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Research Article

Drivers of value addition and product upgrading to shea nuts by collectors in northern Uganda

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This study assessed the factors associated with value addition and product upgrading of shea nut in northern Uganda. We adopted a cross-sectional research design using a multi-stage sampling approach and a structured interviewer-administered questionnaire to collect data from 252 respondents. The results show that 84% of shea nut collectors practise some level of value addition with 11.5% adding value to all of the shea nuts collected. Over 50% of the shea nut collectors had at least one value-added product with about 3% having four value-added products, the most common products being roasted kernel and crude butter (37.3%). Regression analysis revealed that level of value addition was significantly influenced by gender, age, land under shea cultivation, income, information access, association membership and spot marketing, while the number of value-added products was significantly influenced by age, household size, extension access, information access, association membership, informal marketing, formal marketing and location of shea collector. The findings imply that increasing shea value addition in terms of both proportions allocated to value addition and the number of value-added products require adopting a group approach to provision of value addition and shea processing information. Therefore, we recommend the need to encourage shea actors to form associations focused on value addition.

Keywords: shea nut, collectors, product, upgrading, Uganda

Introduction

The shea nut tree, *Vitellaria paradoxa*, is a multipurpose tree crop, indigenous to sub-Saharan African (SSA) and found growing naturally in the wild (Kabiru and Ayanfunke 2018; Orwa et al. 2009; Tijani and Sanusi 2020). The tree is widely encountered in dry savannas, forests, and parklands of the Sudan zone covering an estimated one million square kilometres between western Senegal and northwestern Uganda (Fontaine et al. 2004; Hatskevich, Jenicek, and Darkwah 2011; Tom-Dery et al. 2018). The tree supports the livelihoods of more than 16.2 million collectors and local processors (Naughton, Lovett, and Mihelcic 2015). Today, the shea tree is the second most important oil crop in Africa after the palm nut tree. With about 500 million shea trees currently in existence, this naturally occurring parkland tree species has the potential of producing shea nuts worth about US $150 million annually (Bup et al. 2014). This potential represents substantial earnings for SSA economies when fully exploited.

In Uganda, shea nut mainly grows in the districts of Gulu, Kitgum, Agago, Otuke, Lira, Nakasongola, Soroti, Alebtong, Arua, Abim, Moyo, Nebbi, Amuria, Serere, Katakwi, Dokolo, among others (Okullo et al. 2012). Shea nut trees are characterized by extensive rooting that is critical for their survival during intermittent droughts in the savannahs and have a hardy bark that is essential in withstanding severe fire regimes (Orwa et al. 2009). It is further important to note that the life span of shea nut trees is considerably long, estimated between about 200–300 years. The tree's normal productive time commences after about 15 years, but full fruit production is only attained at about 40–45 years (Karambiri et al. 2017).

The tree is a source of livelihoods for several million people, especially women, both locally and globally due to the economic value attached to oil extracted from nuts and the kernels (Adekambi, Ingenbleek, and Van Trijp 2018). The products are used nationally and internationally in the food industry, cosmetics and pharmaceutics (Bup et al. 2014). The shea value chain starts with collectors and ends with the consumers (Adekambi, Ingenbleek, and Van Trijp 2018; Bello-Bravo, Lovett, and Pittendrigh 2015). Although the shea value chain starts with collectors, the sequence of activities that follows after collection depends on the intended final use of the product (Glew and Lovett 2014). For instance, shea intended for consumption may first be roasted by the collectors or other actors along the chain, whereas shea meant for cosmetics may be sold to local processors in its raw form, for onward processing (Ferris et al. 2001). Consequently, the shea value chain comprises of several activities and functions, some of which can be performed by collectors and others requiring other actors higher in the chain (Ferris et al. 2001; Kent, Bakaweri, and Poole 2014). This implies that, depending on the final use, the length of the shea value chain changes. The length of the value chain notwithstanding, the collector, who sits at the bottom of the chain has become disadvantaged. This disadvantage arises from the increasing competitiveness and globalization of the shea value chain (Bello-Bravo, Lovett, and Pittendrigh 2015;; Elias and Arora-Jonsson 2017 Lovett 2015; Rousseau, Gautier, and Wardell 2015). This increased competitiveness and globalization implies that shea collectors, who are mostly women and children (Adekambi, Ingenbleek, and Van Trijp 2018; Bello-Bravo, Lovett, and Pittendrigh 2015; Hammond et al. 2019; Seghieri 2019), must take on additional

value chain functions and activities to enhance value addition so as to remain competitive (Rousseau, Gautier, and Wardell 2015). This value addition is usually associated with increased income of shea actors including collectors at the bottom of the chain (Agúndez et al. 2019; Kodua, Ankamah, and Addae 2018; Tiamiyu, Adagba, and Shaahu 2014), in addition to improved quality of shea products (Adekambi, Ingenbleek, and Van Trijp 2018; Honfo et al. 2017). The need to increase the competitiveness of shea collectors in terms of their increased participation in the shea value chain is becoming commonplace in development thinking. This is attributed to increased competition from other chain actors and the need to enhance sustainability of the shea value chain (Adekambi, Ingenbleek, and Van Trijp 2018; Rousseau, Gautier, and Wardell 2015). For instance, Gyau et al. (2014) and Bello-Bravo, Lovett, and Pittendrigh (2015) noted that collectors of agroforestry products had poor access to markets. Garba, Sanni, and Adebayo (2015) also noted a number of challenges with which smallholder shea collectors are faced, including discrimination by buyers. Similarly, Tanko (2017) reported low levels of efficiency for most shea traders selling shea nuts. Elias and Saussey (2013) raised the question of fairness in international shea trade due to the low returns of shea producers in Burkina Faso, while Kombiok and Agbenyega (2017) pointed out the challenges associated with financing arrangements in the production and marketing of shea butter.

