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Full Length Research Paper

An analysis of allocative efficiency of shea butter processing methods in the northern region of Ghana

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This study estimated and compared the allocative efficiencies of the traditional, improved shea butter processing technology (ISBPT) and the bridge press (BP) methods of shea butter processing. Data were collected from 110 shea butter processors. Allocative efficiency estimates were obtained using the marginal product approach. The allocative efficiency indices for labour indicate that while labour input is over utilised in the traditional method, it is under utilised in the ISBPT and BP methods. The allocative efficiency indices for capital, show that capital input is over utilised in the traditional and ISBPT methods though the extent of over utilization is greater for the ISBPT method. Processors require training to build their entrepreneurship capacities to ensure their resource use efficiency.

Key words: Allocative efficiency, constraints labour, capital, marginal value product.

INTRODUCTION

Ghana is said to have a comparative advantage in the production of shea nut than any of her West African neighbours due to relatively early maturing trees and better quality of the nuts (NARP, 1993). This comparative advantage can best be exploited if studies could be con-ducted to reveal how increasing efficiency could increase net revenue from shea butter processing. Presently there are no studies to this effect. This research seeks to bridge this knowledge gap.

Furthermore, Aboyella (2002) has noted that shea butter processing and trading are major income gene-rating activities that offer employment to rural women. In Aboyella's view, shea butter extraction plays a significant role in poverty alleviation and food security and has in recent times attracted the attention of the government which has led to the establishment of a division of the Cocoa Research Institute at Bole in the Northern Region to research into the development of cultivable species of the shea nut tree. Therefore, any measure taken to increase total output of shea butter production will ultimately raise the income of shea butter producers in particular, and the living standards of shea butter consumers, and thus contribute to an increase in national income (Paschal, 1978).

Shea nuts and shea butter have multiple uses (CRIG, undated). In a domestic setting, sheanuts constitute an important source of affordable cooking fat (Abbiw, 1990). Locally, shea butter is sold in loaves in markets. It is esti-mated that a Malian family of seven (7) people consumes about 150 g of butter a day (Fluery, 1981). Shea butter is also used as a base for medicinal and cosmetic ointments, as a pomade, as a hair cream, for soap production and as an illuminant (Abbiw, 1990).

Low quality butter and by-products of processed nuts are smeared on earthen walls of houses as a waterproof to protect walls during the rainy season (Fluery, 1981). Other parts of the Shea nut tree are also utilized in various ways (Lovett and Haq, undated). The fruit pulp is edible and is said to have some laxative properties (Soladoye, et al., 1989). The leaves are used as medi-cine to treat stomach-ache in children (Millee, undated). The leaves may be hung in the doorway when a woman is in labour (CRIG, undated). Shea branches can also

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be used for covering the dead prior to their burial (Agbahungba and Depommier, 1989). Roots and root bark are ground to paste and administered orally to cure jaundice (Ampofo, 1983). Also, the roots mixed with tobacco are used as a poison by the Jukun of Northern Nigeria (Dalziel, 1937). The wood though not commonly cut is durable and is used to make tool handles, mortars and pestles, and as fuel wood (Abbiw, 1990).

The use of cocoa butter equivalents or improvers (CBEs/CBIs) became a political issue in Europe during the late 1990s following a European Union's directive which allowed for up to 5% substitution of cocoa butter by CBEs/CBIs (Official Journal Of The European Communities, 2000 In: Masters et al., 2004). Some shea stakeholders saw this directive as a major victory. However, the control of the CBE/CBI subsector by just a few companies raises questions as to how prices are determined and whether local producers and exporters can negotiate prices that will be remunerative to the producers (Fold, 2000 In: Masters et al., 2004).

Large quantities of shea nuts are produced in West Africa though the exact production figures are not known (Booth and Wickens, 1988). In a typical year about 200,000 tonnes of shea nuts are exported from West Africa, and as at 1987, the main exporting countries in decreasing order are: Nigeria, Mali, Burkina Faso, Benin and Niger (Delabre et al., 1987). Europe is at present the only regular importer of sheanuts with annual import values fluctuating between 6,000 tonnes and 60,000 tonnes (Teklehaimanot, 2003). At the micro level shea nuts and shea butter trade is often the source of income available to raise the living standards of people in a subsistence economy (Maydell, 1983).

