

Management Practices and Quantification of Spent Shea Products in the Tamale Metropolis and Sagnarigu Municipality of Ghana

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The shea industry is central to the economic and social fabric of Northern Ghana, especially among women engaged in shea butter production. Despite its advantages, improper disposal of shea by-products such as shea cake, shells, and sludge poses environmental challenges. This study assessed the quantity and management practices of these by-products within the Tamale Metropolis and Sagnarigu Municipality. A descriptive research design involving 220 respondents from 10 shea butter processing centres was employed, using structured questionnaires to gather data. Quantitative data was also obtained by measuring the spent shea products at the 10 centres. Findings revealed significant differences in by-product quantities across production centres, with the predominant disposal practices including burning and open dumping, leading to environmental risks. However, opportunities for sustainable valorisation, such as composting, biomass fuel production, and soap manufacturing, were identified. This study emphasised the need for improved management practices and valorisation strategies to enhance sustainability in the shea industry.

Keywords: Shea, by-products, valorisation, environmental, management, sustainable practices

Introduction

The shea tree (*Vitellaria paradoxa*) is highly valued in the African Savannah Region for its numerous benefits to the ecosystem and the local economy (Ky-Dembele *et al.*, 2021). Shea butter, derived from the shea tree's nuts, is commonly referred to as "women's gold" as it provides a vital source of income for women to support their basic needs like food, clothing, and education (Ayelazuno & Yaro, 2024). For many generations, African culture has attached great importance to shea trees, which serve as a crucial source of income for rural communities (Ky-Dembele *et al.*, 2021; Yayah, 2020). Nigeria, Ghana, Benin, Côte d'Ivoire, Burkina Faso, Togo and Mali are the only seven West African countries that account for 99% of the global shea market. Ghana's shea nut output has fluctuated significantly over time, according to recent statistics, based on market demand, meteorological circumstances, and data reporting systems. The Ghana Commodity Exchange (Agricultural Commodities Review, 2023) estimated that the nation produced 34,064 metric tons of shea nuts in 2021, whereas Ecofin Agency (2023) stated that between 2018 and 2022, the average annual production was roughly 33,760 tonnes. Based on both harvested and unharvested yields in the northern regions where shea trees predominate, Ghana's potential production capacity, according to recent government and industry projections, is between 130,000 and 150,000 metric tonnes per year (Ghana Guardian, 2025).

In the northern region of Ghana, the shea tree (*Vitellaria paradoxa*) is still abundantly distributed in the Guinea and Sudan savanna zones. Its density has, however, declined in some locations because of

climate variability, agricultural development, and land degradation (Jepsen, 2024; Attikora *et al.*, 2024; Hale *et al.*, 2021).

The manufacturing of shea butter generates significant by-products that are sometimes disregarded. Shea cake, the residue after shea butter extraction, comprises residual lipids and proteins, while shea shells and wastewater are also produced as by-products at various stages of processing (Adepoju *et al.*, 2020). Continual disposal of waste brown water and waste black sludge at a specific location during the shea butter processing can modify soil structure and characteristics, limit plant germination and growth, and cause environmental damage (Ahmad *et al.*, 2022). If these waste products are disposed of in water bodies, it pollutes the water as well.

The vibrant nature of the shea industry in northern Ghana and Tamale metropolis, requires scientific-based information on the management of shea by-products to inform policy decision and innovations on the management and valorisation of these products to improve the shea value chain, empower women in the shea business and ensure the sustainability of the environment. The current study aimed to assess the quantity and management practices of spent shea products in Tamale metropolis and Sagnarigu Municipal of Ghana. It anticipated that the results of this study can promote effective policy decisions on the management of shea products in Tamale and other environment with similar characteristics.

Materials and Methods

Study area information

The study was conducted in the Tamale Metropolis (Figure 1) and the Sagnarigu Municipality (Figure 2)

in the Northern Region of Ghana. Tamale serves as both the metropolitan centre of the Tamale Metropolis and the capital city of Northern Region. Based on the 2021 census data the Metropolis has a total population of 374,744 (males are 185,051 and females are 189,693) and a growth rate of 3.5%, being the third largest city in Ghana. The Metropolitan Waste Management Department (MWMD) and Zoomlion Ghana Limited (ZGL) offer waste management services in Tamale. According to the Ministry of Food and Agriculture (2022), approximately 72.5% of

urban houses in Tamale report having their solid trash collected (by some service) as opposed to using only communal dumping or no service.