According to Adekambi, Ingenbleek, and Van Trijp (2018), addressing the challenges faced by smallholder shea collectors requires integration into high-value markets by enhancing their levels of value addition and product upgrading. Value addition and product upgrading are processes that enable a firm or any value chain actor to take on more value-intensive functions in the chain, making itself harder to replace, and thus appropriating a larger share of the generated profits. It entails the acquisition of technological capabilities and market linkages that assist producers and enable firms to improve their competitiveness and move into higher-value activities (Akite et al. 2021; Biurrun et al. 2021; Fessehaie 2013; Kaplinsky and Morris 2000; Yongabo 2021). In many cases, smallholder shea collectors must respond to market opportunities by innovating and increasing value-added products, a process also known as 'upgrading'. Through upgrading, smallholder shea collectors can enhance the competitiveness of a value chain and thus contribute to economic growth (Rousseau, Gautier, and Wardell 2015). At the same time, they benefit when their increased value-added contributions to the value chain translate into higher returns to the collectors (Adekambi, Ingenbleek, and Van Trijp 2018). After collecting shea, collectors must make decisions on what quantity to add value to and what value-added products to deal in. In other words, they must make decisions on two possible upgrading scenarios. First, they can decide to sell 100% of the collected shea without any value addition or add value to all or a proportion of the collected shea. The latter is value upgrading which, in this study, is being looked at as actions that change the economic value of the collected shea. Second, they can decide to have no value-added product or to have one of more added products. The latter is product upgrading which, in this study. is being looked at as changing the form of a product by undertaking some processing activities.

Although several options exist in both cases, the collector will choose the options that give the best satisfaction. This upgrading decision can be explained by the utility maximization theory (UMT) which suggests that economic actors (in this case, shea collectors) will choose a given course of actions only if there is a perceived benefit associated with such a decision. Usually, such decisions are subject to a set of social, economic and institutional constraints (Rahm and Huffman 1984). Consequently, when there is no perceived benefit associated with upgrading, a collector will decide not to engage in either value or product upgrading; conversely, when there is a perceived benefit, a collector will only engage in value upgrading up to a level where the benefit is perceived to be highest, amidst existing constraints. The perceived benefits cannot in reality be directly measured but are a direct function of observed constraints which include social, economic and institutional factors (Mugonola et al. 2013).

Despite the benefits associated with both product and value upgrading, it is not clear what drives smallholder shea collectors to undertake upgrading activities. By applying the UMT, this study assessed the influence of the observed social, economic and institutional factors on both value and product upgrading. Specifically, it is important to understand the factors that drive collectors to allocate their collected shea to value addition, and on what products they decide to participate in value addition. This study sought to determine the factors that influence upgrading in the shea nut value chain in northern Uganda with specific focus on shea collector at the base of the chain. Specifically, the study assessed the factors associated with the proportion of shea value added and the number of value-added products that collectors decide to engage in.

Methodology

Description of study area

This study was conducted in northern Uganda, targeting the shea belt in the districts of Pader, Lira, and Otuke where shea nut trees predominantly grow (Figure 1). These districts occur within the Acholi and Lango subregions, between 02°50'N, 33°34'E and 1000–1300 metres above sea level. Rainfall in the study area is convectional and bimodal from mid-November to Mid-May, with annual rainfall ranging between 1000 and 1500 mm. Temperatures are relatively high with a maximum temperature of 26°C and a minimum of 18° C. The soils are ferrosols with woody Savannah thicket and riparian vegetation (Ministry of Agriculture, Animal Industry and Fisheries (MAAIF) 2015). The population of the study area is 690,301 people, with 145,143 households, of which 117,116 (80.7%) earn their livelihoods from subsistence farming (Uganda Bureau of Statistics 2016). Lately, other activities such as shea nut collection

