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Shea butter processing as an engine of poverty reduction in Northern Ghana: Case study of four communities in the Bolgatanga Municipality

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Peasant farming had been seen for many years as a means of fighting rural poverty in the Sub-Saharan zone of Africa. With the passing of time, new researches had shown that the notion is fading off since studies have established that only a small percentage of those farms have seen expansion and intensification leaving the rest stagnated with lowering productivity, decrease in size and low output. Alternative sources of rural income are therefore important to determine for specific locations. This paper looks at the effects of shea butter processing on rural household income in four: communities in the Sumbrungu area of the Bolgatanga Municipality of the Upper East Region of Ghana. Regression analysis performed indicated that shea butter processing activity in the selected communities is a signification source of income as compared to the official minimum daily wage in Ghana. The main factors that influence income of shea producer households are the size of the household, quantity of shea butter produced, farming activity and number of employed members of the household. The location of a community with respect to Atolesum community also has effect on shea butter producer household income. Notwithstanding the potential of the shea industry in poverty reduction, challenges like lack of financial support, lack of ready market, high cost of machinery and others are making the women not fully utilizing the potential of the industry. Governmental as well as Non-Governmental support is therefore needed to put the shea industry in its right place in poverty reduction efforts.

Key words: Shea butter producers, households, communities, household income, Ghana, poverty.

INTRODUCTION

Researchers in recent times have established that non-farm income is on the ascendency and becoming important, accounting for between 35 and 50% of rural household income in SSA (Reardon, 1997; Haggblade et al., 2010). Diversification of source of household income had been identified in SSA of recent times as a means of sustaining livelihood (Losch et al., 2011; Winters et al., 2010; Ellis, 2005; De Janvry et al., 2002). Chalfin (2004)

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recognised the potential of the shea trees as one of the major income generating sources for the people of Northern Ghana since the colonial days. The potential of the shea till date has not been effectively tapped due to the socio-economic conditions and lack of proper policy and governmental backing as in the case of cocoa. It is therefore important that research is carried out to unfold the potential of shea. In this respect, the Upper East Region had been selected for this research work since little or no information could be found in existing literature.

Interestingly, the shea tree which grows in the wild is mainly found in areas of immense poverty. Yidana (1994) states that involvement of all stakeholders in the industry is needed in order to sustain the shea tree. Shea pickers, butter producers and communities of shea growing areas need to strengthen and modify the existing practices in order to make the industry an effective engine for poverty alleviation.

As mentioned in literature (Grigsby and Force, 1993) and also confirmed through a field interview conducted in April, 2012 by the researcher, shea fruit picking, processing of fruits into nuts as well as processing the nuts into shea butter had been the reserve for women. It is also stated by TechnoServe Ghana (2004), 90% of the world's shea nuts as raw material in the world for shea butter processors and marketers can be produced by Ghana. Although the shea industry can effectively alleviate poverty among women, financial constraint and inadequate technical support has made them to remain in poverty.

Kanlisi et al. (2014) also states that shea butter production has the potential to increase income generation to improve the living standard of local women and their households and also create jobs there by slowing down rural-urban drift in Ghana.

At the Sagnarigu Shea Butter Processing Centre, women generally admitted that shea butter processing is the main livelihood strategy that they undertake and has reduced their vulnerability as they have derived some benefits from shea butter processing (Dauda et al., 2014). Daniel et al. (2005), also writes that in Nigeria, shea butter extraction is a lucrative business especially in rural areas where the shea trees thrives. It was realized by Kanlisi et al. (2014) that on an average, each woman in the Wa Municipality earns about 31 Ghana cedis 46 pesewas, which falls below the minimum wage of 104 Ghana cedis 80 pesewas (5 Ghana cedis 24 pesewas per day) of the national level minimum wage rate indicated by the Ghana Trade Union Congress in 2013. An estimated number of about 600.000 women of the Ghanaian northern decent live on the income they acquire through processing and marketing of shea related products (Stichting, 2006). This paper examines the ability of the shea industry to alleviate poverty, the main factors of income generation among shea butter producer households in four communities in the Bolgatanga Municipality namely: Kulbia Bokom, Kulbia Atolesum Kulbia Amolgoduni and Kulbia Anateem.

The main objective of this research is to identify determinants of household income in four communities in the research area. The study's specific objectives are therefore:

1. To verify possible determinants of household income, such as location, household size, gender of household head, number of children, education of household head and shea producer, other income activities other than shea, age of producer and quantity of nuts processed among others.
2. Project household income assuming all other income generating determinants are constant apart from shea activity.
3. Make comparison of projected income as against the minimum daily average wage in Ghana.

The theoretical underpinning of the study is based on the theory of Leedy and Ormrod (2005), which defines a case study as an in depth examination of an individual, program or event.

