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The role of financial and marketing services on rural shea-producing women

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Abstract
Purpose: This study aims to empirically investigate the impact of financial and marketing services on shea butter production, with an emphasis on the Tolon district of Ghana, to inform evidence-based policies and practices.
Research methodology: This study employed a quantitative research design, utilizing a survey approach to collect data from a sample of shea butter producers in the Tolon District of Ghana. In total, 151 Shea nut processors from Tolon, Dimabi 1, and Dimabi 2 were selected using a combination of purposive and simple random sampling techniques. Data were collected through structured questionnaires, which were subsequently analyzed using quantitative methods. Furthermore, the study employed linear regression analysis with an endogenous treatment effect model in STATA version 17 to examine the relationship between financial and marketing services, and shea butter production.
Results: The empirical evidence derived from the linear regression with the endogenous treatment model indicates a statistically significant and positive relationship between financial and marketing services and shea butter production, indicating that financial and marketing services are significant factors in predicting the productivity of shea butter production.
Limitations: The sample size of the study was small, which may restrict the generalizability of the findings.
Contribution: This study provides novel insights into the dynamics of shea butter production in Ghana's Tolon District by highlighting the quantitative effect of financial and marketing services on shea butter production, and the importance of improving access to these services. This study also provides evidence-based recommendations for collaborative synergies between government and non-governmental organizations to establish microfinance programs and marketing service centers to facilitate easier access to these essential services for shea butter producers.
Keywords: *Shea Butter Production, Financial services, Marketing services, Linear Regression with Endogeneous Treatment Effect, Tolon district*
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1. Introduction

Shea butter is an edible fat extracted from the nuts of African shea trees. The shea tree, also known as (Vitellaria Nilotica or Butryospermum paradoxa) grows in West and Central Africa, notably in wild and savannah wood parks, and is found in 21 African countries (Boffa, 2015; Ky-Dembele, Bayala, Boffa, Kalinganire, & Minang, 2021; Naughton, Lovett, & Mihelcic, 2015). It has been recognized that most of the shea trees in Ghana are found in the savannah belt, particularly in the Upper West, Upper East,

and Northern regions, with limited shea growth in the southern part of the country (Aniah, Dumayiri, & Banleman, 2014; Jasaw, Saito, & Takeuchi, 2015; Quainoo, 2019).

The processing of shea nuts has significant potential for poverty reduction, socioeconomic development, and women's livelihoods. In northern Ghana, shea butter production provides a vital source of income and employment for over a million rural women (Naangmenyele, Banye, Bekoe, Zakaria, & Amuah, 2023). Previous estimates indicate that over 3,000 poor households depend on the shea industry for their livelihoods (Kavaarpuo 2010). In addition to the benefits of shea processing, women are the backbone of the shea industry and are actively involved in every process, from shea nut collections to processing and sales of the final product (Adams, 2015; Marlene Elias & Arora-Jonsson, 2017).

Shea-butter processing among rural women is a labor-intensive activity that provides employment and contributes to household income. The Netherlands Development Organization (SNV) (2006) reported that over 600,000 women in northern Ghana rely on earnings from selling shea butter and shea-related products for daily sustenance. This income contributes to household expenses, such as food, education, and medical needs. Furthermore, research has established that earnings from shea butter sales during lean periods account for approximately 12% of the income of poorer households (Pouliot, 2012). Notably, shea butter has been aptly referred to as "women's gold" (Marlène Elias & Saussey, 2013; Mensa & Turvey, 2023; Pouliot, 2012), highlighting its critical role in empowering women economically. Consequently, it is reasonable to expect that shea butter production will far exceed the currently understood levels given its significance as a vital economic resource.

