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Resource-use Efficiency of Shea Nut Processing in Kassena-Nankana West District, Ghana: DEA Approach

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

The Shea tree, *Vitellaria paradoxa,* has been seen as a very important economic God-given tree with numerous benefits for a longtime. The Shea tree, though under threat due to deforestation, still remain abundant in several communities in Ghana. That notwithstanding, shea nut processors have not been able to fully optimize the gains from the Shea tree and thus, this research examines the Resource-use efficiency of Shea nut processing in the Kassena-Nankana West District of Ghana. Data Envelopment Analysis (DEA) was employed to determine the overall technical, pure technical and scale efficiency of the Shea nut processing while bivariate Tobit was used to identify the sources or determinants of both technical and pure technical efficiencies. A SWOT analysis was carried out to identify the potentials and challenges faced by the Shea processors. It was discovered that on the average, the processors operated 50% of their potential overall technical efficiency, 55% of their potential pure technical efficiency and 92% of their potential scale efficiency. Determinants of processors' technical efficiency include age, household size, experience, access to credit and membership of processors' group. The SWOT analysis revealed challenges including poor transportation and difficulty in accessing credit. The study, therefore, recommends that, easy access

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to financial facilities and sensitization on savings are ways to boost processors' use of new, efficient technologies to help enhance their Resource-use efficiency. Improvement on the road network to enhance easy movement of goods and services is highly recommended.

Keywords: Resource-use efficiency; Shea processors; SWOT analysis; DEA approach.

1. INTRODUCTION

Shea tree *Vitellaria paradoxa* is a tenacious crop which is generally found in wild forest service park-lands over the little dry regions of Africa, where yearly precipitation ranges from around 600 - 1500 mm as confirmed by Enaberue ET al. [1]. The Shea tree proves to be fruitful when it is around 15 years of age, which at that point achieves full limit at 25 years and has a life expectancy of around 150 to 200 years [2]. The natural product is around 3 to 5 cm long. It comprises of a thin darker shell that shuts a single, dark coloured, egg-formed seed installed in a green sweet mash. As indicated by Anon [3], average production is around 15 and 20 kg of new natural product per tree, and in consistently one out of each three trees is productive. Dogbevi [4] indicated that, since 1728, Shea butter, the main product from processed Shea nut, has been viewed as a profoundly prized and critical therapeutic item in Africa. Shea butter is rich in vitamins A, E and F amongst others [5] which help to smoothen the skin and thus, a decent item for skin revitalising, increment of blood flow, acceleration of wound healing and for the treatment of numerous different sicknesses [6].

In Ghana, like other parts of Africa, the shea tree is a major economic tree that creates jobs for many particularly rural women. The nuts are processed and utilized traditionally as cooking oil or as pomade for the body and hair. Despite the economic importance of this tree, the process of extracting butter from the Shea nuts still remains basic and very meticulous. Often done in very unfriendly situations like the exposure of oneself to snake bites during the collection stage, and exposure to heat and smoke in the highly inefficient processing stage as reported by Sachibu [7]. Kassena Nankana West District contains a tremendous land with Shea trees as the primary economic tree. Shea picked by women are used as inputs for Shea nut processors and some are sold to interested buyers. Lovett and Haq [8] reported that, substantial volumes of Shea nuts remain unpicked and the amounts gathered are mostly not well kept due to inadequate processing and storage facilities. The processors are unable to produce to optimum because of deficient processing machines and the lack of market for the butter even though there is generally unlimited Shea nut picked. Suleiman [9] noted that, in view of the considerable financial and healthful possibilities of the Shea butter domestically and internationally, the interest for the product is on a consistent rise annually. Disregarding this appeal, the Shea butter delivered by the processors remain deficient in quality suggesting that assets are not efficiently used to generate perfect butter to satisfy both local and worldwide standard. It is hypothesized that, the creation of little amounts of Shea butter takes one individual more time and that, considerable measures of fuel are expected to deliver it [10].