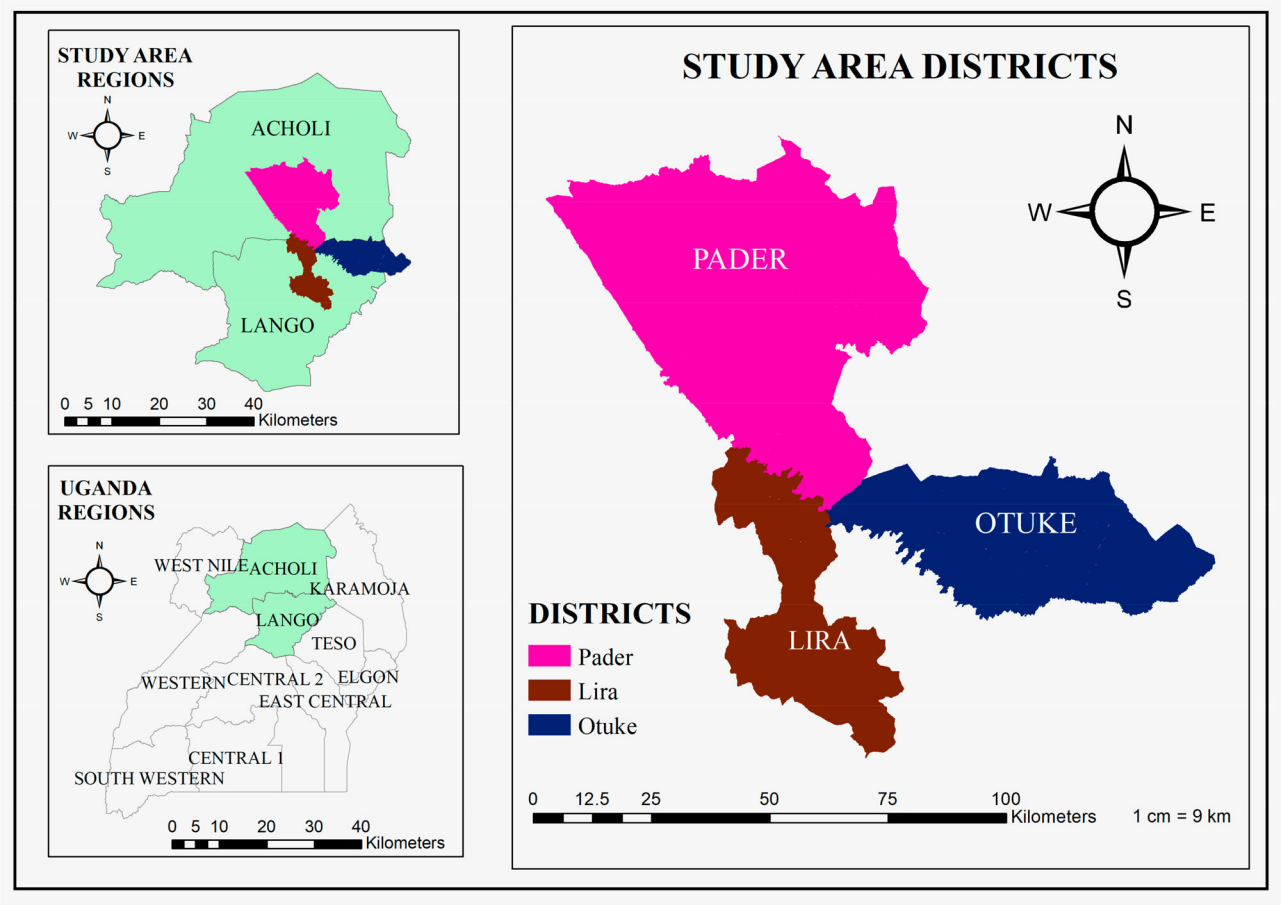

Figure 1: Map of the study area.

and processing have been providing alternative sources of household income.

Data collection and sampling technique

A cross-sectional research design was used at a single point in time. The study used quantitative data to describe the nature of upgrading strategies practised by shea nut collectors in northern Uganda. The cross-sectional approach was applied to a sample of the respondents comprising shea nut collectors i.e., the household communities engaged in shea nut collection. The sample size which indicated the number of shea nut collectors included in the study was determined following Cochran's (1963) formula of sample size determination for an unknown population since there is no recent data on the number of shea collectors available in the study area. The formula is specified in equation (1):

$$n = \frac{Z^2 p(1-p)}{e^2} \quad (1)$$

where: n is the required sample size; Z is the value of the statistic corresponding to 95% confidence level; p is the estimated proportion of shea collectors in the study area (we assumed that the proportion of collectors to the total population is 0.78); and e is the level of precision which was set at 5%. This gave a total sample size of 264 respondents. However, during data cleaning, information from 12 respondents were dropped due to incompleteness of the data. The effective sample size used for analysis was thus 252. In the sampling technique, the study adopted a multi-stage sampling procedure. First, the districts were purposively selected due dominance of shea trees. Secondly, the six sub-counties, two from each district, were also selected purposively following the guidance of the district forest officers on which sub-counties had the higher number of shea trees and consequently shea collectors. Following a list of registered shea collectors obtained from the district forest department, the study randomly selected and interviewed 44 shea collectors from each sub-county. The study used quantitative cross-sectional primary data. Primary data were collected using pre-tested structured questionnaires from households that participated in shea nut collection process. The necessary information from sample households was collected on socio-demographic and economic characteristics as well as their participation and experience in shea nut collection.

Data analysis

Collected data were entered into Microsoft Excel and cleaned before being exported to Statistical Packages for Social Sciences (SPSS) and STATA for analysis. Data analysis involved both descriptive and econometric methods. Specifically, descriptive statistics were implemented in SPSS, while econometric analyses were performed in STATA v14. Descriptive statistics were used to describe and summarize the variables under

study, while econometric methods were used to assess factors influencing value addition and upgrading. Specifically, the ordered logit model was chosen due to its ability to model ordered responses. This study assessed the factors influencing level of value addition in terms of the proportion and number of value-added products. These two dependent variables were defined in an ordered way signifying low levels of value addition to high levels of value addition. The ordered logit model is a regression model for an ordinal response variable. The model is based on the cumulative probabilities of the response variable: in particular, the logit of each cumulative probability is assumed to be a linear function of the covariates with regression coefficients constant across response categories. Value addition, a dependent variable, was analyzed based on different levels of value addition to shea nuts by collectors as well as the number of value-added products sold by collectors.

Let Y denote the response variable with C categories for the i^{th} subject, alongside with a vector of covariates X_i as specified in equation (2). This regression model establishes a relationship between the covariates and the set of probabilities associated with each of the ordinal categories.

$$g_{ci} = \Pr(Y = y_c|X_i),\ c = 1,\ 2,\ \ldots\ldots\ldots C \quad (2)$$

Note that the last cumulative probability is necessarily equal to 1, so the model specifies only $C-1$ cumulative probabilities. An ordered logit model for an ordinal response Y with C categories is defined by a set of $C-1$ equations where the cumulative probabilities $g_{ci} = \Pr(Y = y_c|X_i)$ are related to a linear predictor $\beta X_i = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \ldots$ through the logit function as specified in equation (3):

$$\text{logit}(g_{ci}) = \log\left(\frac{g_{ci}}{1-g_{ci}}\right) = \alpha_c - \beta X_i,\ c = 1, 2,\ \ldots.., C-1 \quad (3)$$

In the ordered logit regression, the level of value addition for each actor is the dependent variable, and the transaction attributes and socio-demographic characteristics of the actors, the independent variables. The level of value addition was measured using two approaches, giving rise to two dependent variables. First, the study considered the proportion of value added with five ordinal outcomes of: 1 = no proportion value added, 2 = low proportion, 3 = medium proportion, 4 = high proportion and 5 = full proportion value added. The study proposed a cut-off that is presented in Table 1. Secondly, the study considered the number of value-added products with four ordinal outcomes of: 1 = no product, 2 = one product, 3 = two products and 4 = three or more products.

In this study, a separate model was estimated for each of the two dependent variables associated with product upgrading and value upgrading. The specification of each model followed equation (4):

$$Y = f(X,\ \varepsilon) \quad (4)$$

where

$$Y = \begin{pmatrix} 1 = no\ proportion \\ 2 = Low\ proportion \\ 3 = medium\ proportion \\ 4 = high\ proportion \\ 5 = full\ proportion \end{pmatrix}$$ in the case of proportion of value added for value upgrading

and

$$Y = \begin{pmatrix} 1 = None \\ 2 = Low \\ 3 = Medium \\ 4 = High \end{pmatrix}$$ in the case of number of value-added products for product upgrading X is a vector of explanatory variables as described in Table 1; ε is the error term. Given the potential correlation between the proportion of shea value added and the number of product values added, the study estimated the two ordered logit models simultaneously using the bivariate ordered logit approach. The adjusted Wald test ($F = 6.08$; Prob > $F = 0.0026$) was significant, implying combined model fit for the models.