The study area

The study area comprises of four communities in the Sumbrungu area of the Bolgatanga Municipality of the Upper East Region. The Region is one of the three northern regions of Ghana and shares borders with Northern and Upper West Regions of Ghana, Burkina Faso and Togo. Like all others northern regions Upper East Region is located in the Guinea savannah agro-ecological zone. It is blessed with multipurpose wild trees like shea and locust bean that have economic values and yet it is one of the poorest and less developed regions of Ghana with her population mainly engaged in rain-fed peasant farming as the primary source of livelihood. Like all indigenous rural communities of the Northern Ghana, the households of the four communities are scattered giving room to farming activities around their houses. Historically, men are engage mostly in the farming activities leaving the women to engage in other income generating activities such as petty trading, basket weaving, shea fruit picking and shea butter processing as well as assisting on the farms.

The region is one of the poorest for several decades in terms of living standards, literacy levels, health and nutritional status which are all extremely low and well below the national average (Whitehead, 2006).

MATERIALS AND METHODS

In this research, the case study was focused on purposefully selected sites and individuals were conducted. Although findings were reported on more than one group, a single case study approach was used to collect data and report results. This is because the case study was focused on shea butter producers in the Upper East Region, precisely the Sumbrungu area. The study

Table 1. Variable identification.

Variable identification	Name of variable
X_1	Size of household
X_2	Age of shea butter producer
X_3	No. of unemployed in household
X_4	No. of children in household
X_5	No. of employed in household
X_6	Shea butter quantity produced
D_1	Gender of household head
D_2	Education of household head
D_3	Education of shea butter producer
D_4	Farming
D_5	Craft (basket weaving)
D_9	Bokom community
D_8	Amolgoduni community
D_6	Anateem community

covered the four aspects of case study namely:

1. The setting (where the research took place);
2. The actors or participants (who was observed or interviewed);
3. The events (what the actor was doing);
4. The process (the evolving nature of events undertaken by the actors within the setting).

The study objective as mentioned earlier seeks to find out the impact of the shea industry in alleviating poverty in the study area. Based on this objective the hypothesis stating that: the socio-economic characteristics of households do not affect household income was verified.

After the step-by-step regression, fourteen (14) explanatory variables (Table 1) out of nineteen making up of six (6) quantitative and eight (8) qualitative were selected to be used to create the maximum multi-variable regression model. The initial set of seemingly significant variables were put into regression and results tested on assumptions in linear regression, thus linearity, independency, normality and homoscedasticity, a final regression model was then obtained.

Data collection and preparation

Household income data were collected from four communities in the Sumbrungu area of the Bolgatanga District Assembly. In all, data from 33 out of 45 known shea butter producer households were taken with the break down as: Kulbia Atolesum 6, Kulbia Amolgoduni 1, Kulbia Anateem 12 and Kulbia Bokom 24. Thus data from 73% of shea butter producers in the four communities were taken. To prepare the field data for the multiple regression analysis, the explanatory variables were first grouped into quantitative and qualitative variables.

Analytical model

A regression model can be expressed in econometric terms as:

$$y_{(t)} = \sum_k \beta_{(k)} X_{(k,t)} + \sum_m \phi_{(m)} D_{(m,t)} + \varepsilon_t \quad (1)$$

Where y is the observed per head household income, t - the time of study, ß- estimated coefficient associated with a given independent quantitative variable $X_{(k,t)}$, Ø - estimated coefficient associated with a given independent qualitative variable $D_{(k,t)}$, ε is the error term and k and m - number of quantitative and qualitative variables respectively. Having a change in time (t+1) and associated changes in condition, the new predicted per head household income could be expressed as:

$$\hat{y}_{(t\_1)} = \sum_k \hat{\beta}_{(k)} X_{(k,t+1)} + \sum_m \hat{\phi}_{(m)} D_{(m,t)} + \varepsilon_t \quad (2)$$

In this work the dependent variable is the total household income over the four months period of farming, collection of weaving material and shea butter processing activity. Household based factors approach was employed to develop a regression model for the prediction of per head household income taken into consideration the most relevance indicators.