Agro-industrial growth is essential for achieving higher economic growth. The efficiency of such industries is crucial in determining their sustainability and profitability. The study is herein justified, as it will provide ways of reducing cost through improved efficiency. In particular this paper looks at how efficiently resources are allocated by shea butter processors and makes appropriate recommendations for improving the livelihood of resource poor households through gains from improved efficiency. In the developing world, most of the studies that examine efficiency have focused on technical efficiency (Bravo-Ureta and Pinhiero, 1993). Without downplaying the importance of technical efficiency, improvement in allocative efficiency will lead to greater production efficiency. Only few studies have examined the effects of technical change on allocative efficiency.

The allocative efficiencies of three distinct processing methods are studied; among these are two improved methods and the traditional method. For the traditional method, mechanized stages include milling and/or crushing of nuts. For the improved methods, the first comprises a grinder (crusher), corn mill, and a kneader. It is referred to in this study 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. The main aim of this study is to estimate and compare the allocative efficiencies of these methods. This will unearth lessons for plugging leakages so as to enhance efficiency. The paper also exposes the limitations to the use of the improved methods of shea nut processing.

Review of previous studies

Limited studies have been done on shea nuts in Ghana, the economics of it in particular. Among those who have analysed the economics of shea nut and shea butter production in Ghana include: Pascal (1978), Asare (1997), Darkwa (2000) and Aboyella (2002).

Paschal (1978) looked at shea butter production in the then Dagomba district now Tamale Metropolis. He used cost - benefit analysis to establish the profitability of traditional shea butter production. His benefit cost analysis yielded a benefit-cost ratio of 1.43 implying "that 1.43 cedis is realized on every cedi invested in shea butter production over a life period of eight years" (Paschal, 1978: 37). Total variable costs accounted for 99.38% of total costs of production with the costs of shea nuts alone being 75.3% of the total variable costs. The low fixed cost (0.62% of total costs) was attributed to the fact that there was no permanently installed capital equipment of high cost used in traditional methods of shea butter production. In Pascal's view the major problem in traditional shea butter processing at the time was technical inadequacy.

Asare (1997) examined the export behaviour of shea nut in Ghana in response to exchange rate policy, over the period, 1975 to 1995. He employed ordinary least squares method (OLS) to estimate domestic supply and foreign demand of Ghana's shea nut in a linear functional form and the double log functional form to estimate the response of domestic price of shea nut to exchange rate policies. Asare estimated the domestic price elasticity of shea nut with respect to nominal exchange rate to be about 1.6 in the short run under a flexible exchange rate and about 0.6 under a fixed exchange rate regime. The supply elasticity of export with respect nominal exchange rate was found to be -1.9 and -2.4 for the short run and long run respectively under a fixed exchange rate regime. Lastly, the elasticity of supply of shea nut export with respect to the world price of shea nut was estimated as 0.54 and 0.6 for the long run and short run respectively. The findings of Asare's study serves as a guide as to how improved efficiency could enhance the demand and supply elasticities of shea butter export.

Darkwa (2000) modelled the export demand and supply of shea nuts in Ghana from 1970 to 1998. Darkwa observed that the export demand for shea nuts increases with growth in income of importing countries. Further, he found the effect of real exchange rate on the export supply of shea nuts to be substantial in both the short run and the long run with the long run effect being greater. This calls for the need to produce quality output to meet export demands.

The aforementioned studies have the following shortcomings. The analytical methods they used are deterministic and ignore the existence of random shocks and statistical errors inherent in efficiency analysis. The studies also failed to provide quantitative allocative efficiency values for shea butter processing units. The superiority of this study over the other studies is that it uses a flexible functional form (translog production function) and also caters for factors beyond the control of the producer as well as measurement errors. Eventually, allocative efficiency values of labour and capital for three shea butter technologies are estimated using the marginal product approach. The studies on shea nuts and shea butter have so far absolutely ignored the issue of allocative efficiency in particular. This study presents by far the most empirically thorough attempt to apply the economic theory of allocative efficiency to the shea butter extraction industry.

