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Evaluating the Viability of Shea Butter Production: A Comparative Analysis

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Abstract

This paper analysed the viability of shea butter processing in the Northern Region of Ghana using household level data on three different processing methods. Semi-structured questionnaires were administered to shea butter processing units. In all 110 processors were interviewed comprising 40 processing units for each of the Traditional and the Improved Shea Butter Processing Technology (ISBPT) methods and 30 for the Bridge Press (BP) method. The analytical techniques used included NPV, B/C ratio, sensitivity analysis and switching values. From the NPV and B/C ratio analyses, shea butter processing generally is a viable enterprise. While the estimates (NPV and B/C) of the BP method are higher than those of the ISBPT method, the estimates of the ISBPT method are higher than those of the Traditional method. The switching value and sensitivity analysis showed that the BP and ISBPT methods are more conditioned to handle risk than the Traditional method. Based on the findings, shea butter processing is recommended to government, Non-governmental Organisations and other stakeholders involved in the fight against poverty as a viable enterprise that offers an opportunity for the economic empowerment of women in both urban and rural areas.

Keywords: NPV, B/C ratio, switching values, sensitivity analysis, shea butter, viability.

1. Introduction

The shea tree is treasured for several reasons including but not limited to the economic value, dietary value of the cooking oil, fruit pulp, bark, roots and leaves, which are used in traditional medicines and for the wood and charcoal, used for building and cooking. It provides hope for several rural folks especially women in Northern Ghana and other parts of Africa. The indigenes of the North and politicians are often quick to refer to sheanut as the “cocoa” of Northern Ghana ostensibly to signal the potential of sheanut as a weapon against poverty. In recent times the industry has attracted the attention of policymakers and private investors especially with the introduction of the Savannah Accelerated Development Authority (SADA). All efforts are being made to give the attention accorded to cocoa production to sheanut production. For instance, government has now instituted guaranteed price for sheanuts. Also a sheanut factory has been established in Buipe in the Northern Region to add value to the crop. Several other factories are on the drawing board. These initiatives are undertaken under the assumption that sheanut picking and shea butter production are profitable.

However the much espoused feasibility of sheanut has not been backed by critical empirical evidence. Studies conducted so far have either focused on other aspects such as allocative and technical efficiency of shea nut processing (eg. Issahaku et al., 2011 and Issahaku, 2011) or on profitability analysis (eg Paschal, 1978; Carette et al. 2009 and Agbenu et al. 2009). Those based on profitability are less rigorous in analytical touch. For instance, studies by Paschal (1978) and Agbenu et al. (2009) ignored the fact that there are several processing methods and therefore focused only on the traditional method. Though Carette et al (2009) recognised the existence of different methods they only focused on two methods viz: manual versus semi-automated methods. Also, all the above mentioned studies but Agbenu et al. (2009) failed to perform sensitivity analysis to give an indication of the resistance of the sheanut processing to shocks. Even though Agbenu et al performed sensitivity analysis they failed to carry out switching value analysis. So far, three different sheanut processing methods have been identified among households. These methods include two improved methods and a Traditional method. In the case of the Traditional method, mechanized stages include milling and/or crushing of nuts. With regards the improved methods, the first consists of a grinder (crusher), corn mill, and a kneader. It is referred to by Issahaku (2011) as ISBPT (Improved Shea Butter Processing Technology). The last one known as the Bridge Press (BP) consists of a crusher, corn mill and a manually operated hydraulic press. In this paper, we estimate the profitability of the three different methods. We also perform sensitivity and switching value analysis to assess the capacity of the various processing methods to absorb shocks.

This paper plugs the holes in the literature by estimating and comparing the benefit cost and NPV ratios of the three different methods for investors to appropriately choose the most profitable processing method. This is particularly relevant given that investors are faced with several investment choices. Evidence about the profitability of sheanut processing will lend critical evidence to government and private interventions in the sheanut industry. After computing the B/C and NPV ratios, the paper finds that sheanut processing is a viable venture and therefore presents a sound investment option for eradicating poverty in the North. Based on the B/C ratios, the BP method is the most viable followed by the ISBP method and the traditional method respectively. The paper extends the analysis further by performing sensitivity analysis. The findings reveal that while the ISBPT and the BP methods remain viable following a 10% cost overrun the traditional method is not.