In order to estimate the actual effects of the different categories of the dependent variables, the study estimated marginal effects as specified in the equation (5):

$$\frac{\partial P_{ij}}{\partial x_i} = [g(\alpha_{j-1} - x'\beta) - g(\alpha_j - x'\beta)]\beta \quad (5)$$

where $g(.)$ is the standard normal density function.

Results

Socio-demographic characteristics

Males were less involved in shea nut collection (40%) than their female counterparts (60%) with significant variation across districts. The average age of collectors was 39.5 ± 13.64 years with no significant variations across districts. On average, collectors had 7 years of formal education with significant variations across districts. Collectors on average had access to 4.5 acres of land under shea nut trees. This varied across districts smaller in Lira and Otuke and was highest in Pader district (Table 2). Most the collectors had an average of 10 years' experience; collectors in Pader district were found to have the least experience in shea nut collection. Comparatively, the income from shea (UGX. 22,2885 ± 211,951/US$ 61 ± 50[1]) was less than the income earned from non-shea activities (UGX. 276,502 ± 537,337/US$ 76 ± 146). Shea income varied significantly across the districts, while non-shea income did not. The low shea income could be attributed to reliance on spot marketing. Most shea income was generated through spot marketing that was deployed by 67% of the respondents. Only 12% of the respondents had access to extension services and, of these, 25% received training, 10% received information,

Table 1: Description of variables used in this study and their a priori expected signs.

Variable	Description	
Dependent variables		
Value upgrading	Proportion of Shea that is value addition to Shea nuts by collector 1 = No Proportion; 2 = Low proportion; 3 = Medium proportion; 4 = High proportion and 5 = Full Proportion	
Product upgrading	Number of value-added products 1 = None; 2 = Low; 3 = Medium and 4 = High	
Explanatory variables		
	Description	***A priori* sign**
Marital status	Dummy i.e., 1= Married, 0 Otherwise	+
Male	Dummy i.e., 1= Yes, 0 = No	+/-
Age	Continuous: (In Years)	+/-
Household size	Continuous: (Number of people)	+
Education	Continuous (number of years spent in school)	+
Land size	Continuous (acreage)	+
Distance to market point	Continuous (in Kilometres)	-
Shea income	Continuous (amount in Ugandan shillings)	+
Non-shea income	Continuous (amount in Ugandan shillings)	+
Experience	Continuous (years in Shea nut collection)	+
Extension services	Dummy i.e., 1= Yes, 0 = No	+
Receive training	Dummy i.e., 1= Yes, 0 = No	+
Receive information	Dummy i.e., 1= Yes, 0 = No	+
Aware of institutions	Dummy i.e., 1= Yes, 0 = No	+
Member of association	Dummy i.e., 1= Yes, 0 = No	+
Spot marketing	Dummy i.e., 1= Yes, 0 = No	+
Informal marketing	Dummy i.e., 1= Yes, 0 = No	+
Formal marketing	Dummy i.e., 1= Yes, 0 = No	-
Spot and formal	Dummy i.e., 1= Yes, 0 = No	+
Otuke district	Dummy i.e., 1= Yes, 0 = No	+/-
Lira district	Dummy i.e., 1= Yes, 0 = No	+/-
Pader district	Dummy i.e., 1= Yes, 0 = No	+/-

Note: The categories for the proportion of value added where created as: - No proportion = 0% of shea value added, low (1–49% value added), medium (50–75% value added), High (76–100% value added), and Full = 100% value added. For the number of value-added products, high and very high levels were combined to high, since very high (4 value-added products) had very few observations.

and 8% were aware of institutions dealing with shea nut (Table 2). There were significant associations between the district of the collector and access to services including extension and information, in addition to the marketing arrangements.

Shea nut value addition and product upgrading

The results show that 84% of the shea collectors practised some level of value addition with 11.5% adding value to 100% of all the shea nuts they collected. Fifteen (15%) per cent of the shea collectors sold all the collected shea kernels without any value addition. There is a positive correlation between the number of shea products with value added and the proportion of shea value added with a Pearson correlation coefficient of 0.404 ($p < 0.01$). District wise, 74% of the collectors added some value to their shea nuts in Lira, 85% in Otuke and 95% in Pader. Over 50% of the shea collectors had at least one value-added product with 2.78% having four (4) value-added products. Thirty-seven (37%) per cent of the respondents had roasted kernel and crude butter as the main value-added products. Other products included fine butter, cosmetics and dried kernels. Shea kernel processing was most pronounced in Pader district. Lira district had the highest proportion of shea nut collectors with no value-added products, while Pader district had the lowest proportion of shea collectors with no value-added products. The most common products were roasted kernel and crude butter (37.3%) and dried kernel was the least with only 1.2% of the respondents involved. Pader district had highest proportion of collectors processing collected shea kernels to roasted kernels and crude butter, while Lira district had the least proportion of collectors processing collected shea kernels to roasted kernels and crude butter (Table 3).

Factors influencing shea nut value upgrading among shea nut collectors

Table 4 presents results of the ordered logistic analysis for factors influencing the proportion of shea that was value added by shea nut collectors. It shows that male gender indicator ($p = 0.061$), age ($p = 0.015$), non-shea income ($p = 0.002$), access to information on shea marketing ($p = 0.028$), membership to an association ($p = 0.008$) and engaging in spot marketing ($p = 0.002$) had a negative significant influence on the proportion of shea that was value added by a shea nut collector. Consequently, these factors are associated with the reduced proportion of shea that was value added by the shea collectors. On the other hand, land size under shea trees ($p = 0.014$) and shea income ($p = 0.004$) had a positive significant influence on the proportion of shea that was value added. This implies that shea collectors with more land and who earn more income from shea, were most likely to add value to more of the shea kernels they collect. With the exception of non-shea income, group membership and access to information, all the other significant variables conformed to the hypothesized signs presented in

Table 2: Summary statistics for demographic characteristics.