The Sagnarigu Municipal was carved from the Tamale Metropolis in 2012. The Municipality is situated between latitudes 9°16' and 9°34' North and longitudes 0° 36' and 0° 57' West. The Municipality has a land area of about 200.41 km² and a total population of 341,712 people, with 170198 males and 171513 females (Ghana Statistical Service, 2020).

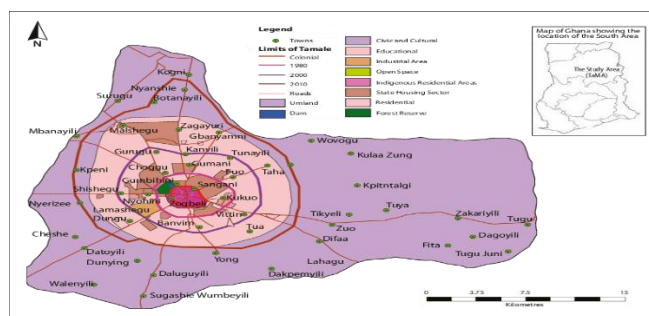


Figure 1: Map of Tamale Metropolis
Source: Mensah (2014)

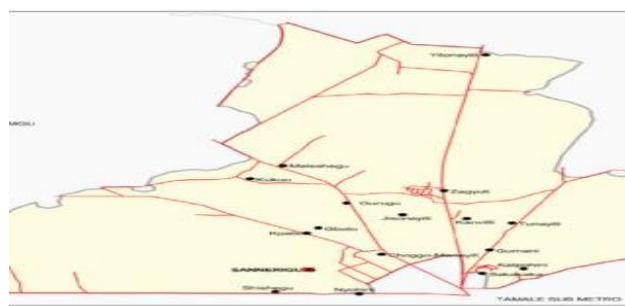


Figure 2: Map of Sagnarigu Municipality
Ghana Statistical Service (GSS) (2021)

Data collection

A survey was used for gathering of data and the assessment of the management practices of shea-by products. By using structured questionnaires, a comprehensive data on current practices, challenges, and opportunities for improvement, was provided thereby informing strategies for the effective valorisation of shea by-products. To determine the quantity of by-products produced in the shea production Centres, the researcher purchased 10 bags of shea nut and each of the Centres were given 1 bag each weighing 102.31Kg for each of the Centres to produce shea butter. The by-products produced from these bags were measured from the various Centres. Ohaus Defender 5000 Series Digital Scale with a capacity of 6 kg to 150 kg range and a sensitivity 0.01kg was used to measure the shell and sludge weights at the various Centres. The measurement of the weight of both the shells and the sludge for each bag was done following the established methods and techniques used in determining the weight of heavy

objects or load described by Ghulam (2023). The Ghulam method is used to determine the weight of heavy objects. Each bag (shells and sludge) was weighed using a calibrated platform scale, with measurements repeated three times for accuracy. The net weight was calculated by deducting the tare (empty bag) weight from the filled bag weight. Accuracy was ensured by pre- and post-sampling calibration with certified test weights.

Population, sample size and sampling technique

The population of this study was four hundred and ninety-one (491) women from ten (10) shea butter processing centres selected out of 14 identified centres in the two study areas using purposive sampling technique. Purposive sampling was used to help exclude the four Centres because they did not meet the predefined criteria for the study (lacked the necessary equipment and resources to participate effectively) (Mugenda & Mugenda, 2003). Detail of the population is shown in Table 1.