2. Methodology

2.1 Analytical Framework on Net Present Value (NPV) and Benefit-Cost (B/C) Ratio

The viability of a project can be evaluated using several financial ratios including break-even analysis, payback period analysis, B/C ratio, NPV, internal rate of return and its modifications, etc. All of these methods have their strengths and weaknesses. B/C ratio and NPV analysis have been chosen for this work based on their simplicity and wide appeal among both financial experts and the uninitiated. Gittinger (1982) provides the theoretical framework for NPV and Benefit-Cost Ratio analysis. The NPV of an enterprise is the present worth of the net incremental benefit or incremental cash flow stream. Incremental net benefit is the increase in net benefit with the project as against the case without the project. The NPV simply describes the present worth of the income stream from an investment. In NPV analysis, a discount rate is required. Usually the opportunity cost of capital is used as the discount rate. This is the rate that results after the utilization of all capital in the economy if all possible investments undertaken in the economy generate that much or more return. In other words the opportunity cost of capital is the return on the last or marginal investment made that exhausts the last available capital.

There exists a problem in the practical application of the opportunity cost of capital. The exact value is unknown. It is usually assumed to be between 8% and 15 % in developing countries (Gittinger, 1982). On the basis of Gittinger's suggestion, Paschal (1978) used 8% discount rate to evaluate the benefits and costs of shea butter processing in the then Dagomba District (now Tamale Metropolitan Assembly). In similar studies conducted by Donkor (1997) and Carrette et al. (2009) no discounting was done. Mathematically, the NPV is generally expressed as:

$$NPV = \frac{\sum_{t=0}^{n}\left(B_t - C_t\right)}{\left(1+r\right)^n}$$

where B_t = benefits in each year, n = number of years, C_t = costs in each year, r = discount rate, t =1, 2,…,n

That is, the NPV is computed by subtracting the total discounted net present worth of the cost stream from the discounted present net worth of benefits. The selection criterion is to accept all independent projects with NPV of zero or greater, at a specified discount rate. A negative NPV implies that at the assumed opportunity cost of capital the present worth of the benefit stream is less than the present worth of the cost stream rendering the enterprise unable to recover its investments. One problem of the NPV is that it cannot be calculated without a satisfactory estimate of the opportunity cost of capital. It cannot also be used to rank independent projects since the NPV is an absolute value and not a ratio. The NPV is, however, preferred in choosing among mutually exclusive projects. Benefit-cost ratio is the ratio obtained when the present worth of the benefit stream is divided by the present worth of the cost stream. As in the case of the NPV, an appropriate opportunity cost of capital is required. The larger the value of the opportunity cost of capital (discount rate) the smaller the value of the ratio. Mathematically, the B/C ratio is generally written as:

$$B/C = \frac{\sum_{t=1}^{n} B_t \Big/ (1+r)^n}{\sum_{t=1}^{n} C_t \Big/ (1+r)^n}$$

where; B_t = benefits in each year, C_t = costs in each year, n = number of years, r = discount rate, t = 1, 2, 3,…, n.

The selection criterion is to accept all independent projects with a B/C ratio of one or greater after discounting costs and benefits at the appropriate opportunity costs of capital. One convenience of the B/C ratio is that it can be used to determine how much costs will rise without making the project economically unattractive. The B/C ratio is however not appropriate for evaluating mutually exclusive projects since it can lead to the wrong investment choice. Also, though projects with higher B/C ratios are often preferred, rankings based on the ratio can lead to the wrong investment choice. B/C ratio has the disadvantage of discriminating against projects with relatively large gross returns and operating costs, even though these may prove to have high capacity for wealth generation.