Several studies have been carried out in this sector including the one of [11], which focused on exploring the profit efficiency of the Shea butter producers. It observed that, out of 120 producers, the majority (23%) of Shea butter producers, of a 100-efficiency score, have profit efficiency scores ranging from 51 to 60, followed by 16% of the producers having their profit efficiency score between 61 and 70 in the northern region of Ghana. Only 24% had their profit efficiency score ranging from 21 to 50. Fifty-one percent of the producers had their profit efficiency score ranging from 51 to 80. About 25% of Shea butter producers had their scores ranging from 71 - 90. In case the least efficient Shea butter producer is aspired to achieve the efficiency mark of the most efficient Shea butter producers, then that Shea butter producer must reduce costs by 80.8%. On average, for a Shea butter producer to achieve the optimal profit efficiency, they must reduce costs by 41.5%. Building on this and other studies, this study examines the resource use efficiency of the shea processors by measuring their overall technical and pure technical efficiency. It further tries to identify the sources or determinants of their efficiency. Finally, the study carries out a SWOT analysis to reveal the potentials and challenges of the shea industry in that study region. This study aims to establish a foundation on which development efforts geared towards the efficient use of resources for improved rural shea processing and reduce waste are discussed. The study also hopes to fill a gap in existing agricultural literature, particularly in the Ghana Shea industry.

2. MATERIALS AND METHODS

2.1 The Study Area, Sampling and Data Collection Technique

The research was carried out in Kassena Nankana West District, a district in the Upper East Region of Ghana. It is located generally between scope 10.97° North and longitude 01.10° west. The area has a total land area of approximately 1,004 sq. km. The population of the district is youthful (44.8%) illustrating a broad base population pyramid with a small number of inhabitants, of the elderly (5.4 %) reported by [12]. Agriculture is the dominant economic activity in the district. The sector employs over 68.7% of the people with the major being millet, sorghum, rice, groundnuts, leafy vegetables, cowpea, Bambara beans, okra, cotton, tomatoes and onion. The unit of analysis was processing households, the study used a multi-stage sampling procedure. First, the district was sub-divided into 5 sections and a community was randomly selected from each section. Next, 28 processors were randomly selected from each of the communities making a total of 140 respondents. Random sampling ensures that results obtained from your sample should to an extent represent what would have been obtained if the whole population had been measured [13]. With random sampling, there exist a higher probability that the data composed represents the entire population of interest. Random sampling technique is favored over other probability sampling techniques because the likelihood of selection becomes the same for every processor in the population. The study used primary data for its analysis, collected with a semi-structured questionnaire through direct interviews and focus group discussions. Data on the inputs, output levels, demographic characteristics and others were taken from the Shea processors in the study area.

2.2 Analytical Framework and Estimation Techniques

This section presents the theoretical framework and estimation techniques employed to achieve the objectives. The research involves a three-stage procedure. First, Data Envelopment Analysis (DEA) was employed to model the various efficiencies i.e., overall technical, pure technical and scale-efficiency. Second, the sources or determinants of processors' efficiency were identified using the bivariate Tobit model. Finally, the study used SWOT analysis to study the potential and challenges of the Shea processors in the district.

2.2.1 Overview of data envelopment analysis (DEA)

The DEA is a technique for estimating the efficiency of Decision-Making Units (DMUs) using linear programming techniques to combine input-output vectors as firmly as possible [14]. DEA makes way for many inputs–outputs to analyzed, at the same time without any presumption on data distribution proposed by [15]. It can be analyzed in a different way concerning return-to-scale by adding weight constraints. Charnes et al. [16] at first, brought about the efficiency assessments of the DMUs for constant return-to-scale (CRS), showing all DMUs utilized at their maximum scale. Later, [17], added the variable returns-to-scale (VRS) efficiency estimation model, making it promising for efficiency to be segmented into pure technical and scale efficiencies in DEA.