Table 1: Selected Processing Centres, Location and Population

S/N	Processing Centre	Location	Population
1.	Tiyumtaba Shea Cooperative	Sorugu	60
2	Maltiti Shea Butter Processing	Malshegu	35
3	Tunteiya Shea Butter Processing	Jisonayili	40
4	Kpangmanga Shea Butter Precessing	Malshegu	48
5	Bori Bi Jeri Suli Co-Operative	Nwodua	45
6	Sagnarigu(Africa 2000 Network)	Sagnarigu	45
7	Tiehisuma Shea Butter Processing	Gurugu	80
8	Kasalgu (Sekaf Ghana Limited)	Kasalgu	42
9	Kafiayili Shea Butter Processing Centre	Kafiayili	60
10	Kasalgu (Sekaf Ghana Limited)	Nambgawu	36
Total			491

Simple random selection was used to obtain respondents for the study from the 10 identified Centres. This was achieved through a ‘yes’ or ‘no’ exercise on the population regarding their participation in the survey. This sampling technique was used because it afforded all the members under consideration the equal chance of being selected (Creswell & Plano, 2018). A sample size of 220 respondents were arrived at using the Yamane (1967) formula.

$$n = \frac{N}{(1+N(\alpha)^2)}$$

Where; n = is the required sample size; N = the population size; α = margin error (which in this study was pegged at 5%). The sample size was thus calculated as follows:

$$n = \frac{491}{1 + 491(0.05)^2}$$

$$n = \frac{491}{1 + 491(0.0025)}$$

$$n = \frac{491}{1 + 1.2275}$$

$$n = \frac{491}{2.2275}$$

$$n = 220.43 = 220$$

Proportional allocation was used in calculating the size that is supposed to be taken from each stratum. The formula that was used in calculating the sample to be taken from each stratum is presented below:

$$nh = \frac{Nh}{N} \times n$$

Where; nh = Sample size of each stratum (each Centre); Nh= Population size of each stratum (Centre); N = Total size of population; n = Total sample size

Table 2: Sample Calculation from each Centre

Processing Centre	Sample Size Determination
Tiyumtaba Shea Cooperative	sample = $\frac{60}{491} \times 220 = 27$
Maltiti Shea Butter Processing	sample = $\frac{35}{491} \times 220 = 16$
Tunteiya Shea Butter Processing	sample = $\frac{40}{491} \times 220 = 18$
Kpangmanga Shea Butter Precessing	sample = $\frac{48}{491} \times 220 = 21$
Bori Bi Jeri Suli Co-Operative	sample = $\frac{45}{491} \times 220 = 20$
Sagnarigu(Africa 2000 Network)	sample = $\frac{45}{491} \times 220 = 20$
Tiehisuma Shea Butter Processing	sample = $\frac{80}{491} \times 220 = 36$
Kasalgu (Sekaf Ghana Limited)	sample = $\frac{42}{491} \times 220 = 19$
Kafiayili Shea Butter Processing Centre	sample = $\frac{60}{491} \times 220 = 27$
Kasalgu (Sekaf Ghana Limited)	sample = $\frac{36}{491} \times 220 = 16$

Data analysis

SPSS 24 software was used to analyse the data in the form of descriptive Statistics (means and percentages) on the management practices of shea butter by-products. Frequencies and percentages were used to summarise categorical data, such as the number of

respondents using specific waste management practices. SPSS was used to do correlation analysis to establish the relation between respondent’s socio-economic factors and management practices.

Results and Discussion

From Table 3, the majority of respondents are female (99.5%), which indicates that women play a leading role in the shea butter production sector. This situation mirrors the traditional responsibilities of women in shea butter production in Northern Ghana, where shea nut processing is commonly viewed as a source of livelihood for women's economic enablement (Ahmed *et al.*, 2020)

Most of the respondents were between 40-49 years of age (54.5%). This indicate that the most active age group in shea nut production is middle-aged women. A smaller proportion of the youth aged between 18-29 years (13.6%) were into share production, this implies

a low involvement of the youth in the industry, probably due to migration or attraction to other employment sectors. A significant percentage, 72.7% of the respondents were married indicating that most women who are married are involved in the shea industry and it may serve as a source income to the family. The results also indicate that 60 of the respondents representing 27.3% have no formal education, highlighting the low literacy rates among women in the shea industry synonymous with women in agriculture-based communities (UNESCO, 2021) Nevertheless, 31.8% have completed SSS/SHS indicating that some participants possess some level of education.