2.2 NPV and B/C Ratio of Shea Butter Production

The NPV of a shea butter production unit is the discounted value of future stream of net returns above costs over the life span of production (Paschal, 1978). It gives the future net returns at the time of project appraisal. Mathematically it is represented as:

$$NPV = \frac{\sum_{t=0}^{n} (B_t - C_t)}{(1+r)^n} \qquad (1)$$

where B_t = benefits in each year, n = number of years, C_t = costs in each year, r = discount rate. The cost components include costs of sheanuts, opportunity costs of family labour, firewood costs, costs of calabash, costs of dyes, depreciation of machinery and equipment, costs of milling and market tolls. This cost specification differs from that of Paschal (1978) and other previous studies in that the specification in this study includes the contribution of family labour as a quasi-fixed input. The main benefit or return is the value of sales of shea butter. By-products in the shea butter production process are not saleable but are sometimes used as waterproofing coating for walls of buildings. These are however not quantified in this analysis. From the data collection it was realised that 51% of the respondents borrowed from banks at an average interest rate of 25%. It was assumed that the remaining 49% borrowed from money lenders at 100% interest. Pooling the weights together, the discount rate used in this study was computed as:

(0.51*25) + (0.49*100) = 62

A discount rate of 62% is therefore used in this study. Benefit - Costs analysis is also done to supplement the NPV results. This is the ratio of discounted benefits over discounted costs. The B/C ratio is given as:

$$B/C = \frac{\sum_{t=1}^{n} B_t \Big/ (1+r)^n}{\sum_{t=1}^{n} C_t \Big/ (1+r)^n} \qquad (2)$$

The variables are as defined above.

Validation of hypothesis

The paired t-test was used to test the differences between the mean (μ) NPVs of the three methods. The hypotheses are stated as follows:

1. H_0: μ_{NPV} ISBPT = μ_{NPV} BP
   H_1: μ_{NPV} ISBPT ≠ μ_{NPV} BP

2. H_o: μ_{NPV} ISBPT = μ_{NPV}Traditional
   H_1: μ_{NPV} ISBPT ≠ μ_{NPV}Traditional

3. H_o: μ_{NPV} BP = μ_{NPV} Traditional
   H_1: μ_{NPV} BP ≠ μ_{NPV} Traditional

2.3 Data Collection

Cross-sectional data were collected from various users of the technologies in the Northern Region of Ghana by the use of a semi-structured questionnaire. The data were collected over the 2004/2005 sheanut season. In all 110 processors were interviewed, 40 processing units for each of the Traditional and the ISBPT methods and 30 for the BP method. The use of 30 respondents for the BP method is as a result of the limited number of users of the technology. Each processing method group was identified and respondents sampled randomly. The communities used for this study include, Yong, Savelugu, Sankpagla, Vitting, Kaanfiehihyili, Mbanaayili and Kpilo.

2.4 Costs of Shea Butter Production

Total cost of shea butter production refers to all expenditures incurred in the processing of sheanuts into shea butter. This comprises the cost of labour, capital expenditure, the cost of raw material and fixed cost. Labour cost is evaluated as the opportunity cost of family labour. Family labour is mainly used in shea butter production. In this study, labour cost is evaluated by multiplying the total number of man-days of a production unit by the daily wage prevailing in the study area.

Capital expenditure refers to all cash payments involved in milling, crushing and kneading of sheanuts. These are service charges for the use of processing machines. It also includes transportation costs, costs of fuel wood, cost of dye, market taxes, costs of weighing shea butter and the depreciation of physical capital items such as pots, pans and roasting machines. The cost of equipment such as kneaders, crushers, mills and presses are not included since they are not owned by individual producers but by groups. These equipment are maintained by revenues obtained through the services rendered to processors. Cost of raw material refers to the amount of money used in purchasing sheanuts for processing into butter. Fixed costs include costs of capital items such as pans, roasting machines, and pots which do not vary in the short run. In this study it is assumed that these items are replaced in the eighth year when the project would have completed a cycle.