The concept of efficiency generally centres on the possibility of producing a certain level of output at lowest cost or of producing the optimal level of output from given resources. Conventionally, the performance of a firm is judged utilizing the concept of economic efficiency, which is made up of two components: technical efficiency and allocative efficiency (Kalarijan and Shand, 1999).
According to Hensher (2001) a firm is said to be technically efficient when it produces as much output as possible with a given amount of inputs or produces a given output with the minimum possible quantity of inputs. Several authors have given their views as to the definition of allocative efficiency. Farell (1957) defines allocative efficiency as the ability to choose optimal input levels given factor prices in Table 3. According to Kalarijan and Shand (1999), the willingness and ability of an economic unit to equate its specific marginal value product to its marginal cost is referred to as allocative efficiency. In effect, allocative efficiency refers to the adjustment of inputs and outputs to reflect relative prices (price efficiency) under a given technology (Ellis, 1988). Unlike technical efficiency concepts, which only consider the process of production, allocative efficiency concepts pertain to the idea that society is concerned with not only how an output is produced, but also with what outputs and balance of output are produced (Hensher, 2001).

Allocative efficiency estimates can be obtained by either using the production function approach or the duality approach (profit or cost function approach). While writers like Olagoke (1991), Khandaker et al. (1993), Onyenwaku (1994) and Seidu et al. (2005) used the production function approach, others such as Dittoh (1991), Adesina and Djato (1996) and Sarpong and Asante (2002) used the dual approach. Though the production function approach is criticised for its simultaneity bias, the suggested alternative (profit function approach), which overcomes the endogeniety problem, also suffers from problems such as the non-inclusion of uncertainty leading to a breakdown of the model, and the difficulty in quantifying family labour and other quasi-fixed inputs.

Notwithstanding the many earlier studies on economic efficiency, the concept is not unambiguous and its relevance as a measure of economic performance has come under severe criticism (Torkamani and Hardaker, 1996). For example, Pasour (1981) argues that efficiency measures estimated based on the assumption of profit motive are not appropriate measures of the performance of economic agents operating under imperfect information and whose objective functions involve other elements other than profit. Authors like Dillon and Anderson (1971), and Upton (1979) have also questioned the applicability of rules of neoclassical economics on traditional agriculture.

A bulk of the empirical literature dealing with agricultural efficiency has exclusively focused on the measurement of technical efficiency (Kalarijan and Shand, 1999; Kalarijan, 1981; Ekayanake, 1988; Rawlins, 1985; Taylor and Shonkwiler 1986; Kirkley and Dupaul, 1995). Bravo-Ureta and Evenon (1993) argue that, these works by focusing on technical efficiency, ignore the gains that could be obtained especially in the short run by also improving allocative efficiency. The issue of allocative efficiency is even more critical in the shea butter industry since the available engineering studies indicate that technical efficiency does not differ among the three technologies. Therefore what will make the difference between one production unit and the other will be the efficient allocation of resources given input and output prices and resource constraints.

Data collection and description of variables

Cross-sectional data was collected from various users of the technologies by the use of a semi-structured questionnaire. In all 110 processors were interviewed, 40 processing units for each of the traditional and the ISBPT methods and 30 for the BP method. In the case of the ISBPT and the traditional methods, there were so many processors available for interview, therefore the simple random technique was employed to select a sample of 40 processors each. In the case of the BP method all processors using the method within the catchment were interviewed. The BP method is not so popular among processors because of some reasons outlined lates in this paper. The sample size for each processing method is large enough for the performance of statistical tests. The communities used for this study include, Yong, Savelugu, Sankpagla, Vitting, Kaanfiehihyili, Mbanaayili and Kpilo, all in the Northern Region of Ghana.

Capital refers to all cash expenses incurred in the processing of nuts into butter together with depreciation of buildings and equipment. Capital consists of handling costs, milling costs, crushing costs, cost of firewood, costs of dye and calabash, district assembly market tax and costs of kneading paste. The measurement unit of capital is cedis per 100 kg bag.

Labour refers to the total effort of family and hired labour measured in man-days. One man-day is equivalent to 8 hours in this study.

Raw material refers to the kilograms of kernel processed by an individual production unit.

Output refers to the amount of shea butter obtained (kg) from processing of kernel. A bag of kernel weights 100 kg on the average.

Water refers to the quantity/volume of water used in processing shea butter in litres per bag of kernel.