	Mean (SD)					
Variable	Overall (n = 252)	Otuke (n = 80)	Lira (n = 90)	Pader (n = 82)	F-value/Chi-square	*p*-value
Gender (Male)	0.40(0.49)	0.55(0.50)	0.43(0.50)	0.22(0.42)	19.033	0.000
Age	39.54(13.64)	39.95(39.95)	38.78(13.3)	39.96 (13.66)	0.210	0.807
Household size	6.42(2.91)	6.11(2.40)	6.42(2.74)	6.72 (3.48)	0.880	0.415
Education	6.8 (1.92)	7.38 (1.99)	6.22(1.11)	6.95 (2.35)	8.350	0.000
Land size	4.47(4.64)	3.91(4.17)	3.09(3.44)	6.53 (5.47)	14.030	0.000
Distance to market point	4.86(7.18)	4.02(4.02)	4.42(3.96)	6.17 (11.11)	2.110	0.123
Processing income	222,884.90 (211,951.30)	160,850.00 (87,604.56)	255,244.40 (260,760.10)	247,890.20 (226,744.70)	5.220	0.006
Non-processing income	276,502.00 (537337.80)	249,256.30 (232041.70)	307,755.60 (794857.60)	268,780.50 (382258.00)	0.260	0.780
Experience	10.26(8.76)	10.21(8.41)	12.57 (10.41)	7.76 (6.11)	6.760	0.001
Extension services	0.12(0.33)	0.15(0.36)	0.00(0.00)	0.23 (0.42)	22.144	0.000
Receive training	0.25(0.43)	0.26(0.44)	0.00(0.00)	0.50 (0.50)	57.997	0.000
Receive information	0.10(0.29)	0.15(0.36)	0.00(0.00)	0.15 (0.36)	14.743	0.001
Aware of institutions	0.08(0.28)	0.15(0.36)	0.03(0.18)	0.07 (0.26)	7.711	0.021
Member of association	0.07 (0.26)	0.04 (0.19)	0.01 (0.11)	0.17 (0.38)	18.517	0.000
Spot marketing	0.67 (0.47)	0.69 (0.47)	0.44 (0.50)	0.91 (0.28)	43.302	0.000
Informal marketing	0.17 (0.38)	0.09 (0.28)	0.33 (0.47)	0.07 (0.26)	24.246	0.000
Formal marketing	0.10 (0.30)	0.19 (0.39)	0.11 (0.32)	0.01 (0.11)	13.545	0.001
Both spot & informal	0.05 (0.22)	0.04 (0.19)	0.11 (0.32)	0.00 (0.00)	11.302	0.004

Note: In case of dummies, the values in the column for means are proportions which are multiplied by 100 to get percentages for the reference category. SD = Standard deviation. One-way analysis was used to compare means value across districts, in case of continuous variables and the chi-square test of association was used to compare association between districts and dummy variables.

Table 3: Shea nut value addition and value-added products among shea collectors.

Variable	Category	Per cent				Chi-square	*p*-value
		Overall (*n* = 252)	Otuke (*n* = 80)	Lira (*n* = 90)	Pader (*n* = 82)		
Proportion of shea value added†	No proportion	15.48	15.00	25.56	4.88	41.214	0.000
	Low proportion	34.13	41.25	37.78	23.17		
	Moderate proportion	20.24	13.75	14.44	32.93		
	High proportion	18.65	20.00	6.67	30.49		
	Full proportion	11.51	10.00	15.56	8.54		
Number of value-added products†	None	49.21	41.25	68.89	35.37	26.474	0.001
	Low	19.84	25.00	8.89	26.83		
	Medium	18.65	17.50	15.56	23.17		
	High	9.52	13.75	5.56	9.76		
	Very high	2.78	2.50	1.11	4.88		
Value added product is roasted kernel	Yes	37.30	37.50	20.00	56.10	23.908	0.000
	No	62.70	62.50	80.00	43.90		
Value added product is crude butter	Yes	37.30	41.25	30.00	41.46	3.192	0.203
	No	62.70	58.75	70.00	58.54		
Value added product is fine butter	Yes	15.08	20.00	8.89	17.07	4.461	0.107
	No	84.92	80.00	91.11	82.93		
Value added product is a cosmetic product	Yes	5.95	10.00	1.11	7.32	6.382	0.041
	No	94.05	90.00	98.89	92.68		
Value added product is a dried kernel	Yes	1.19	2.50	1.11	0.00	2.159	0.340
	No	98.81	97.50	98.89	100.00		

†There is a significant ($p < 0.01$) correlation between number of shea products value added and proportion of shea value added. The Pearson correlation coefficient = 0.407.

Table 1. Other factors including, household size, collector's level of education, distance to the market point, experience, access to extension services, training, awareness of shea institutions, and geographical location of the shea collector did not have any significant influence on the proportion of shea that was value-added. This study also presents results of the marginal effects analysis for factors influencing the level of value addition to collected shea nuts (Table 5). It shows consistent estimates of the effects of the independent variables on the different categories of the dependent variable.

Factors influencing the number of shea nut product upgrading activities

This study also investigated the factors associated with the number of value-added products in which the shea collectors engaged. It shows that age, access to shea marketing information, and both formal and informal marketing arrangements had a negative and significant influence on the number of value-added products that a shea collector engages in. Household size, access to extension services, membership of an association, and use of both spot and informal marketing arrangements had a positive and

Table 4: Factors influencing the level of value addition among shea nut collectors.

