by Awono et al. (2002) on Safou fruit in West Africa showed a positive relationship between sales volume and marketing margins received by producers of the fruit. Household land holding had a significant positive influence on the marketing margin of producers. An increase in land holding by one acre resulted into 24% increase in the marketing margin. This is an indicator of domestication of *T. indica* in that those producers who have more land tend to domesticate more *T. indica*. As such they collect and sell large quantities, which translate into high marketing margin. Market distance had a negative and significant influence on the marketing margins of *T. indica* producers. A one kilometer increase in market distance resulted into a decrease in the marketing margin by 17%. Therefore, the hypothesis that market distance negatively influences marketing margins for producers could not be rejected. This finding is in line with *a priori* expectations. A study by Rokhsana et al. (2006) found that market distance was negatively related to the marketing margin among beans producers. This implies that market outlets where *T. indica* are usually sold are either distant from producers or are not easily accessible due to poor road infrastructure. This therefore increases the marketing costs for producers hence reduced marketing margins.

Household income had a negative and significant influence on the marketing margin for *T. indica* producers. An increase in average annual household income by one Ugandan shilling led to a reduction in marketing margin by 29%. These findings seem to indicate that the poorer the household was, the more money it made out of the sale of *T. indica* products. Perhaps, they achieved this by dealing in significant volumes of fruits which they gathered from the wild and/or harvested from own trees and trekked great distances to search for better paying markets, such as town markets. The marketing margins obtained by *T. indica* producers also depended on the variety of the fruit sold and their district of origin. Producers who dealt in sour varieties received 37% higher marketing margins than those who sold sweet varieties. Sour varieties were more preferred by consumers because it had multiple uses. For instance, it was used in the preparation of local bread and porridge among others. Similar results were found by Masette et al. (2015) where more than three-quarters (76%) of consumers preferred sour over sweet *T. indica* pulp extracts as better food enhancers. Thus, *T. indica* producers sold sour fruit varieties at a higher price than that of sweet fruit varieties.

Regarding district of origin, producers in Kitgum had (37%) and Soroti (58%) higher marketing margins than those from Moyo district. This can be attributed to low sales volume as result of low demand and low prices for *T. indica* products in Moyo compared to Kitgum and Soroti.

Other factors which were found not to affect the marketing margins of *T. indica* producers were: sex, age, education, experience, type of product and number of trees owned. Of these, type of product was expected to significantly affect marketing margins obtained by producers in that value added products would fetch more money for producers. However, little value addition took place at the producer level as the most commonly traded product was mature pods/fruit pulp.

3.8 Factors affecting marketing margins for *T. indica* traders

Table 9 below reveals that trading experience and sales volume had a positive and significant influence on the marketing margins of *T. indica* traders. Traders' marketing margins also depended on their district of operation. Unlike in the case of producers, pulp was the only *T. indica* product traded in urban areas, so the variable capturing type of product was excluded from the traders' marketing margin model.

Table 9: Regression results showing factors affecting marketing margins of *T. indica* Traders

Variable	Coefficient	Standard error	t-value
Constant		4645.322	-.162
District (producing)	-.147	2036.320	-1.895*
Sex (male)	-.009	2006.961	-.138
Educational level (years)	-.007	2199.984	-.091
Occupation of trader (non farming)	.055	2101.728	.709
Age of trader (years)	.087	77.110	1.218
Variety of <i>T. indica</i> sold (sweet)	.050	2071.892	.639
Experience in <i>T. indica</i> trade (years)	.182	124.912	2.640**
Sales volume (kg)	.783	6.702	9.167***
Annual income (Ush)	-.046	.001	-.586
<i>Number of observations</i>	<i>64</i>		
<i>Adjusted R²</i>	<i>0.289</i>		

Note: Significance levels: *** (1%), ** (5%) and * (10%). Exchange rate: 1 US\$ = Ush 1780.

Experience had a positive and significant influence on the marketing margins for *T. indica* traders. An increase in experience by one year increased the marketing margins for traders by 18%. Traders who have spent more years in *T. indica* trade have an advantage over traders who are relatively new in the business because they know where to cheaply source their products from and where to sell their products at better prices. This gives experienced traders a competitive advantage over those with less experience.

The hypothesis that sales volume positively influences the marketing margins could not be rejected. Just like for producers, sales volumes positively and significantly influenced marketing margins for traders. A one kilogram increase in the marketed volumes resulted into an increase of 78% in marketing margin for traders. This finding is in conformity with theory and *a priori* expectation. A study by Awono et al. (2002) on Safou fruit in West Africa showed a positive relationship between sales volume and marketing margins received by traders. Perhaps, this is because traders experience significant costs savings when they handle bigger sales volumes.

T. indica traders operating from non-producing districts had significantly higher marketing margins (15%) than traders from producing districts did. This could be attributed to the fact that within the producing districts, *T. indica* products are in abundant supply, especially during the on-season. As such, traders are forced to charge lower prices. In the non-producing districts, however, there is scarcity in supply of *T. indica* products as a result of long distance from the product source (producing districts). Traders from non-producing districts therefore could be charging abnormally higher prices hence higher marketing margins. Moreover, traders in non-operating districts might be facing more affluent urban customers or those customers who might be using *T. indica* products in specialized ways, such as medicine. In fact, *T. indica* was said to act as medicine against diseases, such as high blood pressure, which is more prevalent in urban than rural areas.

Demographic characteristics of traders (sex, age, education, occupation, and income) and as well as variety of *T. indica* sold were found not to influence the marketing margins of *T. indica* traders. Variety of *T. indica* was expected to significantly affect marketing margins obtained by traders as in the case of producers. However, there appeared to be lack of consumer preference for the sour over the sweet type of *T. indica* in urban markets. This is probably because most of these consumers do not use *T. indica* products in traditional ways such as in the preparation of local bread and porridge.

4. Conclusion

There is a small but growing market for *T. indica* products in Uganda which if further developed, could lead to increased commercialization and domestication of the *T. indica* trees as well as increased incomes of women, the dominant players. However, the development of *T. indica* value chain in Uganda is still constrained by seasonality in supply, low demand, high transportation costs, and lack of proper storage facilities. Low marketing margins received by the producers may also be a disincentive to them to trade in *T. indica* products and hence, resort to other alternative uses of the tree, such as fuel wood and charcoal burning, which will negatively impact the *T. indica* domestication.

Therefore, it is recommended that *T. indica* producers and traders need to be trained on its postharvest handling, value addition, and marketing. Development of value added products that can be stored for a long period of time could even out supply and market prices as well as attract new consumers. Organizing *T. indica* producers and traders into groups/associations would not only provide training platforms but will also go a long way in improving *T. indica* product marketing in terms of reduced transport costs, better prices and improved access to market information.

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