3. **Results and Discussion**

3.1 NPV and B/C Ratio Analysis

The Net Present Values (NPV) and Benefit-Cost ratio computations for processing a tonne of sheanuts into shea butter using the Traditional, ISBPT and BP methods are presented in Tables 1 – 4. Processors using the Traditional method usually sell in the open market where prices are low (Gh 65p per kg) while those using the improved methods usually sell to exporting agencies at an average price of Gh ¢1.10 per kg of shea butter. The exporting agencies are usually introduced to the processors by Non-governmental Organisations (NGOs). But since the exporters do not come regularly, they also sometimes sell in the open market. Tables 1 – 4 show the NPV computations for the three methods with a project life span of eight years at 62% interest rate.

Table 1 PV Estimates for the Traditional Method per Tonne of Sheanuts Processed in Ghana Cedis

Year	Initial Investment	Operating Costs	Gross Costs	Discount Factor at 62% Discount Rate	Present Value of Cost at 62% Discount Rate	Gross Benefits	Present Value of Benefits at 62% Discount Rate
0	21.865	0	21.865	1	21.865	0	0
1	0	193.513	193.513	0.617284	119.4525	202.75	125.1543
2	0	313.491	313.491	0.381039	119.4523	328.455	125.1542
3	0	507.856	507.856	0.23521	119.4528	532.097	125.1545
4	0	822.727	822.727	0.145191	119.4526	861.997	125.1542
5	0	1332.817	1332.817	0.089624	119.4524	1396.436	125.1542
6	0	2159.163	2159.163	0.055324	119.4535	2262.226	125.1554
7	0	3497.845	3497.845	0.03415	119.4514	3664.806	125.1531
8	0	5666.508	5666.508	0.02108	119.45	5936.985	125.1516
Total	**(A)** **21.865**	**(B)** **14493.92**	**(C)** **14515.785**	**(D)** **2.578902**	**(E)** **977.4825**	**(F)** **15185.75**	**(G)** **1001.232**

NPV at 62% discount rate = G – E = 1001.232– 977.483 = 23.749

Benefit – cost ratio at 62% discount rate = G ÷ E = 1001.232 ÷ 977.483 = 1.024

Table 2 PV Estimates for the ISBPT Method per Tonne of Sheanuts Processed in Ghana Cedis

Year	Initial Investment	Operating Costs	Gross Costs	Discount Factor at 62% Discount Rate	Present Value of Cost at 62% Discount Rate	Gross Benefits	Present Value of Benefits at 62% Discount Rate
0	35.09	0	35.09	1	35.09	0	0
1	0	213.943	213.943	0.617284	132.0636	286	176.5432
2	0	346.588	346.588	0.381039	132.0635	463.32	176.543
3	0	561.472	561.472	0.23521	132.0638	750.578	176.5435
4	0	909.585	909.585	0.145191	132.0636	1215.937	176.5431
5	0	1473.527	1473.527	0.089624	132.0634	1969.818	176.543
6	0	2387.114	2387.114	0.055324	132.0647	3191.105	176.5447
7	0	3867.124	3867.124	0.03415	132.0623	5169.59	176.5415
8	0	6264.741	6264.741	0.02108	132.0607	8374.736	176.5394
Total	**35.09**	**16024.09**	**16059.18**	**2.578902**	**1091.596**	**21421.08**	**1412.341**

Table 3 PV Estimates for the BP Method per Tonne of Sheanuts Processed in Ghana Cedis