Table 3: Demographic Characteristics of Respondents

Characteristics	Frequency	Percentage (%)
Gender		
Male	1	0.5
Female	219	99.5
Total	220	100
Age Distribution		
18-29 years	30	13.6
30-39 years	60	27.4
40-49 years	120	54.5
50 years and above	10	4.5
Total	220	100
Marital Status		
Married	160	72.7
Single	40	18.2
Divorced	15	6.8
Other	5	2.3
Total	220	100
Level of Education		
No formal education	60	27.3
SSS/SHS	70	31.8
Diploma	40	18.2
Degree	39	17.7
Masters	1	0.5
Other	10	4.5
Total	220	100

Quantity of by-products produced in the shea production centres

From Table 4, the results show variations in quantities of shea by products in the various processing Centres. There were significant variations in spent shell weight across the ten production centres $p = 0.0450$. The Nyohini Shea Cooperative recorded the lowest shell weight of 12.15 kg, followed by Tunteiya Shea Butter Processing with 12.40 kg, while Kukuo Women's Shea Group recorded the highest shell weight of 13.20 kg. Other centres, such as Sagnarigu Community Centre and Kasalgu (Sekaf Ghana Limited), recorded values of 12.80 kg and 12.70 kg, respectively.

The least sludge weight recorded was Nyohini Shea Cooperative, with 66.50 kg, followed closely by Tunteiya Shea Butter Processing, with 66.60 kg, while the highest was Sagnarigu Community Centre, recording 68.30 kg. Other remarkable values are 67.90

kg from Kukuo Women's Shea Group and 67.80 kg from Tiehisuma Shea Butter Processing. The sludge weights across the ten production centres are varied significantly ($p= 0.0345$). These differences can be attributed to the moisture content of the nut, nut weights due to difference in sizes, variations in drying techniques (sun drying, kiln drying, etc.) and drying durations across processing Centres, differences in mechanical processing efficiency (e.g., grinding and crushing) and the quality and quantity of water used in processing and environmental conditions, such as humidity, temperature, and rainfall during nut collection and storage (Teye *et al.*, 2018; Akihisa *et al.*, 2023).

In the present study, the ten centres might have used different methods for crushing, boiling, or pressing, which affected the extraction and separation of shea butter from the nuts. Research has demonstrated that

elements like pressure applied, temperature used, and processing duration have a considerable effect on the by-products produced during shea processing. For example, higher temperatures or extended boiling times can increase the weight of sludge but decrease the weight of intact shells remaining (Saba *et al.*, 2022). The various production centres in this current study might also differ in expertise levels and access to advanced machinery, resulting in using different processing techniques such as mechanical processing technology, chemical extraction methods, or the traditional water extraction approach.

Centres with more skilled operators or superior equipment can better optimize the extraction process, reducing waste and effectively managing by-product generation (Saba *et al.*, 2022). The result in the variation in the by-product (sludge) can also be attributed to the amount of water added during the processing period and the moisture present in the shea butter, potentially leading to hydrolysis, as higher temperatures typically accelerate the rate of hydrolysis reactions.

Table 4: Quantities of By-Products Produced From 1 Bag (102.31kg) of Shea nut Used for Shea butter Production

By-products	Nyohini Shea Cooperative	Kukuo Women's Shea Group	Sagnarigu Com. Centre	Tiyumtaba Shea Cooperative	Maltiti Shea Butter Processing	Tunteiya Shea Butter Processing	Kpangmanga Shea Butter Processing	Bori Bi Jeri Suli Co-Operative	Tiehisuma Shea Butter Processing	Kasalgu (Sekaf Ghana Limited)	p-value
Shell Weight (kg)	12.15 ^c	13.20 ^a	12.80 ^{ab}	12.50 ^b	13.10 ^a	12.40 ^c	12.90 ^{ab}	12.60 ^b	13.00 ^a	12.70 ^b	0.0450
Sludge Weight (kg)	66.50 ^c	67.90 ^{ab}	68.30 ^a	66.80 ^c	67.70 ^b	66.60 ^c	68.00 ^b	67.20 ^b	67.80 ^b	67.50 ^b	0.0345

^{abc}Means in the same row with different superscripts are significantly different ($p < 0.05$). kg = Kilogram

Management practices of shea butter processing by-products

The results presented in Table 5 provide valuable information regarding the management practices for three important by-products of the shea industry: shea shells, shea cake, and shea sludge. Majority (40.9%) of the respondents reported that they dispose of shea shells/cake by dumping them in open spaces, raising concerns about environmental and health issues. This is followed by 36.4% of respondents. Nonetheless, 13.6% of respondents who use shea shells as household fuel indicates a possible pathway for sustainable use, aligning well with the aims of this research. The high percentage of respondents (59.1%), who discard shea cake in open areas points to a lack of utilization. On the other hand, 27.3% of respondents employ it as compost. Majority (63.6%), of respondents, dispose of sludge in open areas, which presents environmental risks.