Empirical estimation of allocative efficiency of shea butter processing methods

Variables associated with the technologies are categorized into output (Y) of shea butter per 100 kg bag of kernel, Labour (Lab) in man-days per bag of kernel, Raw material (Raw) in kg of processed nuts, Capital (Cap) in cedis per bag of kernel, and volume of water (Wat) per bag of kernel. The model is given as:

$$Y = f(Raw, Lab, Cap, Wat) \quad (1)$$

The compositions of the factors differ from technology to technology. The operational translog stochastic frontier for a shea butter processing technology is expressed as:

$$\ln Y = \beta_0 + \beta_1 \ln Raw + \beta_2 \ln Lab + \beta_3 \ln Cap + \beta_4 \ln Wat + 0.5\psi_1(\ln Raw)^2 + 0.5\psi_2(\ln Lab)^2 + 0.5\psi_3(\ln Cap)^2 + 0.5\psi_4(\ln Wat)^2 + \Pi_1(\ln Raw * \ln Lab) + \Pi_2(\ln Raw * \ln Cap) + \Pi_3(\ln Raw * \ln Wat) + \Pi_4(\ln Lab * \ln Cap) + \Pi_5(\ln Lab * \ln Wat) + \Pi_6(\ln Cap * \ln Wat) + E_i \quad (2)$$

where all the variables are measured in per 100 kg bag of shea nuts. E_i is the composite error term given as $E_i = V_i - U_i$ where V_i is statistical errors and random shocks such as bad weather and machine breakdowns, U_i is the error term measuring the level of inefficiency in shea butter processing. The β's represent parameters of linear terms, ψ's represent parameters of quadratic terms, Π's represent parameters of interaction terms.

Two kinds of information are needed in estimating the efficiency of firms. First, the varying degrees of success of firms at maximizing output from given levels of inputs. This is the technical efficiency dimension. Second, the judgment of firms in respect of relative prices of inputs and outputs. This is the allocative efficiency dimension. The requirement for the fulfilment of allocative efficiency is for the marginal physical products (MPPs) of all productive resources to be known (Ellis, 1988). The aim of this study is to estimate the allocative efficiencies of labour and capital since it is these factors that are substituted for in the various technologies.

From the translog function presented in Equation 2, the factor elasticities of labour and capital (E_L and E_K respectively) are derived as:

$$E_L = \partial \ln Y / \partial Lab = \beta_2 + \psi_1 \ln Lab + \Pi_1 \ln Raw + \psi_2 \ln Cap + \Pi_5 \ln Wat \quad (3)$$

$$E_K = \partial \ln Y / \partial \ln Cap = \beta_3 + \psi_3 \ln Cap + \Pi_2 \ln Raw + \Pi_4 \ln Lab + \Pi_6 \ln Wat \quad (4)$$

The estimation of efficiency is based on the allocative efficiency rule, which states that the slope of the production function (MPP) should equal the inverse ratio of input price to output price at the point of profit maximization (Ellis, 1988).

$$MPP_l = \frac{w}{p_y} \quad (5)$$

w is the wage rate and P_y is the price of output (shea butter). By cross multiplying,

$$MPP_L P_y = MVP_L = w \quad (6)$$

$$\frac{MVP_L}{w} = 1 \quad (7)$$

That is, the marginal value product of the variable input divided by the input price should equal 1. That is, the allocative efficiency index (Z) for a single input is given by:

$$Z = \frac{MVP_x}{P_y} \quad \text{for any input X} \quad (8)$$

Similarly for capital,

$$Z = \frac{MVP_K}{r} \quad (9)$$

r is the unit price of capital

Following from Seidu et al. (2005) the marginal products are calculated as follows:

$$MP_L = \frac{\propto Y_i}{\propto X_i} * E_L \quad \text{(10) for labour}$$

$$MP_K = \frac{\propto Y_i}{\propto X_i} * E_K \quad \text{(11) for capital}$$

The allocative efficiency ratios are then expressed as:

$$Z = MP_L * \frac{P_y}{w} \quad \text{(12) for labour input}$$

$$Z = MP_K * \frac{P_y}{r} \quad \text{(13) for capital input}$$

where MP_L, MP_K are the marginal products of labour and capital respectively, μY_i *and* μX_i are the arithmetic means (logs) of the output and inputs respectively of a particular processing method. If Z = 1, it implies the input is utilized efficiently. If Z > 1, it implies an under utilization of the factor input. On the other hand if Z <1, it implies an over utilization of the factor input.