Proxy indicators

The foundation of an income prediction model is the proxy indicators used which forms the conceptual framework. The selection of the proxy variable is therefore of great importance. Although such models are not suitable for determining any cause-effect relationship, proxy variable that have proved to be of strong logical and empirical links with household income will lead to a more concise prediction. The variables linking household income can be grouped into two main categories: namely the internal household dependant and external variables. Over the period of more than four decades, literature on the determinates of household income had established that the main internal household determinates include household size, age and gender distribution of the household, education, employment, health status, assets, capital among others (Schultz, 1961; Welch, 1970; Hassan and Badu, 1991; Lanjouw and Ravallion, 1995; Simler et al., 2004; Otsuka and Yamano, 2006). Similarly, the external determinants are recognised to be infrastructure, climate, prices, Governmental policies, geographical location, etc. Adebayo (1985) suggested that income levels of the rural poor may be attributed to some crucial determinants, hence understanding these determinants could result in developing effective polices aimed at alleviating rural poverty. There exist several potential variables that can be used, but it is

important to minimize the size of variables in other to minimize the error associated with the model. A combination of the forward and backward approach as well as variable transformation strategy was used to determine the most optimal model (Greene, 1993). Hastie et al. (2001) indicates that the error associated with a model is dependent on two factors (variance and square bias) which oppose each other, it is therefore important to have a trade-off between them. Limiting the number of variables will lead to reduction of variance but increases the square bias thus overall R-square value will be reduced. The overall R-square can be increased by transforming some variables and including some interaction terms between the variables but that will also lead to increase in variance since more complex models turns to have some statistically insignificant variables not withstanding that they may have high R-square values. Trading-off is therefore necessary to arrive at a model that in-cooperates variables that will lead to an R-square value close to 1 and also having all coefficients statistically significant.

Based on the motive of this work which seeks to develop a per head household income predictive model, socio-economic variable with close link to household characteristics were used. Among these variables are: Household size, gender of household head, income generating activities of household, education status, number of children in household, age, etc.

Selection of model

When there is no pre-knowledge as to the factors that determine the respondent variable in a regression problem, there appears to be so many probable independent variables which make the regression equation complex. The independent variables may include interaction terms, qualitative and quantitative variables which may or may not be relevant. It is therefore necessary to reduce the model to contain only the variables which provide important information about the dependant variable. There are a number of methods to arrive at the best simple model which explains the independent variable to the best possible level and making the regression statistically meaningful. In doing so, two main issues must be taken into consideration thus: Selection criterion and selection procedure.

Selection criterion

Selection criterion deals with the selection of explanatory variables to be included in the possible reduced model and also grade all possible reduced models from best to worst. There are different criteria for reducing a regression model. The econometrical expressions of three of them namely: R^2or adjustable R_a^2, F-test and Mallow's C_m criteria are given as:

Adjustable R^2 statistic - $$R_a^2 = 1 - \frac{n-1}{n-k-1}\left(1-R^2\right) \quad (3)$$

Based on this criterion, the model with the highest R_a^2 or R^2 is chosen.

F-test criterion- $$F_m = \frac{\left(RSS_m - RSS_k\right)/(k-m)}{RSS_k/(n-k-1)} \quad (4)$$

Where *RSS* is defined as:

$$RSS_j = \sum_{i=1}^{n}\left(Y_i - \hat{\beta}_{j,0} - \hat{\beta}_{j,1}x_i,1 - \hat{\beta}_{j,2}x_i,2 - \ldots\ldots - \hat{\beta}_{j,j}\ x_i,j\right) \quad (5)$$

Whre $\hat{\beta}_{j,1}$ denotes the least squares estimator for the regression parameter β_i in the model with *j* explanatory variables.

Mallow's C_m statistic - $$C_m = \frac{RSS_m}{RSS_k/(n-k-1)} + 2(m+1) - n \quad (6)$$

In using C_m criterion the reduced model with the smallest value of C_m is chosen.

For the purpose of this work the R^2 criterion was used. All explanatory variables were correlated with the dependent variable and their R^2 values observed. The criterion set was that the explanatory variable should have a relation with the dependable variables.

Selection procedure

In literature, three strategies are used in selection of best model after a chosen selection criterion is used to select the relevant explanatory variables. The selection strategies are the traditional forward and backward selection, stepwise regression and the most recent all possible model procedure.

The forward and the backward selection procedures determine whether each of the explanatory variables should or should not be included in the model and it is quick to run but do not always lead to the best final model.

The stepwise regression strategy is a modification of the forward or backward selection procedure. The removal and re-addition of explanatory variables as at when necessary, enhances the possibility of arriving at a best model.

The recently introduced, all possible model is the most efficient strategy but suffers from huge calculation and time consuming especially if the number of explanatory variable is huge. The number of regressions to run is equal to the factorial of the number of explanatory variables thus a set of 5 explanatory variables will demand over 30 regressions. Due to the possible huge size of the set of explanatory variables and its associated number of regressions, interpretation of the results could be quite difficult.

For the purpose of this work, the stepwise regression strategy which is a combination of the forward and backward selection strategy was used and as such a brief description of the procedure is given here subsequently.

The procedure starts with the most relevant explanatory variable as determined by the selection criterion. Each time a new variable is added to the regression model, the significance of individual variables incorporated are re-examined. The variable with the highest P-value is removed from the model and the model re-fitted before the next new variable is added. The procedure so continue until there is no more variables to be added or removed. In this work the threshold was set at P-value ≤ 0.1.