With respect to the work by Pascoe et al. [18] regarding constant returns-to-scale (CRS), the frontier is characterized by point C and every other point falling beneath the frontier are noted as underutilization of resources. Nonetheless, with variable returns-to-scale (VRS), the

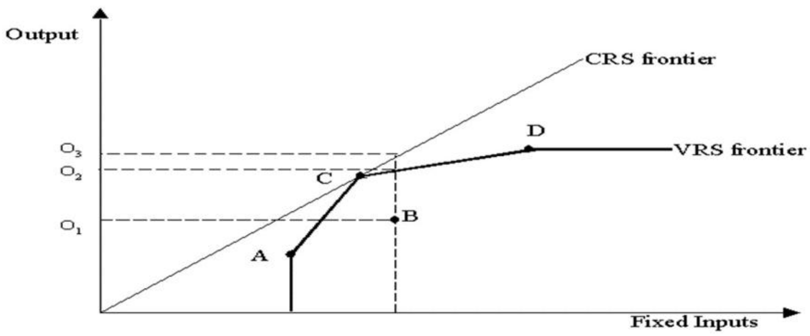

Fig. 1. DEA efficiency frontier [18]

efficiency is demonstrated by points A, C and D, and just point B lies underneath the frontier i.e., underutilization.

For constant return-to-scale [15],

$$\begin{aligned} & Min_{\theta,\lambda}\theta, \\ & s.t. \\ & -y_i + Y\lambda \geq 0 \\ & \theta x_i - X\lambda \succ 0 \\ & \lambda \geq 0 \end{aligned} \tag{1}$$

In variable return-to-scale, the above equation can be altered to take care of VRS by including an extra convexity constraint (λ) [19]:

$$\begin{aligned} & Min_{\theta,\lambda}\theta, \\ & s.t. \\ & -y_i + Y\lambda \geq 0 \\ & \theta x_i - X\lambda \succ 0 \\ & N1'\lambda = 1 \\ & \lambda \geq 0 \end{aligned} \tag{2}$$

If θ =1, the processor is on the frontier and technically efficient (also known as Overall technical efficiency, OTE). If θ<1, the processor lies below the frontier and technically inefficient. x_i and y_i denote input and output vectors, X and Y denote the input and output matrices. θ is the scalar and λ is the N1 vector of constants that leads to a VRS frontier. The VRS is also referred to as pure technical efficiency (PTE) and the model is known as BCC model named after the initials of the authors who recommended it [17].

2.2.2 Bivariate tobit

Now, it is eminent that the results from the DEA used as dependent variables cannot have a normal distribution. It has a censored distribution since TE lies between 0 and 100.

Because OLS yields inconsistent estimates in such cases, we adopt a maximum likelihood approach to estimate the parameters of a Tobit regression model.

The bivariate Tobit model with k dependent variables is expressed as:

$$\begin{aligned} & Y_{ik}^* = \beta_k X_{ik}^{'} + \varepsilon_{ik}, \quad i = 1,2,...,N, \quad k = 1,2,...,K \\ & Y_{ik} = Y_{ik}^* \qquad if \;\; Y_{ik}^* > 0 \\ & \quad = 0 \qquad if \;\; Y_{ik}^* \leq 0, \end{aligned} \tag{3}$$

Where;

N is the number of observations, Y_i is the dependent variables, X_i is a vector of independent variables, β is a vector of estimable parameters, and ε_i is a normally and independently distributed error term with zero mean and constant variance σ^2 .