According to the Global Shea Market report, the Shea butter market is projected to expand by $1.32 billion 2021 2025. However, shea butter production in Ghana presents untapped resources that could further expand the market and drive global economic growth. Evidence suggests that Ghana has the potential to increase butter production and drive global economic growth by producing up to 90% of the global supply of shea nuts (USAID, 2004). Despite this potential, the shea butter industry in Ghana faces critical challenges, including inadequate marketing services and financial constraints (Kent, Bakaweri, & Poole, 2014; Kombiok & Agbenyega, 2017; Osewa, Alamu, Inegbedion, Abegunrin, & Jolaiya, 2020; Pufaa, 2010; Sikpaam, Mintah, & Fearon, 2019). This affects value chain actors of the industry, including small and medium-sized enterprises (SMEs) and individual shea butter producers.

The lack of capital and insufficient marketing services affect industry growth, profitability of shea butter marketing, and producers' ability to invest in modern processing equipment. Research indicates that improvements in shea nut collection and storage methods are essential for delivering high-quality shea butter to the international markets. This is contingent on the access to financial and marketing services. Hence, this study aims to investigate the potential effect of financial and marketing services on shea butter production in the Tolon District of Northern Ghana.

1.2 Research Objective

This study investigates the effects of financial and marketing services on shea-butter production.

The primary research question guiding this study is as follows:
What are the effects of financial and marketing services on shea butter production in the Tolon District of Northern Ghana?

2. Literature review

2.1 Uses and Importance of Shea Butter

The versatility of Shea butter is well documented, with a plethora of applications numbering up to twenty-one (21), as noted by the American Shea Butter Institute. This commodity has been used since ancient Egypt, where it was valued for its cosmetic properties (Goreja, 2004). Locally, shea butter has been used by healers to treat a variety of ailments, such as rheumatism, inflammation, nasal congestion, leprosy, cough, and minor bone dislocations (Nahm et al., 2013). Further research by Lovett and Mihelcic (2015) indicated that shea butter is a popular ingredient in soapmaking, waterproofing

buildings, and lamp fuel. Robinson (2020) remarked that shea butter can be used to treat digestive problems like bloating and indigestion. Nwankwo and Daodu (2021) added that shea butter is used as a hair styling cream, sun and weather protection, and to treat rheumatic and joint pain relief, and healing wounds, bruising, swelling, and cuts. Nwankwo further asserts that shea butter is also used as a popular choice for massaging pregnant women and children. Shea butter also holds promise as a pre-warm bath treatment for newborns because it promotes smooth and supple skin (Nanpuan, 2021). The work of Alain et al. (2022) indicated that shea butter is an affordable edible oil that adds a unique identity to dishes in West African cuisine.

Shea butter has also been recognized as a substitute for cocoa butter in the chocolate business, although its taste is different (Abdullahi & Baba, 2020), and it is less expensive than cocoa butter (Bello-Bravo, Lovett, & Pittendrigh, 2015). This suggests that shea butter can reduce the cost of chocolate. In addition to being a substitute for the chocolate industry, it also serves other economic purposes. From an economic perspective, processing shea nuts into butter is a significant source of income for rural women (Hammond et al., 2019). The shea butter business provides jobs and employment to thousands of people. An estimated 500,000 people are employed in Ghana's shea industry as a source of livelihood (Al-Hassan 2015). Most people who work in the shea industry are from the poorest households and, therefore, depend on the shea industry as a significant part of their income and household food security (Pouliot, 2012). Hence, by actively participating in the industry, women gain economic empowerment, enabling them to make significant decisions and invest in their own lives, families, and communities (Pufaa, 2010).

2.2 Shea Butter Extraction; Technologies

Earlier studies have found that shea butter is processed in West Africa by traditional, semi-mechanized, and fully mechanized industrial systems (USAID, 2004). Subsequently, as revealed by Didia et al. (2018), shea butter can be extracted using enzymatic and chemical methods.