The common practice of discarding shea shells/cake in open areas (40.9%) and burning them (36.4%) aligns with reports from prior studies, highlighting waste mismanagement in the shea industry. Jasaw *et al.* (2015) emphasised that improper disposal contributes to environmental degradation, such as air pollution and land contamination. However, research also suggests that shea shells can be effectively valorised into sustainable biofuels. A study by Oladimeji *et al.* (2013) found that converting shea shells into briquettes

significantly reduces deforestation by replacing firewood with eco-friendly alternatives for household energy needs. The 13.6% usage of shea shells as fuel in this study highlights a growing awareness of this potential, but further promotion of briquette technology could maximize adoption.

Shea cake disposal in open spaces (59.1%) represents a major underutilization of this by-product. As indicated by Akintayo *et al.* (2021), shea cake contains valuable nutrients, making it suitable for use in organic compost to enhance soil quality, supporting the findings of your study where 27.3% use it for farming. Furthermore, studies show that shea cake can also serve as animal feed due to its high fat and protein content, although this practice remains underexplored with only 4.5% of respondents reporting its use. There is empirical evidence that shea cake can be processed further into biomass fuel, potentially adding economic and environmental value. Promoting such practices aligns with sustainable waste management and the objectives of your research (Idris *et al.*, 2024). The dumping of shea sludge in open areas (63.6%) raises environmental concerns, particularly for groundwater contamination. Research by Dzandu *et al.* (2018) found that improper sludge disposal affects soil health and pollutes water bodies in communities surrounding shea processing areas.

Table 5: Management practices of Shea Butter processing By-Product

Management practices	Frequency (N)	Percentage (%)
Shea shells		
Burning	80	36.4
Discard in open space	90	40.9
Use as household fuel	30	13.6
Other	20	9.1
Shea cake		
Feed for animals	10	4.5
Compost for farming	60	27.3
Discard/Dumped in open areas		
Other	20	9.1
Shea sludge		
Dumped in open areas	140	63.6
Used as fertiliser	40	18.2
Used for soap production	30	13.6
Other	10	4.5

Comparison of shea butter by-product management practices across the various centres

A comparison of the management practices across the 10 centres is presented in Figure 3 in a stacked bar chart. Burning and open dumping are the most practiced in almost all centres, with open dumping particularly high in Sagnarigu (60%) and Tiyumtaba (50%). The use of composting as a management option varies across centres, with generally low percentages across all

centres but slightly higher in Kasalgu and Maltiti, 15% respectively. Shea by-product used as household fuel was at a lower level (3–8%) across most centres.

The findings revealed that burning and open dumping were the most common practices in Sagnarigu. In a related study, Abalo *et al.* (2022) established that open dumping is a dominant practice in rural Northern Ghana due to the fact that waste collection services are very inadequate and designated landfills are lacking. Mensah

et al. (2021) similarly reported that burning is widely practiced in agricultural communities as a quick and low-cost way of managing organic waste, despite its environmental and health hazards. Yumnam *et al.* (2023) reported that composting is less practiced due to a lack of awareness about its benefits, technical skills,

and time constraints. According to Ferronato *et al.* (2022), cultural resistance to using agricultural waste as fuel and labor-intensive processes in the pretreatment of waste for use as fuel-for example, briquetting-reduce the adoption.