RESULTS AND DISCUSSION

Allocative efficiency of shea butter processing methods

The OLS result of the pooled sample using a translogarithmic production function is presented in Table 1. Table 1 indicates that among the linear terms it is only raw material and capital that are significant. All the square terms are significant and are all positive. The implication is that the square of all the linear terms increases shea butter output. All the interactive terms are significant apart from the interaction between labour and capital. Apart from the interactions raw*lab, raw*cap and cap*wat all other interactive terms have positive signs and therefore positively affect the output of shea butter. Hence the combination of factors is very important in shea butter production.

The R^2 is 0.999, which means 99.9% of the variation in shea butter output is explained by the independent variables in the model. The almost perfect goodness of fit may suggest the presence of multicolinearity. But according to Gujarati (2003) multicolinearity can be ignored especially in the case of a translog production function. Also most of the estimated co-variances are less that 80% which is quite acceptable. The F-statistic is significant at 1% level. This also means that the fit of the model is good.

The samples of the three methods were used to provide OLS estimates separately for each method using a translogarithmic production function. The factor elasticities and marginal value products were then computed from the OLS results. For the purpose of illustration and for want of space, the OLS results of only the ISBPT method is presented in Table 2.

For example, the allocative efficiency of labour is computed as follows: The estimates in Table 2 are substituted into Equations 3 and 4. From Equation 3, elasticity of labour input is given as:

$$E_L = 0.866 + (0.943 \cdot 22.7) + (-1.761 \cdot 21.15) + (1.178 \cdot 16.656) + (0.211 \cdot 21.421) = 9.1675$$

and,

$$MP_L = \frac{L_{NY}}{L_{NLAB}} \cdot E_L \qquad \text{(from Equation 10)}$$

$$MP_L = \frac{3.770}{22.732} \cdot (9.1675) = 1.520397$$

$$MVP_L = MP_L \cdot P_y \qquad \text{(from Equation 6)}$$

$$MVP_L = 1.520397 \cdot 9.20 = 13.99$$

Allocative efficiency index (Z), from Equation 8 is given as:

$$Z = \frac{13.99}{8.50} = 1.65 \qquad \text{(as in Table 4)}$$

All the variables are measured on per bag of shea nuts processed. A bag of shea nuts weighs 100 kg. The same procedure was applied to the other methods. The resulting allocative efficiencies are presented in Table 4. If the allocative index Z is less than 1, it implies the resource is over utilised. If the Z is greater than 1, it implies the resource is underutilised and if Z is equal to 1, it implies the resource is efficiently utilised. From the table the allocative efficiency ratio of labour for the ISBPT method is 1.6 which is greater than 1. This implies that labour is under utilised by the users of the ISBPT method. This may be partly attributed to the fact that machine services are employed, reducing the need for manual labour.

It should be noted that the translog fuction has level terms, quadratic terms and interactive terms. Though a level term may not be significant, the variable as a whole may still have an impact on the model through quadratic effect (note that, all square terms are significant in the pooled sample), interaction with other variables (interacttive effect). More so, the estimation of allocative efficiency is not based on the pooled sample but on the individual samples. And it is interesting to note that labour even as a level variable is significant in the traditional and BP methods. These are reasons that informed the inclusion of labour in the allocative efficiency computations.

Labour is more over utilised in the BP method. The allocative efficiency ratio of labour for the BP method is 1.8 which is greater than unity. Therefore labour is inefficiently utilised by producers using the BP method. This means that labour is paid less than its marginal value product in the improved methods. The allocative efficiency ratio of labour for the traditional method is 0.5 which is less than unity. Labour is therefore over utilised by producers using the traditional method. This means that labour is paid more than the marginal value product. This may be due to the fact that apart from milling all the other processing stages are carried out manually (Aboyella, 2002) in the traditional method.