2.2.1 Traditional Extraction Method

Previous studies have shown that the traditional method of extracting butter from the African Shea tree follows a well-established process, with documented steps including de-pulping and de-marking the fruit, cooking, sun drying, peeling, cracking, grinding sun-dried nuts into grits, roasting, grinding again into a paste, mixing with water, kneading, boiling the emulsion, skimming the fat, and finally cooling. Despite well-established processes, the prevalence of this method has been within the scope of some prior studies. For instance, USAID (2004) found that rural women in the region use traditional manual methods to extract approximately 60% of all raw butter produced, with an extraction rate of approximately 20%. The author argues that the prevalence of this method is due to the lack of funds for simple tools that could facilitate and scale up production. However, Sikpaam et al. (2019) indicated that the semi-mechanized method dominates shea processing among the producers. These findings present mixed views in the current body of knowledge regarding the most dominant method of extracting shea butter. Although semi-mechanized methods and traditional methods have been indicated as common methods of shea butter production in research, to the best of the researcher's knowledge, no evidence suggests that a fully mechanized method of producing shea butter is the prevalent method of shea nut processing.

Traditional methods can sometimes result in inferior and unsanitary products, leading to low prices for shea butter. Through the provision of financial and marketing services, traditional processing techniques can be improved, hygiene prioritized, and competitive prices obtained for the butter.

2.2.2 Semi-Mechanized Method

Issahaku, Al-Hassan, and Sarpong (2011) noted that there have been efforts to introduce new technologies in the production of shea butter. The semi-mechanical extraction process closely follows the traditional method, but with the use of modern techniques, such as drying machinery, roasters, crushers, and hydraulic presses, replacing the manual sun drying, crushing, roasting, and kneading

processes (Adams, 2015). Research has highlighted that this technological upgrade has led to an increase in extraction yield from 20 per cent to 35-40 per cent (USAID, 2004).

2.2.3 Fully Mechanized Extraction Method

According to USAID (2004), West Africa's mechanized processing system can provide up to 40% extraction of shea butter from raw nuts. Compared with semi-mechanical and traditional systems, the efficiency of fully mechanized systems allows for higher extraction levels. Addaquay espoused that most West African plants produce less than a quarter of their installed capacity, and they only operate for six months out of the year to compensate for the high cost of storing the nuts. There are five shea butter processing facilities in Ghana with a capacity of 100,000 tons. The utilization of these five facilities was approximately 19 per cent. Juaben Oil Mills lead to a utilization rate of over 50%. The country can produce approximately 200,000 tons of shea butter annually.

2.3 Sources of financial support services for shea butter production

Numerous studies have explored the various sources of financial support available to shea butter producers. For example, Kombiok and Agbenyega (2017) found that NGOs and financial organizations (FOs) provided technical support services, whereas others relied on contract financing. However, the authors argue that contract financing may not be the best option because it limits expansion and excludes women from negotiations, leading to lower prices for the shea butter produced. Similarly, Pufaa (2010)identified two major funding sources for producers: formal and informal sources in a case study research. However, accessing funds from these sources can be challenging because of high interest rates, collateral requirements, cumbersome documentation, physical distance, repayment terms, level of education, size of operation, experience, risk management attitude, perception of lending procedures, and other factors. As a result, many shea butter producers are discouraged from exploring formal means of financing (Ali, Agbo, Ukwuaba, & Chiemela, 2017; Hananu, Abdul-Hanan, & Zakaria, 2015). In addition, Aryeetey (2005) notes that informal sources of credit are unattractive due to short maturity periods and high interest rates for clients seeking working capital or investment loans.

2.4 Role of financial services in shea butter production

Access to finance is crucial for small businesses, including those involved in shea butter production, to thrive. Research has shown that the amount of shea butter produced is directly related to the availability of financial resources from NGOs and FOs, contract funding, and technical support for shea butter processors. According to Tweneboah Kodua, Ankamah, and Addae (2018), access to credit positively impacts the profitability of shea butter manufacturing. This means that women who have access to credit can invest in their businesses, resulting in a higher quality and quantity of shea butter. Women with access to microfinance can sell their shea butter on better terms, leading to increased income (Kodua et al. (2018) and business growth (A. F. Anoke, 2023).