RESULTS AND DISCUSSION

The result of the regression analysis indicates that the explanatory variables: size of household and quantity of shea butter produced are the most significant independent variables with P-values virtually zero. The location indicators are also very significant with P-values virtually zero. Farming activity is less significant with a P-value of 0.018. The values are far below the predetermined accepted significance level of 0.05. From the result it

Table 2. Predicted household monthly income with variation in shea butter produced for different locations and family employment status.

Community	Shea butter produced per month (kg)								
	With employed member of the family								
	20	30	40	50	60	70	80	90	100
Bokom	216.50	303.66	390.83	477.99	565.16	652.32	739.49	826.66	913.82
Amolgoduni	203.17	290.33	377.50	464.66	551.83	638.99	726.16	813.32	900.49
Anateem	214.98	302.15	389.31	476.48	563.64	650.81	737.97	825.14	912.30
Atolesum	160.31	247.47	334.64	421.80	508.97	596.13	683.30	770.46	857.63
	Without employed member of the family								
Bokom	200.74	287.90	375.07	462.23	549.40	636.56	723.73	810.89	898.06
Amolgoduni	187.40	274.57	361.73	448.90	536.07	623.23	710.40	797.56	884.73
Anateem	199.22	286.38	373.55	460.72	547.88	635.05	722.21	809.38	896.54
Atolesum	144.55	231.71	318.88	406.04	493.21	580.37	667.54	754.70	841.87

could be said that the seven explanatory variables in cooperated in the reduce model do explain the dependant variable of household income at 99.9% leaving only 0.1% of the factors of the household income missing. The overall regression equation's accuracy which is expressed in terms of R^2 and adjusted R^2 is estimated to be above 99% which could be considered to be quite significant. This is an indication of how accurate the regression line approximates the real data. It also gives an indication that the dependent variable's variance is determined by the explanatory variables' variance at a level of 99%. Significance F of 5.25E-32 obtained indicates that the probability that the regression output is by chance.

From the regression model, household annual income of shea butter producing families in the research area can therefore be estimated by the expression:

$$Y = -367.50 - 26.22X_1 + 189.14X_5 + 104.60X_6 + 167.37D_4 + 656.09D_6 + 514.30D_8 + 674.29D_9 \quad (7)$$

The result indicates that producers in Anateem community stand to earn more than their counterparts in the Atolesum community followed by Bokom and Amolgoduni.

Prediction of household income of shea butter producing families in the research area was done two scenarios: Families with employed member and families without employed member. The predictions were made on the following assumption that the families are of the same size and also have the same level of income from farming activity. The monthly income in Ghana cedis obtained with quantity of butter ranging between 20 and 100 kg per month as presented in Table 2.

From Table 2, it is clear that a producer should produce at least 20 kg of shea butter per month in order to earn up to the average wage of 150 Ghana cedis for unskilled labour. It therefore indicates that producers who are able to produce more than the 20 kg of butter per month do earn more than their collages employed. It can also be induced that the effect of the salary of the employed member of the family does not significantly affect the income of the shea butter producer.

Challenges involved in shea butter processing

Notwithstanding the fact that the study results indicate the potential of shea butter processing as effective poverty alleviation machinery, therefore exist some challenges that do prevent the women from coming out of their poverty situation. Lack of financial support was identified as a major challenge that lead to the women not able to buy enough shea nuts during the main season for all year round production. Ready market for their butter was also identified as a challenge. Their products are sold basically on the local market with few bulk purchasers sometimes coming round to buy from them at their own prices. It was also found out the high cost and unavailability of machinery was another challenge. Some producers have to travel distances in order to mill their roasted shea nuts thus increasing their production cost and also limiting their production capacity. Though the machines are locally produced by the GRATIS Foundation the women cannot afford them.

Conclusion

From the study it is made clear that income from shea butter production as compared with the wage of an unskilled labour is quite significant hence, shea butter production can be an engine of poverty reduction. To fully utilize the potential of shea butter processing a means of income poverty alleviation for the rural northern women it requires the use of inputs in the form of technology

such as grinding mill, oil filters, toasters, dryers as well as special storage facilities. These inputs though locally produced are quite expensive for the women as they do not have adequate financial support to purchase them. There is the need to buy enough shea nuts during the main season and store for an all year round production. This requires some capital which is not available to the women. Taking into consideration the fact that unemployment, season unemployment and under employment in the study area is phenomenal as against the relatively high financial requirement of the shea butter processing industry in order to produce quality butter and make the process profitable, it is necessary that both Governmental and Non-Governmental support is rendered to the women to facilitate all stages of shea butter production. This will empower them to effectively alleviate their poverty.

Conflict of Interest

The authors have not declared any conflict of interest.

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