Table 1. Description of variables, measurement and *apriori* expectation

Variables	Description	Unit of measurements	Apriori expectation
Age	Age of processor	Years	**+/-**
HH size	Household size of processor	Numbers of HH size	**+/-**
Marital status	Marital status of processor	Dummy; 1 if married and 0 if otherwise	**+/-**
Education	Educational level of processor	Years	**+/-**
Experience	Level of experience of processor in Shea industry	Years	**+**
Credit accessibility	Credit accessibility by processor	Dummy; 1 if yes and 0 if no.	**+**
Belonging to a group	Processor belonging to a processors' group	Dummy; 1 if yes and 0 if no	**+**
Shea nut price	Price of Shea nut	GH¢	**-**
NGOs support	Support or training from NGOs	Dummy; 1 if yes and 0 if no	**+**
Transportation cost	Cost of transporting Shea butter to point of sale.	GH¢	**-**

[*]Variables used in the Bivariate Tobit model

It is assumed that there is an implicit, stochastic index (latent variable) equal to Y_i^* which is observed only when positive and exist between zero and one. The bivariate Tobit model was used to estimate the sources or determinants of the technical and pure technical efficiencies from the output of DEA. This is bivariate because, the dependent variables (i.e., overall technical efficiency and pure technical efficiency) are two and thus, used against independent variables that are prospective determinants of these efficiencies.

2.3 Description of Variables, Measurements and a Priori Expectation

The study had expectations at the end concerning the various variables which were used as independent variables against the dependent variable which is the *apriori* expectation. The *apriori* expectation is the sign (-/+) that the study expected as an indication of the impact of the independent variables on the dependent variable which the bivariate Tobit model would estimate.

3. RESULTS AND DISCUSSION

3.1 Descriptive Statistics of Socioeconomic Variables

Descriptive statistics for all the independent variables in the model are presented in Table 2. Processors had an average age of 40 years with the highest age of 65 years and minimum age of 22 years. Considering the average age, the young and strong people in the district are greatly involved in Shea processing. Averagely, 7 people live in a household and the maximum and minimum household size is 15 and 2 respectively. Respondents have a maximum experience of up to 30 years in Shea nut processing and an average of 6 years. The level of education is low among the Shea nut processors, considering the mean estimate of 2.6 (lower primary education), although there were some processors with tertiary education. About 80% of the processors were married. 70.7% of them had access to credit to help in their work through Village Savings and Loans Associations (VSLAs) and other sources. On the average, every processor incurred a transportation cost of GH¢8.28 and only 29% of the processors had support from various NGOs i.e., in kind or cash.

3.2 Efficiency Levels

The overall technical efficiency score stretched from 0.2 - 1.00 with an average level of 0.50. The closer the score is to one (1.0), the more efficient the processor becomes. A representation of overall technical efficiency of Shea nut processors in Kassena-Nankana West District is reported in Table 3, which revealed that only 0.71% of the processors in the study area were technically efficient (1.0). About (96.43%) of the processors were technically inefficient (between 0.2 – 0.8), Thus, these processors were not producing on the CRS frontier. 2.86% of the processors scored between 0.8 and 0.99, thus closer to being efficient in their work. The mean technical efficiency that the study identified was 0.50 or 50%. This implies that averagely a processor in the district is producing 50% of the potential output, given the level of technology and input use and revealing that, there is more room for improvement for the processors. This is similar to Owombo et al. [20], who reveals that the average technical efficiency of Shea butter producers in Oyo state was 67.6%.

There are usually processors who are efficient but not on the CRS frontier, that is, they are experiencing variable returns-to-scale as reported by Banker et al. [17]. These processors

Table 2. Descriptive statistics of socioeconomic variables

Variables	Minimum	Maximum	Mean
Age	22	65	39.785
Household size	2	15	7.291
Experience	1	30	6.200
Years of education	0	18	2.638
Marital Status	0	1	0.779
Access to credit	0	1	0.707
Transportation cost	0	35	8.275
NGO support	0	1	0.293

Field Survey Data, 2018

Table 3. Distribution of Technical (TE), Purely Technical (PTE) and Scale efficiency (SE) Efficiencies in Deciles Range