Mawa (2008) and Zeller and Sharma (1998) found that providing financial services is a potent weapon against poverty. Zeller and Sharma stressed the importance of using public funds to provide these critical services to the poorest individuals. The authors noted that without financial assistance, impoverished smallholders would struggle to afford the necessary services and miss out on viable economic opportunities to increase their production. Contrary to Zeller and Sharma's findings, the findings of David (2019) research suggest that microfinance may not significantly reduce poverty.

2.5 Role of marketing services in shea butter production

Marketing services play a crucial role in the success of shea-butter production. For example, Tweneboah Kodua et al. (2018) affirmed that access to market information, finance, production cycle length, savings, experience, and household size influence the gross margin of shea butter marketing. Kent et al. (2014) emphasized the importance of connecting butter processors with markets and financial sources to foster growth in the shea value chain. In line with Kent al. (2014), F. Anoke, Ngozi, Uchechukwu, and Joyce (2022) highlight that the growth and sustainability of SMEs including shea butter producers hinges on need-oriented marketing and technology-driven marketing. Al-hassan

(2012) noted that the level of education and business skills of entrepreneurs are significant determinants of success in the shea butter market.

Despite efforts to boost the market for shea butter, researchers have identified the lack of standardized metrics (size, color, and weight) and market prospects as major challenges for shea butter processors. Garba, Sanni, and Adebayo (2015) also highlighted significant challenges faced by shea butter marketers, including issues related to standard measurements, limited access to finance, suboptimal storage and transportation facilities, and market price volatility. Conversely, Issahaku et al. (2011) suggested that training in entrepreneurial skills is essential for producers to optimize their resource utilization. They also noted that challenges in quantifying family labor and other quasi-fixed inputs hinder the profit function method.

Institutional arrangements, such as pay-on-delivery and marketing expertise, have been shown to increase the acceptance of shea butter producers in high-income markets (Adekambi, Ingenbleek, & Van Trijp, 2018). Addressing logistical challenges and implementing effective marketing strategies can greatly enhance the marketability of shea butter products among customers in affluent areas, thereby expanding business prospects and profitability for producers. Tijani (2018) emphasized that access to market information, production level, and distance to the market are key factors influencing shea butter processors' participation in the Nigerian market. For Ghanaian producers, Kodua et al. (2018) noted that shea butter production is a lucrative enterprise, with profitability hinging on critical elements, such as access to market information, credit opportunities, and savings.

Based on previous findings, it is evident that financial and marketing services influence shea butter production and profitability. However, the quantitative effects of financial and marketing services on shea butter production have not yet been studied. In addition, there is little research on the unique effects of financial and marketing services on shea butter production in Ghana's Tolon District. This geographical context introduces specific factors and conditions that may affect the role and effectiveness of these services differently than in larger regional or international studies. Therefore, this project aims to fill this research gap by focusing on the local context of the Tolon area and providing a more detailed understanding of how financial and marketing services influence shea butter production in this district.

3. Research methodology

3.1 Study area and sampling methods

The study was conducted in the Tolon District, located in the northern region of Ghana. The district comprises 159 communities based on the Community-Based Surveillance (CBS) concept, with a population of 118,101 people and an annual growth rate of 4.6% (Ghana Statistical Services, 2021). Agriculture is the primary industry in this area, with approximately 80% of the population engaged in small-scale farming. Notably, shea nut collection and shea butter production are prominent economic activities among rural-producing women in the region.

A two-stage sampling approach was employed in this study, combining purposive and simple random sampling methodologies. Three communities, Tolon, Dimabi No. 1, and Dimabi No. 2, were purposively selected because of their active and predominant participation in shea butter production. Subsequently, a questionnaire was administered to a random sample of respondents, enabling the efficient utilization of resources and resulting in time and cost savings. A total of 151 respondents were randomly selected based on the sample size.