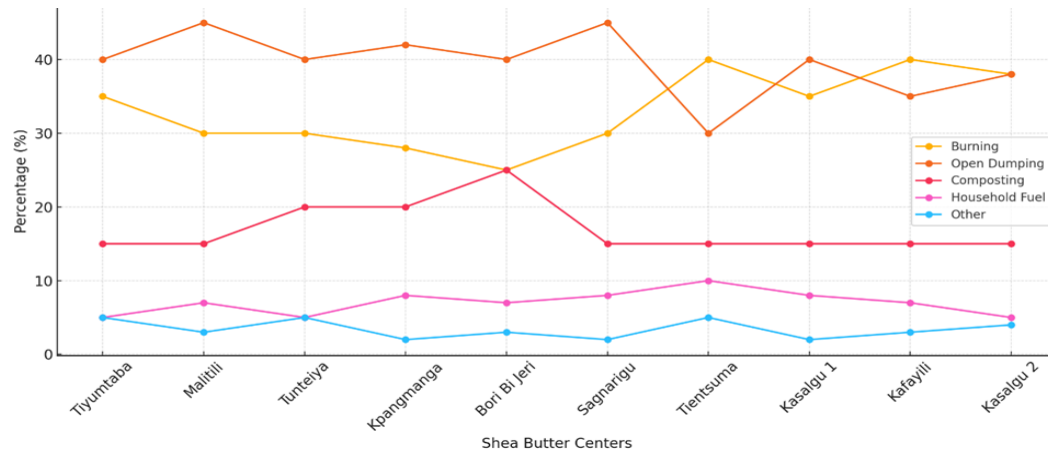


Figure 3: Stacked graph showing Management practices across the various Centres

Relationship between management practices and demographic characteristics of respondents

From Table 6, the results indicate that, significant differences in burning shea shells with respect to gender, $p = 0.04$, and disposing of shells in open areas, at $p = 0.02$. Significant differences were observed in the disposing of shea shells in open areas ($p = 0.04$) and the usage of shea shells as household fuel ($p = 0.02$) (Table 6). Younger respondents may be less involved in shea waste management, either due to lower involvement in the shea industry or migration to urban areas. There are significant differences in the disposing of shea cake in open areas based on marital status has a ($p = 0.01$). Married respondents are bound to give more importance to waste management due to family responsibilities and maintenance of a cleaner household environment. The assertion of the dominance of women in shea butter processing is supported by Harsch (2017), who indicated that women form the greatest labour

contingent for shea-related activities in West Africa. Okorley *et al.* (2004), in a study of shea butter processors in Northern Ghana, asserted that women are more likely to adopt low-cost waste management techniques due to limited access to resources and infrastructure for modern methods. Waste management behaviour was also found to be influenced by age which concurs with the observation by Kpodo *et al.* (2019), who noted that it was generally seen to be the young population moving into urban areas and disengaging from the age-old waste management behaviours. The findings of this present study that there is a positive relationship between the level of education and environmentally friendly practices are also confirmed by Koul *et al.* (2022) on agricultural waste management in Ghana who established that educated respondents had a better understanding of the advantages of composting and recycling.

Table 6: Chi-Square Analysis of Demographics vs. Management Practices

Demographic Characteristic	Management Practices	Chi-Square Value	df	p-Value	Remark
Gender	Burning Shea Shells/cake	4.12	1	0.04	**
	Disposing Shea Shells/cake in Open Areas	5.34	1	0.02	**
	Using Shea Shells/cake as Household Fuel	2.15	1	0.14	*
Age	Burning Shea Shells/cake	6.42	3	0.09	*
	Disposing Shea Shells/cake in Open Areas	7.35	3	0.04	**
	Using Shea Shells/cake as Household Fuel	9.12	3	0.02	**
	Burning Shea Shells/cake	3.23	2	0.20	*
Marital Status	Disposing Shea shell/Cake in Open Areas	8.45	2	0.01	**
	Composting Shea Cake	4.50	2	0.11	*
Education Level	Burning Shea Shells	10.35	4	0.01	**
	Using Shea Shells/cake as Household Fuel	12.14	4	0.00	***
	Composting Shea Cake	15.72	4	0.00	***

*Not significant, **Significant, ***Highly Significant

Logistic regression on shea by-product management practices vs. demographic characteristics

From Table 7, educational level consistently shows the highest positive influence on all management practices, especially composting and using shea products as fuel. Higher education (Master degree) consistently increases the likelihood of engaging in sustainable management practices like composting with a coefficient of 0.28 and p-value of 0.020 and using shea products as fuel ($p = 0.035$, $\beta = 0.22$) (Table 7). A cross tabulation (Table 8) shows master’s degree holders to be with the highest odds of 1.82 for composting and using shea products as fuel respectively.