Explanatory	Coef.	Robust Std. Err.	Z	P > z
Gender (Male)	−0.509	0.270	−1.880	**0.061**
Age	−0.026	0.011	−2.460	**0.015**
Household size	0.036	0.048	0.740	0.460
Education	0.054	0.076	0.720	0.472
Land size	0.080	0.032	2.460	**0.015**
Distance to market point	0.024	0.016	1.520	0.129
Log shea income	0.426	0.149	2.850	**0.005**
Log non-shea income	−0.312	0.102	−3.070	**0.002**
Log experience	−0.110	0.184	−0.600	0.549
Extension services	−0.366	0.343	−1.070	0.287
Receive training	0.512	0.319	1.610	0.110
Receive information	−0.680	0.307	−2.210	**0.028**
Aware of institutions	−0.617	0.522	−1.180	0.238
Member of association	−1.299	0.487	−2.670	**0.008**
Spot marketing	−1.941	0.618	−3.140	**0.002**
Informal marketing	−0.300	0.602	−0.500	0.619
Lira	−0.513	0.461	−1.110	0.266
Pader	−0.304	0.319	−0.950	0.341
Intercept/cut1	−1.802	1.727		
Intercept/cut2	0.283	1.730		
Intercept/cut3	1.341	1.718		
Intercept/cut4	2.723	1.710		
Number of observations	252			

Note: Spot marketing was the base category for market arrangements variables, while Otuke was the base category for districts variables.

Table 5: Marginal effects results for factors influencing the level of value addition among shea collectors.

	No value addition			Low value addition			Medium value addition			High value addition			Full value addition		
Variable	dy/dx	Std. Err.	$P>z$	dy/dx	Std. Err.	$P>z$	dy/dx	Std. Err.	$P>z$	dy/dx	Std. Err.	$P>z$	dy/dx	Std. Err.	$P>z$
Gender (Male)	0.053	0.029	**0.066**	0.073	0.040	**0.064**	−0.032	0.019	**0.087**	−0.058	0.032	**0.069**	−0.036	0.019	**0.061**
Age	0.003	0.001	**0.022**	0.004	0.002	**0.017**	−0.002	0.001	**0.037**	−0.003	0.001	**0.018**	−0.002	0.001	**0.026**
Household size	−0.004	0.005	0.466	−0.005	0.007	0.457	0.002	0.003	0.457	0.004	0.006	0.463	0.003	0.004	0.469
Education	−0.005	0.008	0.479	−0.008	0.011	0.470	0.003	0.005	0.468	0.006	0.009	0.479	0.004	0.006	0.476
Land size	−0.008	0.003	**0.018**	−0.012	0.005	**0.020**	0.005	0.002	**0.038**	0.009	0.004	**0.019**	0.006	0.003	**0.024**
Distance to market point	−0.002	0.002	0.137	−0.004	0.002	0.134	0.001	0.001	0.151	0.003	0.002	0.138	0.002	0.001	0.142
Log Shea Income	−0.043	0.015	**0.005**	−0.064	0.025	**0.009**	0.026	0.011	**0.016**	0.050	0.019	**0.007**	0.031	0.013	**0.016**
Log Non-Shea Income	0.031	0.012	**0.007**	0.047	0.016	**0.003**	−0.019	0.008	**0.024**	−0.036	0.013	**0.005**	−0.023	0.008	**0.003**
Log Experience	0.011	0.018	0.549	0.017	0.028	0.550	−0.007	0.011	0.539	−0.013	0.022	0.549	−0.008	0.014	0.563
Extension services	0.041	0.042	0.338	0.050	0.042	0.236	−0.026	0.028	0.350	−0.041	0.037	0.267	−0.024	0.020	0.243
Receive training	−0.046	0.027	**0.081**	−0.081	0.052	0.125	0.024	0.013	**0.055**	0.061	0.039	0.118	0.042	0.030	0.172
Receive information	0.084	0.044	**0.058**	0.081	0.031	**0.008**	−0.054	0.030	**0.073**	−0.072	0.030	**0.016**	−0.039	0.016	**0.012**
Aware of institutions	0.075	0.076	0.321	0.075	0.047	0.112	−0.048	0.049	0.325	−0.066	0.050	0.192	−0.036	0.024	0.124
Member of Association	0.179	0.086	**0.038**	0.121	0.030	**0.000**	−0.106	0.046	**0.022**	−0.126	0.039	**0.001**	−0.068	0.022	**0.002**
Spot marketing	0.325	0.143	**0.023**	0.073	0.071	0.304	−0.161	0.047	**0.001**	−0.158	0.032	**0.000**	−0.080	0.022	**0.000**
Informal marketing	0.033	0.073	0.651	0.041	0.074	0.579	−0.021	0.048	0.653	−0.034	0.064	0.601	−0.019	0.036	0.591
Lira	0.054	0.053	0.301	0.073	0.061	0.233	−0.034	0.034	0.327	−0.058	0.052	0.257	−0.035	0.029	0.219
Pader	0.032	0.034	0.357	0.044	0.045	0.330	−0.020	0.021	0.352	−0.035	0.036	0.338	−0.021	0.023	0.348

Table 6: Factors influencing the number of shea products upgraded by a shea nut collector.

Explanatory variable	Coef.	Robust Std. Err.	z	P > z
Married	0.557	0.529	1.050	0.294
Gender (Male)	−0.297	0.312	−0.950	0.343
Age	−0.033	0.013	−2.490	**0.013**
Household size	0.093	0.049	1.900	**0.059**
Education	0.038	0.075	0.510	0.607
Land under Shea nut	0.039	0.033	1.190	0.235
Log Experience	0.187	0.172	1.090	0.277
Extension	0.989	0.427	2.310	**0.022**
Receive trainings	0.381	0.380	1.000	0.316
Receive information	1.172	0.626	1.870	**0.062**
Aware of institutions	−0.407	0.332	−1.230	0.220
Member of Association	1.163	0.541	2.150	**0.032**
Informal marketing	−0.910	0.463	−1.970	**0.050**
Formal marketing	−1.499	0.419	−3.580	**0.000**
Spot informal marketing	1.543	0.573	2.690	**0.008**
Lira	−1.079	0.387	−2.790	**0.006**
Pader	−0.438	0.364	−1.200	0.230
Intercept/cut1	1.025	1.136		
Intercept/cut2	2.040	1.157		
Intercept/cut3	3.339	1.201		
N	252			

Note: Spot marketing was the base category for market arrangements variables, while, Otuke was the base category for districts variables.

significant influence on the number of value-added products that a shea collector engages in. There were also significant differences in number of shea value-added products that collectors engage in across districts (Table 6). Only informal marketing and formal marketing conformed to the hypothesized signs stated in Table 1. On the other hand, the gender and marital status of collectors, education level, land size for shea, experience, training and awareness of institutions did not have any significant influence on the number of value-added products (Table 6). In order to understand the specific effects of the explanatory variables on the dependent variable (number of value-added products), the study estimated marginal effects for each category of the dependent variable. The estimated marginal effects were consistent with the model estimates (Table 7).