The allocative efficiency ratios of capital for the ISBPT and BP methods are 0.2, and 1.0 respectively. This means that while capital is over utilised in the ISBPT method, it is efficiently utilised in the BP method. The over utilisation of capital in the ISBPT method may be attributed to the fact that all processing stages are mechanized and require capital expenditure. The allocative efficiency ratio of capital for the traditional method is 0.6 which is less than unity implying over utilization. However, the extent of capital over utilization is greater for the ISBPT method than the traditional method. Capital is allocated inefficiently (over utilisation)

Table 1. OLS estimates of pooled sample using Translog production function.

Variables	Parameters	Coefficients	SE	t-value
Constant	β	6.818	1.1514	5.922 ***
Ln Raw material	β_1	2.359	1.555	1.517**
Ln Labour	β_2	-2.082	1.365	-1.525
Ln Capital	β_3	-4.287	1.281	-3.345***
Ln Water	β_4	1.143	0.681	1.679
0.5*(Ln Raw material)^2	ψ_1	1.400	0.183	8.201***
0.5*(Ln Labour)^2	ψ_2	0.869	0.120	7.239***
0.5*(Ln Capital)^2	ψ_3	2.021	0.447	4.510***
0.5*(Ln Water)^2	ψ_4	0.724	0.548	13.203***
Ln Raw*Ln Labour	Π_1	-1.168	0.122	-9.534
Ln Raw*Ln Capital	Π_2	-1.673	0.328	-5.102***
Ln Raw*Ln Water	Π_3	1.218	0.565	21.5 4***
Ln Labour*Ln Capital	Π_4	1.392	0.286	4.870***
Ln Labour* LnWater	Π_5	2871	0.169	1.701*
Ln Capital*Ln Water	Π_6	-1.039	0.133	- 7.780***
F-Statistic		9451***		
R-squared		0.999		

***, **, *, mean, 1, 5, and 10% significance level respectively.

Table 2. OLS estimates for the ISBPT method.

Variables	Parameters	Coefficients	SE	t-value
Constant	β	7.029	4.236	0.109
Ln Raw material	β_1	0.181	6.087	0.030
Ln Labour	β_2	0.866	6.521	0.133
Ln Capital	β_3	-3.311	3.702	-0 .894
Ln Water	β_4	0.216	2.256	0.010
0.5*(Ln Raw material)^2	ψ_1	2.489	0.399	6.233***
0.5*(Ln Labour)^2	ψ_2	0.943	0.397	2.376**
0.5*(Ln Capital)^2	ψ_3	1.523	1.282	1.188
0.5*(Ln Water)^2	ψ_4	-0.279	0.180	-1.556
Ln Raw*Ln Labour	Π_1	-1.761	0.372	-4.738***
Ln Raw*Ln Capital	Π_2	-1.632	1.229	-1.328
Ln Raw*Ln Water	Π_3	1.072	0.113	9.467***
Ln Labour*Ln Capital	Π_4	1.178	1.378	0.840
Ln Labour* LnWater	Π_5	0.211	0.241	0.087
Ln Capital*Ln Water	Π_6	-0.2650	0.447	0.593
F-Statistic		92331***		
R-squared		0.999		

***, **, *, are 1%, 5%, and 10% significance level respectively.
N= 40, LnY, $\bar{X}$: 3.770; lnRaw, $\bar{X}$: 21.150; Lnlab, $\bar{X}$: 22.732; Lncap, $\bar{X}$: 16.656; Lnwat, $\bar{X}$: 21.421.

by users of the traditional method. This may be due to the fact that firewood costs, roasting costs and milling costs are also incurred in this method.

To the best of the knowledge of the authors, this is a pioneering work on allocative efficiency in the shea nut industry. Therefore, there are no comparable studies with which to compare results.

Constraints to the adoption of improved methods of shea butter processing

Though the improved methods have been in use for

Table 3. Factor prices.

Method	Variable	Factor prices (GH¢)
ISBPT	Labour	8.50
	Shea Butter	9.20
	Capital	90.29
BP	Labour	8.50
	Shea Butter	10.00
	Capital	48.07
Traditional	Labour	8.50
	Shea Butter	6.50
	Capital	50.00

Table 4 Allocative efficiencies of Shea butter processing methods.