Year	Initial Investment	Operating Costs	Gross Costs	Discount Factor at 62% Discount Rate	Present Value of Cost at 62% Discount Rate	Gross Benefits	Present Value of Benefits at 62% Discount Rate
0	31	0	31	1	31	0	0
1	0	187.748	187.748	0.617284	115.8938	289.333	178.6006
2	0	304.151	304.151	0.381039	115.8934	468.72	178.6006
3	0	492.725	492.725	0.23521	115.8938	759.326	178.6011
4	0	798.215	798.215	0.145191	115.8936	1230.109	178.6008
5	0	1293.108	1293.108	0.089624	115.8935	1992.776	178.6006
6	0	2094.835	2094.835	0.055324	115.8947	3228.298	178.6024
7	0	3393.632	3393.632	0.03415	115.8925	5229.812	178.5981
8	0	5497.684	5497.684	0.02108	115.8912	8472.343	178.597
Total	**31**	**14062.1**	**14093.1**	**2.578902**	**958.1466**	**21670.72**	**1428.801**

Table 4 NPV and B/C Estimates per Tonne of Sheanuts Processed in Ghana Cedis

Method	NPV	Benefit – cost Ratio
Traditional	23.749	1.024
ISBPT	320.746	1.293
BP	470.655	1.491

From Tables 1 and 4, the NPV estimate of the Traditional method at 62% discount rate is Gh¢23.749. Since it is positive the conclusion is that shea butter extraction under the Traditional method is viable at an opportunity cost of capital of 62%. The criterion for selecting projects under NPV analysis is to accept all projects with positive net present values. From Tables 2 and 4, the NPV estimates of the ISBPT method is Gh¢320.746 This implies that at an opportunity cost of capital of 62% shea butter processing under the ISBPT method is viable. Similarly, from Tables 3 and 4, the NPV for processing a tonne of sheanuts into shea butter using the BP method is Gh¢470.655 implying that shea butter production is viable at a discount rate of 62%.

Eight years is used as the life cycle of a shea butter production unit because by the end of the eighth year capital equipment such as roasting machines, pans and pots will reach their useful life span and will have to be replaced. In absolute value terms the BP method gives the highest NPV. This may be partly attributed to relatively low labour and capital expenditure and the fact that processors are able to process more than one batch of kernel in a week unlike in the Traditional method where processors are only able to process one or at most two batches of kernel a week due to the time consuming nature and the labour intensiveness of the Traditional method. Therefore, though all the three enterprises are viable but the ability to save time and labour enables the processors who use the improved methods to reduce costs and to process higher quantities of sheanuts than those using the traditional method. The result of the paired t-test is shown in Table 5. The conclusion from the paired t-test is that the average NPVs of the three methods differ significantly at 5% level. At 62% discount rate, therefore, the BP method has the highest NPV followed by the ISBPT and Traditional methods respectively.

Table 5 Paired Samples Test NPV Estimates of Processing a Tonne of Sheanuts at 62% Discount Rate

Method Pair	Mean of paired difference	Std. Deviation	Std. Error Mean	t- value 5%	Sig. (2-tailed)
TRAD – ISBPT	-2895726.6000	469594.4378	74249.4000	-39.000	.000
TRAD – BP	-4262225.0333	892796.3217	163001.5616	-26.148	.000
ISBPT – BP	-1292249.0333	892796.3217	163001.5616	-7.928	.000

From Table 4, the benefit cost ratios are 1.023, 1.293 and 1.491 for the Traditional, IBPT and BP methods respectively. Since all the B/C ratios are greater than 1, all the methods are economically viable. The BP method is the most viable followed by the ISBPT and the Traditional methods respectively. Thus, both the NPV and the B/C ratios indicate the viability of the various shea butter processing methods though at varying degrees. The B/C ratios found in this study compares favorably with the results of Agbenu et al. (2009) in the Wa Municipality of the Upper West Region of Ghana. They found a B/C ratio of 1.21. It also compares well with the 1.43 B/C ratio found by Paschal (1978) in the then Dagomba District of the Northern Region of Ghana.

3.2 Switching Values

One advantage of B/C analysis is that it allows for the computation of switching values. A switching value is used to determine how much an element would have to change unfavourably before the project loses its viability when judged by the measures of project worth (Gittinger, 1982). From the B/C analysis above, we can determine by how much cost will rise or by how much benefits will fall before a project becomes unprofitable.