Older age groups (40-49 and 50+) are more likely to engage in composting and shea cake/shell as fuel ($p = 0.040$ and $\beta = 0.30$) with odds ratio of 1.82 indicating that 82% older individuals are more likely to engage in composting and shea cake/shell as fuel. Comparatively younger age groups (18-29) showed the less likelihood of these practices. Age group 40-49 has a lower likelihood of disposing in open areas (0.61 odds ratios). Gender has no significant influence on any of the management practices.

The strong positive relationship between higher education-master's degree level-and sustainable practices such as composting and the use of shea products for fuel agrees with the findings of Shu-aib (2020) and Okiror (2012). These authors observed that education increases awareness of sustainability and management of resources, thereby providing an individual with the knowledge to adopt practices such as composting and fuel briquette production. Meanwhile, Gnangle *et al.* (2022) reported that "with higher education contributing to an inclination for more modern sustainable methods of shea management, persons less formally educated used indigenous systems. The results on age also aligns with Shu-aib (2020), who argued that older individuals are most likely to adopt environmentally responsible behaviours. Conversely, Gnangle *et al.* (2022) found that younger people within the age bracket of 19-30 years are more likely to engage in shea-related activities when incentivized. The study did not find any significant influence of gender on management practices.

Table 7: Logistic Regression Results for Management Practices vs Demographic Characteristic

Management Practice	Demographic Characteristic	Coefficient (β)	Odds Ratio (e^{β})	P-Value
Burning Shea Shells/Cake	Gender	0.00	1.00	0.050
	Age	0.14	1.15	0.030
	Marital Status	0.05	1.05	0.080
	Education Level	0.22	1.25	0.035
Disposing in Open Areas	Gender	-0.10	0.90	0.150
	Age	-0.13	0.88	0.050
	Marital Status	0.08	1.08	0.070
	Education Level	0.10	1.11	0.050
Composting Shea Cake/Shells	Gender	0.00	1.00	0.080
	Age	0.30	1.35	0.040
	Marital Status	0.05	1.05	0.060
	Education Level	0.28	1.32	0.020
Using as Household Fuel	Gender	0.00	1.00	0.070
	Age	0.15	1.16	0.045
	Marital Status	0.20	1.22	0.030
	Education Level	0.28	1.32	

Table 8: Cross-Tabulation of Management Practices vs. Demographic Characteristics

Demographic Characteristic	Burning Shea Shells/Cake	Disposing in Open Areas	Composting Shea Cake/Shells	Using Shea as Household Fuel
Gender	1.00	1.00	1.00	1.00
Age				
18-29	0.70	0.82	0.90	0.74
30-39	1.11	1.16	1.22	1.49
40-49	1.35	0.61	1.65	1.16
50+	1.65	1.05	1.82	1.42
Marital Status				
Married	1.28	0.90	1.35	1.22
Single	0.86	1.42	0.90	1.65
Divorced	0.67	1.22	1.22	0.86
Other	1.11	0.86	0.78	1.35
Education Level				
No Formal Education	0.74	1.22	0.82	1.22
SSS/SHS	1.49	0.67	1.49	1.42
Diploma	1.16	0.86	1.16	1.11
Degree	1.28	1.35	1.28	1.49
Masters	1.82	1.65	1.82	1.73

Conclusion

There were variations in the quantities of shea shells and sludge produced by the ten processing facilities that depended on factors like nut moisture content, drying procedures, and processing efficiency. Shea by-products (shells and sludge) were burned and dumped in the open by most processors which could lead to air pollution, and soil contamination. Waste management practices were highly impacted by demographic characteristics. The study identifies opportunities for composting, home fuel (briquettes), and soap production from shea by-products despite the limited use of this by the shea butter processors. These could enhance the shea value chain and generate extra income for women. The environmental health department should increase

awareness and training on sustainable management practices of shea by-products to reduce environmental risks and also unlock the economic potential of shea by-products.

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