Discussions

This study has shown that there are different levels of engagement in value-addition activities by shea collectors. This variation could be attributed to gender roles at household level with shea nut picking more associated with women, children and young adults than men. It is also a cultural attribute within these communities for shea nuts collection and processing to be undertaken by women, as over historical time women have amassed immense local knowledge associated with shea nuts handling. Similar patterns have been documented elsewhere. In Benin for example, women were more engaged in shea value addition than males because most the locally available value-adding activities are usually less preferred by men since they have traditionally been considered women's roles (Agúndez et al. 2019). Further, in parts

Table 7: Marginal effects results for factors influencing the number of value-added products for shea collectors.

	None			Low			Medium			High		
Variable	dy/dx	Std. Err.	P > z	dy/dx	Std. Err.	P > z	dy/dx	Std. Err.	P > z	dy/dx	Std. Err.	P > z
Married	−0.137	0.125	0.275	0.039	0.046	0.389	0.059	0.051	0.250	0.038	0.030	0.203
Gender (Male)	0.074	0.078	0.340	−0.017	0.019	0.371	−0.033	0.036	0.349	−0.024	0.024	0.325
Age	0.008	0.003	0.013	−0.002	0.001	0.049	−0.004	0.002	0.019	−0.003	0.001	0.015
Household size	−0.023	0.012	0.058	0.005	0.003	0.104	0.011	0.006	0.066	0.008	0.004	0.061
Education	−0.010	0.019	0.607	0.002	0.004	0.618	0.004	0.008	0.608	0.003	0.006	0.601
Land under Shea nut	−0.010	0.008	0.234	0.002	0.002	0.265	0.004	0.004	0.238	0.003	0.003	0.240
Log Experience	−0.047	0.043	0.276	0.010	0.010	0.285	0.021	0.020	0.287	0.015	0.014	0.281
Extension	−0.235	0.092	0.011	0.015	0.018	0.387	0.110	0.044	0.013	0.109	0.063	0.082
Receive trainings	−0.095	0.093	0.310	0.017	0.014	0.216	0.044	0.044	0.324	0.034	0.037	0.363
Receive information	0.270	0.123	0.027	−0.094	0.059	0.109	−0.110	0.048	0.022	−0.066	0.023	0.004
Aware of institutions	0.101	0.080	0.210	−0.028	0.027	0.292	−0.044	0.034	0.200	−0.029	0.021	0.174
Member of Association	−0.268	0.106	0.011	0.002	0.031	0.945	0.124	0.050	0.013	0.141	0.088	0.107
Informal marketing	0.219	0.103	0.035	−0.068	0.039	0.085	−0.092	0.043	0.033	−0.059	0.027	0.027
Formal marketing	0.331	0.074	0.000	−0.121	0.035	0.001	−0.132	0.033	0.000	−0.078	0.021	0.000
Spot informal marketing	−0.333	0.093	0.000	−0.026	0.045	0.559	0.145	0.039	0.000	0.214	0.105	0.042
Lira	0.262	0.088	0.003	−0.068	0.032	0.032	−0.114	0.039	0.003	−0.079	0.027	0.003
Pader	0.109	0.089	0.223	−0.027	0.024	0.265	−0.048	0.039	0.220	−0.034	0.028	0.227

of Ghana, this has been considered to be the role of women (Awo and Anaman 2015). Meanwhile, while value addition is considered a women's role, the protection of shea nut trees, the primary source of the raw material, is considered the role of men. This is because land is traditionally owned by men, and it is their role to safeguard the land and the resources on it, including shea nut trees. According to Kent (2018), this gender disaggregation of roles was evident in areas that are dependent on non-timber forest products (NTFPs) such as shea nuts.

Whereas value addition increases collectors' incomes (Tom-Dery et al. 2018), there were still some collectors who did not engage in any type of value addition. Similar findings were also reported in Ghana by Adams, Abudulai, and Bashiru (2016) who observed that about 14% of the shea collectors did not participate in local shea butter processing in Ghana. Adégbidi et al. (2017) observed that despite the benefits, not all actors usually embrace value addition. Several factors were identified to influence the level of value-addition activities reported in this study. The factors had either negative or positive influence on the proportion of collected shea that is value-added and the number of value-added products that shea collectors engage in. Whereas some of the factors were only significant for one aspect of study (either proportion of value added or number of value-added products) a number of them had significant influence on both. Specifically, collector's age, access to information, group membership and marketing arrangement had significant influence on both proportion of shea value added and number of value-added products, although the influence had varying directions and magnitudes.

An increase in collector's age was associated with increased probability of having no value-added product, while zero and a low proportion of shea that is value added reduced probability of engaging in medium, high and full levels of value addition and more than one value-added product. These findings imply that value-addition activities are preferred by relatively younger farmers who engage in more value-added products and add value to a larger proportion of their collected shea kernels. Similar observations were also reported by previous studies. According to Khoza et al. (2019), older farmers in the Gauteng province of South African were less likely to participate in agro-processing. In another study in northern Ghana, older shea collectors were also reported to be less efficient in shea processing (Tanko 2017). Relatedly, Maku, Kitambo, and Mugonola (2022) observed that age of the youth was a significant driver of their participation in value addition in the maize value chain. This finding can be explained by the negative influence of age on innovation (Parsons 2015). Specifically, older individuals are usually reluctant to try new approaches to processing and marketing their products, including value addition.