Method	Variable	MVP (GH¢)	MFC (GH¢)	Z=MVP/MFC
ISBPT	Labour	13.99	8.50	1.6
	Capital	22.13	90.29	0.2
BP	Labour	14.66	8.50	1.8
	Capital	45.86	48.07	1.0
Traditional	Labour	4.15	8.50	0.5
	Capital	33.83	50.00	0.7

Table 5. Respondents' reasons for not using the improved methods.

Reason	Sum of ranks	Ranking
Inaccessibility of improved methods	50	1
High cost of equipment and lack of access to credit	78	2
High maintenance cost	121	3
Lack of awareness	162	4
Inferior quality of butter	191	5

some time now, most processors especially in the hinterlands do not use them. The views of processors who use the traditional method and why they do not use the improved methods were sought. Table 5 contains a summary of the reasons, specifying the ranks of respondents. Forty (40) processors using the traditional method were asked to identify and rank in order of importance the reasons why they do not use the improved methods.

The reasons that were enumerated and ranked by processors on a scale of 1 to 5 are high cost of processing equipment and lack of access to credit, lack of access to improved equipment, high maintenance cost, lack of awareness on the improved methods and the poor quality of butter produced in the BP method.

From Table 5, the lack of access to improved methods has the highest ranking and therefore is the most limiting factor to the adoption of the improved methods. Only a few communities have the full component of the equipment of the ISBPT and BP methods. Many communities especially do not have the kneader. Sometimes processors will have to trek for over 2 km to crush/or mill their kernel. Even in communities where the machines are available processors form long queues since there is usually one plant available in a community. The high cost of equipment limits access, which in turn greatly limits the quantity of shea nuts processed.

The next most limiting factor to the adoption of the improved methods is high cost of equipment and lack of access to credit with a rank score of 78. The high cost of equipment such as grinding mills and kneaders makes it difficult for individual processors to own the improved equipment. Most of the processing plants in the communities were installed with the assistance of NGOs and other development agencies. Individual establishments are hardly found. Only grinding mills which are multipurpose are established by individuals. Cost of maintenance of machines is the third most important obstacle to the adoption of the improved methods. Processors claimed the machines break down frequently and therefore require regular maintenance. The fourth most limiting factor to the adoption of the improved methods is lack of awareness about the various improved methods available and their associated strengths and weaknesses. It has a rank score of 162.

Finally, the inferior quality of butter from the bridge press is least regarded as a limiting factor to the adoption of the improved method. Processors hold the view that because nuts are not roasted the butter produced is 'hard' and therefore difficult to cook with. However the quality of the butter of the ISBPT method is said to be comparable to that of the traditional method.

From the previous discussion, it is clear that the main obstacles to the adoption of the improved methods are lack of access to improved equipment and the high cost of processing machines and lack of access to credit. This implies that despite the low capital intensiveness of the traditional method processors are willing to save time and labour which can be made possible by the use of the improved methods.

Validation of hypothesis

The Kendall's Coefficient of Concordance (W) was used to test the following hypothesis:

H_0: There is no agreement among processors who use the traditional method concerning the factors that limit the adoption of the improved methods.

H_1: There is agreement among processors who use the traditional method concerning the factors that limit the adoption of the improved methods.

The F-statistic calculated is 207.56 compared to F-statistic ($F_{(4, 35)}$) from the F-distribution table which is 3.91 at 1% level of significance. Therefore the null hypothesis is rejected in favour of the alternative hypothesis. The implication is that there is agreement among processors who use the traditional method regarding the ranking of factors that limit the adoption of improved methods.

CONCLUSIONS AND RECOMMENDATIONS

Since labour is underutilised in the ISBPT and BP methods, more of the effort of the existing labour should be tapped to enable efficient allocation of labour input. Labour use in the case of the traditional method should be reduced to allow for efficient resource use. In the case of capital, capital expenditure should be reduced under the traditional and ISBPT methods for efficient resource allocation. The BP method is allocatively efficient in the use of capital. To enhance the adoption of the improved method of processing, limiting factors such as high cost of processing equipment and lack of access to credit, lack of access to improved equipment, high maintenance cost, lack of awareness on the improved methods and the poor quality of butter produced in the BP method must be addressed. These factors could be addressed through the provision of effective and efficient extension education on the operation of processing machines, increased access to credit, and the development of more efficient processing machines at affordable prices.

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