3.2 Analytical methods and econometric model

This section provides detailed information about the statistical and econometric models used to achieve the research objectives. The socio-demographic characteristics of the respondents were analyzed by generating descriptive statistics using Stata version 25 and SPSS version 25 computer programs. The effect of financial and marketing services on shea butter production was investigated using linear regression with an endogenous treatment effect model, also known as the endogenous dummy variable model, with the assumption that an unobserved factor that influences access to financial and marketing

services also influences the quantity of shea butter produced (errors in the outcome variable and unobserved treatment errors are related).

In addition, we assumed that there was no correlation between unobservable treatment errors and outcome errors. The endogenous dummy variable model was suitable because it provided the capacity to estimate the effect of treated variables on the outcome variables of interest, ensuring that changes in the outcome variable were associated with changes in the treated variable and not unobserved factors. It also provides an opportunity to estimate the parameters of a linear regression model as well as the average treatment effect (ATE), showing the effect of the treated variable on the outcome variable. The endogenous treatment effect model comprises a treatment endogenous equation (in this study, financial and marketing services) and an outcome equation specification (quantity of sheabbutter produced). The quantity of shea butter produced is represented as Qi, while access to or participation in financial and marketing services is denoted as Zi. The outcome and treatment equations are as follows:

$Q_i = X_i\beta + \sigma Z_{i+} v_1$ …… *(1)*
$Z_i = w_i\gamma + u_i$…… *(2)*

The error terms v_1 and u_i in both equations are normally distributed bivariate with zero-mean matrices. This is because the error components in equations one and two are exogenous. The empirical model is as follows.

$Q_i = \beta_0 - \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 - \beta_5 X_5 + \delta Z_i + v_1$ …… (3)
$Z_{i=} \gamma_0 - \gamma_1 X_1 + \gamma_2 X_2 + \gamma_3 X_3 + \gamma_4 X_4 + \gamma_5 X_5 + \gamma_6 X_7 + u_i$…… (4)

Where;
X_1 = Sex of the respondent (Male =1, Female =0)
X_2 = Age of the respondents (years)
X_3 = level of education (1=No formal education, 2=Primary/JHS, 3=SHS, 4=Uni/Tech education)
X_4 = Household size (count)
X_5 = No. of household members in school (count)
X_6 = Experience level (years)
$X_{7=}$ Membership to Shea Group
Qi = Log of a quantity of shea butter produced (kilogram)
Zi =Financial and marketing services (1 if accessed, 0=otherwise)

4. Results and discussions

4.1 Demographic Characteristics of Respondents

Table 1 presents a detailed account of the respondents' demographic profiles. The results indicate that an overwhelming majority (96.69%) of the respondents were female, with the remaining 3.31% constituting males. This finding corroborates existing research suggesting that women are the primary participants in shea production (see Sikpaam et al. (2019); Marlene Elias and Arora-Jonsson (2017); Garba et al. (2015)). Gender differences in shea butter processing have economic implications. The first implication is that it empowers women financially, as identified by Mbowa, Businge, Ssemaluulu, and Eton (2023), women are empowered through practices such as economic activities, development of their competence, and sharing of market information. Second, they enable women to contribute to economic development.

The results (as presented in Table 1) also suggest that 43.71% of the respondents were between 30-39 years, 35.10% were between 40-49 years old, and 21.19% were between 50 and 59 years. The age distribution of the respondents indicates that all respondents were economically active, which suggests a positive economic outlook. These findings provide credence to Kombiok and Agbenyega's (2017) affirmation that the processing of shea butter serves as an instrumental employment source for economically active women in rural areas.

The results displayed in Table 1 further reveal that most of the respondents (78.81%) had no formal education. This finding aligns with Sarkodie et al. 's(2016) research, which revealed that most women involved in shea butter production lack a formal education. A significant proportion of respondents without formal education justified the need for specific educational programs to increase the skills and capacity of individuals involved in shea butter production. Such programs are essential to help women develop business acumen, adopt best management practices, and improve their access to information vital for their personal and economic growth.