Efficiency range	*OTE*		*PTE*		*SE*	
	Freq.	%	Freq.	%	Freq.	%
0.2 – 0.39	18	12.861	11	7.860	1	0.711
0.4 – 0.59	99	70.715	85	60.710	3	2.145
0.6 – 0.79	18	12.862	35	25.005	12	8.571
0.8 – 0.99	4	2.861	4	2.864	92	65.723
1.00	1	0.711	5	3.571	32	22.860
Efficiency measures						
Mean score	0.500		0.554		0.915	
Minimum	0.209		0.276		0.384	
Maximum	1		1		1	
Returns-to-scale (%)						
Increasing RTS	34.26					
Constant RTS	2.14					
Decreasing RTS	63.60					

**Distribution of efficiency score and returns to scale levels. OTE[1], PTE[2] and SE[3] denote Overall technical efficiency[1], Pure technical efficiency[2] and scale efficiency[3], respectively.*

are said to be experiencing pure technical efficiency. The pure technical efficiency scores also reached from 0.2 - 1.0 with an average level of 0.55. A representation of the pure technical efficiency level of the processors in the district is reported in Table 3, where only 3.57% of the processors are pure technically efficient (1.0). Close to 93.6% of the processors were pure technically inefficient and ranged (between 0.2 and 0.8). This means 93.6% of the processors are not even producing on the VRS frontier. 2.86% of them worked closer to the frontier, thus between 0.8 and 0.99. The mean level of 0.55 or 55% shows that averagely a processor in the study area is producing 55% of the potential output under VRS, given the level of technology and input use.

A DMU is said to be SE if its size of operations is optimal so that any changes in its size will make the unit less efficient. The value for scale efficiency is obtained by dividing the OTE in this case by the PTE as reported by Coelli [21]. The SE score ranged from 0.2 to 1.0. Here, about 23% were efficient and close to 66% worked closer to the efficiency score, as reported in Table 3. Only 11.42% were inefficient and worked between 0.2 and 0.8. The average score was 0.92 or 92% which shows that averagely, a processor in the district is seemingly scaled efficiently.

Concerning returns to scale, 34.3% of the processors were producing under decreasing returns to scale (DRS) which means, output increasing by less than a proportionate increase in input. 2.14% were operating under constant return-to-scale (CRS), suggesting that output increases proportionately with the increase in input. Finally, 63.5% operated under increasing return-to-scale (IRS), implying output increases by more than a proportionate increase in input.

3.3 Determinants of Efficiencies of Shea Nut Processors

The variables that were taken into consideration during the estimation using Bivariate Tobit included Age, Household (HH) size, Marital status, Transportation cost, Years of education, Years of experience, Access to credit, Membership of processors' group, the Price of Shea nut and Support from Non-governmental Organization (NGOs). Among these variables considered, the statistically significant ones for the OTE were age, household size, experience, credit accessibility and membership of processors' group as indicated in Table 4 and the statistically significant ones for the PTE were age, transportation cost, household size and shea nut price.

3.4 Determinants of Overall Technical Efficiency

From the study, age is positively related to OTE suggesting that older processors are more technically efficient than younger processors. This shows that when the age of a processor increases by a year, he or she becomes 20% more technically efficient, holding all other things constant. Older processors would usually have more time and concentration in the processing that the younger ones and not abstracted by their

Table 4. Determinants of technical efficiency

	OTE		PTE	
Variables	**Coef.**	**Stand. Error**	**Coef.**	**Stand. Error**
Transportation cost	-0.141	0.216	-0.525	0.254**
Age	0.204	0.109*	0.332	0.128***
HH size	1.657	0.401***	1.481	0.469***
Marital status	1.735	2.516	-0.229	2.965
Education	0.083	0.244	0.155	0.287
Experience	-0.478	0.206**	-0.381	0.159
Credit accessibility	4.418	2.251*	0.039	2.650
Membership of a group	-7.051	2.439***	-3.41	2.885
Shea nut price	0.063	0.132	0.328	0.158**
NGOs support	0.890	2.507	1.532	2.959
Diagnostic statistics				
Log likelihood	-1036.5291			
Sample size	140			
Wald chi (20)	72.53			
Prob> chi2	0.0000			

****, ** and * are 1%, 5% and 10% significance level respectively, Summarized from computer output (STATA). Field Survey Data, 2018*

mobile phones or other forms. The positive coefficient of age in this research coincides with the work of [22] but contrary to [20], where he found out that, age is statistically insignificant to efficiency and thus, does not affect the efficiency level of Shea nut processors in Oyo state, Nigeria.