From Table 4, by simple inspection it can be said that cost will rise by 2%, 29% and 49% before the production unit of Traditional, ISBPT and BP methods respectively become unprofitable. On the basis of this it can be deduced that the processing unit under the Traditional method is vulnerable to costs shocks such as sharp rises in costs of raw material and capital expenditure than the mechanized methods when shea butter is sold in the market. If costs should rise by over 2% the processing unit under the Traditional method will make losses, all things being equal. A processing unit of the ISBPT method is better positioned to absorb cost hikes since total cost must rise by 29% before the project loses its viability. A processing unit of the BP method has the highest level of resilience. Costs must rise by 49% before the project becomes unprofitable.

Similarly, it is possible to determine how much benefits must fall before a project loses its viability. Taking the reciprocal of the B/C ratio and subtracting it from one gives an idea of how much benefits must decline before a project loses its viability. Using thr B/C ratio as an example, the switching value can be computed as follows:

$$1-\left(\frac{1}{1.02}\right)=0.02$$

This means that benefits must fall by 2% before the average production unit under the Traditional method becomes unprofitable. For a production unit of the ISBPT and BP methods, benefits must fall by 22% and 33% respectively before the project losses are incurred. Therefore, the BP method offers more resistance to shocks in prices of both input and output even when butter is sold in the open market.

3.3 Sensitivity Analysis

Sensitivity Analyses at 10% Cost Overrun

The sensitivity of a production unit to a rise in costs elements is important in determining the riskiness and viability of a project. The sensitivity of the average shea butter production unit to a 10% rise in overall cost is examined in this study. NPV values when a 10% cost overrun is assumed at the opportunity cost of capital of 62% are Gh¢-73.9992, Gh¢211.5870, Gh¢374.8425 respectively for the Traditional, ISBPT and BP methods. The NPV value in the case of the Traditional method is negative implying that the production unit of the Traditional method will be risk prone when overall cost increases by 10%. The processing units of the ISBPT and BP methods can comfortably absorb 10% cost overrun.

Sensitivity Analysis at 10% Increase in Benefit

Table 6 shows sensitivity analysis at 10% increase in benefit by processing a tonne of sheanuts. The NPV estimates in ascending order are Gh¢123.8727, Gh¢461.9814, Gh¢613.5380 respectively for the Traditional, ISBPT and BP methods. A paired t-test reveals that the differences in NPVs are significant between the Traditional and the improved methods. However there is no significant difference between the NPVs of the ISBPT and BP methods.

Table 6 Sensitivity Analysis at 10% Increase in Benefit by Processing a Tonne of Sheanuts

Method	NPV	Benefit – Cost Ratio
Traditional	123.8727	1.127
ISBPT	461.9814	1.423
BP	613.5380	1.640

4. Conclusions and Recommendations

This paper analysed the viability of shea butter processing in the Northern Region of Ghana using household level data on three different processing methods .From the NPV and B/C ratio analyses, shea butter processing generally is a profitable enterprise. However, while the estimates (NPV and B/C) of the BP method are higher than those of the ISBPT method, the estimates of the ISBPT method are higher than those of the Traditional method. Therefore, shea butter processing is recommended to NGOs and other welfare organizations involved in the fight against poverty as a viable enterprise that offers an opportunity for the economic empowerment of women in both urban and rural areas.

From the NPV, B/C ratio estimates the BP method is economically the best shea butter processing method. This notwithstanding, the BP method is losing popularity as a result of the poor quality of the butter according to the judgement of local consumers and processors using the method. To overcome this problem, research must be carried out to upgrade the BP method so that the shea butter produced will appeal to the local consumer. The switching value and sensitivity analysis showed that the BP and ISBPT methods are more conditioned to handle risk than the Traditional method. One way to deal with this problem is for the Ministry of Food and Agriculture to vigorously promote the use of the improved methods not only by establishing large scale factories but by bringing improved technologies at the door steps of households. Another way of dealing with this issue is for government to extend guarantee price for sheanut to shea butter.

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