Table 1. Demographic information of Respondents

Variable	***Frequency***	***Percentage***
Sexual characteristics		
Female	146	96.69
Male	5	3.31
Age distribution		
30-39	66	43.71
40-49	53	35.10
50-59	32	21.19
Household size		
5 – 9	52	34.4
10 – 14	37	24.50
15 – 19	62	41.06
Educational level		
No formal education	119	78.81
Primary	22	14.57
JHS	10	6.62
Experience		
1-5 years	25	16.56
5-10 years	66	43.71
10+ years	60	39.74

Source: Field Data Analysis, 2023.

4.2 Effect of financial services on shea butter production

Table 2 shows the average treatment effect of access to financial services on the quantity of shea butter produced each month. The results in Table 2 demonstrate a positive and statistically significant effect of access to financial services on the quantity of shea butter produced per month. Specifically, the endogenous dummy variable model reveals that shea butter producers with access to financial services exhibit a significant increase in production, with an estimated average increase of 0.459 kg per month, compared to those lacking access to such services ($p < 0.01$). This finding is intuitively plausible because access to financial services enables producers to invest in their businesses, thereby enhancing their productivity.

Furthermore, the results indicate that the age of the respondents has a positive and statistically significant effect on shea butter production ($p < 0.1$). This means that an increase in the shea butter producer's age by one more year will lead to an increase in the quantity of shea butter produced ceteris paribus. (see, Table 2). Related to Table 2, the results further indicate that other business activities (apart from other bizzes) have a significant and negative influence on the quantity of shea butter produced. This suggests that diversification into other business ventures may distract from or even compromise shea butter production.

Notably, the results also indicate that membership in shea processing groups and sex have negative and statistically significant relationships with access to financial services ($p < 0.01$ and $p < 0.1$, respectively). Specifically, shea-butter producers who belong to shea-processing groups are less likely to access financial services. Similarly, male shea butter producers are less likely to access financial services, as observed in our sample.

Table 2. Effect of financial services on shea processing

Lnquantity produced	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
Sex	-0.024	0.153	-0.16	0.873	-0.323	0.275	
Age	0.006	0.004	1.68	0.093	-0.001	0.013	*
Educational level	-0.014	0.048	-0.3	0.767	-0.108	0.08	
Household size	0.001	0.007	0.2	0.838	-0.012	0.015	
Household members in school	0	0.014	0.02	0.986	-0.028	0.028	
experience level	-0.019	0.039	-0.47	0.639	-0.096	0.059	
Apart shea other biz	-0.105	0.04	-2.65	0.008	-0.183	-0.027	***
1. Financial services	0.459	0.05	9.1	0	0.36	0.557	***
Constant	0.764	0.223	3.42	0.001	0.326	1.201	***
Sex	-1.006	0.577	-1.74	0.081	-2.137	0.125	*
Age	-0.019	0.013	-1.46	0.146	-0.046	0.007	
Educational level	0.318	0.222	1.43	0.151	-0.117	0.754	
Household size	-0.045	0.028	-1.63	0.103	-0.099	0.009	
HH members in school	0.086	0.06	1.44	0.149	-0.031	0.203	
Experience level	0.18	0.142	1.26	0.206	-0.099	0.458	
Membership to group	-0.839	0.168	-4.99	0	-1.169	-0.51	***
Constant	1.943	0.86	2.26	0.024	0.256	3.629	**
athrho	-2.075	0.343	-6.05	0	-2.748	-1.402	***
lnsigma	-1.116	0.07	-15.99	0	-1.253	-0.98	***

Mean dependent var	0.715	SD dependent var	0.453
Number of obs	151	Chi-square	102.067
Prob > chi2	0	Akaike crit. (AIC)	163.57

*** p<.01, ** p<.05, * p<.1

Source; Analysis of field data, 2023

Note: 1 kg of shea butter = 25 GHc (shea butter producers' conventional chart); 1. Financial services= average treated variable, access to financial services =yes/no, lnquantity_produced= natural log of quantity of shea butter produced.