Household size is significant and positively related to technical efficiency implies that, the larger the size of the processor's household, the more technically efficient he or she becomes, all other things being equal. Thus, as more people are present in the household, the processors get more helping hands that would facilitate the production to increase technical efficiency. This output confirms a similar study by Tanko [11] that presented a positive correlation between household size and profit efficiency of Shea butter processors.

Years of experience (experience) has a negative relationship with technical efficiency. This infers that, the longer the processor has been in the processing business the lesser his or her technical efficiency, all other things being equal. This could result from the more experienced using archaic methods that would not contribute to OTE. This result confirms a similar study by [11], where experience negatively affects profit efficiency. This also contradicts the study by Owombo [20] that showed experience is statistically insignificant to the efficiency of Shea butter producers.

Access to credit by the processors is positively related to OTE. This suggests that processors who have access to credit are more technically efficient than those who have no access to credit, *ceteris paribus*. Processors who get credit – in cash or in kind – are usually able to improve their efficiency by investing more in the business than those without access to credit.

Membership of a processor group is negatively related to technical efficiency. This implies that processors who belong to processor groups are less efficient than those who do not belong to processor groups. Processors who belong to groups usually would receive assistance in the form of credit or capacity building easily but the decrease in efficiency could be as a result of the misappropriation of assistance obtained from the group and the processors not willing to adopt the knowledge.

3.5 Determinants of Pure Technical Efficiency

Transportation cost is significant and has a negative relationship with PTE. This implies that, as the cost incurred in transporting the processed Shea nut to the market center increases, the processor's PTE decreases, ceteris paribus. This is because more resources that can be used in processing to improve the PTE is diverted to the cost of production. Unlike PTE, Cost of transportation was not a significant factor in determining OTE. The results from this study contradict a similar finding by Tanko [11], which shows a positive correlation between the cost of transportation and profit efficiency of Shea nut processors in the northern region of Ghana.

Similar to its effect on OTE, age is positively related to PTE which implies, older processors are more technically efficient (pure) than the younger processors. This shows that, when the age of a processor increases by a year, he or she becomes about 33% more pure technically efficient, holding all other things constant. Older processors may usually have more time and concentration in the processing that the younger ones. The positive coefficient of age in the research coincides with the work of Abdulai and Huffman [22]. This is also contrary to [20], where he found out that, age is statistically insignificant to efficiency.

Similarly, household size is significant and positively correlated with PTE. It shows here that, the larger the size of the processor's household, the more efficient he or she becomes, all else unchanged. This shows, as more people are present in the household, the processors get more helping hands that would facilitate the production to increase PTE. These results confirm a similar study by Tanko [11] that showed a positive relationship between household size and profit efficiency of Shea butter processors in the Northern region of Ghana efficiency.

Finally, Shea nut price is significant and has a positive relationship with PTE. This means as the price of Shea nut purchased for processing by the household increases, the processors' PTE increases, *ceteris paribus*. This is contrary to the findings of [20], who found that there was a reverse relationship between efficiency of Shea nut processors and the price of the Shea nut purchased in Oyo state, Nigeria.

Education, marital status and NGOs support were not significant in both OTE and PTE and thus showed no influence on the efficiencies. Afolayan et al. [23] contradict these findings by indicating that the level of education is a significant determinant of output level in Ekiti state, Nigeria. Similarly, a study conducted by Owombo [20] showed a positive and significant relationship between educated Shea nut processors and technical efficiencies.