Whereas access to shea market information is important, the type of information received can either improve or reduce the level of value addition of the collectors. This study has shown that collectors who had access to shea marketing information were more likely to sell raw kernels and not have any value-added products, and allocated none or only small quantities of collected shea to value addition. Shea marketing information usually creates awareness of the availability of markets for non-value-added shea. Consequently, collectors may be attracted by the need to obtain cash from their collected shea nuts amidst uncertainty involved in value addition. According to Ngenoh et al. (2019), access to market participation discouraged participation in high value vegetable chains in Kenya. Whereas value addition would increase the premium received, shea collectors usually find it hard to forego a ready market.

Unlike access to information, access to extensions was only significant for number of value-added products but not for the proportion of shea that is value added. Consequently, shea collectors who had access to extension where more likely to be engaged in value addition of two or more shea products. The influence of extension on the number of value-added shea products can be attributed to the fact that during extension services shea collectors are usually exposed to several other shea products from which they can choose. A study by Donkor et al. (2018) reported that access to extension was important in enhancing the decision to participate in cassava value addition, as well as the level of participation, in Nigeria. Similar findings were reported by Gashaw, Habteyesus, and Nedjo (2018) in coffee value addition in Ethiopia. Whereas extension is able to influence the number of value-added products shea collectors engage in, it may not be able to influence how much of the collected shea is value added. Generally, access to extension improves the level of participation in agro-processing (Khoza et al. 2019).

This study has also shown that membership to an association is important in enhancing collectors' participation in value-addition activities. Specifically, collectors who are members of an association were more likely to add value to only one or a low proportion of shea collected. They were however more likely to have one or more value-added products. This contradictory finding was expected given that associations and groups are usually involved in a number of activities including shea processing and marketing. Where group membership supports collective marketing in addition to sharing of skills on value addition, collectors prefer to add value to only a small portion of their collected shea, while marketing the rest collectively since they are able to bargain for better prices. Several studies (Adekambi, Ingenbleek, and Van Trijp 2018; Donkor et al. 2018; Hans, Taruvinga, and Mushunje 2018) have shown the importance of membership of a farmer's group in enhancing value-addition activities. In a study on wild non-timber forest products in the Eastern Cape province of South Africa, Hans, Taruvinga, and Mushunje (2018) reported that bee farmers who were members of a farmer's group were more likely to bottle their honey, but were less likely to process bee wax.

The need to increase the premium received from shea drives participation in value-addition activities. Findings from this study have shown a significant relationship

between income from shea and income from non shea sources, and the proportion of shea which is value added. The results reveal that increased levels of shea income were associated with higher (medium, high and full) proportions of shea that are value added. Conversely, increased levels of non-shea income were associated with lower (none and low) proportions of shea that is value-added. According to Olorunfemi et al. (2015), the probability of participating in a fish value-addition initiative increased with increased fish income of the fish farmer in north central Nigeria. Consequently, the need to increase income usually motivates collectors to participate in value-addition activities.

Gender plays a critical role in the decision to participate in value-addition activities. From this study, male collectors were more likely to add value to none or only low proportions of shea collected, while female collectors were more likely to add value to higher (medium, high and full) proportions of shea collected. Most the value-added products and activities, including processing of crude butter and roasting the kernels are associated with conventional roles of women. It is thus not surprising that men were seen to allocate only a portion of the collected shea to value addition. According to Adams, Abudulai, and Bashiru (2016), most value-adding activities of the shea value chain are usually performed by women. According to Kent (2018), men are usually involved in appropriate roles other than performing the roles in shea production and processing. Similar findings were also reported in other studies. According to Hans, Taruvinga, and Mushunje (2018), most honey value-addition activities are more likely to performed by female farmers.

This study has also shown that although household size did not influence the proportion of shea that is value added, it had a significant influence on the number of value-added products that a collector engages in. According to Khoza et al. (2019), household size has a positive influence on the level of participation in agro-processing. Specifically, larger households were more likely to have one or more value-added products, as opposed to small households who were more likely to have no value-added products.

Participation in value-addition activities is also influenced by the market arrangement adopted. Collectors, who were using spot marketing as their means of access markets, were more likely to add value to none or low proportion of collected shea. Similarly, collectors who had either formal or informal contracts were less likely to engage in one or more value-added products, while those who engage in both spot and informal marketing arrangement at the same time, where less likely to engage in one or more value-added products. This study therefore shows that, although spot marketing does not favour higher proportions of shea to be value added, it promotes engagement in many products, while contracts, discourage engaging in many products, Usually, contracts have strict product specifications that collectors must abide by. Such collectors would therefore have to agree to the terms and conditions which include product specifications and supply quantities.

Location of the collection usually influences the level and form of value-addition activities. In this study, whereas there was no significant difference in proportion of value added across the districts, collectors in Lira were more likely to engage in no value-added products compared with collectors in Otuke and Pader. Similar findings were reported by Donkor et al. (2018), who reported that a location was significantly associated with a farmer's decision to participate in cassava value addition, but not with the level of value addition. This could be attributed to proximity to urban centres with large-scale shea processors that usually buy raw shea for their processing plants. Collectors in Lira are thus able to reach the urban market in Lira City more quickly than those in Otuke and Pader, who would opt to add value to their shea.

Conclusions

This study assessed the factors associated with shea upgrading activities. Specifically, the study assessed factors associated with value upgrading as measured by the proportion of value added and factors associated with product upgrading as measured by the number of value-added products undertaken by shea collectors. Findings point to the need to support older farmers in enhancing their capacity for value addition, since they were less likely to participate in value and product upgrading. Results also showed gendered participation in value addition with females more likely to engage and allocate more of the collected product to value addition. There is a need to encourage participation of men in shea value-addition activities to enhance sustainability of shea value addition. The study also shows the importance of access to marketing information and extension services in enhancing shea value addition. A sole focus on the provision of market information for the raw shea was shown to hinder value addition. There is a need to package vital value-addition messages together with market information to enhance value-addition activities. Dissemination of such information to shea actors belonging to their various associations would enhance uptake and lead to better value-addition outcomes. Lastly, collectors should be encouraged to negotiate contracts that allow for value-addition options if they are to increase their level of value addition.

Note

1. 1US$ = UGX 3,650 at the time of the study.

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