4.3 Effect of marketing services on shea butter production

Table 3 shows the effect of marketing services on shea butter production among shea butter producers with access to these services. These results suggest that shea group membership significantly influences access to marketing services. Shea group membership has a negative influence on access to marketing services, as indicated in Table 3. This was because of limited resources within the shea groups. The limitation of resources to effectively access marketing services within shea groups has harmed access to marketing services. Second, weak collective bargaining power, according to one of the respondents, also affects their access to marketing services. Meanwhile, the treated variable (access to marketing services) was statistically significant at the 1% level and had a positive influence on shea butter output. The coefficient reveals that, on average, shea butter producers with access to marketing services are more likely to increase their shea butter production by 0.587 (kg) compared with their counterparts who lack marketing services if all other factors are constant.

The results in Table 3 also indicate that the gender of respondents had a significant ($p<0.05$) and negative effect on the quantity of shea butter produced. This implies that males produce a lower quantity of shea butter than females. Similarly, the other business activities of shea butter producers had an inverse relationship with the quantity of shea butter produced. As shown in Table 3, age, educational level, experience level, household size, and the number of household members in the school were found to have no significant influence on the quantity of shea butter produced and access to marketing services.

Table 3. Effect of Marketing Services on Shea processing

lnquantity_produced	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
Sex	-0.27	0.133	-2.04	0.042	-0.529	-0.01	**
Age	0.003	0.003	1.02	0.308	-0.003	0.009	
Educational level	0.017	0.042	0.41	0.684	-0.065	0.098	
Household size	0	0.006	-0.08	0.94	-0.013	0.012	
Experience level	-0.016	0.034	-0.48	0.632	-0.082	0.05	
apart_shea_otherbiz	-0.166	0.045	-3.72	0	-0.253	-0.078	***
1. Marketing services	0.587	0.07	8.43	0	0.45	0.723	***
Constant	0.757	0.194	3.9	0	0.376	1.138	***
Sex	2.567	174208.71	0	1	-341440.24	341445.37	
Age	-0.012	0.018	-0.65	0.517	-0.047	0.023	

Educational level	0.41	0.308	1.33	0.183	-0.193	1.013	
Household size	0.033	0.036	0.89	0.371	-0.039	0.104	
Household members in school	0.01	0.066	0.15	0.877	-0.12	0.14	
Experience level	0.228	0.193	1.18	0.239	-0.151	0.607	
Membership to group	-1.17	0.429	-2.7	0.007	-1.998	-0.316	***
Constant	2.191	1.381	1.59	0.113	-0.516	4.898	
athrho	-1.53	0.324	-4.74	0	-2.167	-0.899	***
lnsigma	-1.21	0.066	-18.92	0	-1.381	-1.121	***

Mean dependent var	0.887	SD dependent var	0.317	
Number of obs	151	Chi-square	91.078	
Prob > chi2	0	Akaike crit. (AIC)	119.113	

*** *p<.01*, ** *p<.05*, * *p<.1*

Source: Analysis of field data, 2023

Note: lnquantity_produced = Natural log of quantity of shea produced

5. Conclusions

This study examines the effects of financial and marketing services on shea butter production in the Tolon district of Northern Ghana. Linear regression with an endogenous treatment effect model was used for the estimation because it ensured that changes in the outcome variable were attributed to the treated variables and not unobserved factors. The results suggest that access to financial and marketing services has a significant and positive influence on shea-butter production. Differently expressed as access to financial and marketing services is a significant factor in predicting shea butter production productivity. However, access to financial and marketing services was significantly influenced by respondents' sex and membership in shea-processing groups. To improve access to these services, interventions should aim to foster close collaboration between government and non-governmental organizations to establish microfinance programs and marketing service centers. This will help provide low interest rates and facilitate access to financial and other services. Finally, this study is not without limitations. One notable constraint is the restricted sample size, which may compromise the external validity of the findings, thereby limiting their generalizability to other contexts. This limitation underscores the need for future research to replicate and expand upon these findings by utilizing larger, more diverse samples to enhance the robustness and applicability of the results.

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