3.6 Strengths, Weaknesses, Opportunities and Threats (SWOT) Analysis

Following series of focus group discussions on the field, a SWOT analysis was carried out to know basically the strength, weakness,

Table 5. SWOT analysis

Strengths	Weaknesses
• Presence of grinding mills for shea processors • A processing center built by catholic church for processors • Existence of numerous groups for women to facilitate capacity building • Presence of Village savings and loans associations (VSLAs) in most communities to help credit access. • Presence of major markets for sale of shea butter	• Increasing levels of shea nuts with poor quality purchased. • Presence of few grinding mills solely for grinding shea nuts in most parts of the district. • Still rigorous and old ways of extracting shea butter which is very hectic. • High cost of other inputs • Loss of output during processing
Opportunities	**Threats**
• Periodic visits by NGOs and other agencies to help in capacity building, etc. • Afrikids (NGO) help in contract processing and gives credit in form of Shea nut. • Presence of Shea trees in most parts of the district. • Good sunlight for drying of nuts	• Unsustainable relationships with external agencies. • Some contractors don't give them good prices • No support from government and other agencies in terms of Roads, grinding mills, etc. • Poor transportation linking processing centers or homes and markets. • Difficulty in getting funds to boost production • Reduction of quality of shea nuts due to climate change

**Various strengths, weaknesses, opportunities and threats identified following the focus group discussions.*

challenges, and potentials of the Shea nut processors in the study area. The details are seen in Table 5.

4. CONCLUSIONS AND RECOMMENDATIONS

The study was to investigate the resource-use efficiency of Shea nut processors in the Kassena Nankana West District of the Upper East region of Ghana, using the Data Envelopment Analysis (DEA) Approach. Firstly, the DEA method was used to estimate the overall technical efficiency, pure technical efficiency and scale efficiency of the Shea nut processors. Secondly, Bivariate Tobit was used in estimating the Determinants of efficiencies among the Shea nut processors for the overall technical efficiency and pure technical efficiency. Finally, a SWOT analysis was done to find out the potentials and challenges of the Shea industry in the district. A total of 140 processors were selected at random after purposively selecting the district which is noted for Shea nut processing.

Taking OTE into consideration, only one (1) processor was producing on the frontier and the average score was 0.50 representing 50%. This suggests that, on average, a processor produced 50% of their potential. The factors that affected this efficiency were age, household size, experience, membership of a processor group and access to credit. These variables were all positively related to OTE except membership of a processor group and years of experience which had negative effects. This shows that, if these variables are properly employed and carefully handled, the processors may attain the 100% mark. Membership of a processor group and experience did not meet our *apriori* expectation may be due to the diversion of resources given to members of the groups and use of archaic methods by the highly experienced and old processors. Regarding PTE, five (5) processors produced on the frontier and the average score was 55%. This implies that on the average, a processor produced about 55% of their potential. Determinants of efficiency include; age, household size, price of Shea nut, and transportation cost. Additionally, 32 processors were scale efficient and 92 of them between 80 to 100% efficient. The average score was 92% implying that almost all the processors were working on their require scale of production. Finally, the study found that, the shea nut processors had a major strength of grinding mills present for the processing and a weakness poor quality of shea nut and high cost of inputs. They are existed numerous shea trees and good sunlight as opportunities that the processors can take advantage of. Their major threat was the reduction in the quality of shea nut due to climate change.

Policy interventions, stakeholders and other agencies should take advantage of the large parcels of land covered by Shea trees by providing processing centers in the area to facilitate the usage of the God-given resource and create employment and source of income to improve the livelihoods of the rural people. Access to credit was a major determinant of efficiency and thus, if the processors are provided with more credit schemes, their production would increase and then increase their efficiency. High transportation cost was a major problem which reduced efficiency. Better roads should be provided as to ease movement of Shea nut and butter to and from homes and markets. This would reduce the cost of transportation and thus improve efficiency. There should be education by government and other agencies through technical and managerial skill development programs in Shea production to expose these Shea processors to the new and innovative ways to make them more efficient and effective.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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